# DISSERTATION / DOCTORAL THESIS

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## The Development of the Circular Economy in the People's Republic of China
## -
## Institutional Evolution with Effective Outcomes?

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Dedicated to

my father Wolfgang Steuer (1943-2015),

who taught me the essence of learning from failure

and

my mother Andrea Steuer,

who imparted the concept of reciprocity to me

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**List of Abbreviations**

AC – Administrative Committee

CCP – Chinese Communist Party

CE – Circular Economy

CEDZ – Circular Economy Demonstration Zone

CEPL – Circular Economy Promotion Law

CEPL – Cleaner Production Promotion Law

COD – Chemical oxygen demand

CP – Cleaner Production

CPPL – Cleaner Production Promotion Law

EC – European Commission

ECL – Energy Conservation Law

EIE – Evolutionary Institutional Economics

EIP – Eco-Industrial Park

EOL – End-of-Life

EPB – Environmental Protection Bureau

EPL – Environmental Protection Law

FYP – Five Year Plan

GST – General Systems Theory

HH – household

HHW – household waste

IRS – Informal Recycling Sector

LCIP - Low-Carbon Industrial Park

MEP – Ministry of Environmental Protection of the People's Republic of China

MFA – Material Flow Analysis

MIIT – Ministry of Industry and Information Technology

MM – Middle Man

MOC – Ministry of Commerce of the People's Republic of China

MOEJ – Ministry of Environment of Japan

MOF – Ministry of Finance of the People's Republic of China

MOHURD – Ministry of Housing and Urban-Rural Development

MOST – Ministry of Science and Technology of the People's Republic of China

MRL – Mineral Resources Law

MSW – Municipal Solid Waste

NBS – National Bureau of Statistics of the People's Republic of China

NCE – Neo-classical Economics

NDRC – National Development and Reform Commission

NPC – National People's Congress of the People's Republic of China

OfN – Old-for-New Scheme

OIE – Old Institutional Economics

PPP – Private public partnerships

PRC – People's Republic of China

REDA – Rizhao Economic Technological Development Area

REL – Renewable Energy Law

RMB – Chinese Yuans

SC – State Council of the People's Republic of China

SEPA – State Environmental Protection Administration

SHM – Second-hand market

SMC – Supply and Marketing Cooperative

SND – Suzhou New District

SOE – State-owned enterprise

SWEPPL – Law for the Prevention of Environmental Pollution through Solid Waste

TCE – Ton of coal equivalent

TEDA – Tianjin Economic-technological Development Area

TP – Trading Point

TRS – Target Responsibility System

WEEE – Waste Electrical and Electronic Equipment

WL – Water Law

WM – Waste Management

WM – Waste Merchant

WP – Waste Picker

WPPL – Water Pollution Prevention Law

# 1 Introduction: The trendsetting nature of the Chinese Circular Economy, its key characteristics and the premise of effective outcomes

At the outline of this introduction stands one simple, yet crucial question: Why is it indispensible to engage with the Chinese Circular Economy (CE) for anticipating future trends in the domain of global environmental-economic institutionalisation? It is beyond any doubt that China has achieved the most substantial socio-economic transformation during the 20th and early 21st century. Within slightly more than 100 years, the country has evolved from a mostly agrarian, semi-colonised imperially governed nation into the most populous, economic hegemon ranking only second to the United States of America. While China's economic development constitutes a unique outcome of historically inherited and geographically endowed features, the looming economic-environmental challenges it faces are similar to those encountered by other global players. What however puts the PRC at the forefront of this problem nexus is the particular transformation trajectory of the country. In an effort to catch up with leading international economic performance, China has undergone a substantial socio-economic transformation since reform and opening in 1978/9: Embarking on an export oriented economic strategy Chinese production has manufactured goods for the world and thereby amassed enormous economic wealth at home. However, the hereby achieved success in economic growth came at the expense of environmental sustainability and resource conservation, let alone the impact for human health (Zhu et al., 2012, 144; Wang and Lin, 2010, 1704-1707).

Given the intensity of this process and the thereof resulting ecological deterioration, China is now at the forefront of an international challenge: More than any other state, the PRC is confronted with the problem of how to foster continued economic growth in the context of increasingly severe environmental and resource related constraints. It is exactly this constellation that renders the problem and the solutions of the Chinese case into one of global interest: Not only is the issue of environmental degradation and resource depletion particularly pervasive, there is moreover no other single country that has put equally intensive efforts into solving it. In light of this novel problem context, the respective approaches by China to counter these environmental-economic challenges entail wider implications: In case of success, the Chinese experiences may in turn produce an institutional model with valuable lessons for other countries that face similar problems along their development path.

The focus of the present thesis is set on the Circular Economy (CE) in China, where it constitutes a particularly recent and very prevalently practiced concept to master this dual challenge of the economic-environmental domain. Albeit being a conceptual idea devised in the Western hemisphere, decision-makers in the PRC have not only seized the CE tenet, but moreover incorporated it into its national development agenda. Having been discussed in political circles since 2003, the CE has been casted into a law in 2008 and gained an ever growing strategic prominence via its highlighting in the recent five-year plans. Given the gradual expansion of CE related practices in China, the following chapters centre on the question of how this concept has evolved in the PRC. Herein, the foremost aim is to discern the quality of outcomes generated in this process: By adopting an institutional, i.e. rule-system based, perspective, the guiding idea is to verify whether specifically devised rule structures effectively solve CE related problems. Given this analytical outline, it is however first necessary to address some key questions: What does the CE stand for, why is it practiced, who engages in CE related activities and finally how does the CE manifest itself in the PRC?

In regard to the first question, the CE can be seen as an alternative to the traditional economic patterns. Thus, in contrast to the linear trajectory of production-consumption-waste generation, the CE concept aims to lace both ends of this linear process and thereof create a cyclic perpetuation of these sequential activities. Herein, the most significant conceptual change is that 'waste', i.e. discarded products, are not seen as an end in itself, but as a means of production. The central idea is to use 'waste' from prior economic activities as secondary resource and feedstock for a subsequent round in production. This CE key concept of circulation is also presented in more comprehensive definitions, which are presented in current literature on the topic. Geissdoerfer et al. and Moreau et al., who have invested some effort in compiling the most tangible descriptions, both highlight the definition forwarded by the most prominent research institution on the CE: The Ellen MacArthur Foundation describes the concept as an 'industrial economy that is restorative or regenerative by intention and design' (Geissdoerfer et al., 2017, 759). The CE thus 'preserves and enhances natural capital, optimises resource yields, and minimises system risks by managing finite stocks and renewable flows' (Moreau et al., 2017, 497). With respect to the China specific focus of this thesis, it is necessary to extend these Western definitions with interpretations of the CE in the PRC. Geng and Doberstein for example describe the Chinese CE as a means to realise a closed loop of material flows in the entire economic system (Geng and Doberstein, 2008, 232). Another definition is forwarded by Zhu Dajian, one of the early proponents of the CE in China, who designates the main purpose of the CE as a system for conserving resources via

increasing recycling efforts (Zhu, 2007, 5f). In direct contrast to the relatively broad set of definitions forwarded by Western scholars, China's framing of the CE is primarily centred on material loops. As the later chapters show, this primarily resource-oriented focus expressed in the Chinese definitions in fact permeates CE practices in the PRC.

The particularity of the Chinese concept is directly linked to the questions of why the CE is practiced in the PRC and who engages in CE related activities. Within this subject matter an important differentiation has to be propounded: There are in essence two distinct actor groups, who due to different, interest-specific reasons adopt CE related practices. By implication, the Chinese Circular Economy is by no means only confined to the official, political realm. It rather constitutes a generic term that encompasses a broad set of activities conducted by different actor groups.

On the one hand, the CE represents a system promoted by the formal, official realm and its respective state-actors (ministries, municipalities, officials, state-owned enterprises). In this domain the CE is perceived as a solution for the dual challenge of environmental degradation and resource depletion on the one side and the continuation of economic growth on the other. In this regard, the sustaining of economic growth and in further consequence social stability constitutes two of the pivotal premises for Communist Party rule in China. The environment and its natural resources can by extension be perceived as the antecedent fundament, which determines the quality of both premises. Hence, instead of devising mere measures to protect environment and resources, the official CE development strategy rather serves as a means to alleviate resource constraints for production while reducing the ecological impact. While this approach explains the explicit material cycling focus of the official CE concept, it should moreover be seen as an effective conceptual solution by the government to master challenges along China's development.

On the other hand, CE practices emerge also from the activities of non-state actors in China. Corporate and non-formally registered, so called informal actors have for a certain period engaged in means and ways of material circulation. While these practices undoubtedly constitute a part of the Chinese CE, the operations of this second actor group were not directly inspired by the official CE agenda of the government. It is rather the case that these activities resulted from the pursuance of actor-specific, economic interest realisation. And yet, as asserted for the state-actor group, these operations can be seen as a solution to particular (mostly economic) problems encountered by non-state actors.

These constellations give rise to the last key question regarding how the CE becomes reality in the PRC. More than any other of the above questions, an answer to this query is very much depending on the chosen methodological approach. For example, an assessment of the Chinese CE from an orthodox mainstream economic perspective would most likely centre on relative and absolute quantitative outputs generated by CE relevant sectors. While such data-oriented facts undoubtedly provide an interesting glimpse into current realities, this approach may easily fall short of depicting the dynamic context in which the CE evolves. In order to capture this process of an unfolding, new economic system in China it appears to be more suitable to focus on the essential *structures* that are generated for the purpose of realising the CE.

The subject matter hereby referred to are institutions, i.e. systems of rules that structure actor behaviour and interaction within a socio-economic environment. Especially for the CE, the significance of institutions is particularly ostensible: Devised as an economic model for the management of environmental and resource related challenges, the CE depends on a rule-based framework to initiate an operative shift from linear to circular economic management. Moreover, given the fact that rules are generally devised to solve a particular problem, the concept fulfils the function of a rule based solution to actor-specific, environmental economic problems. The particular significance of institutions for the CE has also been acknowledged in secondary research. Moreau and colleagues for example emphasise the essential role of institutions for the CE by stating that ‘perhaps more than any other economic concept, the CE exemplifies the essential role of institutions’. Herein, their basic argument is that institutions, e.g. those of a fiscal policy nature, feature a powerful mechanism to induce an operative shift among actors towards more sustainable practices. In the opinion of the authors, it is especially the Chinese case in which institutions have exerted a significant impact on the creation of CE related industrial structures (Moreau et al., 2017, 501). Similar opinions are shared by others such as Ghisellini et al., who correctly assert that the CE constitutes a very recent concept, which is far from having achieved maturity. Therefore further refinement regarding institutional structures is absolutely indispensible (Ghisellini et al. 2016, 19). This not only demands for a further institutionalisation of cyclic activities in alignment with the laws of nature, but also for regulatory improvement to increase efficiency and effectiveness of CE related operations (ibidem, 16 and 19). Therefore it can be stated that institutional elements emerging in the context of the CE are most characteristic for the manifestation of this novel system: While tangible, physical structures represent the visible outcomes of the concept,

their operation is dependent on a rule-based framework that structures and coordinates executing actors and their respective activities.

However merely highlighting the existence and operation of CE related institutional structures in China is not the main objective of this work. Rather, as indicated in the title of this thesis, the discussions in the following chapters adopt a dynamic perspective for the analysis of the development of the Chinese CE. The essential rationale to do so stems from the fact that CE practices in China emerge from a multitude of actor groups, who in order to pursue their objectives, devise and resort to their respective institutional regimes. As outlined in the above, the methodological approach chosen in this study essentially distinguishes between the formal and the informal actor specific domains. Given the fact that both sides constantly devise new rule systems and accordingly practice respective institutional solutions to overcome particular problems, a connecting element of reciprocity between both domains emerges. This in turn gives rise to an evolutionary process, in which the outcomes are not planned or determined by one actor or actor group. Rather the institutional structures, which result from this interaction, feature teleological as well as spontaneous elements. Given the absence of a unitary, omnipotent authority that oversees and controls this development process in China, the Chinese CE can be rightfully interpreted as evolutionary.

The evolution of the CE, as it is depicted in this thesis, is a constant process that continues along an unfolding sequence over time. It is shaped by mechanisms of inheritance (learning input) from preceding institutionalised experience, the selection of novel institutions to solve particular challenges and the variation in solution outputs. Over these procedural cycles some institutional solutions prevail, while others are discarded. This in turn leads to the crucial aspect of institutional effectiveness, which constitutes the central theme of this research work. With regards to the Chinese CE, the pivotal query asks whether the resulting institutional outcomes feature elements of effectiveness in terms of solving actor specific, CE related problems. Understanding and assessing the dynamic of institutional outputs thus aims to assess the success of the Chinese CE development. In a second, yet subordinated instance, the findings of this investigation can also be taken as a point of reference indicating the extent to which the Chinese experience may serve as a model for other socio-economic systems.

# 2 Research questions, content focus and state of the art of research on the CE

## 2.1 Primary and secondary research questions

As indicated in the introduction, the primary focus of this thesis centres on the evolution of the institutional scaffolding of China's CE. Therefore the primary research question is formulated as:

W*hich institutional outcomes have been generated by the evolution of the CE in China?*

This relatively broad phrasing primarily serves the purpose to set forth the general theme of inquiry, which revolves around the institutional outcomes of continuous evolutionary cycles. As set forth in the methodology (chapter 4), every evolutionary cycle consists of three interdependent mechanisms: (1) A learning-based, inherited institutional repository that influences the (2) selection mechanism in which actors devise institutional solutions and which in turn generates a (3) variation in institutional solution outcomes. However, in order to refine this generally formulated primary research question and obtain comparatively tangible results the following set of secondary research questions is set forth.

In first instance, the following chapters analyse *how the formal-informal institutional dynamic shapes institutional selection and in further consequence the CE*. The topic of formal and informal institutional domains refers to the aforementioned multitude of actor groups, which engage in CE practices. In order to achieve their particular objectives these actors devise and practice corresponding rule-systems, which are aligned with their respective interest preferences. As shown in the sections on theory and methodology (chapters 3 and 4) these rule-systems or institutions can be broadly categorised as either formal or informal in nature. This constellation gives rise to a crucial aspect of institutional solution: Given that actor specific interests and thereof formed institutions always exist in interdependence to each other, a reciprocal dynamic between both domains arises. The perpetuation of this dynamic is driven by the different interests of actors, which sometimes complement sometimes oppose each other and thus shape the institutional selection mechanism. In this sense, the first secondary research question asks for the manner of how this reciprocity between interacting domains shapes institutional selection.

The next research question addresses the consequences of the above outlined process and thus asks for *the institutional variation emerging from the selection process*. This query is equally linked to the topic of evolution and follows the logic that a multitude of actors engaged in

solution finding processes gives rise to the emergence of a plurality of institutional outcomes. The existence of variation in these institutional outputs is simply the result of the vast array of actor-specific interests and spatially differing approaches to a particular problem. The hereto related research question thus intends to capture the degree of variation in the investigated cases of the CE.

Thirdly, the thesis tackles the aspect of effectiveness in institutional outcomes. The respective research question is thus phrased as: *Which types of institutional outcomes are effective and how can effectiveness be measured*? In essence, the guiding thought behind this query is to identify if there are particularly composed institutional solutions that prove more effective than others for the solution of CE related problems. This aspect is tackled in more detail in the methodology chapter (chapter 4) and aims to discern two features: Firstly, effectiveness through the inclusion of a broad array of interest and secondly effectiveness via the successful solution of a problem. In regard to the aspect of measurement, the subsequent chapters discuss various approaches for measuring effectiveness: Benchmarks for measuring effectiveness are in some instances of a quantitative nature, while in other cases it is simply the sustained use and practice of an institution that qualifies it as effective.

The fourth query centres on the characteristics of imitation and experimentation in institutional solutions. Both elements are highly significant for institutional evolution and indicate two general strategies to tackle novel problems: Actors may either resort to previously effective solutions so as to cope with an emerging challenge, or if the degree of novelty is too high, may be forced to adopt a heuristic, experimental approach. In order to assess the prevalence of both practices, the corresponding research question has been formulated as: *Which institutional patterns for solving CE related problems prevail – imitation or experimentation*?

In final instance, the following chapters also attempt, wherever possible, to offer an *assessment of the future development trajectory of the Chinese CE*. In this regard the key idea is to discern patterns among institutional solution outputs of the recent past in particular fields, i.e. waste management, and thereof forward conjectures about the future development in the particular field. Due to various influencing, non-anticipatory variables, such assessments are not possible in every instance. Yet, there are some trends that indicate features allowing for approximations of the CE's future development, which in turn constitutes a solid fundament for interpretations

## 2.2 Content focus and structure of the thesis

In matters of content focus some important aspects have to be mentioned beforehand. Firstly, the analysis of the Chinese CE in the following chapters is conducted along an institutional-evolutionary methodology. Thus instead of focussing on numerical statistical data and figures the discussions centre on institutional structures established by actors, who aim to pursue and realise their respective interest preferences. Given the significant role attributed to the concept of evolution, an additional focus is therefore set on the process of institutional change and interaction over time. Third, in regards to the array of CE specific fields, the present thesis centres on the aspect of material resources. This however should not induce the misleading thought that the CE concept is solely reduced to material flows. Rather, also such aspects as energy and emission management play a significant role for CE systems. However due to the personal research interest of the author and feasibility constraints these aspects are have not been addressed in this thesis.

Given the above research questions and the particular content focus, the following chapters are organised as follows: The first content chapter (chapter 5) begins by outlining the major CE specific challenges in China and explain why the CE constitutes a suitable solution. In a subsequent step, the CE concept regarding its origins and institutional particularities are introduced. In a final step the chapter then compares the formal institutionalisation of the CE in China, Germany, Japan and the EU.

The subsequent chapter (chapter 6) thereupon delves deeper into the institutionalisation of the CE in China. With a focus on the official political domain, the first step is to discern the actor groups and respective interests within the Chinese government involved in the CE. Second to that the discussion switches to the formal institutional selection process, while the concluding section analyses the institutional outcomes generated by the formal domain.

The first case study (chapter 7) deals with industrial clusters that were set-up for the purpose of realising CE practices in industry. In an initial step the institutional inheritance and the evolution of industrial estates towards CE objectives are highlighted. In order to deepen this analysis, the subsequent section focuses on the evolution of selection in the two most representative CE-relevant park types. In the final step, the institutional outcomes in Chinese CE parks are assessed in regard to the aspect of effectiveness.

The second case study and final chapter (chapter 8) then turns to the field of waste management and centre on the dynamic between the formal and the informal domains. After

providing some general characteristics for performance and organisation of the actor groups on both sides, the subsequent sections contrast the different effectiveness degrees of both institutional systems. In a concluding step, the reciprocal dynamic between the institutional solutions of both sides are highlighted.

### 2.3 Body of literature: State of the art in research on China's CE

In order to conclude this chapter some remarks on the state of the art literature on the Chinese CE have to be added. Tackling the entirety of so far published research on this topic constitutes a particular difficulty for the following reasons: Firstly, Geissdoerfer et al. (2017) and Ghisellini et al. (2016) have outlined that there exists a plethora of research on the CE, especially for the Chinese case. These numbers especially surged in 2013-2016, which in turn denotes the significance and actuality of this subject. For the Chinese case, the fields of implementation at micro (corporate), meso (industrial park) and macro (city and province) levels, indicator systems as well as technical aspects have received particular attention (Ghisellini et al., 2016, 13). Secondly, CE related research is conducted by researchers from a broad array of disciplines. These not only include mainstream economics and business management, but also extend to such fields as chemistry, urban and spatial planning as well as material sciences. The author has to the best of his knowledge skimmed through Chinese as well as Western publications and thereof derived key elements with institutional relevance. In order to provide the reader with a topic-specific overview on the most notable publications, the following matrix comprehensively lists the most valuable contributions for the various key topics in the chapters of this thesis.

| Chapter sequence | Focal topics | Most significant contributions |
|---|---|---|
| Chapter 5 | Origins, aims, principles and key concepts of the CE & international CE strategies | Preston 2012; EMAF, 2013 and 2014; Ghisellini et al., 2016; Wilts et al., 2016; Winans and Deng, 2017; Geissdoerfer et al., 2017; McDowall, 2017; |
| | Institutionalisation of the CE in China | Geng and Doberstein, 2008; Mathews and Tan, 2011; Geng et al., 2013; Su et al., 2013; Naustdalsid, 2015; Li, 2016; Ghisellini et al., 2016 ; Winans and Deng, 2017; |
| Chapter 6 | CE relevant, interest preference constellations within the formal domain in the PRC | Mol, 2006; Su et al., 2013; Jiao and Boons, 2014; de Jong et al., 2016; Jiao and Boons, 2017; Winans and Deng, 2017 |
| | Formal institutional selection process for the CE and related fields in the PRC | Hofem, 2010; Heilmann and Melton, 2013; Zhang et al., 2015; McDowall et al., 2017; Jiao and Boons, 2014 and 2017 |
| | Formal institutional outcomes of the Chinese CE development | Mo et al., 2009; Geng et al., 2010 and 2012; Su et al., 2013; Jiao and Boons, 2014 and 2017; |
| Chapter 7 | Institutional inheritance for CE relevant industrial parks | Geng and Zhao, 2009; Shi et al., 2012a; Yu et al., 2015a; Bai et al., 2014; Thieriot and Sawyer, 2015; Ghisellini et al., 2016; Liu et al., 2016; |
| | Evolution of industrial estates under China's CE development agenda | Geng et al., 2008a and 2008b; Shi et al., 2010; Zhang et al., 2010; Shi et al., 2012b; Bai et al., 2014; Jiao and Boons, 2014; Yu et al., 2014b; Zhu et al., 2014; Thieriot and Sawyer, 2015; Liu et al., 2016; Winans and Deng, 2017 |
| | Assessment of CE related industrial park performance in China | Shi et al., 2010; Mathews and Tan, 2011; Shi et al., 2012b ; Dong et al., 2014; Bai et al., 2014; Yu et al., 2014a; Liu et al., 2015; and Sawyer, 2015; Ghisellini et al., 2016 |
| | Analysis of individual CE related industrial parks | Shi et al., 2010; Yu et al., 2014a and 2014b; Yu et al., 2015a and 2015b; Wen and Meng, 2015; Liu et al., 2016; Wang et al., 2017a |
| Chapter 8 | Overview of Chinese waste management & formal and informal systems | Wang and Nie, 2001; Chen et al., 2010; Salhofer et al., 2013; Wang et al., 2013; Linzner and Salhofer 2014; Gu et al., 2015; Steuer, 2016b; Steuer et al., 2017a; Steuer et al., 2018 |
| | Institutional setup of the formal system in Chinese waste management | Mo et al., 2009; Yu et al., 2010; Zhong 2010; Chi et al., 2011; Chung and Zhang, 2011; Zhou and Xu, 2012; Qu et al., 2013; Wang et al., 2013; Steuer, 2016b; Steuer, 2017; Schulz and Steuer, 2017 |
| | Informal institutional systems in Chinese waste management | Li, 2002; Chi et al., 2011; Wang et al. 2011; Zhang and Wen, 2014; Fei et al., 2016; Steuer, 2016a and 2016b; Tong and Tao, 2016; Steuer et al., 2017a; Steuer et al., 2018 |
| | Institutional dynamic between formal and informal systems in Chinese waste management | Zhou, 2010a; Schulz, 2015; Tao et al., 2014; Steuer, 2016b; Tong and Tao, 2016; Goldstein, 2017a and 2017b; Steuer et al., 2017; Steuer et al., 2018; |

In regard to the herein used literature, two relevant questions need to be discussed: Firstly, to which degree does the literature feature agreement and dissent regarding the assessment of China's CE? Secondly, what constitutes the innovative and novel contribution of this thesis to the overall research on China's CE?

As for the first matter, a notable characteristic permeating the entire body of scientific literature on the CE in China is that by and large all works highlight the necessity of the CE

for the PRC's future. In this sense, most of published research tends to highlight the advances in China's CE, while criticism on shortcomings and deficiencies is relatively limited for most areas of research. Noteworthy exceptions in this regard are the works of Geng Yong (e.g. Geng and Doberstein, 2008; Geng et al., 2010, 2012, 2013) and Su et al., 2013. Both emphasise that particularly the top-down governed CE development often neglects various complications regarding the alignment of ecological and economic objectives. In their view, especially on the topic of CE relevant industrial parks, too little is done to capture and include corporate, bottom-up emerging trends and efforts. The prominent exception in CE related research, in which dissonance is clearly discernable, is the field of waste management. Herein, assessments on CE performance deviate quite substantially, particularly in regards to achievements of the informal sector: While some authors tend to sideline the topic (Qu et al., 2009; Ren and Hu, 2014; Gu et al., 2015; Liu, 2015; Mian et al., 2016; Zeng et al., 2016), an increasing number of scholars highlights the significant role of the informal recycling sector and even advocates more recognition and integration by the government (Li, 2002; Ensmenger et al., 2005; Chi et al., 2011; FON, 2011b; Qu et al., 2013; Tao et al., 2014; Fei et al., 2016; Tong and Tao, 2016; Goldstein, 2017b; Schulz and Steuer, 2017; Steuer, 2017; Tong, 2017; Steuer et al., 2018). Overall, the relatively small number of academic disputes within the subject matter of China's CE may be attributed to the broad array of research disciplines involved. Herein, humanities and social sciences, which traditionally put a strong emphasis on discussion and debate, are by far outnumbered as technical and engineering research on China's CE dominates the field.

This in turn opens a window of opportunity for the present thesis: By adopting an approach of the Old and Evolutionary Institutional Economics, I intend to highlight the evolution of the institutional framework, which structures and governs the operation of the CE in China. Based on the central question of institutional effectiveness, this dissertation offers a new angle on why particular rule solutions emerge and under which premises these institutional outputs operate in an effective manner. For the purpose of analysis, I have developed a novel analytical model that captures evolutionary institutional dynamics based on interest specific competition among different actor groups. This in turn generates a reliable explanatory capacity for the analysis of institutional outputs and subsequently provides an analytical insight to readers for the assessment of institutional outcomes in China's CE. To the best of the author's knowledge, this approach constitutes a novel contribution to academic research in several respects: (1) It proposes a new model on institutional evolution, which in its application is not confined to China's CE, nor to China alone, but can also be translated to

other socio-economic systems. (2) The herein presented discussion investigates and juxtaposes institutions devised by state and non-state actors in terms of their capacity (effectiveness) to solve CE relevant problems. (3) These research outputs are based on numerous interviews and field investigations, especially in the domain of urban waste management, which in turn offers new insights on a so far hardly analysed aspect of China's CE and its socio-economic system at large.

## 2.4 Additional materials

In addition to the primary and secondary literature, the findings of this thesis are based on research outputs obtained in the course of several research projects between 2013 and 2016 (see acknowledgment section). During this time period, the author was employed as a research assistant at the Institute of Waste Management of the University of Natural Resources and Life Sciences, Vienna (BOKU). During more than 10 field research visits to China, over 200 semi-structured and open interviews were conducted with formal and informal stakeholders in Chinese waste management between 2013 and 2016. The innovative element of these field surveys is twofold: Firstly, the research group succeeded in ascertaining the performance of the informal recycling sector in terms of waste recyclable and discarded electronic device recovery. In this process, it was possible to quantify daily collection amounts (kg/cap/day) and the informal sector's capacity of absorbing generated amounts at the household level (informally recovered recyclables and devices as proportion of the overall generated quantities) (Steuer et al., 2017). Secondly, the survey also accounted for institutional aspects. In this regard, it was possible to discern transfer and exchange patters, organisational structures and operative systems of value generation (Steuer et al., 2018). While most of these findings were made in Beijing and Guangzhou, additional verifications in Shanghai, Wuhan, Shenzhen and Xi'an were conducive to establish some general assessments on the informal sector in waste management. The thereof derived findings are presented in the final chapter of this thesis (chapter 8) in either direct form or indirectly via references to previous publications by the author.

# 3 Theory

## 3.1 Introduction: Is the Circular Economy evolutionary in nature?

As elaborated in the chapter on the primary and secondary research questions (chapter 2) the main inquiry of this thesis revolves around two subjects of interest: On the one hand it addresses the concept of the Chinese Circular Economy, on the other hand it focuses on the institutional, i.e. rule-based, evolution of this system. In order to tackle the research questions on China's CE evolution, it is necessary to devise an appropriate methodological framework. For this purpose, the present chapter delves deeper into the evolutionary institutional literature and discern the most significant building components, which are used for the design of the analytical model (see chapter 4).

However, before engaging with the body of relevant literature, it is first necessary to address one central question: To which extent does the CE fit the qualification of being an evolutionary institutional system? (Institutional) evolution is in this thesis understood as a process of multidirectional, uncontrolled and consecutive change of rule-systems. Instead of being confined to one linear trajectory, evolutionary change manifests as a multitude of *simultaneously ongoing* processes that are 'self-continuing or self-propagating and have no final term'(Veblen, 1919, 37 in: Hodgson, 2002, 116). Furthermore, the systemic evolution from one state to another is not teleological, but blind (Nelson, 1995, 66), which implies that there is not a predefined goal, to which evolution or the driving mechanisms behind it would aspire. Despite the absence of teleological elements, evolution in the biological and economic domain nevertheless exhibits structural principles that determine its procedural pace, direction and results. Institutional theorists have in this regard put much effort into highlighting the three Darwinian principles inheritance (or replication), selection and variation and their decisive role for the evolution of socio-economic systems (Hodgson, 2013b, 978). According to Thorstein Veblen, it is only due to these core features that evolution as an endlessly repeating sequence of causal events can emerge and proceed in the biologic and economic context (Hodgson, 2008c, 401-404).

The rationale for applying a theoretical framework of evolutionary institutional change to the analysis of the Circular Economy can be explained against the very background of the CE itself: Given its characteristic of an explicitly normative development program that conforms to specific ecological and economic values, the CE cannot be analysed by means of a static theoretical and methodological framework. Quite on the contrary, any research that intends to

investigate the broader implication of the CE for the socio-economic environment requires a theory that can capture two features: That is firstly the aspect of systemic development and secondly the therein defining, structural principles.

In regards to the first point, an analysis of the CE as a constantly developing phenomenon requires a time-dynamic model, which can explain the sequential causality between the individual stages of this development. As for the second point, the guiding theoretical thought is founded on the fact that any entity undergoing change will do so according to its structural principles. The Circular Economy – be it in terms of outcome or as theoretical, normative concept – is based on institutions as defining structural principles. A closer look at the CE concept helps to understand this theoretical subjection to institutions: In order to come into being, the CE has to evolve along a sequence of stages that are measured by indicators and results. This process itself can only be realised via context specific institutions that provide guidance along the path. Without such rule systems it would be impossible to realise this ecological-economic paradigm.

The CE's dependency on rule-systems becomes even more evident when looking at the concept's three key values and their condition for realisation: The so-called three Rs – reduce, reuse, recycle – embody the operative ideals or values of the CE. Their realisation however is not causally founded in any 'natural propensity' of society, but dependant on rules and habits that emerge and become ingrained in people's minds due to external pressures. We can imagine such pressures to be of a top-down enforced nature or as a self-imposed, individual responsiveness to deteriorating environmental conditions. All in all, the realisation of such values requires time and repeated practice, and is thus bound to happen along a learning-by-doing trajectory. As discussed below, the storing and conservation of learned experiences requires a medium, which comes in the form of institutions and their respective subcomponents. This is simply because any know-how, such as how to realise the 3R-values, that is not memorised in the mental maps of society, will disappear over the generational succession. Institutions do in fact function as a remedy against such knowledge loss and can furthermore instruct individuals in society in how to handle emerging (socio-economic) challenges. In this regard any realisation of the CE is based upon a complex combination and sequencing of rule-based structures. Without institutions that store relevant knowledge and experience on what works and what not, the CE could not be realised.

The question remains why the CE development in China should be conceived as an evolutionary process, and not in terms of a systemic transformation or transition. The primary

rationale behind this argument stems from the herein adopted distinction of the CE as an ideological tenet for development promoted by the government vis-à-vis the larger phenomenon of systemic change. This latter categorisation of the Chinese CE also includes practices that exceed the delineated boundaries of the official development program. If this thesis were primarily confined to the analysis of the former aspect, the CE development could undoubtedly be well explained in terms of a concerted and organised process that resembles a systemic transformation or transition. These two concepts are especially prominent in political-economic theories on post-socialist reform developments in Eastern Europe and East Asia. According to Janos Kornai transition exhibits the following characteristics: Firstly, the process features a clear beginning and an end based on clearly defined objectives or goals. Secondly, transition, at least towards socialism, does 'not arise by organic development', but is rather imposed on society by top-down means. A return to capitalism would equally require initial institutional, signal-like triggers that have to come from a political authority (Kornai, 2000, 293f). These characteristics stand in stark contrast to the pattern of institutional evolution, which is in this thesis ascribed to the Circular Economy in China. Firstly, there is no clear beginning or end when it comes to the institutional evolution of the CE system. Even with regards to the formal ideological paradigm, the Chinese government has not a priori set forth a catalogue of objectives that could be adduced to indicate the degree of CE completion in China. Apart from that the CE as herein understood in its broader sense beyond the official tenet is a free-wheeling, non-teleological process of continuous change, which does not develop along goals or objectives.

Transformation, as the second concept in question, does feature notable similarities to transition. Wagener (1997, 179) describes it as a *deliberate* process to change the existing institutional system with the *aim* to bring about a new, albeit in terms of objectives, not explicitly defined order. And yet, transformation follows a certain blueprint of objectives, which are modelled on prior, system-external experiences (Kollmorgen, 2010, 2). In contrast to transition, transformation is not necessarily a top-down induced process. Moreover, it is promoted by a new elite that may either originate from government or civil society circles. Their primary intention is to achieve a sufficient degree of control and steering capacities to implement imported institutional blueprints, merge them with the existing rule system and eventually push for their internalisation by the mass of society (ibidem, 2). Here again the difference to evolution is quite evident: Transformation does build upon human agency that strives to bring about systemic change. Evolution on the other hand implies systemic change that is not led by human agency. In this sense Menger and Hayek have quite aptly referred to

evolution as the ‘result of human action, but not the result of human design’ (Wagener, 1997, 180). This perfectly fits into the earlier stated characteristic of evolution being in essence a non-teleological, blind process (Nelson, 1995, 66) that does not develop along a trajectory towards predefined goals. Moreover evolutionary change manifests as a multitude of simultaneously ongoing processes. In institutional terms, evolution could thus be understood as a multi-agency result, where institutional efforts that stem from top-down enforcement respond, collide or simply merge with bottom-up initiated institutional practices. In fact, the methodological chapter (chapter 4) of this thesis presents a new model of institutional change, which is based on the evolutionary principles and the reciprocal forces of these two institutional domains. Therein, the Circular Economy in China is captured as an evolutionary process based on this continuously perpetuating, institutional dynamic.

In addition to the research questions, the above deliberations are central for the choice of a theory and a thereof derived methodology to engage in the investigation of the Chinese Circular Economy. Given the enormous size and the respective multitude of CE practices and applications in China, the use of mathematical models or material flow accounting techniques are rather prone to increase complexity than help to interpret reality. Instead, what is herein proposed is an approach based on the Old Institutional Economics (OIE) and its subordinate branch the Evolutionary Institutional Economics (EIE). The advantage offered by these schools lies in their proposed ontological conceptualisation, which can capture the meta-patterns of CE related development and change in China: Instead of tracking and analysing all flows of materials as well as labour force and monetary exchanges, the institutional, i.e. rule-systemic, approach rather allows for assessing and understanding the context within which CE practices and application take place. By implication, setting the primary focus on rule systems and their subordinate elements includes a certain degree of reductionism, which is however necessary for bringing sense into these complex matters.

The following paragraphs set out to establish the theoretical fundament for the methodological model and start by outlining the concept of institutions as understood by the OIE. Since these rule systems are composed of generative structural sub-elements, the chapter introduces these one by one and thereupon continue by discussing the function and conditions for institutional effectiveness. In a further step the focus is shifted to the evolutionary section of the OIE, the EIE, which in its own right can be considered as a subordinate branch of institutional economics. Herein, the core elements of inheritance, selection and variation constitute the most significant parts of evolution as they help to explain how prior knowledge

and experience shape posterior development paths. Finally, a completing paragraph is dedicated to the aspect of learning. Learning is the result of institutional interaction and practice, contributes to the evolution of institutions and decisively forms ideas and behaviour of the socio-economic actors[1] in OIE models.

## 3.2 On the choice for institutional economics and the delineation to other economic theories

The choice for institutional economics as theoretical foundation is in first instance correlated to the research questions of this thesis. As they have set forth, the main idea is to investigate the causal implications of the operation and evolutionary changes of the rule-systems that guide and shape China's Circular Economy. Such a premise demands a particular theory that provides a dynamic, analytical framework that can capture the evolutionary change of rule systems. By implication this approach however excludes any recourse to neoclassical economics (NCE), which are bound to a set of predefined assumptions that confine all economic activities within a static framework: In first instance, the NCE ascribes a rational, utility-maximising behaviour to actors, who are presumed to have stable and immutable preferences. Furthermore, any change in economic interaction is limited to shifts between states of equilibria, where supply and demand for goods and services is perfectly allocated. Finally, neoclassical economics tend to exclude the problem of chronic information scarcity, which however represents a ubiquitous problem in real life decision-making (Hodgson, 1998a, 169). In the context of evolution the most striking anomaly of the NCE is its conviction to the 'rational actor' concept. Due to the hyper-rationality that neoclassical economics ascribes to the decision maker, he or she always knows best when to do what. Given the strict adherence to this model the NCE has either great unwillingness or difficulty to incorporate the concept of learning into its models (Hodgson, 2000, 327). In contrast to that, reality provides a plentiful of examples, wherein economic change was based on previously acquired and learned experiences. For the case of many post-socialist countries in Eastern Europe, Janos Kornai and others have shown that socio-economic transformation was based on elements of individual as well as system-level learning from earlier or foreign experiences. Once these acquired features were imported into the transforming process they began to play a significant role in economic development (Kornai, [1992] 2007; Cypher and Dietz, 2009).

[1] In this thesis the 'economic actor' is the 'general term for any decision-maker in an economic activity (production, distribution, consumption), that can be an individual, a group of individuals, an organisation a firm or a government' (Groenewegen et al., 2010, 369).

In contrast to the NCE, the Old Institutional Economics (OIE) offers a more flexible and inclusive perspective on economic realities. The school itself emerged during the late 19th century and became promulgated through the works Thorstein Bunde Veblen, John Rogers Commons and Wesley Clair Mitchell. These scholars devised a bundle of economic theories that were in parts influenced by other societal sciences such as sociology, pragmatist philosophy, law and history. The resulting outcome has been subsumed within the OIE, which combined this multitude of variables into an institutional, i.e. rule system based, theory for the explanation of economic processes. In light of the obvious discrepancy between the OIE and the NCE, Hodgson (1998a, 174) has taken up the effort to identify several characteristics that elucidate the major differences between both schools of thought: Firstly, the OIE includes cultural, historical and societal rule-relevant factors, which the NCE traditionally excludes. Secondly, analyses employing a traditional institutional perspective recognise insights from other societal sciences such as politics, psychology and sociology among many others. Thirdly, there is no recourse to models of the rational, utility maximising actor. Rather OIE studies feature a preference for the learning actor, who in the course of his existence is capable to adapt her or his practices and preferences based on her or his prior experiences. Fourth, OIE related analyses do not begin their inquiry by employing pre-built mathematical models, but make use of stylised facts and theoretical conjectures concerning causal mechanisms so as to construct explanatory framework. Finally, OIE approaches make extensive use of historical and comparative empirical materials concerning economic institutions. These above listed features make a compelling case in favour of an OIE related model to be applied for the investigation of institutional evolution in the Chinese CE.

The OIE is however not the only institutional approach that offers an analysis of rule systems and their change. A theory that is comparatively well-known since the 1990s is the New Institutional Economics (NIE). This school has been gained much prominence in recent years, especially due to its two Nobel Prize laureates Elinor Ostrom and Douglass Cecil North as well as the prominent exponent Oliver Eaton Williamson. Since the 1970s, the NIE received increasing attention as it reinstated the role of institutions for the purpose of an economic analysis of markets, enterprises and economic actors. Especially in Williamson's perspective the centre of investigation is placed upon transactions, which take place within an exogenously given, static institutional context. At the same time transaction activities are moulded by endogenously emerging, dynamic governance structures (Groenewegen et al., 2010, 65f). In a similar fashion, North identifies an overall formal institutional framework that determines the incentive structure for societal actors (North, 1994c, 359) by imposing higher

or lower transaction costs (North, 1994a, 3). However for North, the formal institutional structure is not an exogenous feature of the economic system. Rather it is subject to remoulding and modification, which originates in informal rule patterns that are practiced among individual actors in pursuance of their interest-specific goals (North, 1994b, 8). Despite the significant contribution of the NIE to institutional economics, this body of theory is prone to the same fallacy that is ingrained in the NCE: The NIE centres on the same antiquated assumption, which equips the human agent with given preference functions of the utility-maximising kind (Hodgson, 1998a, 176f). In order to design a faithful picture of the complex and steadily evolving human nature the OIE has tackled this conceptual flaw by perceiving individuals and their preferences as outcome and result of their institutional environment. It thus perceives the individual as 'both a producer and a product of her circumstances' (Hodgson, 1998a, 177), which in turn implies that individual preferences and purposes are malleable and prone to change (Hodgson, 2000, 325).

Apart of the interpretation of actor characteristics, there are some other aspects that exemplify the differences between the OIE and the NIE: In similar detachment to the NCE, the NIE mostly ignores the dynamic state of the economy and the need to holistically explore it as a part of the societal system (Groenewegen et al., 2010, 152). And whereas the OIE positions the dynamics of change in a descriptive perspective in its centre, the NIE confines itself to a normative efficiency-oriented analysis of institutional change (ibidem, 76). A comprehensive overview of the key analytical differences for both schools is given in Table 1.

**Table 1. Differences between the NIE and the OIE regarding pivotal elements of institutional analysis (adapted from Groenewegen et al. 2010, 77)**

| Elements of analysis | NIE | OIE |
|---|---|---|
| Research question | • What are the *efficient* government structures given the institutional environment?<br>• What are *efficiency* reasons for the origins of and changes in institutions? | • What explains the dynamics of institutions including (in)formal institutions and organisations from a broad perspective (not necessarily efficiency)? |
| Actors | • Bounded rationality and opportunism; rule of behaviour to minimize transaction costs | • Procedural rationality; shared mental maps, habits and defence of vested interests |
| Structures | • Technology, culture and formal institutions are given; limited number of explanatory variables<br>• Role of government is first of all 'getting the formal institutions right'<br>• Markets are efficient allocation mechanism under the condition of adequate institutional environments | • All structures are constituted in an interactive process; wide range of interdependent explanatory variables;<br>• Role of government is pro-active in formulating societal objectives based on broad participation of the population<br>• Markets are not neutral mechanisms but reflect societal power structures |

What can be discerned from Table 1 is that the NIE frame the socio-economic reality within a relatively static perspective. Herein, many assumptions resemble those of the NCE, which in turn do not suffice to fully capture the evolutionary dynamics that are subject to the present thesis. The approach of the OIE on the other hand fulfils these premises and furthermore offers an extension towards the evolutionary field – the EIE. This branch of economic inquiry has emerged in the wake of by Nelson and Winter's ground braking 1982 work on the evolutionary theory of the firm (Nelson and Winter, 1982). In most respects this institutional school builds upon the basic principles of the OIE established by Veblen, Commons and other contemporaries, while in other aspects it picks up more modern ideas that are akin to key concerns of the NIE such as matters of technological change, organisational theories and theories of the firm (Vromen, 2008, 2). Institutional evolution based on prior experience and novel outcomes that result from this dynamic are at the centre of respective research efforts. Within this subject matter there are four basic principles of the EIE that build the cornerstones for the methodological approach used in this thesis: First, all socio-economic activities are perceived within a continuously changing context and are themselves subject to change. Second, these processes of economic change constantly generate novelty, which given the multitude of variables leads to a variation in outcomes and thus new sources for novelty and innovation through change. Third, the EIE emphasises the complexity of economic systems, which stems from the vast dimension of causal interactions between actors and respective institutional structures and thereby entailed institutional outcomes. Forth, it is acknowledged that many institutional structures and other social arrangements emerge spontaneously through actor intervention and are not solely bound to a planning entity or blueprint (Hodgson, 2010, 5f).

## 3.3 Definition of institutions and their subordinate components

### 3.3.1 Introducing institutions as primary object of analysis

In light of socio-economic evolution as a complex, multi-dimensional phenomenon, the first necessary step for analysis and thus the choosing of a corresponding theory and methodology is to determine the object of analysis. It has been alluded above that institutional economics opts for institutions rather than individuals to be the basic unit of scrutiny. The reason behind this decision is that institutions feature a degree of invariance over relatively long periods of time. Furthermore, institutions are the socialising context into which economic actors are born into (Hodgson, 1998a, 172). Both factors embed a certain degree of permanence and stability into the constantly operating dynamics of evolving systems. What needs to be emphasised in

this context is that choosing institutions as main objects of analysis does not imply a neglect of the role of individual actors. Rather the OIE sees both factors as mutually constitutive of each other – institutions form and are formed by individual actors. Human agency and structure, albeit being connected in a circle of reciprocal interaction and interdependence, are per se distinct (ibidem, 180f).

So how is the functioning of institutions and their relation to socio-economic actors comprehended by the OIE? A relatively concise definition in this regard has been provided by Groenewegen and colleagues (2010, 25), who describe institutions as '…systems of hierarchical man-made rules that structure behaviour and social interaction. They consist of established, durable and stable rules, and vary from social values through norms to laws with ensuring specific rules.' So described, institutions serve as the basic structuralising elements that guide socio-economic activity. What is furthermore significant for the above delineation are the various subordinated elements of institutions, to which Groenewegen et al. allude: Institutions are ontological entities in their own right. However they are composed of smaller generative components that significantly determine the overall institutional performance. The following chapters step by step introduce and discuss these elements starting with the simplest up to the more complex.

### 3.3.2 Values

Values are the most basic, meaningful institutional elements and are constitutive for the culture of society. Fundamentally speaking values represent believes about what is considered to be the most important things in life (Groenewegen et al., 2010, 26), which may cover a variety of ideals such as individual freedom, justice, security or wealth. Values thus provide a general direction for the behaviour of actors and serve as a pivot for the coordination of actor groups (ibidem, 27). Also proponents of the NIE have referred to the particular contribution of values to the overall institutional structure: Douglas North for example has underscored the role of values in regard to informal institutions, which he calls 'informal constraints'. According to his analysis, they are deeply embedded in society and because of their direct foundation on values, informal rule-systems cannot be changed 'over night' (North, 1994a, 8). Vice-versa, this perspective positions values at the very centre of institutions indicating their characteristic of durability and adverseness to swift change. Values, once being shared within a group or organisation, can help to reduce the divergence in mental models of the actors and unify their perceptions of reality and its challenges (Hodgson, 2007c, 330). However, in order to put values or value based belief structures into effect, e.g. for structuring human interaction

according to group-specific ideals, they need to be ingrained into and amended by other elements that eventually give rise to larger rule-systems, i.e. institutions.

### 3.3.3 Habits

The institutional elements that occupy the next higher ontological level are habits. From the perspective of the early institutionalists the concept of habit has been depicted as a self-sustaining, 'largely non-deliberative and self-actuating propensity to engage in a previously adopted pattern of behaviour' (Hodgson, 1998a, 178). Institutions per se depend on habits since these represent the fundamental elements that store and carry the prevalent and permanent way of thoughts and actions, which are induced by institutions into the human mind (ibidem, 179). It is important to note at this point that habits – as a propensity or disposition – are to be distinguished from behaviour as an actual action (Hodgson, 2007b, 109). In their seminal work on the evolution of economic change Nelson and Winter (1982, 73) touch upon the concept of habit and attribute a sequentially operative structure to it: In their view the habit, which they term 'skill', comprises a smooth sequence of coordinated behaviour, whereby each successive step is triggered by and followed closely upon the completion of the preceding one. Furthermore their description of the knowledge ingrained in habits is by and large of a tacit nature, implying that the performer of a habit is not fully aware of all the details of his performance. Additionally, Nelson and Winter interpret the practice of habit as involving numerous choices. Akin to the early institutionalists' perception of habit, the authors state that during the choice making process particular options are selected automatically and without awareness that a choice is made (ibidem, 73).

These definitions of the concept of habit allude to its most important function, which is to serve as knowledge conserving elements that store learned responses to familiar and repetitive situations. The pragmatist philosopher John Dewey saw the essence of habit to be 'an acquired predisposition to ways or modes of response' (Dewey, 1922, 42, in: Hodgson, 2004a, 652). They dispose over 'submerged repertoires of potential behaviour… [that, the author] can be triggered or reinforced by an appropriate stimulus or context'. In essence habits embody a propensity to behave in a certain way given a certain type of situation (ibidem, 2004, 652f). Moreover, habits feature a highly flexible nature, which as an institutional component employed by socio-economic actors, facilitates the adaption to complexity and unpredictable change (ibidem, 654f). It is in essence a necessary tool to deal with the many signals and bits of information conveyed by the socio-economic environment. However what is needed to establish a certain habit among the mental maps of socio-economic actors?

Primarily it requires the repeated engagement with or exposure to situations in which a specific behaviour is practiced. Repeated action is thus necessary for the establishment of a habit (Hodgson, 2008a, 3). Once a particular habit is properly learned it becomes the grounding for reflective and non-reflective behaviour for a particular set of situations (Hodgson, 2007b, 106f).

As institutional components, habits are devised and practiced by actors. Although they emerge at the individual actor level, a particular habit is not a stand-alone concept limited to one person only. Rather, it can be replicated and shared by several actors, and moreover rise along the institutional hierarchy to become a rule. In regards to the aspect of replication, habits are transmitted and emulated by means of behavioural expression: Under given circumstances the habit based behavioural patterns of one person are consciously or unconsciously followed by others as a result of incentive or imitation (Hodgson, 2003, 373). Whether so copied behaviour becomes rooted as a habit within the mental map of the follower naturally depends on a broad set of factors: Repetitiveness of a certain circumstance inducing the same habitual pattern, the visibility and perceptibility of the habit for others, or the existence of a compatible basis of values and norms that facilitates the emulation of the habit.

According to Hodgson, for habits to be transmitted, all of the above conditions must apply. Firstly, a repetitive practice of the habit has to occur at the conveying side, while the receiving side has to have the propensity to imitate these habits (Hodgson, 2007b, 107). Although this propensity to imitate is seen as a natural endowment to the human actor, successful replication can only take place within an institutional framework that is common to particular a group or social culture. This framework does in further consequence have to be based upon common fundamental value modules. Once a habit emerges and starts to spread in this environment it will become part of adherent actors' cognitive framework. As a knowledge-conserving agent habits equip actors with the knowhow on how to manage certain socio-economic challenges. Depending on the prevalence of these challenges a used habit may evolve towards the next higher institutional hierarchy and become a routine, custom or rule. The habit's transmission to other actors and its expansion towards a higher institutional rank is facilitated and promoted by the surrounding institutional structure (Hodgson, 1998a, 180; Hodgson, 2004b, 168). Especially the latter development deserves additional explanation. For any habit to reach the status of a rule, it has (1) to gain and extend an inherent, normative content (on how things are to be done), (2) needs to exhibit the potential to be codifiable (exhibit a discernable content of prescriptive actions) and (3) gain some prevalence among a group. If these

conditions are fulfilled habits become an even more integral, constitutive part of the institutional structure, which in turn provides it with enhanced durability, power and normative authority over a communal actor group (Hodgson, 2007b, 107).

### 3.3.4 Routines

Another institutional subcomponent that is closely related to the concept of habit is the routine. This notion has gained in prominence in the EIE after the publication of Nelson and Winter's Evolutionary Theory of Economic Change (1982). In their investigation of the evolutionary change of companies, the authors have taken routines as the basic unit of analysis, which essentially follows the idea of the old institutionalists' focus on habits. For Hodgson, routines represent the organisational analogue to habits, whereby routines are organisational meta-habits that exist on the substrate of habituated individuals within a social structure. Individuals thus have habits, whereas actor groups have routines (Hodgson, 2003, 375). In that sense habits encompass the individual dispositions to engage in previously acquired behaviour that is triggered by particular stimuli. The routine on the other hand is an organisational disposition to energise conditional behaviour patterns among an organised group of actors that sequentially responds to emerging cues (ibidem, 379; Hodgson, 2013b, 977).

In terms of function and characteristics, routines exhibit notable similarities to habits. On the one hand routines are self-actuating and non-deliberative patterns of actions triggered by contextual stimuli. In other words, once put into practice routines are not bound to active deliberation on behalf of the actors. On the other hand however the emergence or design of these institutional elements depends on thoughtful deliberations on the part of actors. Thus, in the process of becoming a routine, the constitutive behavioural actions undergo repeated evaluation and pondering by practicing actor groups (Vromen, 2010, 177). By implication the more often a routine is applied to a repetitive challenge, the less deliberation is required for the choice and application of the routine (Nelson and Winter, 1982, 93). Via the repetition of specific routines, smaller bits of information and knowledge on challenges and respectively required responses are combined and stored within the larger body of the routine. For any communal group the routines thus constitute elements of the overall organisational memory (Vromen, 2010, 179). Given the sequential process, the learning efforts and the repetitive, response-based application, routines exist in a self-sustaining manner and can emerge without any kind of overarching blueprint or enforcement. Changing routines thus requires a respectively strong effort and equally long period of time (ibidem, 178). Similar observations

in regard to routine durability have been presented by Janos Kornai in his analysis of socialist systems. He equally perceives routines to exert a high degree of inertia or sustainability, which is primarily based on two elements: Firstly, the system (or organisation) creating routines must have been in existence long enough to create a stable institutional environment and secondly the existence of routines is to a large extent bound to the existence of the system, which they inhere (Kornai, [1992] 2007, 13).

Similar to habits routines represent a rule-like mechanism that equips the user with a tool to respond to (re)occurring situations. Given their stability over time and robustness despite personal turnover in organisations, routines are highly reliable mechanisms. They predictably transform certain sorts of incoming signals and information into the learned behavioural actions of the firm or organisation (Vromen, 2010, 182). As a conditional, input-output producing mechanism that is designed for a certain environment it features a sufficient degree of discernable and thus codifiable components, which allow it to become transformed into a rule. The routine as an organisationally learned and executable capability for repeated performance to contextual pressures (Hodgson, 2003, 366) can be seen as a complex disposition. This in turn puts routines only one step away from the level of being a normative injunction or disposition that 'in circumstances X do[es] Y' (Hodgson, 2015b, 502f), which is the primary characteristic of the rule.

### 3.3.5 Rules

Rules feature a significantly distinct characteristic compared to the other institutional subcomponents discussed in the preceding sections, which is their potential to normatively impel patterns of behaviour among actors. Following rules is seen as a much more conscious and deliberative actor response than the behaviour, which is induced by habits or routines (Hodgson, 1998a, 185). This stems from the fact that rules are codified norms, conventions, habits or routines, which are in many cases enforced or guaranteed by a particular authority within an actor group (Groenewegen et al., 2010, 26f). Rules can be described as learned and mutually understood entities that are socially transmitted and act as 'customary normative injunctions or immanently normative dispositions that in circumstances X [induce actors to, the author] do Y' (Hodgson, 2008b). Its normative characteristic implies the necessity of a rule enforcing authority. However beyond that rules have to exhibit a certain degree of prevalence in actual and potential use within a community or a group of actors (Hodgson, 2015b, 502f). The normative characteristic says much about the societal function of rules: Their primary purpose of existence is to generate order and predictability among the repetitive,

interdependent relationships between socio-economic actors. Thus rules represent the result of actors' efforts to render their socio-economic environment understandable and predictable (Ostrom, 1986, 5 in: Voigt, 2013, 5).

### 3.3.6 Institutions

Institutions stand at the top of the institutional hierarchy and build upon all subordinate institutional components. Due to the different approaches within the institutional tradition there are several diverging definitions of institutions. The most suitable definition for the purpose of this thesis is the one promoted by Groenewegen et al. (2010, 25 and 372) according to which institutions represent 'systems of hierarchical, social rules that structure behaviour and social interaction'. The advantage of this interpretation is its comparatively objective and neutral definition of the concept of institutions. This stands in stark contrast to the definition of Douglas North, who in the course of distinguishing formal and informal institutions attributes the term of 'constraints' to the latter. According to his line of thought informal institutions are to be considered as constraints since they hamper the generation of wealth at the benefit of other, e.g. ceremonial, cultural values (North, 1994a, 2). North's conception of informal institutions is quite similar to that of another traditional institutionalist, Clarence Ayres, who identified ceremonialism – a broad term to encompass informal rule-systems – as major obstacle for the advancement of technology and innovation (Cypher and Dietz, 2009, 180f). The fallacy to which both approaches fall victim is the adoption of the reductionistic perspective of neoclassical economic efficiency: In their view institutions have to serve the purpose of economic growth and advancement. Everything else, it seems, cannot qualify as an institution. From the perspective of the OIE, following this line of thought would imply to limit the analytic margin to the question of efficiency. By implication, this rules out much of the explanatory dimension, which is concerned with the question of why different socio-economic environments have generated different forms of economic structures.

This conceptional error can be avoided by including the factor of actor-institution relationship into the definition of institutions. The first and fundamental feature in this regard is the proposition that institutions are 'inter-subjectively shared by a collective of individuals' in an either conscious or unconscious way (Stein, 1997, 730). Within this context matter, individuals interact to form institutions while at the same time their purposes and preferences are moulded by the institutional framework (Hodgson, 1998a, 177). The institutionalist Walton Hamilton has described this process as an 'endless drama of the social process'. According to the subsequent argumentation of Commons, this reciprocal process is enforced

by the fact that mutual habits and customs are embedded in the interacting actors' portfolio of preferences. In a further step Wesley Mitchell identified a prescriptive authority of institutional elements over the behaviour of humans, which in a particular way makes it impossible for them to exit from this institutional cycle (Hodgson, 2000, 324). Analysing actor-institution dynamics within this type of framework may evoke the impression of a 'psychological mass-imprisonment' dilemma. However at closer investigation it becomes clear that the 'prison' as well as its inhabitants are equally subject to transformation and change. In citing the writings of Commons and Veblen, Hodgson sees the actor-institution dynamic as a process of reciprocal causation and change: On the one hand side, upward causation originates in the changing and creation of institutions by humans, whereas in the subsequent downward causation institutions mould and structure individuals (ibidem, 326).

Given that the reciprocal change of actors and institutions is perpetuated by an ongoing, intrinsic process of causation and responsiveness, it is necessary to identify the fundamental components that lie at the source of this process. In regard to this subject matter it is useful to revisit the function of values, i.e. the systems of beliefs determining the standards of human ideals (Groenwegen et al., 2010, 26). For Commons believes and values are the cornerstones of the actor-institution relationship: They form the basis for affection upon which each person interacts with her or his counterpart. The institutional structure, within which every actor finds himself confined to, is both the cause and effect of one's believes. Therefore common believes and values define the institution as the vitalising force for human interaction (Hodgson, 2000, 326). By implication any institution is 'a socially constructed belief system about the way things are and the way things should be' regarding the organisation of human thought and action (Stein, 1997, 730). Herein, the institution of money may be adduced to exemplify the constitutive capacity that values contribute to the institutional impact on human nature. According to Mitchell, the function of money cannot be reduced to the aspects of cost reduction and individual convenience. Moreover money 'stamps its pattern upon wayward human nature, makes us all react in standard ways to the standard stimuli it offers, and affects our very ideals of what is good, beautiful and true'. So if particular value(ideal)s that induce specific stimuli among actors are institutionalised and in their institutional form and function become subject to change, this process will induce changes in the mentality, preferences and the way of thinking among individuals (Mitchell, 1937, 371 in: Hodgson, 2002, 116). In a similar fashion proponents of the OIE see habits as fundamental elements that structure and stabilise their superordinated institutions: Given their relatively stable and inert quality, habits both reinforce and are reinforced by institutions. Via the spread of habits specific institutions

can be passed through time and generations (Hodgson, 1998b, 13) and yet both are subject to gradual change. In summary, there are two characteristics of institutions that guide the further theoretical and methodological elaborations in this thesis: Firstly, institutions generate structure for the interaction between socio-economic actors. Secondly, institutions are evolving phenomena that are both media and outcome of the processes they put into action (Stein, 1997, 730).

In order to complete the definition of institutions, a final differentiation between the two types of institutions is required at this point: Any socio-economic system is constituted by formal as well as informal institutions. This distinction hints to the complexity of societal structures and the interaction between actors. Herein, some aspects of everyday life are explicitly structured and governed by the design and enforcement of codified rules such as laws (formal institutions). However, all socio-economic activities and practices that exceed this superstructure and which are not contextualised in any type of codifiable format thus constitute the realm of informal institutions. An interpretation of how both institutional dimensions interact is presented in the methodology section (chapter 4) and thus for now the discussion confines itself to the primary characteristics of the two categories.

According to Groenewegen et al. (2010, 25), formal institutions are public rules of behaviour, which are designed and enforced by a public authority with legislative, executive and judiciary powers that entail the right of penalisation. Typical examples for formal institutions are laws or administrative regulations. Informal institutions on the other hand represent private rules of behaviour that have been developed gradually and spontaneously. Informal institutions do not need any legal enforcement, as they are sanctioned by private parties themselves (self-regulating) or because it is in the self-interest of actors to adhere to these rules (self-enforcing). In terms of impact, informal institutions have been observed as featuring a much deeper level of socio-economic permeation and persistence. Douglas C. North has endorsed this argument by stating that that '…informal constraints, unlike formal rules cannot be changed overnight. They evolve slowly', simply because informal rule systems are constructed upon the deeply ingrained values and beliefs that constitute their core (North, 1994a, 8). This point of view has proven to be especially significant for the analysis of institutional structures in different countries: In their paper on governance and economic institutional quality in Asia, Zhuang et al. (2010, 4f) produce evidence that suggests different economic performance in countries that feature similar formal institutional settings. They

continue by attributing these differences to respectively evolved informal institutional arrangements.

### 3.4 Function and effectiveness of institutions in the context of problem solving

The preceding paragraphs of this chapter have already touched upon several functions of institutions, e.g. structuring behaviour and interaction, increasing of predictability in interaction and the normative feature to induce specific behaviour patterns among individuals. However, in light of the research questions and thereof derived methodological objectives, the present section focuses on the function and effectiveness of institutions as problem solving entities.

A look at preceding literature indicates that this particular functional feature of institutions has received some attention: According to the early institutionalist John R. Commons institutions can serve as mechanisms to solve conflicts, which arise from differing value preferences among socio-economic actors (Groenewegen et al., 2010, 27). This perspective can be combined with the insight that problems and challenges of any kind are continuously reoccurring, which in turn triggers the necessity to install institutions so as to resolve these problems (Mantzavinos, 2001, 7). In terms of the functional effectiveness of institutions we may distinguish between the two classifications of formal and informal rule systems. As for the former, formal effective solutions must fulfil a set of conditions: As a basis, formal rules need to be broadly accepted and in order to achieve this status they have to be general, certain and open. The characteristic of being 'general' refers to the rule nature of being non-discriminatory and thus equally applicable to all actors under all circumstances. 'Certain' indicates that the rule has to be transparent and reliable. By implication meaning and consequences of violation must be known to the people. The third characteristic of being open indicates flexibility so that actors can respond to new circumstances by flexibly applying the rule in question. Finally, for any institution to become effective it must be completed by enforceable sanctions that may prevent actors from acting against the rule (Groenewegen et al., 2010, 29). This final aspect is particularly popular among proponents of the NIE school. North for example emphasises that effective enforcement is the single most important determinant of institutional performance. In line with the prescriptive nature of the NIE, North proposes that only an impartial system of laws and courts can guarantee the enforcement formal rules (North, 1994a, 3). This element of the Good Governance ideal however neglects the historical evidence produced in authoritarian regimes, where a combination of power,

authority and ideology has – at least for a certain time period – successfully managed the adherence of socio-economic actors to formal rule systems.

As for the case of informal institutions it has been pointed out earlier that their functional effectiveness depends on internal sanctioning mechanisms. Such private rule systems of behaviour have emerged gradually and spontaneously. Their enforcement is either sanctioned within private parties themselves (self-regulating) or guaranteed by self-interest induced rule abiding (self-enforcing) (Groenewegen et al., 2010, 25). These group internal, societal sanctions to enforce a particular behaviour are based on strong intrinsic value standards, such as honesty, integrity or the desire for self dignity, which in turn induce a self-subjection to particular codes of conduct (North, 1994a, 3).

All of the above said on formal and informal institutions, does however primarily address the aspect of functional effectiveness, i.e. whether people subject to a rule-system. What it does not touch upon is the question of how well an institution can solve a specific problem for which it is created. Nor does it explain how well an institution performs in realising or preserving certain value ideals, around which interest groups have formed and which they attempt to protect. As these aspects are not discussed in the institutional literature, but simultaneously play a major role for the case of the Chinese CE, respective elaborations are again presented in the methodology section.

One so far little addressed institutional function, which to some extent also determines the degree of a single institution's effectiveness, relates to the aspect of information conservation and storage. Once a problem becomes solved by means of applying an institutional solution to it, information or know-how on the specifics of the solution will emerge. Depending on particular design and execution, institutions 'influence how information is retrieved, organised and selected' (Stein, 1997, 732). The processing of such information is very similar to the collection and application of individual experiences. In the case of institutions this is done by the virtue of routines, which 'encapsulate the institutional memory …[that, the author] is manifested in interaction routines' (ibidem, 732). For the interpretation of these bits and pieces of information actors have to again resort to other institutional elements, be it symbol systems or other types of rules for communication and knowledge transmission (Hodgson, 2007b, 331).

How well such information is processed and interpreted is another sign of effectiveness, however that subject matter can be again framed as finding and creating a solution

(interpretation & analysis) for a problem (handling incoming information). From a meta-perspective on the entire information management mechanism, which includes the subordinate procedures of information collection, processing and interpretation, routines can be taken as a useful proxy as they store and transmit information within societal systems. In citing Nelson and Winter (1982) Hodgson (2003, 357) acknowledges the important function of intra-firm routines as information repositories that conserve and inherit information through time so as to transmit it to following generation of workers. In a more recent work, Nelson and Winter even extend their conception on the institutional functions of routines. In their view routines combine the feature of information safeguarding with the capacity to solve problems in the intra-firm context. In detail the authors attempt to show that storing and accessing knowledge as is done by routines helps to surmount the problem of information asymmetries and the lack to adequately respond to repetitive challenges. As learning and the learning of routines comes at a certain cost, the resulting knowledge can be considered as an asset that will be incorporated in the common portfolio of the enterprise. Adhering to prior routines and the propensity not deviate from them simply resembles a company trying to maintain and protect its assets. Another problem-solving feature of routines is that they serve as inter-actor conflict mitigating tools. In this sense routines constrain conflict seeking behaviour, since they prescribe certain behaviour patterns for a particular context. Departures from established routines may lead to anxieties and conflict, which in turn can prove to be very costly to all participants. Hence the tendency of companies to stick to established routines (Nelson and Winter, 2002, 30f). This particular stress on the institutional subcomponents' role for institutional performance is not unique to a Nelson and Winter type of analysis. The works of traditional institutionalists have in a similar fashion underscored the significance that the OIE attributes to habits and values for the workings of institutions. According to the Veblenian tradition, institutions can only fulfil their function if they incorporate the prevalent habits of thought and behaviour that are practiced within the concerned socio-economic context (Hodgson, 2007b, 106). By implication, any institution designed to be effective in terms of problem solving, information conserving and transmitting needs to be constructed upon the values, habits and routines that are prevalent within the respective socio-economic context.

## 3.5 Darwinian principles of institutional evolution – inheritance, variation and selection

### 3.5.1 Introduction

In order to produce an adequate approach to the evolution of the Chinese Circular Economy it is necessary to construct a framework that covers more than just a mere instant in time. So what is required for the purpose of this thesis is an explanatory framework that captures the dynamics of cause and effect, where the emergence of one element induces the creation of one or a series of subsequent responses. At the core of this dynamic are institutions together with respectively influenced and influencing actor groups.

In the scholarly field of economics, institutional and evolutionary ideas have a long history: For example Adam Smith had promoted one central idea namely that economic outcomes are not necessarily the result of conscious overall design. Rather, any type of social order can emerge without central direction (Hodgson, 2007a, 8). Another major figure, Alfred Marshall was inspired by the evolutionary ideas of Herbert Spencer (Hodgson, 2013a, 958) and Thorstein Veblen as one of the founders of the OIE finally imported the evolutionary principles of Charles Darwin into the social sciences (Hodgson, 2007a, 8). The synergy that resulted from the influx of evolutionary ideas into economic theory gave birth to the conceptualisation of the economy as being subject to a constant process of change. Herein, the emerging context confronts socio-economic actors with novelty and various unfamiliar elements that need to be gradually mastered through learning, experimentation and imitation (Nelson, 2006, 2).

From the perspective of the researcher any investigation into the origins of these matters and their underlying principles of causation need to be addressed by going back and forth along the historical, evolutionary process (Winter, 2014, 15). In order to produce respective explanations the evolutionary institutionalists focus on three theoretical cornerstones, namely Darwin's core principles of evolution that were put forth in his 'Origin of the Species' – variation, inheritance (or replication) and selection (Hodgson, 2003, 356f). Before going deeper into this subject matter one aspect requires clarification: Evolutionary Institutional Economics in the tradition of Veblen and as applied to the topic of this thesis intend to avoid the fallacy of biological reductionism or sole metaphorical playfulness. Quite differently, this dissertation adheres to the conviction expressed by Veblen, which is that the Darwinian concepts of variation, inheritance and selection shape the evolution of socio-economic

systems (Hodgson, 2004b, 191). More precisely, they shape the evolution of the institutional framework of these systems. However, before analysing the three Darwinian principles in detail, a general understanding regarding their role must be put forth first. Basically variation is necessary for evolution to proceed. Variation itself may be either random or purposive in design, but without variation natural selection could not operate (Hodgson, 2008c, 401). The proof for variation to exist is that within a given population its individual entities differ in relevant characteristics (Vromen, 2008, 740). Secondly there is the effect of inheritance or replication, through which offspring resemble their parents more than other members of their species. Within this process of inheritance operates a mechanism through which individual characteristics are passed on through generations (Hodgson, 2008c, 401). The significant function of replication is thus the preserving of properties along the generational line of entities (Vromen, 2008, 740). Finally, the entire evolutionary process is guided and structured by natural selection. This mechanism kicks in because better-adapted entities generate increased numbers of offspring or because the preserved variations provide an advantage in the struggle for survival (Hodgson, 2008c, 401f). By implication this means that some entities are more mortal and degradable than others and in the face of scarcity loose out against other competitors in the struggle for existence (Vromen, 2008, 740).

### 3.5.2 Inheritance and Replication

Evolution is an endlessly reproduced sequence of causal events that has neither beginning nor ending. What is most significant for this process is that every stage in the sequence depends on the developments preceding it. In institutional terms this means that every rule system evolves and changes on the basis of the preserved, preceding institutional structures. As it has been stated above, one significant function of these rule systems is to store experiences and knowhow, e.g. via values, habits and routines. For the process of evolution this mechanism of inheritance and replication of preceding experiences is of the utmost importance: The storing and copying of information is needed for the instruction and guidance of future institutional developments (Hodgson, 2013b, 981).

In this regard an essential requirement is that the original information remains intact and is copied with a sufficient degree of faithfulness so that it can be retrieved for the development of future systems. In the course of evolution it is relatively common that such information, be it in the form of experiences or know-how, is subject to gradual negligence and loss (ibidem, 981). At the same instance, it is difficult to assess at which speed and due to which factors this loss occurs. Evidence from periods of communist rule in various countries in Eastern Europe

and East Asia indicates that certain institutional elements from before the transformation towards socialism have survived this interregnum. Some commonly cited examples of economic institutional structures that could not be extinguished under socialist planning were informal markets and informally kept private farming plots. In East Asia there is evidence of such structures to having existed during the Maoist times in China (Naughton, 1996, 277) or in Vietnam before the formal transformation to present-day's market socialism (Kerkvliet, 2001, 9; Kerkvliet, 1995, 399). From the perspective of the institutionalist, such structures and practices may only survive if they are replicated in social practice and not merely in ideology. More specifically, 'they must be ingrained in the habits and conceptions of the people and sustained by other institutions' (Hodgson, 2006, 884). Rule-system related inheritance is however not necessarily bound to happen within one designated spatial realm. In an essay regarding entrepreneurial talent in contemporary capitalist China, Thomas G. Rawski traces this institutional feature back to the locus of the traditional village society: The hardships of the natural environment as well as the politico-economic pressures, especially during the 20th century, 'required every rural adult to monitor and respond to external circumstances' (Rawski, 2008, 11f). In summary, Rawski identifies this environment as trigger for the cultivation of 'an unusually rich and flexible portfolio of organisational skills with which to pursue economic advantage' (ibidem, 11). So acquired habits were in turn seen as the basis for the success of township and village enterprises, which could resort to a sufficient supply of local entrepreneurial talent (ibidem, 12).

The above cases exemplify the decisive function of inheritance and replication for the process of evolution: The main purpose consists in transferring workable institutional solutions along time and generations. For socio-economic actors this mechanism presents the benefit of avoiding costs and risks that are associated with learning the solutions anew. In light of the institutional evolutionary perspective adopted in this thesis, inheritance could not operate without the institutional medium: Firstly, institutions store and save information and thus allow a retention and replication of specific know-how. Secondly, this know-how is in itself a valuable component of information as it embodies solutions to repetitive problems that in one variant or the other can be expected to re-emerge in the future. Without institutions and their capacity for the retention and replication of problem solutions socio-economic evolution could not take place (Hodgson, 2008c, 401).

What at this point requires further clarification are the conditions for inheritance to be effective. As there is no consensus on generally applicable benchmarks for effective

inheritance, and relevant observations have been primarily confined to the aspects of imitation vis-à-vis experimentation and the reduction of copy errors. As for the first aspect it seems that there needs to be a good mix of both elements. Given ubiquitous complexity and uncertainty some elements of planning, guidance and experimentation is necessary. However for avoiding the incurrence of high costs and risks, any actor has to primarily rely on previously tried and tested knowledge (Hodgson, 2013b, 981). When it comes to faithful copying, the second aspect in the larger context of imitation, there are quite a few cases of successful businesses that have in the course of global expansion focussed on the reduction of copy errors. In this regard Hodgson emphasises that careful replication by companies is done via exact copying of internal habits and routines. In this regard he cites Intel's 'Copy Exactly' factory strategy, whereby every process flow, equipment set and training methodology existent in the original plant is replicated faithfully in the local branch. Similar approaches have been adopted by McDonalds, Burger King, Pizza Hut, Kentucky Fried Chicken, Holiday Inn, Novotel, Hilton and many others (ibidem, 982). This indicates another piece of evidence of how inheritance and thereby induced transmittance of effective problem solutions affects economic evolution.

### 3.5.3 The selection mechanism

The process of selection represents the major flywheel upon which evolution operates. It essentially represents the mechanism, wherein entities of the same kind come together and compete for survival. According to Veblen, the entities that are subject to selection in socio-economic evolution are not people, but institutions. The principle of selection is thereby applied to a competition between systems of rules and habits of thought (Hodgson, 2004b, 138ff). What lies at the bottom of institutional selection are however not the institutions themselves. It is rather the driving force of values that determine the outcomes of the selection process: In his conceptualisation of selection, Veblen saw society as being on a constant path of selective adaption. What thus guides the choice of human actors in their adherence to something is not a certain system of rules, but the specific values that are embodied in particular institutions (Veblen, 1934, 143 in: Hodgson, 1999, 98f). In that sense the choice for or against certain institutions always depends on the respectively ingrained value sets to which actors or larger interest groups feel attracted to (Groenewegen et al., 2010, 151).

By introducing value based elements into selection the evolutionary model of institutionalism noticeably departs from the efficiency oriented perspective of market selection as it is promulgated by the NCE and the NIE. Not only do these theoretical schools perceive economic change from an institution free (NCE) or exogenously given, unchanging meta-

institutional (NIE) ‘state of nature’. Both schools moreover severely neglect the importance regarding distributional and power considerations that affect selection and development of institutions (Hodgson, 2002, 115). Indeed, the market itself as the one and only selection mechanism has to be put into question. When it comes to the field of law and legislation there is considerable doubt on whether decisions primarily follow the purpose of economic efficiency. Instead of a market, it is rather an amalgam of economic and political interests together with professional and lay believes that decide about what and how the law should be. Therefore the selection and evolution of law rather results from the workings of various norms and interests that compete for dominance (Nelson, 1995, 83). So if the market is taken as selection mechanism it would be comparatively more useful to perceive it as an institution in its own right: It incorporates and is composed of ‘social norms and customs, instituted exchange relations, and… information networks’ (Hodgson, 2002, 114).

Given this multitude of rule systems and institutional subcomponents that interactively form and mould each other there is no reason to believe that evolutionary selection environments exhibit a stable or stringent nature. Nor do they select exclusively on the basis of economic efficiency (Nelson, 1995, 83). What in turn can be stated is that selection processes operate blindly, without providing a specific benchmark regarding its outcomes. Simultaneously however the selection mechanism is measured by the general standard of generating ‘fitness’ among the outcomes that it produces. Therefore the explanatory power of an evolutionary theory that includes selection depends on its capacity to specify ‘fitness’ plausibly. In this regard the theories of the NCE and NIE are prone to look for a (market) selection mechanism that defines ‘fitness’ according to a company’s capacity to ‘sell’ goods and services and thereby generate ‘profit’. When it comes to other fields such as technology and law, selection and fitness cannot be ascertained solely on the basis of profit. In these cases it can still be argued that economic markets influence the selection outcome, however simultaneously the selection process is also shaped by professional judgements, law as well as political factors. In fact, next to the purely economic principles of market supply and demand there are other aspects such as ideology, interests and power that determine selection outcomes in the evolutionary context (Nelson, 1995, 66).

In further consequence this means that evolutionary theorising on selection needs to take several different and possibly conflicting criteria into account. Some of these clearly exhibit an economic nature such as profits, product quality, price elasticity of a certain good or service and so forth. Others again feature elements that are associated with interest groups and

value preferences originating in political, legal, scientific and other professional circles. Within any particular subject matter that is concerned with selection a crucial and yet unanswered question is how long lasting the determinant selection criteria are in regard to their operation and production of outcomes. According to Dosi and Nelson, the durability of selection criteria is highly dependent on the subject context under which selection takes place. On the one hand side, the authors attribute a high degree of invariance to these variables when it comes to commonplace problems of accessing food and water. On the other hand side criteria invariance does not necessarily prevail in all economic and social circumstances (Dosi and Nelson, 1994, 156f). Given the element of strong contextual dependency, a suitable theory for a selection mechanism that can be applied to the case of the Chinese CE must consider the value and belief ideals, which exist and compete within the institutional realm that forms the selection mechanism.

### 3.5.4 Variation

Inheritance and for that matter selection can however not operate without a given set of variation. Evolution as it is conceptualised in this thesis is a process that is based on inputs out of which it evolves and thereby generates new outputs. The mechanism that produces outputs is selection, which is fuelled by the inputs from inherited lessons. What results from this selection process are outputs, which generally exhibit a variation in type and quality. This variation in outcomes constitutes a critical factor for producing viable solutions to given problems and challenges. In that respect Nelson and Winter stress that successful solutions can only be identified if a broad set of (institutional) variety is at the disposal of decision makers (Nelson and Winter, 2002, 26f).

And yet whether variations of problem solutions can emerge, depends on the boundaries set upon the selection mechanism: In some cases, only a few number of interest groups with respectively little variation in their value systems may be involved in the selection mechanism. This in turn reduces the variation in outputs during one single evolutionary sequence. However, over a longer period of evolution with several sequences, variation is guaranteed. According to Veblen, cultural variation is cumulative as the growth of a culture is the product of a cumulative sequence. Herein, ‘each new situation is a variation of what has gone before and embodies as causal factors all that has been effected by what went before’ (Veblen, 1908, 628 in Hodgson, 2008c, 402).

As alluded in the above, variation is in essence the result of and the fuel for the operation of selection (Hodgson, 2013a, 969). What however needs to be considered in this relationship is that selection may also minimise variety (and therefore variation)[2], at least within a certain time period. In their analysis of industries evolving over time, Nelson and Winter state that variety tends to be at the maximum level during the early stages of an industry. However once major hurdles such as in technology or design are resolved and a dominant design has emerged, natural selection may seemingly have reached a turning point from which on variety becomes gradually diminished. A particularly notable characteristic of this process is path dependency, which makes it impossible or at least very difficult for the selection system to return to earlier branch points and alternate a previously taken choice. At a certain point of industrial maturity the evolutionary process may thus not have much variety to work with (Nelson and Winter, 2002, 36). Albeit this argumentation features a tempting angle to illuminate evolutionary impacts on variety, it does not fully take account of industry-external influences, which may impact on selection and in further consequence variation. Taking the effect of depleting natural resources as an example of an externally induced challenge or problem, manufacturing industries will under specific circumstances be bound to respond internally. Presented with this challenge the industries in question will overhaul their selection mechanisms in regards to producing new and different technologies (variation) that are able to cope with the challenge.

In summary, any investigation of variation in evolutionary systems has to keep in mind three factors: (1) The sources and replenishment of variation, (2) how information on variation in outputs is passed along and (3) why some entities (in variation) are more successful in surviving or passing on their information (Hodgson, 2013b, 978).

### 3.6 Learning as a means to sustain the evolutionary sequence

One objective of the above chapters was to combine the elements of old institutionalism with the concept of evolution presented by the EIE. The aspect that has so far been left untouched

[2] In the herein cited article of Nelson and Winter (2002) one of the central topics relates to the aspect of variety, which in nature differs from the Darwinian principle of variation. However, the authors discuss variety in a manner that implicitly involves the concept of variation in their analysis. For the authors, a variety of institutional outcomes (e.g. different technologies) appears to 'naturally' contain elements of variation (see Nelson and Winter, 2002, 36). In a later publication that deals with the Darwinian principles, Hodgson (2003, 358) has come to a similar conclusion: In his analysis of Nelson and Winter's 1982 seminal work, Hodgson states that Nelson and Winter have incorporated the three Darwinian notions into their theory, albeit without explicitly mentioning these.
In this thesis, variation is rigorously distinguished from variety, in as far as the latter indicates a multitude of say institutional outcomes, whereas the former addresses different characteristics in otherwise similar institutional outcomes.

for the most part concerns the means that keep institutional evolution on-going. In order to fill this gap it is necessary to theoretically engage into a discussion on the medium through which information on developments in prior stages of institutional evolution is transferred to and influences respective developments in later stages. From an evolutionary perspective the medium of knowledge and information transfer is manifested in the concept of learning. According to some institutionalists, learning can be perceived as the key feature of any economic system. In fact the economy is by itself a learning system, in which learning and thereby induced change is the one of the few constants in this dynamic process (Nelson, 2006, 3). One crucial reason that induces learning among actors is the emergence of a problem and the respective trials to resolve it. One type of such a problem-solution context is competition, which, if considered as a problem, forces players and organisations to continually invest in generating and obtaining knowledge (i.e. the solution) for the purpose of survival (North, 1994b, 22).

Evolutionary theory has placed the aspect of learning at the centre of its investigation of the principles of variation, selection and inheritance. At the most basic level, evolutionary theory can be viewed as a theory on how socio-economic systems learn (Dosi and Nelson, 1994, 158). As a result, evolutionary theorists discern a constantly ongoing process of adaption among actors and institutions. The process itself does in turn exhibit characteristics of generating novelty through adaption based on systemic trials and errors. As Dosi and Nelson contend, this kind of discovery process applies to all human and institutional entities within the system (ibidem, 158f). Herein, the particularly important role ascribed to institutions is their function to store and circulate prior learned lessons. Once information or knowhow is translated into the form of an institution, individuals can simply ‘learn the lesson’ by adhering and practicing it in its institutional form. In further consequence, this means that the more the institution is practiced, the more actors remember its inherent knowledge (Stein, 1997, 734).

What must be pointed out here is that learning consists of more than mere information acquisition. Rather the learning process induces the development of new means and modes for cognition, calculation and assessment among individual actors. In turn this means that by learning, some kind of a transformative and re-constitutive process takes place among actors, which involves the creation of new habits, propensities and conceptual frameworks (Hodgson, 1998a, 175). As for the above alluded function of institutions as problem solving entities, learning plays an essential, dual role: Learning from previous experiences does on the one hand facilitate the identification of (institutional) solutions to emerging problems. While on

the other hand it may help to redefine the nature of the problem itself, e.g. through learning from previously conducted trials on solving it (Stein, 1997, 734). From a Darwinian perspective this problem-solving capacity acquired by actors depends on and grows through their access to previously accumulated knowledge incorporated in the surrounding institutional structure. This structure has in turn resulted from a multitude of trial and error sequences over the course of socio-economic evolution (Hodgson, 2008a, 9).

Albeit the main focus of the theoretical discussion in this chapter is on institutions, the very concept of learning brings us back to the nature and propensities of the economic actor as presented in institutionalism. For North learning represents the solution for actors to reduce the uncertainties within their environment and render it intelligible. In contrast to Neo-classical economists he, as many other institutionalists, does not frame humans as hyper-rational, all-knowing savants, but as being constantly faced with the problem of missing information on their environment. Therefore he describes human learning to be a ubiquitous effort to deal with the 'uncertainties in a non-ergodic world' (North, 2005, 5). In order to cope with these uncertainties, actors begin to construct belief (systems) about the nature and the working of the reality and the system it creates. Learning from experiences is thus based on interaction with the physical world and the socio-economic patterns within it (North, 2005, 2 and 15). In further consequence effective learning has to be conserved or somehow stored, which is done by means of creating institutions that in turn provide guidelines of how particular problems can be handled.

The characteristic of procedural rationality old institutionalism ascribes to human actors is highly relevant in this context: This feature is a capacity of actors to increase their experience through learning by doing. Given the fact that humans can only resort to incomplete information and furthermore face limited capacities for processing information at hand, they need to develop regularised patterns to structure their way of behaviour and interaction (North, 1994a, 10). The cumulative outcome of this learning process consists in the development of institutional structures, which are agreed upon by a group of actors. Again it is essential to note that these outcomes are not necessarily efficient from an objective perspective that oversees the entirety of socio-economic activities. Learning results are in fact very much bound to spatial and temporal conditions of particular actor groups and to the information they can access. Due to the subjectivity of experiences and differing environments, the institutional outcomes for solving a universal problem may vary widely among different

economies and may furthermore exhibit different levels of performance effectiveness (ibidem, 10).

Other institutionalists such as Nelson and Winter (2002) hold akin views on the topic of learning in the context of actor rationality. They refute the neoclassic claims of the hyper-rational actor on grounds of the impossibility to possess vast computational and cognitive powers that would allow humans to ex-ante deliberate and accurately foresee future events in the socio-economic environment. Instead, they claim that quite often (organisational) decision processes display elements that seem to defy basic principles of rationality (Nelson and Winter, 2002, 29). In order to counter this 'shortcoming', their model of actors is one of procedural rationality: Via employing a 'learning-by-doing' approach, Nelson and Winter's actors develop a set of routines – or habits at the individual level – which to some extent help them to cope with future challenges. These routines themselves as well as their improvement are based on learning from the results of routine application and practice. The methodological trick of this conception is that routines themselves are equipped with a mechanism that enables a change of routines. The mechanism simply operates on the individuals' willingness to allow learned experience to change the routines (Nelson and Winter, 2002, 39f). This mechanism can thus be explained as the capacity of adaption. Likewise, Hodgson identifies learning as the developmental and re-constitutive substance that enables institutions, and in further consequence actors, to adapt to changing circumstances (Hodgson, 2000, 327).

From an evolutionary point of view, learning constitutes a continuously operating agent to sustain the repeating cyclic loop between inheritance, selection and variation that as sub-processes shape evolution. Herein, it is especially the connection between learning and selection that requires further examination. Selection is the core evolutionary mechanism in the process of creating institutional solutions as it determines institutional solution outputs based on provided inputs. At the input side there is on the one hand a challenge or problem that requires an institutional solution and on the other hand the lessons learned from prior experiences. Selection as a constantly repeating process will always use the inputs from learning to adapt the institutional system to current requirements. The hereby produced outcomes only represent suboptimal solutions simply because of information asymmetries and the imperfect nature of information gathering. Albeit information scarcities seem to be an impediment for perfect efficiency, it nevertheless perpetuates the learning process endeavoured by socio-economic actors. By doing so, they simply aim to improve solutions and adapt more effectively to the requirements of reality (Nelson and Winter, 2002, 26).

In this sense economic growth can be seen as a society's advancement based on the constant replenishment of the institutional structure with knowledge and information learned in the process of solution finding (Hodgson, 2004b, 182). Without institutions, learning could not take effect within society at large as it would simply be lost over the succession of generations. Institutions on the other hand could not change and evolve, if it were not for the process of learning. Learning thus constitutes the essential link that binds institutions and actors together. In this context the only impediment for the free wheel of evolution is the curtailment of information flows and reception enforced by power structures or interest groups. There is sufficient historical evidence on authoritarian regimes that highlights the effects of institutional structures, which were set up for the purpose of oppressing information and know-how that could harm existing power structures. However for economic growth and thus evolution to take place, a free flow of information and learning based experience has to be permitted (Roland, 2008, 149).

## 3.7 Concluding observations on the reception and application of (evolutionary) institutional economic theories for the case of China

The bulk of theory introduced in this chapter has its origins in the sphere of Western scientific research. Given the fact that the present dissertation engages with matters of Chinese socio-economic development, it begs the question to which extent the above presented theoretical body can be applied to Chinese socio-economic circumstances.

In his recent book on China's Economic Culture the German Sinologist and Economist Carsten Herrmann-Pillath has addressed this issue and the problematic results, which stem from overzealous applications of Western theory on Chinese realities. In this regard he cites Max Weber and how Weber arrived at the conclusion of the Chinese human nature being irrational, if analysed through the lens of Weber's rationalisation model of human behaviour (Herrmann-Pillath, 2017, 108-112). The case to be made for the theoretical choice in this dissertation is for one based on the argument of ubiquity of rule systems in human societies. It is the firm belief of the author of this thesis that any social organisation or group in any part of the world establishes and makes use of institutions to govern its members' interactions and behaviour. Furthermore, the author adheres to the conviction that rule systems change over time, i.e. they evolve. If in a next step the concept of institutional evolution is incorporated into this framework of change, it becomes necessary to identify the process governing elements per se. In this regard, the Darwinian principles of inheritance, variation and selection happen to offer a powerful explanatory framework, in which institutional evolution is seen as

being determined by the operation and intertwining of these evolutionary sub-processes. The herein expressed preference to include evolutionary elements into the institutional analysis follows a simple rationale. In the view of the author human institutions are more akin to organic systems than to mechanistic ones. For one, humans are a result of the evolution of nature. Therefore evolution is an intrinsic part of human life and of human society. Finally, evolutionary systems are by implication non-mechanistic. Technical mechanisms do not change over time, but, continue to operate in an immutable manner and in accordance with their pre-designated purpose. Organisms on the other hand evolve over time, that is, in response to their changing environment. This fundamental distinction can be seen as the benchmark that divides the EIE from NCE-based theories such as the NIE. In further consequence it raises a relevant question for any researcher in the social sciences, whether she or he intends to approach societal phenomena by adhering either to a mechanistic or to an organic mindset.

Apart from the reflection on and choice over theories, it is necessary to consider the conditional context for their application. One example of flawed application is Weber's model of rational behaviour that resulted in the misconception of Chinese behaviour being 'irrational'. For this thesis it is imperative to avoid the sort of Weberian fallacy and bearing such in mind I will approach the question of theory applicability from the opposite direction. The following paragraphs therefore explore how institutional and evolutionary institutional economic theory is perceived and applied by Chinese academics. Hereby we can identify how Chinese scholars respond to these, originally foreign schools of thought and to which extent they deem such concepts useful for application to the Chinese context. In a second, concluding step valuable theoretical amendments and ideas from the Chinese discourse is incorporated into the overall theoretical framework.

A proper start for the analysis is to clarify the degree of prevalence of institutional economics in the PRC. For this purpose, an online query has been conducted via using the Google web search engine. The aim it is to quantify the varying degrees of reception for the NIE (新制度经济学), OIE (老制度经济学) and EIE (制度演化经济学 or 演化制度经济学[3]) in Chinese texts. The hereby obtained output displays a distribution of 166,000, 12,800 and 9,420 or 2,490 hits for the four terms respectively[4]. Although such a quantitative approach can at best

[3] A review of relevant articles indicates that both terms are used to refer to evolutionary institutional economics.
[4] This online web search has been conducted on 5.2.2017.

represent a rudimentary approximation to the actual manifestation of interest on these topics, it yet seems to hint towards a relative preference for the NIE over the other two schools of thought. A closer look on the works of Chinese NIE proponents sheds some light on the reasons behind this bias. For example, a paper by Ouyang and Xu (2004) comes to the conclusion that the OIE succumbs to the NIE, because it lacks a clearly discernible theory suitable for analytical application. In the view of the authors, the OIE at best serves a 'descriptive' purpose for the analysis of historic events. However, in contrast to NCE related theories such as the NIE, the authors describe it as lacking a coherent, universally applicable theory (Ouyang and Xu, 2004, 6). There are several, in tone similarly negative appraisals of the OIE expressed by NIE proponents, who generally tend to criticise the lack of a useful model for analytical application (Li, 2009). This highly critical, but biased stance is also promoted by more influential figures such as Stephen N.S. Cheung (张五常). Cheung, who is of Chinese descent and a neo-institutionalist presents a comparative analysis of the OIE and NIE that is more nuanced, but similarly dismissive of the former. According to his view, the OIE foremost focuses on comparing economic systems and shows 'what is good and what not (Shenme hao, shenme bu hao 什么好什么不好)'. The OIE's 'concepts are vague (gainian mohu 概念模糊)' and its 'contents are empty (neirong kongdong 内容空洞)'. Such then descriptive approaches, Cheung contends, only ended with the advent of scientific methods, such as introduced to economics by Milton Friedman (Cheung, 2012). Cheung admits his interest for the OIE's contribution to economic history, but in the same instance belittles old institutionalists for their lacking knowledge of neoclassical marginal analysis (ibidem). One reason for the dismissive stance of Chinese scholars may stem from the perceived complexity and diversity of the OIE's research program (Feng, 2016), which indeed comprises a multitude of often differing views and convictions such as on the nature of economic change[5].

But more fundamentally, the preference of Chinese scholars' for the NIE over the OIE can be explained via recent historical developments in the PRC: The reform and opening process constitutes a major caesura in socio-economic realities and thus had a significant impact on everyday life on the Chinese mainland. When looking at the beginnings of the reform process it becomes relatively evident that the NIE captures much of what has become subject to change, i.e. property rights, matters of transaction costs and a new form of economic

[5] The reader may be referred to the theories of Clarence Ayres and his negation of earlier institutionalists (Hodgson, 2004b, 345-354)

governance (Lin and Tsai, 2004). Moreover, the Chinese reform process chronologically coincides with two significant developments within the NIE: Firstly, Ronald Coase the initiator of the NIE received the Nobel Prize for Economics in 1991, which helped to spread these, at the time novel concepts of transaction costs, property rights and externalities in scholarly circles around the world. The responsive reception of Coase's ideas in China began at latest around the early 1990s[6] and contemporary Chinese researchers stress the important contribution of his later work on China for explaining the development and emergence of Chinese capitalism (Sheng and Geng, 2013). In further consequence this has initiated an academic hype around Coase and specifically the NIE in China, where his demise in 2013 was accompanied by a wave of mourning and commemoration among local economists. The prominent element that permeates their commemorative appraisals is the emphasis of the NIE's concise theoretical body, the clear formula of key principles for application and the normative approach towards increasing economic efficiency (INFZM, 2013). Secondly, the NIE has at a theoretical level repeatedly confined itself to getting 'the formal rules of the game (polity, judiciary, bureaucracy)' as well as 'the play of the game (aligning governance structures with transactions) right' (Williamson, 2000, 598). This approach very much corresponds to the socio-economic realities that came into being with the reform process in the PRC: Indeed the rules of the game and how it is played have changed, however the game itself as being designed and controlled by the CCP appears to have remain the same.

The fundamental problem of the NIE's methodological limitation becomes evident once elements of the OIE are included into the analytical perspective. Firstly, it concerns the informal institutional dimension, in which the formal setting is embedded and which is conveniently left out of the calculation in the NIE by seeing it as exogenously given (Williamson, 2000, 598). For example the interactive dynamic between formal and informal institutions in China has generated new patterns of behaviour and deliberation among the economic and political elites in China. Political entrepreneurship today can in this perspective be seen as an informal response to bottom-up efforts that were imported into the formal rule framework in the course of reforms. Secondly, there is the aspect of effectiveness vis-à-vis efficiency. Whereas the NIE puts a normative stress on creating efficient institutions, the OIE attempts to explain why some rule systems operate more effectively than others. This again relates very much to the informal institutional context, within which some institutional solutions to general problems are feasible, while others for reasons of accepted values or

[6]As indicated by the homepage of the *Ronald Coase Institute*, translations of his works into Chinese date back to 1990. See: behttps://www.coase.org/coasepublications.htm

consolidated interests are not. Academics in China have, to a yet small degree, begun to take these aspects into account, and within this subject matter a particular interest in evolutionary models can be discerned. As Yang Hutao (2006) shows, the development history and the origins of the EIE are well documented in China. By means of a historical overview, Yang goes to great lengths to outline how institutional economics competed with NCE related theories in the early 20th century and how both sides were shaped by natural sciences. It is especially the EIE that receives most of the attention in this contribution and yet the author makes no attempt to engage with questions concerning the application of the theory to the Chinese context (Yang, 2006, 4f).

Possible reasons for the hesitance to apply EIE and OIE related models to China are presented in a relatively pronounced critique by Gu Genliang. In two instances Gu points out that the OIE and EIE have so far not received sufficient attention and popularity in China (Zuo et al., 2011). According to Gu, this can be attributed to a long cultivated propensity of Chinese economists to prefer mathematical formalism and static equilibrium postulates over alternative more dynamic theories (Gu, 2011). In his opinion, the EIE features three major advantages for the purpose of analysing economic developments in China: Firstly, the EIE helps to identify pivotal developments of the past and thereof derive explanatory variables that affect institutional developments of the future. Secondly, the non-rigid, flexible theory framework of old institutionalism allows synergies with other heterodox theories such as Marxism or Post-Keynesianism, which in turn offers the potential to develop new methodologies for the analysis of economic change. Thirdly, Gu draws on the development experiences of the economic transformations during the 19th and 20th century in Great Britain, Germany the United States and Japan. In his view, the early institutional analysis of these historical cases presented plenty of insights that can be adduced to explain China's economic rise in the aftermath of the reform and opening process (ibidem). In summary, however, Gu's attempt to apply EIE based concepts to the Chinese case are tacit at best.

As outlined in the paragraphs above there are only a few and then mostly tentative examples, in which Chinese economists apply EIE concepts to China's socio-economic context. However there is one substantial piece of work that provides a valuable contribution to the theoretical body presented in the earlier sections of this chapter. In this paper on Chinese institutional change, Zhou Ye'an develops an explanatory framework that is based on the evolutionary theories of the Austrian economists Hayek and Schumpeter. He explicitly rejects Neo-institutional theories due to their statist approach and primary focus on property rights

and transaction costs (Zhou, 2000, 2). Instead he focuses on the role of local and central governments, which playe a significant role in China's transformation since the initiation of reforms (ibidem, 3). The institutional dynamic as he portrays it is one of competition between two institutional domains, one formal, top-down enforced through state actors and one informal, bottom-up emerging rule system promoted by non-state actors. In a Hayekian tradition Zhou adds another structural element for analysis, namely internal rules (neibu guize 内部规则) that emanate as a result of interaction between individuals, and external rules (waibu guize 外部规则), which are a product of organisations. According to Zhou's line of reasoning, individuals may form organisations so as to have better chances to realise their objectives. Herein, the internal rules of these individuals produce the structuring principles of organisations and in turn decide over the respective external rules. These external rules are practiced by organisations once they come into contact and engage with other organisations. For Zhou both types of rule systems are constitutive of and reciprocally influencing each other (Zhou, 2000, 3ff). This element is highly significant as it suggests a way to explain the dynamic of institutional selection in the politico-economic context of the PRC. Beyond that the author introduces another feature of the Hayekian tradition by identifying competition as the major driver for evolution. In that sense it is only through the challenge of competition that organisations evolve in terms of their rule systems. Once external rules appear to be inadequate for successful competition between organisations, they will resort to their intrinsic repository of internal rules for innovation. At this second layer between external and internal rules Zhou sees another process of competition, that is, as to which degree internal rules cede their dominance to external rules and vice versa. Both types of competition induce learning and adaption processes, which in turn fuel the institutional innovation per se (Zhou, 2000, 5ff). In summary Zhou states that the pattern of institutional change since the opening and reform process has been dominated by the competition between two organisations, i.e. the state and civil society, on the one hand and their respective internal vis-à-vis external rule competitions. His take on this dynamic is that the resulting institutional evolution is primarily dominated by bottom-up developments, where the external rule systems of civil society exerted more pressure and influence on the government's rule systems than vice versa (Zhou, 2000, 7ff).

In reference to the initial question at this section on whether China's academic circles have generated valuable insights for the theory of this thesis, the response is twofold. Firstly, Chinese economists have expressed strong criticisms towards the OIE and EIE theory regarding the alleged lack of a suitable analytical model for application. However, as shown

above both schools do feature methodological elements that can help to construct applicable methods for the analysis of China. For one there are options for historical and local comparisons of different institutional structures that may serve the purpose to identify why certain rule systems are more effective than others. Apart from that, Darwinian elements presented in the EIE prove to be quite useful when it comes to explaining institutional evolution in terms of its origins (inheritance), internal decision processes (selection) and outcomes (variation). Nevertheless, a constructive takeaway for the methodology would be to devise a model that features a sufficient degree of application. Secondly, the ideas of Gu (2011) and Zhou (2000) on how to integrate evolutionary elements into the analysis of China's institutional evolution is taken up in the methodology section: On the one hand, Gu's elaborations on how inherited elements influence future outcomes as well as the OIE's openness to integrate new analytical elements provide a useful basis for the design of an analytical model. On the other hand, Zhou's concepts on bottom-up vis-à-vis top-down dynamics, the operation of the institutional selection process and his ideas on competition as motor for institutional innovation are particularly valuable. Together with Western, OIE related concepts these ideas serve as a useful basis for the methodological framework presented in the following chapter.

# 4 Methodology

## 4.1 Introduction

Any methodology is established on a theoretical framework. For this purpose the body of relevant institutional theories has been delineated in the preceding chapter. Based on this foundation, the following paragraphs proceed by constructing a viable model so as to explain the operation of institutional evolution in the context of the Chinese CE. Herein, the primary task is to establish an analytical approach with the purpose of answering the formulated research questions. In first instance this means to address the issue of outcomes that are created in the process of China's CE related institutional evolution. Secondly, the model needs to take several subordinate issues into account. These encompass the formal-informal institutional dynamic, generated institutional variations and operating selection mechanisms, the topic of institutional effectiveness as well as patterns of institutional solution finding and projections a future development trajectory for the CE (see Table 2).

**Table 2. Primary and secondary research questions**

| | |
|---|---|
| **Primary research question** | Which institutional outcomes have been generated by the evolution of the CE in China? |
| **Secondary research questions** | How does the formal-informal institutional dynamic shape institutional selection and in further consequence the Chinese CE? |
| | What institutional variation emerges from the selection process? |
| | Which types of institutional outcomes are effective and how can effectiveness be measured? |
| | Which institutional patterns for solving CE related problems prevail – imitation or experimentation? |
| | Assessment of the future trajectory of the Chinese CE? |

## 4.2 The basic elements of the model

### 4.2.1 Evolutionary institutional economic foundations

As can be discerned from the research questions, the primary concern for the modelling process is to devise an explanatory framework that can incorporate constantly changing factors as well as interdependently operating mechanisms. In short, the objective is to present a meta-mechanism that captures the process of institutional evolution in the context of the Chinese CE.

Herein, what is required for evolution to begin is a particular impetus that challenges the institutional status quo of an economic system. In this regard Mantzavinos (2001, 7) has adequately described institutional change as being based on the continuously reoccurring

sequence of challenges, which emerge and thereupon become tackled by institutions. The thereof generated result is the emergence of a new problem. In this conceptualisation institutions can be conceived as the mechanisms to solve (re)occurring socio-economic problems. The herein established interdependency between problems and institutions constitutes the very first cornerstone of the model. As for its applicability to reality, the primary argument is that this cyclic reoccurring phenomenon is ubiquitous in the context of socio-economic developments: In principle every society and every individual is constantly facing problems and challenges that impede their respective development. Solving such issues is the initial, reoccurring and ad-infinitum existing task. Therefore institutions – as guidelines for how to solve a problem or challenge – become devised and depending on their effectiveness, will spread, become imitated or changed. Evolutionary psychology provides a useful explanation to this claim: Its proponents argue that the process of evolution has over millions of years in social and hunter-gatherer contexts equipped the human brain with 'specific mental modules that apply to specific problems and circumstances'. Rather than being an all-purpose calculator, this perspective identifies the 'modular brain… [to consist, the author] of many special-purpose and domain-specific mechanisms' (Hodgson, 2015a, 106f). In this sense the problem-solving capacity of humans, which rational choice theory captures in the concept of 'rationality', is in Darwinian terms explained as the result of knowledge that is accumulated in rule systems. These rule systems are in turn used by humans to structure their behaviour. The generation of this knowledge is based on preceding trial-and-error sequences to solve problems and thereof emerging individual learning (Hodgson, 2015a, 107). Therefore the first and fundamental mechanism of the model is manifested in the ever repeating process of problem occurrence, identification and institutional solution finding, and the subsequent emergence of a new problem.

Herein, it is especially the central process of problem recognition and solution generation that deserves further clarification. Firstly, recognition and identification of a problem play a crucial role since what happens at this point is the conveyance of information and signals to decision making actors. It is only due to these information flows that actors can begin to devise and apply corresponding institutional solutions. Secondly for the creation of proper solutions, actors do not only process the direct signals emitted from the challenges, but also their previously gathered know-how and experience. This second input represents the beneficial results of preceding learning processes, i.e. the knowledge gains that have been derived through mastering previous challenges. Depending on the distinctness in nature between the current problem and preceding problems, actors in light of the present challenge

might either adopt an imitative or experimental, trial-and-error based approach to engage in the problem solving process[7].

Undeniably, socio-economic actors play a significant role when it comes to the creation and practice of institutional systems. Nevertheless, the methodological core of this thesis will stick to institutions as the basic unit of scrutiny. This choice is not only based in the observational advantage offered through the discernable characteristics of rule systems and their organising function for societal groups (Hodgson, 1998a, 172). Moreover, institutions present entities, which have accumulated particular interests and values so as to exert a normative, structuring influence on societal groups. So instead of setting the analytical focus on the specific, individual exchanges between actors, the investigation of institutions enables us to identify exchange phenomena at a higher ontological level. A further, crucial advantage is that institutional analysis offers the possibility to devise a theory or methodology on socio-economic evolution. In the sense of Veblen any evolutionary science has to be a 'theory of a process, of an unfolding sequence' (Veblen, 1989, 2). Herein, growth is determined by economic interest and its development manifests as a cumulative sequence of economic institutions (ibidem, 12). Based on this perspective, institutions can be taken as a kind of proxy that captures the societal changes in interest and values in an accumulated form. Whereas individual actor groups in most cases come and go more or less unnoticed, institutions as the larger manifestations of actors' interests do in fact leave a discernable mark in societies' history.

The model on institutional change presented in this chapter follows the above line of thought and moreover incorporates several conceptual premises of the OIE and EIE: In regard to the OIE and in line with Hodgson (1998a, 173) the model puts an emphasis on comparative institutional analysis and on the examination of a broad set of factors. This is done so as to produce adequate causal explanations for socio-economic phenomena in the CE context. Furthermore, the model explicitly excludes any recourse to the type of rational, utility-maximising actor promoted by the NCE. Rather, the conception of the actor herein chosen is one that emphasises habitual patterns in behaviour and thinking as well as the intrinsic drive of curiosity. These propensities in turn induce the occurrence of new challenges, to which actors respond by generating respective solutions, i.e. outcomes of novelty.

[7] This aspect will be discussed in more depth in section 4.4 of the present chapter.

As far as the EIE are concerned, the present model set-up has equally taken some of its core principles into account, which have been proposed by Dosi and Nelson (1994, 154). Firstly, the analysis is expressively dynamic with the purpose to explain the change of institutional structures over time. Secondly, the methodological framework presented below (see section 4.3) incorporates elements of inheritance, selection and variation. Inherited elements hereby represent the stored results from mistake-ridden learning and discovery, while variation indicates the diversity among these variables. The selection process itself is seen as a mechanism that incorporates inherited elements and in turn generates a certain variation of institutional products. Dosi and Nelson (1994) especially stress the significance of the concept of fitness, which implies 'the identification of a unit of selection and a certain mechanism through which selection operates'. Furthermore, the authors specify four core principles that are necessary for the operation of selection: (1) A fundamental unit of selection, (2) a mechanism that links the subject of selection (genotype) with the objects of selection (phenotypes)[8], (3) some processes of interaction that yield the selection dynamics and (4) some mechanisms that generate variation among the set of selection subjects, which in turn affects the selection objects (Dosi and Nelson, 1994, 155).

This very useful blueprint has been translated into the model in section 4.3 with slight modifications so as to conform with the context of the Chinese CE: (1) The fundamental unit of selection is therein represented by the given value systems of the PRC that are reflected in concurrent vested interests and thereof generated power structures. These manifest in the form of larger combinations of institutional structures. Taken as selection units, these elements are assumed to be relatively stable and constant over the course of years and only exhibit minor changes if compared to the modification in the systems of rules they produce. As for the (2) mechanism that links subject and objects of selection, the following model has incorporated a functional process that generates institutional solutions. Herein, the subjects of selection (genotypes) are represented by actor groups, who in their pursuit to realise their respective key values, are engaged in a constellation of reciprocal interaction. As shown further below, this interaction between contesting interests results in the creation of rule solutions (phenotypes), to which each group respectively adheres so as to attain individual goals. These rule solutions will after some time replenish the institutional inheritance stock that buttresses

[8] A useful explanation regarding this EIE analogy of evolutionary biological matters is given by G. Hodgson: 'The genotype is the genetic coding of an organism. The phenotype is the organism's behavioural propensities and manifest attributes. The phenotype is an outcome of the genotype and the organism's environment' (Hodgson, 2004b, 53, footnote 8). Since Veblen saw institutions as the objects of selection in socio-economic transformation (ibidem, 138), it should equally be possible to see larger institutional combinations and their constitutive interests and values as subjects of selection.

the operation of selection. For the sake of model operability one explicit specification is stipulated, that is to define only two major, contesting actor groups, which either belong to the formal or the informal institutional realm. This relationship is further explained in section 4.2.2. In third instance, the model incorporates a feedback flow of information, experience and learned outputs that emerge as a sub-sequential product of the institutional outcomes generated by the selection mechanism. These feedback flows are rechanneled into the institutional environment and through their input affect interest groups and their value systems. Thus these feedback flows replenish both institutional domains and reshape the way of how selection per se operates. However there is one variable within the evolutionary concept of Dosi and Nelson that is not fully incorporated in the model of this thesis. This concerns how (4) variation outputs affect selection subjects. In this thesis it is assumed that interest and value constellations in the context of the Chinese CE have remained relatively steady over the observed period of the early 1990s to the mid 2010s. Given this short timeframe it is relatively safe to assert a certain degree of interest invariability in the operating selection subjects. The guiding assumptions of the model do not exclude smaller changes within each domain's value and interest structures. However they deny profound changes that would recalibrate the operating selection mechanism and for example transform the nature of the two opposing domains into a synergetic one.

### 4.2.2 The economic actor

Due to the prominent role of institutions for the theoretical and methodological considerations in this thesis, relatively little emphasis has so far been assigned to the concept of human agency. Given the many contesting thoughts on this subject among different economic schools, the following paragraphs introduce an actor model akin to the OIE and EIE that fits into the larger conception of institutional evolution presented in this thesis.

As stated earlier, institutions and individuals are mutually constitutive of each other in as far as institutions mould and are moulded by human action. Actor and institutional structure hereby remain ontologically distinct, and yet they are connected through a circle of mutual interaction and interdependence (Hodgson, 1998a, 181). A crucial factor regarding human agency and the decision-making process of actors in the economic context manifests in the so-called rationality assumption. The optimisation-based theories of the NCE tend to ascribe a type of hyper-rationality to its actor model, according to which human beings possess vast computational and cognitive powers enabling them to always make the most efficient choice. The EIE and OIE schools have expressed strong doubts towards this assumption. In reference

to observations of organisational decision processes, some authors contend that actor behaviour observed in reality strongly deviated from the NCE's rationality principle (Nelson and Winter, 2002, 29). As an alternative to this hyper-rationality conception, the OIE have devised a model of human agency that can be traced back to the elaborations of Thorstein Veblen. In his view, human action in the socio-economic context is primary teleological, 'in the sense that men always and everywhere seek to do something' (Veblen 1919, 80 in: Hodgson, 1999, 150). Veblen herein states that humans are endowed with a proclivity for purposeful action (Veblen, 1934, 80 in: Hodgson, 1999, 150), which is ultimately explicable in causal terms (Hodgson, 2004b, 157). Douglas North has further refined this picture of human agency by outlining the circumstantial conditions of socio-economic interaction. He asserts that actors always suffer from incomplete information and limited mental capacity. Therefore they depend on the development of regularised exchange patterns so as to render their environment intelligible. In further consequence this implies that their choices do not necessarily lead to efficient results (North, 1994a, 10). Errors that result from such choices can only be corrected gradually, i.e. through information feedbacks that actors receive and process. This kind of rationality that evolves over time is captured in the notion of procedural rationality (North, 1994b, 17f).

Given the causality between actor interaction, behaviour and respective adaption it is necessary to integrate the function of learning into the model. Because actors use rules to achieve their objectives and thereupon evaluate the consequence of their practice, they will always tend to adapt, learn and thereby generate institutional novelties. This process simultaneously imputes elements of imitation as well as experimentation to actor behaviour (Dosi and Nelson, 1994, 157). In adherence to the procedural rationality concept, the methodology in this thesis incorporates a model of human agency, in which actors continuously encounter challenges and solve these through the application of institutions. As time proceeds, this process of problem emergence and solution finding is indefinitely repeated, which in turn constitutes a steady learning feedback that accrues to actors. By such, actor specific experiences constantly increase, and since the mindset of actors evolves according to procedural rationality, their behaviour and decisions gradually change by virtue of these new experiences. In this sense actors are not taken as ultimately rational, but as gradually augmenting their capability to make ever more effective choices.

Another significant explanation regarding the actor concept in this model is owned to the thesis-specific constellation of interest groups that influence the process of institutional

evolution. It has been indicated above, that one premise for the advancement of institutional evolution is the mechanism of selection. This selection process is per se seen as the result of opposing power structures that interact with each other. Based on personal observations, I assert that every instance of institutional change in the PRC at least encompasses two actor groups, which are to some extent aligned in opposition to another. The opposition itself emerges because of the different interests held by each group and may vary in their degree of dissonance. As for the origins of the two or more groups, we may imagine a constellation of state and non-state groups that oppose each other. And yet in a similar fashion there are cases in which also different state actor groups oppose each other, i.e. local versus central governmental bodies. As for the specific actor groups addressed in thesis, the following chapters are primarily confined to discuss the institutional practices of stakeholder groups that are relevant for either the formal or informal domain. In line with this institution-centred approach, it does therefore not suffice to distinguish between state and non-state actors. Rather, each chapter draws a line of distinction between those actors that devise and practice institutions belonging to the formal realm and those who are active in the informal realm. The reason to do so is that also state actors may in cases resort to informal rule-solutions so as to realise their respective interests. This assumption thus implies that every case analysed in the content chapters (chapters 6, 7 and 8) exhibits a constellation of two opposing institutional domains – one formal, one informal – which in their operation are propelled by particular actor groups, who pursue their respective interests. These cases may thus manifest constellations, in which either state- and non-state or two different state actor groups are opposing and competing with each other by institutional means.

In the following chapters, the discussion on institutional evolution thus firstly includes central and local (provincial and municipal) government actors, who equally practice institutions of the formal and informal domain. Secondly, also corporate as well as private actors (households, individual groups in WM) are analysed. The reason for these choices is twofold: Firstly, all these groups are engaged in CE relevant practices in particular CE fields, such as Eco-Industrial Parks or waste management. Secondly, for the depiction of institutional evolution, it is always necessary to identify the interaction between the two institutional domains. These domains are in turn composed of actor groups, who pursue diverse and frequently opposing or rival interest preferences and values. However, is it ultimately a given that actor groups in the course of pursuing their respective interests do necessarily encounter other, opposing actors? In this thesis I make this reductionist step and assume that for those settings, in which different actor groups encounter each other, their drive to realise their

interests puts them in initial opposition. Out of this opposition different approaches to solving one and the same problem result. These differing approaches originate in the respectively different interests aspired by each group. The hereby generated interaction between contesting actor groups constitutes the selection process, which in turn yields different institutional outcomes that are respectively devised and practiced by the opposing actor groups. A useful case to exemplify this dynamic is offered by the case of urban Chinese waste management (WM). In this domain we can discern two opposing actor groups, one represented by state agencies and formally registered companies, the other being informal waste recyclers. Both sides create and practice rule-based solutions to manage a perceived problem. For the formal side, this problem manifests as continuously generated amounts of waste that under the premise of sustainability require treatment. The informal group on the other hand is faced with the need to make a living and perceives discarded materials as part of the solution to their problem: By collecting, selling and treating discarded products these informal actors realise an opportunity to turn waste into profit. As will be discussed in the chapter on urban WM (see chapter 8) both sides design and practice their individual institutional structures. More important at this point however is that this example provides some insight on how opposing actors diverge when it comes to framing a problem and realise their interests. In the above case we find that the problem per se is not the same for both sides: For the formal side the challenge lies in how to cope with waste materials, whereas the informal side is primarily concerned with making a living. The smallest common denominator however is that the interests, problem perception and institutional solutions of both sides are centred on the material subject of municipal waste. By implication this means that opposing interest groups individually create solutions on one specific problem and thereby combine differing interests and differing perspectives.

The justification for incorporating opposing actor groups with a slightly different problem perception into one explanatory model is provided by the institutional outcomes of the selection process: Both sides for example set up and implement individual institutions that fulfil a similar purpose – broadly, the treatment of waste materials. As will be shown in the chapter on Chinese WM, the solution outputs manifest in a parallel structure of formal and informal, rule based collection, pre-processing and final treatment systems. In other words, despite differing interests and a differing problem perception the opposing actor groups have in essence produced similar institutional solutions. The crucial point to keep in mind for understanding the actor dynamics in the model is that in some cases, such as above, either problem identification or problem solution may not be fully congruent for each side of

involved interest groups. What however allows their juxtaposition in the model is that their respective institutional solutions exhibit similar, ultimate characteristics and functions.

### 4.2.3 Institutional dynamic: Top-down vs. bottom-up

One significant explanatory purpose of the preceding section was to show that institutional evolution is primarily propelled by the contest between opposing actor groups that pursue their respective values and interests. They do so by means of creating institutional solutions in response to a given problem and these institutional solutions serve the purpose of realising their respective interests. What will be clarified in this section, is that opposing actor groups interact and respond to each other. They do so not by means of interpersonal contact, but via the institutional structure they have created and via each round of new institutional solutions they set up. Herein, institutions as systems of rules serve as proxy for the interests of respective actor groups. As will be discussed further below, the methodological model generally asserts a dynamic between two opposing, and interactively responding institutional domains, which in all cases of analysis are situated in a context of mutually responsive contest. This approach also incorporates a specific Chinese dynamic outlined by Zhou (2000), which has been presented in the theory chapter (see chapter 3).

In regard to the characteristics of the contesting institutional domains, I have adopted a concept of differentiation proposed by the OIE. Herein, the differentiation that is set forth is the delineation of formal (codified) institutions and informal institutions (self-regulating and self-enforcing rules). The former type of rule systems is devised by a public authority with legislative and executive powers and implemented via top-down means. What lies at the very bottom of this formal institutional domain are the values and interests which this authority aspires. In the case of the Chinese CE the public authority would be represented by the central and local government, which conveys its values and interests through formal rules. The latter group of institutions emerges within actor groups, who share a set of particular interests and values. What effectively binds these groups together is that they share and make use of the same informal rules to attain their respective objectives. Here again for the case of the Chinese CE, one such actor group could be informal waste collectors, who practice the same or similar rule systems to collect waste. In another instance, such an actor group could also be composed of formal enterprises, which yet use informal rule systems to attain their goals. At this point it should be pointed out that ‘informal’ does not automatically equal ‘illegal’. Rather informal rules denote all rule systems that are not (yet) codified by the formal framework. Furthermore, it is also perfectly possible that official actors of the state, who

generally make use of formal rules, may in specific cases resort to informal rules so as to attain their individual goals. This is especially true for the context of the CE in China, where local governments have in some cases resorted to informal rule solutions to achieve local sustainability targets (Lo, 2014). By implication this means that state-actors or actors, who generally operate within a formal context, are not univocally or exclusively bound to formal rule systems.

Another aspect that requires clarification concerns the pinpointing of actor group specific interest and values. Given the multitude of interests and values upon which each actor's behaviour is founded, it would be difficult if not impossible to ascertain the entirety of all of these traits for each actor group under analysis. Rather what will be done in the course of analysing the various actor dynamics in the CE is to discern and identify the institutions practiced by respective actor groups. Since institutions are composed of and founded on these constitutive elements, they can be seen as an encompassing representation of many particular interests and values. In turn the practice of institutions by actors helps to explain the objectives and goals as well as the interest and values that actor groups strive to attain.

The interactive dynamic between formal, top-down enforced and informal, bottom-up emerging institutions constitutes the core mechanism, upon which the operation of institutional selection is modelled in this thesis. The relationship between these two institutional realms has been discussed to some extent in preceding literature (Williamson, 1991, 2007; North, 1994a, 2005; Hodgson, 1998a, 2006b, 2007a, 2007b; Zhou, 2000), but as of now, there still is no general consensus or theory on how and to which extent both domains shape and influence each other. However there is an obvious need for a respective theory: When it comes to the Chinese CE, relevant literature (Tong and Tao, 2016; Fei et al., 2016; Goldstein, 2017) as well as observations and field research by the author have indicated that both domains play a significant role in shaping this ecological-economic system. Therefore the present chapter will devise an analytical tool that helps to explain the workings and outcomes that emerge from this relationship between formal and informal rules.

I hereby start by establishing one basic premise: In any socio-economic context of problem emergence and institutional solution creation the formal and the informal institutional domains are immutably bound to each other. In the process of creating one or more institutional solutions to an encountered problem or challenge, the two institutional realms stand in a constant, interactive dynamic, which at times features oppositional, at times synergistic characteristics (Groenewegen, et al., 2010; Hodgson, 1998a; Hodgson, 2006;

Hodgson, 2007b). These characteristics can again be ascribed to the value and interest structures of the respective domains. What herein functions as the conjoining element that establishes the link between the two realms and subsequently perpetuates institutional evolution is the embedded mechanism of information- or signal-based responsiveness. This responsiveness is in first instance initiated by the emergence of a problem and in second instance triggered by the actions within the opposing domain. Both instances can be perceived as actions that entail consequences. These consequences are nothing less than the transmission of signals, or bits and pieces of information, which are received by actor groups within the opposing domain. The existence of such conveyed information is a constant given, which means that even in cases where no change in one domain takes place, the other will realise this lack of activity and thereupon either respond by taking institutional action or not. Translated into actual events in the Chinese CE, this means that there are periods in which relatively little institutional change or innovation appears. During other times it is possible to discern a high degree of alternating formal and informal institutional outputs. Quite often such latter periods are those in which novel problems occur that force a novel institutions response from both domains.

The principle that perpetuates this responsive dynamic between the two sides is rooted in the values and interests of each domain's actor groups, which they constantly strive to uphold and realise. Given the difference in values and interests both sides will come up with their own institutional solutions, which while emerging from the background of contest may at times be rival and oppositional, at times synergetic and complementary. In the former case, the simultaneously created formal and informal institutional solutions are opposing because they build up similar but parallel rule solutions, which capitalise on the same benefits. However the opposing rule systems only channel these benefits to their respective actor groups. By implication, under this constellation the solution of one domain only serves the interests of its respective actor groups, while excluding those of the other domain. In contrast to that, the latter case occurs when one side creates a new rule that occupies or fills out a loophole or latitude left open by the opposite institutional realm. The hereby created complementary effect may generate benefits for both sides, if it improves the solution to a problem perceived as such by all involved actors. This second pattern of (informally) nesting into a (formally) given leeway can also be considered as a special case of the first form (of institutional competition).

What in any case propels the responsiveness dynamic to continue is the transmittance of signals or information. As soon as one domain's institutional solution is in place, it will send out relevant signals, a kind of unintentional feedback, which is sooner or later received by the other side. What subsequently triggers the institutional reaction by the other domain is the difference in interests: While the solution of the first domain fulfils the interest and the values of its respective actor groups, the actors of the other side may in many cases see their interests and values only partially fulfilled. Therefore they will come up with an institutional solution of their own. What in further consequence follows is a subsequent process of responsive institutional creation and innovation that may either continue indefinitely or until a steady state of institutional constellation is achieved. In this case, all involved actor groups see their respective interests and values satisfied. The reason for the simultaneous creation of institutions with different provenience can simply be explained by the fact that actor group related vested interests interpret problems and the means for their solution differently. As outlined in this section the informal-formal institutional dynamic significantly shapes the institutional evolution process. The following subchapter will thereupon proceed to incorporate all constitutive building blocks into a comprehensive model of institutional evolution.

## 4.3 A model for institutional evolution in the Chinese context

### 4.3.1 The two sequences of institutional evolution

The primary aim of the herein presented model of institutional evolution is to capture the infinitely ongoing process of change within a pattern of two constantly repeating sequences. This does not imply that institutional evolution can be reduced to a controllable set of processes. Rather, the idea is to depict institutional change as a repeating pattern of similar sequences, in which some components are more and others less prone to change over time.

The type of institutional evolution that is herein applied to the case of the Chinese Circular Economy can be broadly sequenced in two continuously repeating processes: (1) problem emergence and solution creation (Figure 1) and (2) thereof induced learning output and its feedback into the operating institutional environment (Figure 2). These processes are aligned in an indefinitely repeating loop, wherein the ending of one induces the beginning of the other. Both patterns are structured along three interlinked sections, which are the three evolutionary

sub-processes of inheritance, selection and variation[9]. The following paragraphs will display the operation of these processes and how the entire model unfolds.

As alluded in the above, the larger theme of the entire model is the repeating cycle of problem emergence, institutional solution creation and thereof rechanneled learning feedbacks into the institutional environment. In the first sequence (Figure 1) an encountered problem or challenge is tackled by the formal and informal institutional structures that thematically relate to the problem or challenge. The treatment of the problem by both realms is shaped by realm-respective exogenous and endogenous elements.

The former are constituted by what each domain has inherited from prior problem-solving experiences, which are the learned inputs and may be summarised as all forms of knowledge, experience, information and the thereupon constructed institutional environment. As pointed out in Figure 1, both domains are fed by two distinct learned inputs. This can be explained by the fact that formal and informal rule systems have access to distinct information channels and thus process different types of information. Such divergences can be traced back to the very interests and values of respective actor groups, which decide over what experiences, knowledge and information serve their purpose best. Additionally, this distinction also considers the issue of imperfect and asymmetric information, which is to say that not all information available on the 'market' can be effectively gathered by respective stakeholders.

As for the latter aspect of endogenous elements in the solution creation process the model conceptualisation includes two factors: Firstly, each domain devises its institutional solution in accordance with the interests and values of its own actor group. Secondly, both domains are locked into an ever continuing dynamic of responsive interaction. What is assumed here is that both sides are to some extent aware of each other's rules and operation. This in turn leads them to devise their solutions not only in response to the occurring problem, but also in response to the workings of the other side. Given that both realms have been depicted as opposing, the ultimate purpose in the solution creation process is to realise their respective interests. These efforts may in some cases manifest in using loopholes of the opposite side to one's own advantage, while in other cases, may lead to solutions that aim to excel the solutions of the opposite domain. This combination of endogenous and exogenous elements

[9] Winter (2014), Nelson and Winter (1982), Hodgson (2008a and 2008b) Vromen (2008), Dosi and Nelson (1994) have in various instances outlined the significant role of these three mechanisms for evolution. The above presented combination and the dynamic model itself however represents the author's individual conceptualisation of institutional evolution.

does in further consequence lead to the creation of a variety of formal and informal rule solutions, which originate from the respective realms.

In addition to the above elaborations, a final yet crucial question is whether the evolutionary process does in all cases conclude with the generation of institutional solution outputs. The simple answer is that the emergence of a problem automatically triggers a process of institutional solution searching and output. In second instance, this however begs the question, whether the respectively generated solutions are always put into practice. Also in this regard, the answer is yes. Here, however, two important features have to be accounted for: Firstly, the temporal factor needs to be considered, i.e. how long does it take for the solution process of one domain to be put into action. It might for example be perfectly reasonable that one domain requires more time to produce a solution. The other domain might during the same time period generate several solutions over the same evolutionary cycle and simply interpret the inactivity of the other side as acceptance of the status quo. Secondly, there is the aspect of prevalence in institutional practice: Some institutional solutions might only be promoted by a very small number of actors within one domain. Given the interest and value relevant specificity of these solutions, their practice will never achieve a mainstream consensus within this domain. Moreover, these types of institutional outputs might simply be neglected and thus doomed to fall into desuetude after a short time due to an insufficient degree of institutional effectiveness (see section 4.5). In summary, it can thus be contended that in all cases of problem emergence, one or more respective solution outputs follow. As outlined in the above, their temporal emergence, duration of practice and prevalence of application are subject to entirely different conditions.

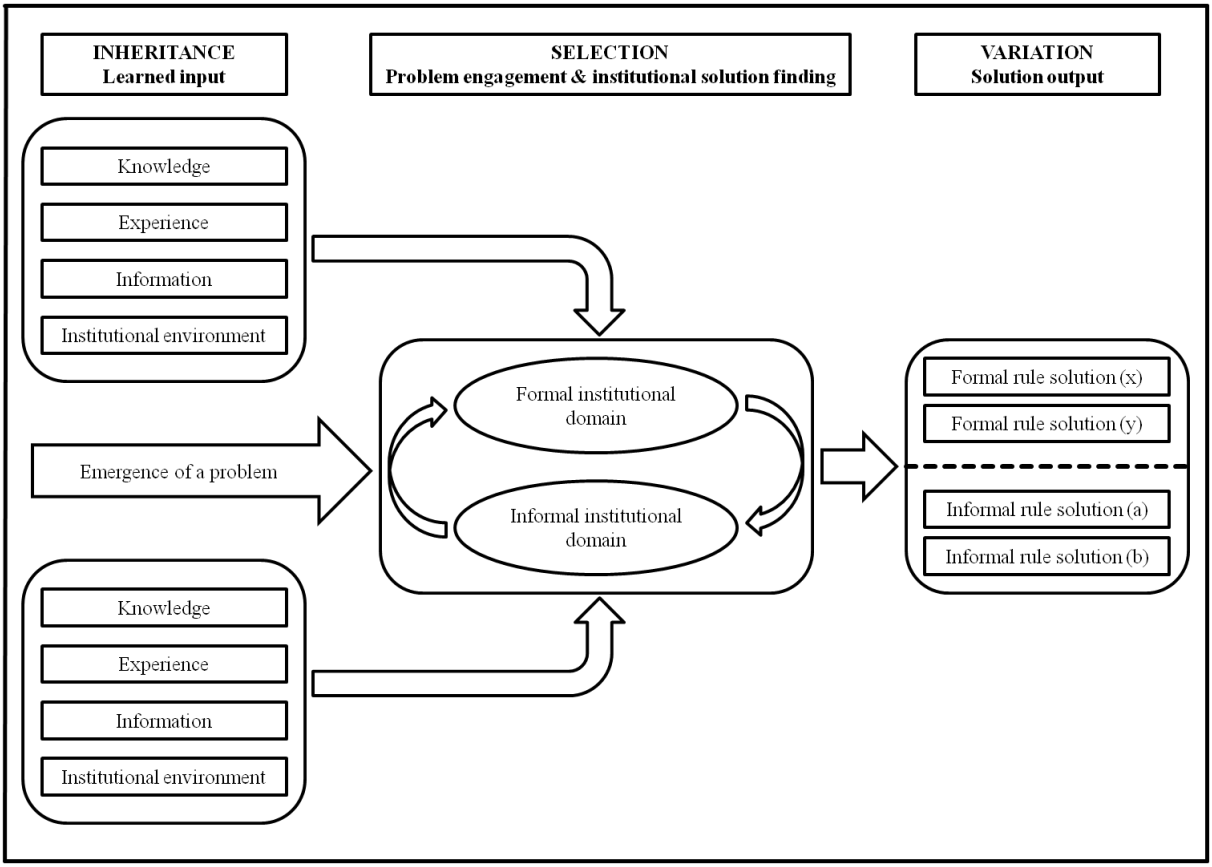


**Figure 1. Sequence 1: Problem emergence and solution**

The first round of the evolutionary cycle is completed once rule solutions have been successfully put into place. At this instance it should be pointed out that such completion is not necessarily marked by the simultaneous creation of rule solutions on both sides. Moreover, developments within the Chinese Circular Economy have shown that in many instances one domain chronologically precedes by creating some solutions first, to which the opposing realm responds by implementing their respective counter-solutions (Steuer, 2016b). This non-synchronicity is in part related to the contesting dynamic between the formal and informal institutional side. For the purpose of completeness it should also be outlined that there might be cases in which problems only trigger rule solutions from one side of the institutional spectrum. Here, the analysis would simply contend that only the interests and values of one institutional domain are challenged, while those of the other domain are not affected and therefore no rule solutions are created by this side. Finally there should also be mention of a constellation in which one and the same initiating problem is tackled in an alternating, responsive sequence by the two domains. Under these circumstances the solution of one side may be perceived as the problem of the other. Here again, institutional evolution proceeds according to the dynamic of reciprocal responsiveness.

The second sequence of the evolutionary process is marked by the learning output and feedback that results from the operation of institutional solutions in practice. As depicted in Figure 2 these outputs and feedbacks manifest in two flows that separately accrue to the respective inheritance storage units of the formal and informal side. These inheritance storage units in turn constitute the vast potential out of which both domains draw their institutional building capacities. Thus, through the process of back-channelling, outputs from rule solutions become learned inputs for the engagement of a new problem. Here again every domain has its very own feedback stream, which is based on the fact that any side primarily learns from the practice of its respective rule solutions.

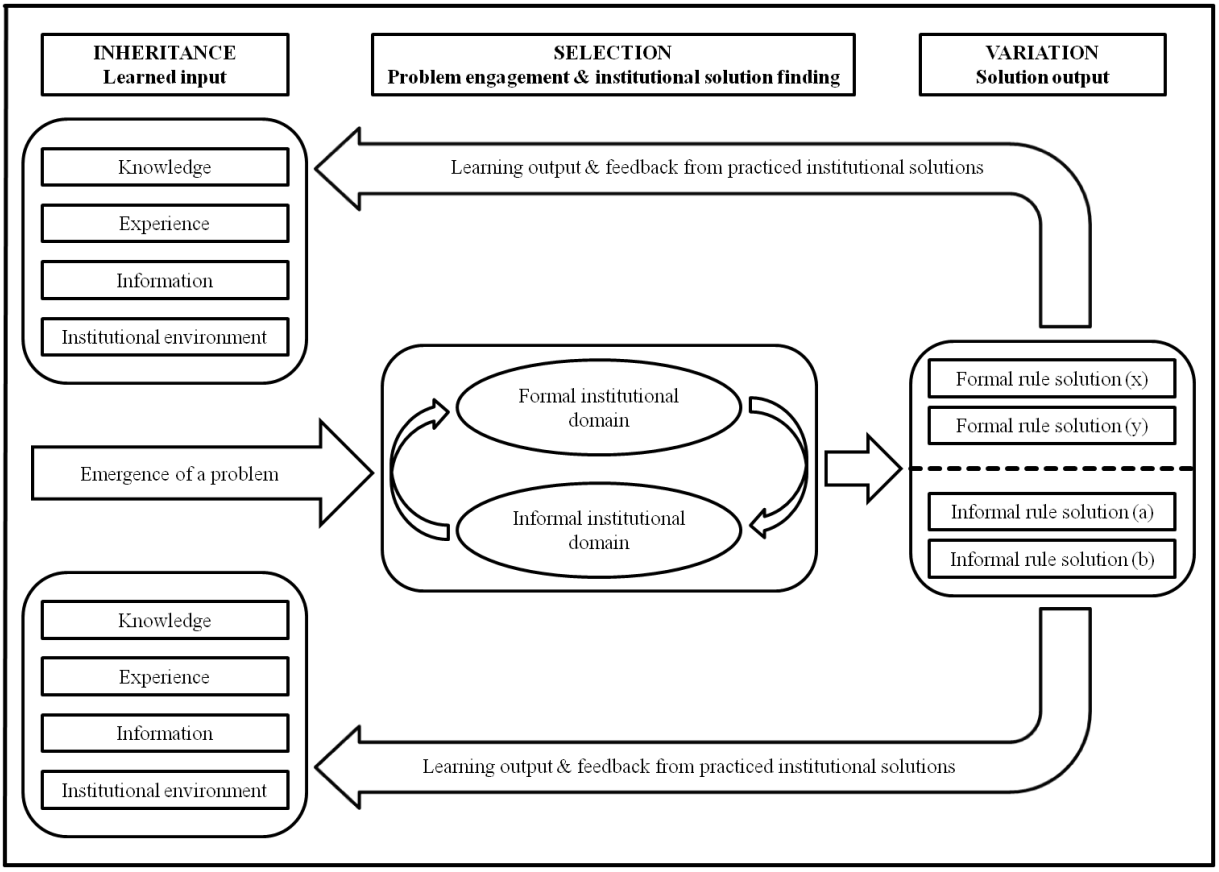


**Figure 2. Sequence 2: Learning output and feedback into the operating system and institutional environment**

The process of institutional evolution that has been outlined in the above model comprises several dynamics at different levels that operate over the course of two sequences. These sequential steps can again be captured within a frame that is structured along the three evolutionary elements of inheritance, selection and variation. In order to clarify each component's function for institutional evolution, the following paragraphs will outline these one by one.

### 4.3.2 Inheritance and the stock of learned inputs

Inheritance, as the first building block, encompasses the constitutive institutional environment, the knowledge and experience gained by the actor groups of the respective domain and the bulk of information gathered in the course of earlier problem-solving. A crucial factor that confines the effectiveness of inheritance and learned inputs arises from the segmentation of this element into two distinct stocks, which separately accrue to the two institutional realms. Despite the fact that this inheritance stock may in some instances overlap between the two domains, it nevertheless manifests as two separate structures. This in turn affects the capacity to devise institutional solutions: The idea is that any new solution to a given problem always represents an improvement to earlier solutions. This is in parts the owed to the endeavour of decision-making actors, who pursue a better realisation of their interests. Moreover, however, the improvement of outcomes over subsequent cycles can be explained by the impact of learning: Via increased information feedbacks, the stock of learned inheritance grows and thus enables actors to devise ever more effective solutions for a particular problem over subsequent cycles. What however limits both domains in their effectiveness is the fact that the actors in each domain only have access to their respectively acquired experiences. What they often lack are the insights and learned experiences of the other domain. Therefore institutional solutions only become more effective over each evolutionary cycle, but never efficient in an encompassing perspective. Moreover this 'natural' limitation explains why the different domains will always generate different and varying rule solutions.

Another pivotal feature that affects the availability of learned inputs concerns the means of how these elements are stored. Some information and experiences may be preserved through codification. However there is a vast amount of knowledge, especially among closed stakeholder groups, that is tacit and intangible (Nelson and Winter, 1982). In such circumstances the best way to convey and share information and know-how is repeated and imitative practice. In this sense, learned inputs only survive if they are regularly practiced and reapplied in, possibly modified, institutional solutions. By implication, the more often certain inherited elements are put into practice in original or modified form, the more likely have they proven to be effective compounds for institutional solutions.

As evolutionary circles ever produce new bits and pieces of learning outputs, the inheritance stock naturally expands. The degree by which this increase advances however very much depends upon two factors: Firstly, for acquired information on solution results to be included into the selection process by one side, it has to be approved by domain relevant decision

making actor groups. Their choice of using such information inputs for the selection group depends on actor group specific values and interests. By implication, the herein prevalent value and interest structures will determine which sets of information are chosen. More crucially however is the second factor, on whether learned lessons from one solution can be properly captured by the feedback channels. This is especially critical if such information has to be transmitted over great spatial and temporal distances and the more actors are involved. In regard to the Chinese CE a typical problem that confronts the formal realm concerns those outputs that are generated at the local level, but which are primarily processed at the central level (so as to become a new national regulation). Since these particular difficulties originate at the solution output stage, I will address this aspect in section 4.3.4 below.

### 4.3.3 The selection of rule solutions

The selection mechanism in this model substantially differs to what is often understood as economic selection in the NCE: In contrast to the NCE's traditional reference to the market as the 'black box' that picks product and company related winners from losers, the herein depicted selection mechanism is based on value-bound vested interest and power structures. In this sense the neoclassic demand and supply forces of the market are replaced by contesting institutional domains that pursue their interests and therefore devise institutional solutions. In analogy to the NCE, rule based solutions represent that what is demanded, whereas the endowed capacities of both domains to devise and implement new rules constitute the supply side.

It has been discussed above that the solution creation mechanism of both institutional realms is triggered by two developments, namely (1) by the emergence of a new problem and (2) the institutional solutions generated by the opposing side. This in turn may, over the course of consecutive evolutionary cycles, lead to a shift of the solution finding process per se: Solutions generated in both domains may be more targeted towards previous solutions of the opposing domain instead of solely addressing the problem or challenge per se. This particular case of institutional evolution however only occurs, if one of the two sides experiences an infringement of its interests and values due to the contesting side's solutions. What thereupon happens is a reciprocal spiral of response and counter-response in which both sides produce ever more effective rule solutions: While being centred on one and the same problem, the effectiveness of rule-based solutions increases, because of ever new learned inputs that accrue to both domains. For the context of institutional selection we can therefore identify the following components that in seemingly chronological order determine the operation of the

mechanism: (1) the emerging problem or challenge, (2) the learned inputs that enhance the solution finding capacities of each domain, (3) the actor groups in each domain, who pursue their respective values and interests and (4) the dynamic of reciprocal responsiveness existing between the two institutional domains. All four factors significantly shape the process of selection for the generation of new rules, however only the element of value and interest structures exhibits relatively stable characteristics. Given that the herein presented model nearly exclusively consists of intangible elements that are subject to constant change, it is worthwhile to go into more depth for the analysis of these relatively resilient compounds lying at the core of the selection process.

Some valuable contributions to the selection mechanism are taken up in the OIE: On the one hand, it sees the values and interests of actor groups as being the pivotal compounds for the operation institutional selection. However, when it comes to actor participation in this process, the OIE contends that decision-making power is unevenly distributed (Groenewegen et al., 2010, 151). The model of this thesis has incorporated such considerations by setting forth two reductionist steps: Firstly, the differentiation between two institutional domains that secondly remain undefined in terms of the power structure of actor groups within each realm. Therefore, the axiomatic mechanism of contest has been imputed to the two domains, which induces a generation of institutional solutions simultaneously or in response to each other. By implication, any competition between actor groups within one and the same domain has been left aside in the particular case studies.

Nevertheless what is included in the analytical framework are the conflicts arising from the division of power within society, which in turn manifest in the institutional outputs. As Groenewegen et al. (2010, 152) correspondingly note, competing value systems and thus different institutional products are a key element in understanding the performance of an economy. In further consequence, such conflicts between interest groups and their contest for value realisation propel and perpetuate institutional change (ibidem, 136). Such dynamics have also been observed in the PRC by Barry Naughton (2009), who in his analysis traces back formal institutional change and innovation to competing interests among formal power-holders. In his view, institutional change only comes as the result of internal compromise between the actors of the formal system. Such institutional outcomes are thus neither ‘best practice’ nor do they produce the biggest efficiency gains. Rather rule changes were only adopted ‘when they both promised efficiency improvements and were acceptable to existing power-holders’ (Naughton, 2009, 13). In a further step Naughton sets forth to explain how

the selection process of institutional evolution unfolds along the formal institutional realm: First, profound changes in the rule system mainly occur alongside the generational changes among decision makers. This also explains the reasons for why the implementation of transplanted institutions is inhibited over longer periods in time. Second, institutional innovations feature elements of a bargain or contract between power-holders. The primary drive in the economic sense is the need to create more efficient, growth-oriented policies and thus changes only succeed if vested interest groups are brought into a new institutional set-up. In third instance, formal rule innovation in the PRC is depending on an enormous amount of experimentation, of which most fails. Because of the fact that successful political-economic entrepreneurship is rewarded while the cost of failure becomes dispersed over the system as a whole, local officials feel motivated to experiment as they see it as an opportunity to rise along the power hierarchy. By implication, those experiments that appear to be failing will be cancelled. Fourth, based on prior experiments and the knowledge about the workings of the economy, Naughton contends that catastrophic failures of institutional implementation rarely occur. Finally, the author stresses the importance of the internal information feedback system, in which constant discussions and evaluations are conducted so as to assess the results of adopted institutional modification and renovations (Naughton, 2009, 13-16).

Quite clearly, Naughton's analysis indicates that institutional solutions not only emerge as a response to a novel problem, they are moreover a product of an intrinsic dynamic originating in actor group specific interest and value conflicts. Additionally, he lines out that institutional evolution equally depends on the feedback loop of learning from outcomes. Solutions, once being in place, therefore remain subject to repeated discussion and re-evaluation, which in turn influences institutional selection in the subsequent cycle of evolution. Despite presenting a very lucid interpretation of formal institutional change in China, Naughton's analysis has sidelined the informal domain and thus implicitly denies it to have any effect on the formation of formal rules and policies. If applied to the Chinese CE, such an approach would prove to be problematic: It is not only the challenge and the interest contests within the formal domain that shape formal institutional outcomes. Moreover, any formal rule quite often comes as a response to existing, rule-based practices of non-state actors. These in turn are clearly products of the informal institutional domain. So the issue with Naughton's interpretation is less founded in the sidelining of the informal institutional activities, but rather the omission of their impacts on the formal institutional domain.

According to the model herein outlined, institutional evolution is to a significant extent kept going through the reciprocal dynamic between formal and informal rule-systems. Taking Chinese green ship recycling as an example, the government has in many instances issued regulations to improve the lacking environmental performance of recycling yards. These in turn have responded by devising and implementing company internal rules as well as informal lobbying routines so as to respond to top-down enforced requirements (Steuer, 2016a). And yet, there are also cases in the Chinese CE that are much more in line with Naughton's depiction of institutional change. In regard to large-scaled, industrial ecological developments within China's CE related Industrial Parks, the institutional selection mechanism exhibits different compositional and operational features: Based on individual observations and text analyses it can be contended that the informal institutional domain only operates to a relatively moderate extent. By implication, informal institutional structures within such parks merely generate a small impetus of opposition or counteraction to the formal institutional domain. More often, informal solutions rather adhere or complement formal regulatory guidelines (see chapter 7). As for the formal realm in the CE industrial park context, diverse, but only moderately oppositional value and interest structures exist and compete with each other. Given this constellation, the formal institutional realm dominates the selection process and in further consequence its rule solution outcomes. In these types of cases, in which only one realm dominates selection, institutional evolution will move slower, as the incentive-generating competition from the opposing side is hardly, if at all, existent. As a consequence, effective solutions to a specific problem may require more or longer evolutionary cycles. This again depends on how fast the values and interests of the dominating realm are realised, and how well learned outputs are captured and rechanneled into the accessible inheritance stock.

What can be discerned from the above is the pivotal role of the selection process for institutional evolution. But in order to maintain this function over the infinite sequence of cycles, the mechanism itself needs to be subject to adaption: Nelson and Winter (2002, 26) for example depict selection as being 'always in a transient phase, groping toward its temporary target'. According to the authors, any temporarily imperfect adaption by the selecting subject can thus be explained via the lack of new inputs or because of still ongoing experimentation and trial-and-error learning. So even despite the ingrained, relatively stable elements of values and vested interest structures within both operating sides, the operating features within the mechanism are constantly augmented. This upgrading process has been captured by the model through learning-based inputs that accrue to both institutional domains, which in the form of

new know-how and knowledge in turn affect selection itself. The modification hereby induced to selection manifests in the outcomes of the selection process, i.e. the solution outputs.

However, this does not within a few instances lead to an entire change of earlier practiced solutions: It is therefore not the entire institutional structure (the meta-level), i.e. the systems of rules, which changes first. The initial modifications rather take place at the level of institutional components such as habits, routines or single rules (the micro-level), which become modified, replaced or realigned to each other. In turn, such gradual, compositional modifications at the micro-level induce a larger change within the respective meta-institution. In WM for example, the practice of habits that guide collection and transport changes first and thereupon affect the entire operational sequence of collection as an institution. As soon as these new features are executed, they will produce a feedback for the respective domain in the selection process. Once such feedbacks or learned inputs are effectively captured, the domain itself begins to extend and adapt its selection mechanism based on the new institutional (learning) input it has acquired.

### 4.3.4 Variation among solutions and the learning feedback process

The finalisation of a sequence in institutional evolution is marked by the creation of rule-based solutions. In the most general case of the model, the hereby produced outcomes feature a certain degree of variation, i.e. any evolutionary cycle ends with more than one solution being generated.

As addressed before, exceptions to the typical procedure may occur: In some instances only one realm within the selection mechanism may be entirely dominant. This constellation in turn results in either the creation of only one single rule solution or in the form of many rule solutions from only one domain. Under these circumstances output variation may temporarily suffer, however given the diversity in values and interests between the two institutional domains in selection, any one-sided solution will trigger a response from the opposite institutional domain. This in turn will again replenish the variation of outputs. So there is a possibility of solution creation either occurring in a synchronised or a consecutive sequence.

Chronological non-synchronicity in the outputs of both realms may be ascribed to two characteristics within the preceding sections of institutional evolution. One concerns the matter regarding how and when newly emerging challenges are tackled. Herein, developments in each domain that span along the horizontal axis of the model are not necessarily timely

coordinated with each other. For example, there may be cases from inheritance (input) over selection (solving) to variation (outputs), in which one domain is simply more active than its opposite side. The other characteristic refers to the direct contest between both domains. As indicated earlier, the solutions of one realm not only emerge in response to the problem, but also as a consequence to the institutional solutions issued by the opposite realm. However in both instances, the determinants behind the 'generative velocity' are twofold: Firstly, how quickly the gains from the input side can be procured and computed as well as secondly, how quickly the institutional solutions can be devised, put into form and practiced.

For the case of the Chinese CE it might be possible to imagine that informal actor groups are much more rapid in devising, practicing and disseminating their solutions than formal ones[10]. The reason is that formal input procurement and respective institutional codifications take more time and have to be conveyed over a wider network of hierarchy nodes. So during a given sequence of cycles it is assumed that the informal realm produces quantitatively more new rules than the opposing formal realm. While putting aside questions of institutional quality and their operative effectiveness the model assumes that any unilateral increase in novel institutions will likewise induce an increase in institutional responses from the opposite realm. This conceptualisation is founded in my observations of cases in Chinese waste management, where sudden institutional shifts that emanated from the formal realm induced a respectively sequenced response from the informal side (Steuer, 2016b). This interactive process of solution creation and subsequent responses denotes the closure of the entire institutional cycle. The logic of the model simply implies that the issuance and practice of any solution induces the initiation of a new problem: Either because a particular solution only accounts for the interests and values of one domain and thus provokes a response from the opposite domain. Or because the addressed problem is comprehensively solved, which subsequently redirects the attention of both domains to the next emerging challenge.

What has so far received relatively little attention is how rule solutions of the two domains interrelate to each other. Given that both sides adhere to different values and interests the resulting rule solutions are not only generating variation, but also a high likeability for conflict. Broadly two different types of constellations can emerge. Firstly, there are instances

[10] North (1994a, 8) has made a similar assessment regarding the different pace of change in the formal and informal institutional domain. Yet, he comes to a different conclusion: North sees 'informal constraints' as being deeply embedded in society (via values) and therefore they won't change 'over night'. The primary argument in this thesis however runs counter to North's conceptualisation. Rather I see that habits, routines or even rules of the informal domain being more responsive to novel circumstances. This does not imply that entire informal institutions change, instead they or their structural compounds adapt in accordance to new requirements.

in which single institutional solutions exhibit an inclusive nature, or several solutions of the two realms feature a particular degree of compatibility. In these circumstances the tackling of the problem by both sides does not come at the expense of any interest group. This in turn temporarily halts those instances of institutional evolution that are driven by competition between the both domains. This situation maintains up until a novel problem occurs. More frequently however the institutions of one domain impede the interest realisation of the opposite domain. In this case, the aforementioned procedure unfolds, in which the opposing side will produce and practice their own solutions in order to pursue their interests. The question of which solution prevails is primarily explained in terms of the degree of effectiveness concerning the larger group of actors involved. Given the wide scope of related implications this aspect will be more deeply addressed in section 4.5. What this context of interrelatedness however shows is that the variation in outputs is to some extent a 'natural' phenomenon due to the diverse interest structures involved. Of course there are instances in which evolution is only propelled by one domain. Here however the produced results are primarily realising the unilateral interests and values of a particular actor group, which in turn ignores the intentions and desires of many if not most other involved actor groups. Under such circumstances in which a sequence of institutional outputs is dominated by one domain, information and feedbacks on this particular constellation will sooner or later also affect the inactive institutional domain. This side will thereupon respond by devising its own institutional outputs depending on the degree of interest inclusion offered by the outcomes of the opposite domain.

The creation of rule solutions is only a single step within the larger process of institutional evolution. So in order to generate an added value to institutional solutions they need to be fed into the larger institutional context so as to serve as a fundament for solving novel challenges. The learning process that hereby takes place is primarily driven by the actor groups' desire to preserve information (Hodgson, 2004b, 138) that has been gained through solution applications. The value of the learning feedback process is highly dependent on two features: Firstly, learning is especially effective if it is directly fed to the decision making entities. Secondly, the afore-going experiences learned by actors must be made relatable to new challenges (Nelson and Winter, 2002, 29f). This implies that those actor groups that are capable to properly organise their learned lessons will have an advantage in addressing novel problems through institutional means. However the process of learning is by no means automatically conducted or accepted by actor groups. Despite the obvious gains for learning

there are in fact certain factors that impede the upgrading of institutional creation capacities through learning.

Here again a case from WM helps to elucidate this problem: Based on observations by the author, it was shown that several officials responsible for policy recommendations in that field have in many instances ignored, or at least not taken into account, actual issues regarding formal institutional solutions. The problem in question related to the lacking performance of formal municipal solid waste (MSW) collection systems, which are outdone by informal collection services. In direct confrontation with this problem, official interview partners have despite unambiguous realities either belittled informal performance or argued that informal activities are only a temporary phenomenon. Such perceptions are especially interesting given that informal collection has been prevalent in urban China since the mid-1980s (Ensmenger et al., 2005; Steuer et al., 2017a; Steuer, 2016). The explanation for such statements may on the one hand side be based on the intention to preserve official authority in front of foreigners. On the other hand however such attitudes may also hint to a deeper logic that relates to values and interests. The official willingness to accept learning inputs from practiced solutions may only go as far as fundamental values and interests of one or the other domain are not compromised. By implication, domain specific interests and values operate as filters that are applied to the inherited experiences. The above case for example shows that particular information feedbacks, such as the performance of the informal sector in WM, may simply be neglected by actors of the formal domain. The reason for doing so is that these informal solutions do not correspond to the values and interest preferences of actor groups within the formal domain. In consequence, the formal institutional inheritance stock misses out replenishment through information on particular, non-formal institutional solution, because formal, value-based filter mechanisms simply impede the documentation of such. In summary, the above depicted example indicates a problematic constellation, in which available lessons are not integrated into the formal domain and that may in turn lead to inefficiencies in future formal institutional outcomes. However, if the formal domain were to accept these learned lessons, it would imply to revaluate so far implemented solutions as failures. This in turn could jeopardise and even lead to abandonment of the formal domain's very core ideals, such as vested beliefs in the efficiency of top-down enforced institutions.

Setting aside issues of intentional impediments to learning, the solution output feedbacks generate ever more effectiveness for subsequent solution finding processes. This effectiveness is determined by the degree of context specificity as well as by the directness and frequency

of the feedbacks. The herein addressed aspects concern the obtaining, transmission and use of solution related information, which in turn are features of the operation of the respective institutional domains. Here again the case of urban WM provides as a good illustrative purpose: Informal waste collectors for example do not primarily focus on broadening their spatial scope for the collection of household waste. Rather, they aim to have access to as many households as possible within their individually pre-designated operational area. Li (2002) for example observed the spatially limited collection area of collectors in Wuhan. A similar observation has been done by the author in the city of Beijing, where actors have very clearly delineated operational areas within which they collect recyclables from households and sell them to informal waste markets (Steuer et al., 2017a). In both cases actors make best use of particular habits (solutions) that most appropriately fit the respective environmental conditions. From time to time these solutions fail to deliver the expected results, primarily because of the emergence of a new problem. In such cases of, where solutions prove ineffective, collectors simply upgrade their institutional practices through learning, i.e. gathering feedback from their working environment. Given that this specific actor group is constantly in direct contact with supplying households, contesting peers as well as demanding recyclable buyers constantly check, countercheck and adapt their institutional practices. As can be discerned from this example their primary advantage in this environment is that these actors constantly have access to very direct and frequent information feedback flows.

What needs to be kept in mind regarding the learning feedback from solution outputs is the high complexity of how this process unfolds in reality. In contrast to the one-dimensional depiction of the feedback loop in the model, actual interactions between actor groups suggest a multi-directional pattern that comprises different hierarchies and practices. In an attempt to capture these patterns I propose to include the following four dimensions: Firstly, learning may take place along a horizontal path, i.e. among peer groups, who engage in similar tasks. Secondly the process may also unfold along a vertical level, i.e. from higher to lower hierarchical levels and vice versa. Thirdly, learning processes may result from the repeated application of a particular rule solution so as to solve a reoccurring challenge. Finally, learning may also occur from experimental approaches to a novel problem, which implies the re-composition and realignment of elements from earlier solution outputs. In regard to the latter two dimensions Stein (1997, 735) has distinguished two patterns, namely what he calls ‘linear’ and ‘revolutionary’ learning. In his view the former builds on established knowledge and tested results, which are consolidated in routines through reoccurring application and thus gradually expand and renew the means to tackle similar challenges. Based on his observations,

Stein argues that linear learning manifests as the prevalent form in economic systems. Stein's concept of 'revolutionary learning' on the other hand occurs only in cases when the feedback from established practices is interpreted as negative. This in turn induces actors to devise and use new routines and habits so as to be more able to tackle the novel challenges they face under particular circumstances. While there is much truth in this analysis, the herein introduced terminology as well as some implicit hypotheses might not be apt to fully capture the implications of learning. Firstly, instead of using the terms 'linear' and 'revolutionary', the use of 'incremental' and 'non-incremental' learning might prove to be more suitable to describe the actual process of learning. Secondly, while negative feedbacks (non-incremental learning) are particularly significant for the generation of entirely novel institutions, they do not in all cases lead to non-incremental learning. Field research by the author in the domain of Chinese WM has shown, that negative feedbacks do not necessarily induce formal institutional systems to change dramatically: As will be discussed in the final chapter (chapter 8), informal systems have not only been neglected by the formal domain over several cycles of institutional solution finding. Moreover, formal, ineffectively operating institutions have also been kept in place over a substantial period of time. In both instance negative feedbacks have were generated, however without inducing a substantial, i.e. incremental, change in subsequently devised formal institutions.

In summary it can be established that solution outputs generate valuable information for the inheritance stock: Either because they gradually confirm and extend previous practices or because they indicate a necessity to change them. Herein, the value of learning feedbacks increases with the degree of variation in institutional outputs: Several solutions being generated by both domains provide a more comprehensive picture on the nature of a particular problem. This in turn generates a larger diversity of inputs for the inheritance stock, as it extends the available options for tackling a novel problem. The hereupon completed closure of a sequence in the evolutionary cycle has a significant implication for an economic system itself: To retain and pass on workable solutions for a particular problem not only improves the chances of survival for the system. Moreover the capacity to learn and retain solutions helps to save costs and avoid risks that emerge from solving one and the same problem from scratch over repeated instances (Hodgson, 2008c, 401). In this regard, Veblen contended that economic production and growth depends on a joint stock of knowledge derived from past experiences. It is only because of the feasibility to accumulate this knowledge in the common stock of the community and transmit it to its individual members that growth can be generated (Veblen, 1908 in: Hodgson, 2004b, 182f). However given that the economy is permanently

facing new challenges, inheritance, selection and variation are in a steady process of adaption and change. Nelson and Winter (2002, 26) describe this circumstance as a situation in which actors are constantly maladapted and subject to what they call exogenous changes. Interpreted through the lens of this thesis such changes constitute the emergence of novel problems originating from outside of the problem solving framework. Therefore they see the solution output and learning process described in this model as a naturally delayed, yet necessary element to for the creation of effective responses to exogenous changes (Nelson and Winter, 2002, 26).

## 4.4 Institutional innovation: Imitation vs. experimentation

### 4.4.1 Institutional innovation as a response to occurring problems

The herein depicted model of institutional evolution in essence displays a pattern of continuous institutional innovation. At the core of institutional innovation lies the conception that institutions represent mechanisms that aim to solve (re)occurring socio-economic challenges (Mantzavinos, 2001, 7). Given that such challenges frequently vary in nature and thus limit the effectiveness of similar, repeatedly applied rule solutions, decision-making actors face two options: They may either resort to institutions that have proved effective in the past or switch to trial-and-error and experimentation so as to better tackle new problems. Both approaches include some degree of innovation, since any practice of application implies a measure of smaller or larger modification of an earlier devised rule solution. By implication, both practices generate some extent of novelty, because any kind of modification of what is inherited leads to a larger change in created outputs. Innovation at the smallest instance may be as little as modifying one element in the operating subroutines and even in these circumstances a small degree of experimentation is included (Nelson and Winter, 1982, 130f). This also means that there never are rule solution outcomes, which constitute an unaltered imitation of earlier institutional solutions. Rather, novel solutions always result from a mix of imitation and experimentation. In regard to the sequences of the model, it can be argued that both types of innovation occur in the course of the selection process. The results of innovation however manifest in and affect the variation outputs as well as the inheritance stocks.

### 4.4.2 Imitation patterns

The very first and fundamental indication of imitation in the context of institutions is exemplified by the particularities of the habit. This starts with the forming of a habit, for

which the imitation of and influence from others plays a crucial role (Hodgson, 2004a, 652). As outlined in the chapter on theory, habits constitute the very foundation of any institutional superstructure. What has however so far been sidelined is that these dispositions to behave in a particular way in specific circumstances can be replicated through imitative learning (Hodgson, 2013b, 977). In this regard Hodgson discusses the process of learning languages in order to highlight the function of imitation: 'Learning a new language, we imitate and repeat…Gradually the knowledge of the language is transferred from one person to another. The replicators are replicated. The process of habit replication relies on behavioural imitation' (ibidem, 977). The purpose of adopting imitation is basically explained in the efforts of humans to render their constantly changing environment manageable. In the context of this struggle, habits represent a consolidated pattern of basic behavioural strategies that have helped humans to cope with the diverse challenges imposed on them by their environment (Hodgson, 2004a, 655). Veblen even considered the propensity for emulation as 'probably the strongest and most alert and persistent of the economics proper' (Veblen, 1899, 107 in Hodgson, 2004b, 163).

Given this deeply ingrained inclination for imitation it is highly probable that imitative institutional practices will be preferred to risky trial-and-error experimentation. Such propensities may also be underpinned by the attractiveness of successful solution outcomes: Once an institution succeeds in solving a problem, there is an initial probability for imitation. The more this solution is thereupon practiced and applied to similar problem contexts, the higher is the likeability that the solution will be memorised and become prevalent among the actor groups within an institutional domain. As long as this successful institutional solution is deemed sufficiently effective, actor groups will continue to imitate it (while gradually modifying it so as to increase its adaptability).

By implication, the adherence to imitation of effective rules will impede any kind of experimentation – or radical institutional innovation – so as to solve reoccurring problems with similar features. At this juncture we encounter a specific form of path dependence. The kind of rule imitation in the evolutionary process of repeated problem solving is not only driven by the implicit expectation to achieve a certain degree of effectiveness. Rather on a more fundamental level, imitative solutions may also be applied because or when they conform to the interests and values of the solution devising domain. In contrast to this approach, any kind of institutional experimentation may lead to outcomes that harm such vested interests or lead to conflicts between the actor groups of the domain in question. In

cases, where a steady state of interests in one domain exists and in which relevant actor groups endeavour to avoid any conflict inducing changes, there is a high probability of institutional imitation that generates rule solutions with little effectiveness. Depending on the relative strength of interest based coalitions such emulations of rules with weak problem solving capacity may continue at a rate of ever decreasing rule effectiveness. In turn this will lead to a state of institutional lock-in, where either the opposing institutional domain will challenge this institutional lock-in or the problem in question will remain unsolved and might simply reoccur in the subsequent institutional cycle. In essence this means that there is a certain limitation for overly unaltered imitation that excludes elements of experimentation.

### 4.4.3 Trial-and-error patterns

While the imitation of rule solutions represents an important mechanism for problem solving, substantial institutional innovation always has to include elements of experimentation. In fact, problem-solving capacities that are incorporated in institutions are the accumulated result of trial-and-error experimentation, which has been conveyed through individual learning over the process of human evolution (Hodgson, 2015a, 106f). In a similar manner, North highlights the value of experimentation for the evolution of societies when he reiterates Hayek's argument that '…The society that permits the maximum generation of trials is the one that has the best likelihood of solving problems through time'. He further contends that adaptive efficiency to new problems is essentially based on learning from failures, which in turn have to be dared to take (North, 1994a, 1).

However, as outlined above, there are factors that impede experimentation, which are herein seen as being centred on the given interest and value structures. In regard to the socio-economic transformation in China, experimentation has certainly played a significant role and continued to do so. An analysis of the country's recent rise to the second largest economy contends that this has been primarily achieved through constant experimentation. Thereof generated positive results manifest in the fields of telecommunications, infrastructure and transports as well as online services (Sheng and Geng, 2015). At the very same instance one must be careful not to generally ascribe this phenomenon of experimentation to both institutional domains in equal measure. Naughton suggests a stance of caution, when it comes to excessive praise of the Chinese state system regarding its willingness to introduce new means for solving problems. In his view, formal experimental rule solutions have always been the result of compromises between the different actor groups. Instead of the often imputed

‘model of open-minded empiricism’, he rather describes official Chinese institutional testing with Heilmann’s ‘experimentation under the shadow of hierarchy’ (Naughton, 2009, 12f; Heilmann, 2008).

Apart from the apparent function of finding a solution to a problem, there is yet another purpose to apply experimentation. Trial-and-error methods are also initiated by one domain so as to trigger a particular response: Either to directly provoke the opposite institutional domain, or in order to stimulate a response from the larger socio-economic environment in which the challenge has originated. Hodgson has related such practices to basic human instincts. According to this perspective any such input is based on instincts behind the fundamental propensity of humans to provoke a reaction from their environment (Hodgson, 2008a and 2013b). Therefore finding a solution to a specific problem might not constitute the primary purpose behind practices of experimentation. Rather such steps might be initially driven by the attempt to render a problem more tangible: What directly results from this approach is that more information on the issue in question is generated, i.e. through the evolutionary solution output induced learning feedback. Secondly, formal experimental approaches that are explicitly marked as such may also indicate the advent of new rules and probably an overhauling of the formal institutional structure for a larger problem context. In regard to the Chinese CE, such practices have been extensively applied during the fist and a half decade of the 21$^{st}$ century in the fields of MSW and Waste Electrical and Electronic Equipment (WEEE) management. As will be discussed in the chapter on WM, formal pilots with clear spatial and temporal delineations have been implemented with the purpose to find solutions to relatively new challenges. What in some cases resulted from these localised process at the end of pre-designated evolutionary circles was a nationally applicable law. This has to some extent exemplified a procedure in which formal experimentation within interest-specific limits has generated a new regulatory solution that in consequence as been promulgated and reassigned for subsequent imitative purposes. Quite interestingly, before the imitation of such regulations is sanctioned, patterns of gradual, marginal increase in experimentation can be discerned. Once these reach a certain breakthrough and produce a functional rule solution, further testing efforts will decrease and subsequently halt (see chapter 8). This to some extent indicates that at least in the formal institutional realm imitation and experimentation appear to be mutually conditional processes in the course of evolutionary institutional innovation: For institutional evolution to take place, the practices of rule imitation as well as experimentation are inevitable.

## 4.5 Measuring the effectiveness of institutional solutions

### 4.5.1 Theoretical approaches and implications for the measurement of institutions

The idea to measure institutions does not represent a particularly new concept in institutional economics. In fact, from a purely technical perspective, there has been quite some discussion in the relevant literature on how to measure institutions. However what has to be kept in mind here, is that many of these ideas originate in the NIE, as this branch is primarily concerned with gauging the efficiency of certain rules within a static and immutable framework. Given that this thesis addresses an evolutionary context in which practically everything is subjected to change, it is necessary to exercise prudence when dealing with the question of how to measure institutional effectiveness.

Although there is no explicit blueprint on how to conduct a measurement of institutions, Voigt (2013) has presented some useful steps for the engagement with this challenge: Firstly, any measurement should always focus on a single rule and avoid broader structures such as 'the rule of law', as these tend to encompass a large variety of institutional subcomponents. Secondly, objectivity is a must. Thirdly, evaluations of institutions have to cover features of codification as well as the practice of implementation (Voigt, 2013, 2). A key premise for measurement concerns the perceptibility or recognisability of the rule in question. This is especially difficult given that many informal institutions are hardly if ever entirely specified or published and are furthermore only fully known to the practitioners themselves (ibidem, 15). In these cases, the academic observer of institutional systems has to be able to look into the mind of the involved actors: The herein implied task is to verify whether they understand the behaviour forming conditions of informal rules, relevant sanctions that apply to deviants, as well as how sanctioning actors identify non-compliance (ibidem, 15). At this point it needs to be pointed out that the analysis in this thesis will only in few cases be able to entirely fulfil the above set of requirements. Similarly, not every instance in the evolutionary cycle of solution creation can be identified, let alone measured. Quite often the observer is presented with an incomplete picture, wherein maybe only one side's developments are documented or only a final solution outcome, but not the entire path towards it is open for analysis.

Measuring institutions and their effectiveness is in most cases confined to the institutional output of the evolutionary process. And yet, these products manifest the significant junction, where an emerging problem has been addressed with a corresponding solution. What can thus be measured is the degree of how well solutions fit to their respective problems. The useful

starting point for such undertakings is offered through the dynamics of the model: In general every institutional solution exhibits a varying degree of efficiencies and inefficiencies when it comes to resolving the given problem. Less effective solutions will not last long and become replaced relatively quickly. More important however any institution of one domain, once being in place and practiced, will send out a signal to the opposing domain. Regardless of whether the problem in question has been solved and thus prove the solution successful, the institutional product may still fail in terms of effectively dominating all relevant interest groups. If for example the opposite side feels that its interests and values are not properly addressed, it will institutionally challenge the opposite domain's solution. In other words, effectiveness can also be measured in terms of suppressing or invalidating responses from the opposing institutional domain. If domination through one side or the other is not given, then both realms will become entangled in the model specific dynamic of mutual responsiveness. Herein, the higher the initial frequency of institutional outputs from both sides is the less effective are their institutional solutions in terms of satisfying a large enough bulk of group specific interests. However over several cycles of institutional evolution the respectively generated solutions are likely to become ever more effective in regard to including ever more interest groups.

The discussion on institutional effectiveness shows that there are two possible instances of measurement: Firstly, it is necessary to investigate whether a problem is adequately tackled by an institutional solution generated by one of the two domains. If that is the case, the evolutionary cycle will proceed by switching to an entirely new problem. Secondly, institutional effectiveness can be gauged by the degree of interest inclusiveness. Such solutions can be interpreted as dominant (i.e. effective), if they succeed in impeding the opposite realm from devising and practicing alternative solutions. In this regard it has to be pointed out that both types of effectiveness only feature a relative impact: For both categories of effective solutions there hardly ever are perfect outcomes generating absolute effectiveness. The reason behind this is that any of the both domains is always suffering from imperfect or asymmetric information regarding either the problem or the opposing realm. On the one hand the nature of the problem is only captured from a subjective, interest-determined point of view by one domain, which in turn neglects certain problem specific ramifications. Including as many interests as possible within one solution on the other hand is equally constrained by the naturally given lack of oversight on the existing diversity of interest structures.

In addition to these context intrinsic limitations, any academic analysis is also constrained by the many dynamics that unfold in the evolutionary cycle and within the two domains. It is nearly impossible to adequately capture the bits and pieces of information and respective activities that flow from the output to the input side, or which are exchanged within the institutional domain. Therefore the most viable approach to institution measurement is to always take institutional solutions as a starting point for analysis. Based on a sufficient overview on the broader topic and its major challenges and problems for the economy, institutional outputs can be adduced to render the particular activities of both domains intelligible for analysis. It is the outputs on both sides of the institutional array, which tell about the intensity of both realms to tackle a particular challenge or problem at a given point of time. If we add a careful evaluation of documents, reports and interviews on different periods along the timeline, it is possible to discern the unfolding of evolutionary cycles over a period of time on a given topic. Undeniably, this kind of approach will always be presented with the conundrum of whether all available developments have been included in the analysis. And yet, for most of the cases in the Chinese CE, it is possible to identify major evolutionary trends within this still young socio-economic system. Through close investigations of failures and successes one encounters a surprisingly high number of cases that allow for an evaluation of rule solution effectiveness.

### 4.5.2 The first category of effectiveness: Solving a problem

In theoretical terms, the first instance of assessing institutional effectiveness is relatively simple: Any rule solution in place has to be gauged against its effects on coping with a specific problem. Applied to the case of urban waste management, one possible problem is constituted by ever increasing quantities of generated waste. Any solution that emerges in response to this problem can be deemed effective, if it is able to contribute to process this waste and thereby reduce the amount of untreated waste in a designated area. This simple sequence of problem emergence and thereupon triggered institutional solution however only marks the first of a sequence of evolutionary cycles. At the end of this first cycle the domain, which generated the solution, will be rewarded by a learning feedback and thereby gain insights on how effective the respective solution has been. By means of learning, the decision-making actors extend their experience and thereby better understand why the implemented institution is effective or not. Given this element of procedural rationality and the gradually increasing capability to entirely grasp the essence of the problem, the actor groups of the rule

devising domain are able to augment their solution in the next cycle and thus improve the subsequent institutional solution (Nelson and Winter, 2002, 40).

In this context there are two elements that need be considered for the evaluation of rule effectiveness. Firstly, the analysis has to identify, at least within a broad scope, the interests and values within the institutional domain that produced a rule solution for a particular problem. In WM, and for that matter in the CE, the officially upheld core values are the three concepts *reduce, reuse, recycle*. Therefore any solution forwarded by the formal institutional domain has to be measured against the realisation of these values. In regard to the above example, solutions that reduce waste quantities can in first instance considered to be effective. If a subsequent rule solution furthermore not only contributes to the reduction but also the recycling of waste, it can be evaluated as more effective than the preceding solution. Secondly, the setting of benchmarks for effectiveness plays a significant role. Herein we find two options, by which effectiveness can be measured. On the one hand it is possible to compare proportions and rates achieved over different periods on the same subject. Taking waste collection as an example, it is possible to juxtapose data related results from earlier with later institutions that both address the same topic. The solution that achieves higher waste collection proportions is thus the more effective one. On the other hand it is also possible to compare the solution outputs of both domains. If for example both domains engage in waste collection, it is possible to measure effectiveness by contrasting respective collection rates of the respective solutions. Naturally, such approaches are only possible if both domains have engaged with the same problem and if their respective solutions exhibit similar features. Such could be practices of transportation, exchange and preprocessing of waste materials within a larger institutional structure addressing waste treatment. Other features that can be compared are typical economic benchmarks such as costs and economic benefits that accrue to the actor groups of the respective domains. In this respect, any evaluation needs to be based on the same unit of comparison, e.g. values and costs in RMB/ton.

So what is done here for measuring the institutional effectiveness for problem solving is to combine figures and data with institutional practices. Provided that the addressed problem(s) exhibit a certain degree of continuity in core features, an analysis over effectiveness can be conducted over several evolutionary cycles. If this continuity persists, it is furthermore possible to introduce a third instance of measurement, namely whether the number of rule solutions forwarded by both domains increases or decreases over time. At this point we arrive at an ontological junction since this aspect is also related to the secondary category of

effectiveness, which revolves around the dominance of rule solutions of one domain over the other.

### 4.5.3 The second category of effectiveness: Interest based institutional domination

The second category of institutional effectiveness is featured in rule solutions that aim to promote domain specific interests and thereby achieve dominance in solution output. The occurrence of this particular category of effectiveness is a consequence of the interest and value structures that form and promote every institutional solution (Groenewegen et al., 2010, 33). In contrast to the first category of effectiveness, finding a solution to a socio-economic problem, is not the primary motivation for such rule outputs. Rather the objective of the domains is to create solutions that facilitate the realisation of domain specific interests. In these cases the domination of solution outputs can be measured by a certain degree of prevalence in practice by actor groups. By implication, the more particular rule solutions are practiced, even in a modified form, the more effectively can they promote the interest realisation of a domain within a specific problem context.

A broader investigation of institutional solutions within a specific context may in further consequence help to identify, which interests and values both institutional domains pursue. In the context of the CE, primary values and interests either feature environmental characteristics such as reduce, reuse, recycle related conceptions or economic ideals, e.g. profit oriented resource recovery. Institutional dominance can also occur because of effective institutional sub-elements. Several formal rule systems do entail powerful regulatory mechanisms that successfully sanction any circumvention or alternation to stipulated rule solutions. The informal domain on the other hand does not have the authoritative capacity to apply sanctions to the opposing formal domain. However, informal solution outputs may equally achieve interest based dominance through rule solutions that are able to satisfy the interests and values of a majority of actor groups. A vivid example is informal waste collection, which not only generates incomes for informal collectors, but also remunerates waste generating households with money and above that even reduces the treatment burden for the formal system. So the prevalence or dominance of certain institutional solutions may also be manifested in the absence of the typical responsiveness dynamic that results from the selection mechanism driven by the contest between the two domains: If one side ceases to create new rule solutions and thereby concedes inferiority to the opposing realm, the latter has achieved solution dominance. In the case of urban waste collection, the very prevalence of the informal domain

has lead to a particular type of institutional dominance, which is based on the broad realisation of many interest groups that even exceed the informal domain (Steuer et al., 2018).

The particular constellation of interest based institutional domination is under specific circumstances prone to come to an end. When a steady state of interests within one domain exists and respective actor groups endeavour to avoid changes that may harm their interests, subsequent problems and respective solutions evolve towards a lock-in constellation. Herein, either the safeguarded interests are highly exclusive and ignore external interest groups (within or beyond one domain); or because interest orientated rule solutions cannot effectively solve a given problem. At this point the consequences are twofold: Not only will a problem remain unresolved and thus become a challenge for the authority of the domain. Moreover the opposing institutional realm will respond with a strong impetus by creating alternative institutional solutions. Overall, the Chinese CE context provides plentiful examples of such cases of interest pursuance, where domain-external interest groups are ignored: Formal WEEE management for example promotes institutional solutions for large scale recycling, while apparently ignoring the vested interests of many informal recycling and refurbishment structures (Schulz and Steuer, 2017). Informal WEEE management on the other hand promotes institutional practices that primarily focus on economic profit, while ignoring environmental sustainability. Both types of rule systems are effective in their own sense of achieving the actor group intrinsic values and interests. For that reason both sides are also subjected to the challenges of the interests of the opposing domain, which in turn perpetuates the institutional evolutionary cycle in WM. At this junction two, possibly simultaneously unfolding processes take place along an evolutionary sequence: In first instance the above alluded frequency of institutional outputs from the opposite domain increases, which simply originates from the negligence or exclusion of its interests. Secondly, the first domain will equally reboot its solution creation process as soon as it realises the increasing competition from the other side as well as the lacking effectiveness of its preceding institutional solutions. This type of reactivation will in most likelihood not resort to imitative, but experimental solution finding. In all cases, the thereupon initiated trial-and-error process aims to achieve effective solution outputs, which may be either directed towards problem solution effectiveness, interest realisation effectiveness or both. The indication for the completion of this process is marked by the gradual decrease of solution outputs from trial-and-error and the shift towards increasingly imitative institutional solutions.

Overall there are several indicators that help to determine cases of institutional domination. Firstly, the dominance of one realm is marked by a decrease in output of institutional solutions, i.e. in terms of institutional solution variation. Albeit this constellation appears to be an obstacle for evolution to proceed, this reduction in institutional variety is only temporal: Given the diversity of interest and value structures and due to the conditionality regarding the emergence of novel problems, evolutionary solution finding processes are bound to occur sooner or later. A second indicator for institutional domination is the above discussed utilisation frequency of a specific rule-based solution. The more prevalently used one institutional solution is, the more likely does it feature a broad scope of interest and value inclusiveness. A high utilisation frequency does therefore indicate that many actor groups, even from the opposing domain, see their interests realised via the application of the rule in question. Thirdly, a sudden increase either in experimental solution finding from one domain or in counteractive institutional solution issuance from the opposing domain indicates the end of institutional dominance. Finally, it can be ascertained which values and interests dominate the institutional solution output from the respective institutional domains. By means of rigorously analysing the characteristics of institutions from one domain, it is possible to identify their fundamental key values. Formal, codified regulations in the CE can for example be analysed to the usage frequency of the 3R notions reduce, reuse, recycle. Emphasis changes that take place over time, can show the primary objectives that the formal domain tries to achieve by forwarding rule solutions. Informal rule systems on the other hand are not codified, but mostly tacit, which renders the process of identification more difficult. This problem can be tackled by means of interviews so as to discern actor group specific value preferences.

## 4.6 Prediction of institutional evolution

One of the key messages repeatedly highlighted in the preceding chapters is that institutional evolution primarily unfolds on the basis of variable, changing elements. By implication, the number of static features in the model that determine this process is comparatively small. Especially the first aspect strongly reduces the capability of the herein presented methodological concept to predict the direction of institutional evolution in the Chinese CE context. However, some specific cases of model constellations allow approximate interpretations of development trajectories for future institutional change.

A first starting point is constituted by the nature of institutions itself: Institutions as systems of rules have the effect of structuring the behaviour and interaction of actors. Based on this

premise, Groenewegen et al. (2010, 31) correctly contend that institutions increase the predictability of behaviour. This predictability is however only given if the institutions in place only feature a relatively small degree of change. Such circumstances have been captured by the model of this thesis: Earlier, I described settings in which the institutional structure remains relatively stable, namely, if *imitative institutional solution finding dominates*. During these evolutionary cycles new solutions strongly resemble preceding ones and subsequent solution output only exhibits a small degree of novelty. Because of the reciprocity between institutions and actor behaviour, institutional and behavioural changes can to some extent be projected. For such variants of model operation, Hodgson (1998a, 172) asserts a high degree of predictability. In reference to earlier studies he argues that models with strong elements of inertia, such as manifested in the persistence of habits, prove to be good tools for prediction. These conceptualisations primarily operate on the basis of simple extrapolation from the recent past into the recent future. In Hodgson's view, methodological constellations that feature a strong habit persistence and institutional self reinforcement prove to be better predictors of macro-economic performance than much more sophisticated economic models (ibidem, 172).

However, once the model exhibits increasingly dynamic and less static elements, institutional prediction as outlined in the above is not further applicable. Such dynamic patterns of institutional evolution are represented in models that exhibit a high degree of trial-and-error and less imitative solutions. This in turn confronts the predictive approach with difficulties regarding how to incorporate the many variables of evolution into the projection of institutional change. In regard to this methodological problem, Nelson (1995, 67) has presented some useful conceptualisations: In reference to the evolution of law, Nelson takes a very cautious step when assessing the predictive capacity of evolutionary theory. He tends to see this particular evolution in the formal domain to be primarily guided by interests, power and ideology, while economic efficiency only plays a minor role. In terms of predictability, he therefore cautions that '…in the absence of ability to explain or predict what influence will dominate in particular cases… the theory has little predictive power, and its explanations are at least partially ad hoc' (ibidem, 67). Two aspects of this statement need to be highlighted: These are the notions 'influence' and 'dominate', which in adherence to the above model can be interpreted as 'value and interest-based influences' and 'domination of selection in institutional solution creation'. By reviewing the earlier stated assumptions applied to the model of this thesis it is possible to resolve the methodological difficulties indicated by Nelson: I assumed that over the short course of CE evolution in China the values and interests

of both domains are relatively stable and only prone to little change. Naturally, this may change over the longer course of the CE's unfolding in China. Nevertheless, actor specific values and interests dominate the solution finding process of both domains and subsequently the entire solution creation process. As long as values and interests of both domains remain relatively stable, their institutional solution outputs will only vary within a delineated scope. This may help to explain particular solution outputs, and in some cases prediction might be possible. However once the learning input from earlier solutions has reached a certain threshold level of accumulation within one or even both domains, the respective values and interests are prone to change. In these cases, approximate predictions may to some extent be possible, if the value or interest shifts are discernable.

One relevant possible example is exemplified in the case of formal WM, which exhibited a value shift in the generated codified institutional solutions. Initially, formal waste management has been dominated by values emphasising waste reduction. Thus land filling has long been the preferred option. In recent years however formal regulations have increasingly underscored the value ideal of comprehensive resource utilisation (zonghe liyong 综合利用), which includes all forms of recovery and reutilisation. This has in turn induced a shift in rule issuances that promote waste incineration (energy recovery) over land filling. Presumably the value shift came as a result to learning feedbacks indicating the increasing environmental problems associated with land filling (Liu, 2015) and induced a shift in the promoted and practiced formal regulations. So once a shift in values can be ascertained, it is possible to foresee a generation of institutional solutions that are centred on the new values and interests.

The herein envisaged attempts of prediction are only of a very modest and cautious nature, and they primarily focus on domain specific solution outcomes. There may be even less cases, which allow to ex-ante conjecture the interactive reciprocity process between the two realms in selection. Herein, a given solution from side A may allow for a prediction of the response from side B. Additionally, another limitation for prediction is the restriction to a given problem upon which interest driven institutional innovation unfolds. For entirely novel problems and subsequent institutional solution finding, the options for prediction are highly limited. In order to clarify the possible instances of prediction via the model, four distinct, indicative patterns will serve as starting point for predictive purposes:

Pattern 1 – Imitative solution creation is dominant

This pattern describes the case in which rule solutions over a particular cycle are relatively similar to preceding ones and in turn constitute a development trajectory that extends into the future. Nelson and Winter (2002, 30) have explained such circumstances via the operations of the respective domains, which in their example were manifested in the entity of a single firm. The reasons for imitative solution creation were herein explained through various factors, such as high costs to develop new solutions, an irrational resistance to change or the attempt to avoid conflicts among the interest groups of the particular domain. In reference to the above model one further instance may be added, namely the consecutive occurrence of problems with relatively similar nature. Herein, actors may be inclined to resort to imitative solution creation practices, if previous solutions proved to be effective.

Pattern 2 – Advent of novel (formal) solutions is indicated by intensive experimentation

For some fields of the Chinese CE, cycles of intensive, formal experimentation have been documented, e.g. WEEE management during 2000-2012 (Schulz and Steuer, 2017; Steuer et al., 2015). Institutional experimentation emanating from the formal or informal domain always indicates a process of creating novel solutions, which is initiated by novel problem- or interest-relevant developments. The purpose of experimentation is to generate a certain feedback, i.e. learning output, so as to better understand the challenge and consecutively generate ever more effective solutions. The specific cycle of experimental solution finding ends, once a sufficiently viable and effective solution is in place. In the case of formal WEEE management this process has been reflected in gradually increasing pilot trials, which stopped and thereupon decreased in number, once an adequate solution for national application had been deployed. In other fields such as formal urban MSW management a similar process is unfolding since 2000 and continues into the present (Steuer et al., 2017b). So what can be predicted for such developments is the following: Any increase in formal pilot trials indicates the search for a novel solution that will substantially diverge for the institutional solutions in place at a certain point of time. Once experimentation has reached a peak in terms of intensity and gradually decreases it can be contended that an ad interim satisfying, novel solution has been created.

Pattern 3 – A shift in formal values and interest leads to new rules

In a similar fashion to the above two patterns the learning feedback plays a significant role in this third instance. However the herein induced shift of values and interests in one domain can be equally triggered by imitative as well as experimental solution practices. The point of

departure for analysis starts with the comparison of formal, codified rule solutions within which a change in values or interests is discernable. Formal documents such as issued regulations or 5-year plans serve as the basis for a text analysis. Thereof discerned shifts in emphasis of key notions, such as presented earlier in regard to the 3Rs *reduce, reuse, recycle*, allow for a prediction on future rule solution outcomes. In cases of such value shifts, from one to another, it is possible to predict that subsequent solution outcomes will be centred on the newly promulgated value or interest concept.

Pattern 4 – Solutions that exclude the interests of the opposite domain triggers a responsiveness dynamic

This final instance of for prediction is of a very general nature, since it adheres to one of the basic features of how the model unfolds. Herein, the primary observation concerns the rule solutions of one institutional realm, which explicitly or implicitly infringes the interests and values of actor groups belonging to the opposite domain. The informal domain has exemplified such solutions in WM, in which WEEE is entirely diverted away from a majority of formal treatment channels, i.e. collection, transport, preprocessing and final processing. In this case the degree of exclusiveness is extremely high as all stages of formal treatment were circumvented by the informal domain. What subsequently followed was the response by the formal domain that issued respective institutional solutions so as to challenge the interim solution of the informal domain. Basically any prediction of pattern 4 developments needs to be based on careful analysis of institutional solutions from one domain or the other. In the course of analysis it must be evaluated to which degree the solution of one domain excludes, harms or infringes the values and interests of the opposite domain.

## 4.7 Concluding remarks on the application of the model

The above outlined methodology comprises a broad set of interdependent variables and mechanisms, which in their combination present an individual perspective on how institutional evolution evolves. The primary purpose of this concluding section is to clarify how the model can be applied to the case of the Chinese Circular Economy. For the purpose of conciseness, the following elaborations on the model application will be centred on the primary and secondary research questions.

The guiding question of this thesis asks for the institutional outcomes that have so far resulted from the evolution of the CE in China. Given the broadness of this guideline for investigation, I have developed a subset of secondary research questions that in more detail engage with the

nature of and the principles behind institutional solution outcomes. Nevertheless, what the primary research question addresses are the types of institutional solutions for CE related problems, which were generated by the formal and informal domain. There are several options to answer this question: An initial step could be to identify the current, most prominent solutions practiced in a certain sector of the CE. When tracing back the institutional development in this sector, it is in some cases possible to discern the sequence of generated solutions in one or both institutional domains. This may in turn help to analyse the path of changes in the rule solution characteristics. Examples for these attributes of change may relate to the level of values and interests, which over time have experienced a shift from one ideal to another. A rather typical instance could be the alteration in dominance of environmental ideals over economic ideals and vice versa. Alternatively, there may also be cases in which a simple assessment of changing institutional output volumes would serve the purpose of answering the primary query. Herein, the idea is to contrast the size or number of one institutional domain at one specific point in time with domain corresponding outputs at an earlier point in time. Similar approaches could be done in terms of contrasting the output intensity of both domains at a given point in time. In essence, the investigation centres on the evolutionary processes of institutional section and thereof generated variation in outputs.

Quite clearly, the above elaborations also implicitly touch upon a variety of important queries that require a more profound engagement. Therefore the secondary research questions were designed in accordance with the hypotheses that are embedded in the model set up. The first query in this regard relates to the responsive dynamic between formal and informal institutions, and how their responsive dynamic shapes the Chinese CE. In essence, I herein focus on the operation of the selection mechanism and how the interests and values of both sides contest with each other. So for any of the CE related developments analysed in the following chapters the first step is to determine the interests and values for the involved domains. In doing so, it will be possible to discern the fundamental building blocks and constellation of the selection process.

Once this step has been accomplished, the subsequent question builds a bridge from selection to variation. At this point the focus of analysis shifts to the variation of institutional solutions that are generated by the selection mechanism in a specific field of the CE. In some cases a variation of solutions occurs within one domain, whereas other instances exhibit variation between the solutions of both domains. In order to highlight the distinguishing elements that determine variation, the analysis will contrast different solution outcomes on a particular

problem and focus on how value and interest specific characteristics are manifested. Here again broad aspects such as an explicit allocation of preference for economic over environmental matters might be a good indicator. In a similar fashion, the degree of interest group inclusion could prove to be a useful starting point.

The subsequent research questions are equally focussed on the solution outputs of both institutional realms. The next query thus focuses on institutional solution effectiveness, namely which types are effective and how their effectiveness can be measured. The latter aspect has received extensive discussion in section 4.5, from which the two indicators of problem solving and interest based institutional domination were derived. Based on these categories, the cases of the CE that are subject to effectiveness measurements in the following chapters will again be discussed in a comparative perspective. Herein solutions of the same or different domains on a particular problem or problem nexus will be contrasted.

In a similar manner, the question regarding the nature of prevailing institutional solution patterns will be tackled. The primary aim is to discern imitative and experimental elements in solution outputs from their respective institutional domains. The primary goal is to clarify if one or both domains tend to favour imitative over experimental approaches to novel challenges. Additionally, some investigated cases also show when and why a domain deviates from its preferred path, i.e. by switching from experimental to imitative solution finding and vice versa.

The final research question will revolve around a careful projection of future institutional developments of the CE in China. As outlined in the section 4.6 this can to some extent be discerned from four patterns among generated institutional solutions: the persistence of imitative patterns, the sudden emergence of experimental approaches, the shift in norms and values in codified institutional solutions and the response provoking exclusion of interest groups from the opposing domain.

In conclusion it has to be added that the comprehensiveness of the model represents advantages and disadvantages in an equal manner: Given the number of processes and mechanisms that interdependently and in sequence to each other constantly unfold, it is quite difficult to pinpoint every single element in a particular problem solving process. Quite often actual cases will only reveal single parts or larger, comprehensive results of a sequence in institutional evolution. The respective case analysis will therefore be confined to these observable or documented pieces and may have to interpret the remaining hidden

developments. On the other hand however, the operational design of the model allows reconstructing an entire picture if key pieces are available. For example, solution outcomes are generally observable, once they have reached certain prevalence in practice. They in turn convey interests and values prevalent in the respective institutional domains. This in turn enables a depiction of the selection mechanism's operation. Given that the model reflects a dynamic process, solutions of the present can be juxtaposed with solutions generated at an earlier point. This again hints to how well the information feedback loop has been received and how it constituted the inheritance section. Therefore the essence of model application is to identify the beginning of a sequence and the end of it, i.e. the emerging, novel problem and the institutional outcomes designated for its solution.

# 5 The Circular Economy: Origins, challenges and forms of institutionalisation

## 5.1 Analytical method

After extensive analysis of institutional economic theory and the establishment of an institutional economic model, this first thematic chapter will take a closer look at the CE concept and its institutionalisation. In line with the methodological proposition that every problem/ challenge induces the emergence of an institutional solution, the following sections centre on the key elements that propel this dynamic: Firstly, there is the challenge of ecological degradation. Owed to the focal choice on China, the discussion of the problem will be confined to the Chinese context. Second to that, the focus of analysis will shift to the CE concept itself, explain its theoretical origins as well as the solutions offered by the theory. Thirdly, the analysis will shift to the forms of CE application in the international context and in China.

Organising the chapter along these three nodes follows the following thoughts: Firstly, it is shown that the methodological-analytical sequence of problem emergence, solution finding and respective application can to some extent be translated to the global level: Not only the challenge for different institutional systems (countries) is the same, there are also similarities in the respectively applied solutions (institutionalisation of the CE). Secondly, this chapter presents the state of the art in research on the CE as theory, in general and with regards to the concept's application and its achievements in China. The herein chosen materials represent the current state of the art depicted by secondary research on Chinese ecological issues, the CE concept and its application in the international context as well as on the Chinese CE development. Additionally, to buttress this analysis officially issued regulations have been included so as to depict the particular value preferences that constitute the formal institutional frameworks of the respective CE systems. Thirdly, the following subsections on China establish a fundamental picture on the status quo regarding China's CE development. This is an essential, first step that bridges the herein presented static analysis with the more dynamic, institutional analysis in the following chapters. In summary, the structure of this chapter is therefore guided by three crucial questions: Firstly, what are the ecological challenges (in China) that demand for a CE-based solution? Secondly, what is the CE, what are its premises and which solutions does it offer? Thirdly, what are the forms of CE institutionalisation in other countries and do they present a model to which the institutionalisation of the CE in

China aspires? The following paragraphs outline how these questions are addressed in this chapter.

In terms of content scope, the chapter is comparatively broad. However this vast topic coverage is owed to the methodological approach of the thesis: The foremost objective is to capture the evolutionary institutional process out of which the CE (in China) first emerged and which the CE subsequently influenced. Hereby, the starting point for the analysis of institutional evolution begins at the meta-level: The starting point is the emergence of a challenge or problem, i.e. environmental degradation and increasing resource constraints, which in turn induces the creation of an institutional solution, in this case the CE. The triggering component of problem emergence is dealt with in the first and second sections of this chapter (5.2 and 5.3), which centre on the particularities of the challenge in the Chinese context. The herein discussed environmental and resource specific problems of the PRC follow the logic of evolutionary causation: The current challenge manifests in terms of environmental pollution and resource constraints for which the CE is now seen as institutional solution or remedy. More importantly, however, is that this current problem does in parts result from specific institutional solutions to a preceding problem: More than three decades ago, the PRC embarked on a reform and opening process so as to engage with the problem of weak economic performance. This in turn induced decision-making actors to devise and implement a solution, which resulted in China's growth oriented, resource-intensive development model. While these first sections are centred on outlining the present dimension of the environmental challenge, the current ecological problem is also interpreted as one stage within a longer cyclic pattern of problem emergence and corresponding solutions.

In order to shift the analysis from problem to solution, the subsequent section (5.4) is centred on the theoretical foundations and the conceptual emergence of the CE. Here again much of the discussion aims to trace the evolution of the CE itself: Despite the ostensible category as a new, formalised solution the interpretation along evolutionary lines proposes a more nuanced picture. In fact there are various concepts that have preceded the CE and in line with the perspective of institutional evolution it can be contended that the CE is a result of the experiences and ideas that came before. In this sense the mechanism of imitation and emulation of concepts exerted a significant influence on the formation of what is now understood under the Circular Economy. This framing parallels the conception of the methodological model presented in chapter 4: Any preceding solution, as in this context a theory or concept, leaves its traces in the inheritance stock out of which new solutions emerge.

Therefore the CE concept is also interpreted as interim solution, which evolved upon the basis of earlier theories that are embedded in the infinitely repeating cycle of problem emergence and solution response. Apart from depicting the various principles and normative strategies for implementation, the section will also address the aspect of CE core values and value practices (the 3Rs - reduce, reuse and recycling). As outlined in the theoretical and methodological chapters, values play the most fundamental constitutive components for institutions. By implication, these key values determine the operational characteristic of CE institutions. Therefore a significant effort is made for clarifying the meaning and operational implications of these values.

The third section deals with the CE institutionalisation in three countries[11] including China (5.5 and 5.6) and resumes the discussion on how key values are incorporated within the respective institutional frameworks. The analysis of each country will be based on the methodological perspective of problem emergence and solution response. Via secondary literature and legal documents as primary sources the investigation looks at the chronology of individual challenge contexts and respective institutional responses. In order to identify the differences in the country specific CE developments it is useful to assess the degree to which the key values have been incorporated into the formal institutional CE scaffolding. At the institutional level, the analysis of each country case aims to tentatively show how well the respective CE laws have been translated into follow-up institutions: Institutional creation patterns such as the intensity of revisions and amendments or frequency of newly issued laws provide further insights into country specific particularities of institutional evolution. Hereby the analysis touches upon the fundamental logic of formal institutional renovation and whether countries tend to modify prior solutions or rather devise and implement novel institutional supplements. Along these sections an attempt is made to juxtapose particular institutional outcomes in the three countries so as to highlight similarities and differences in implemented solutions at similar stages of respective CE development.

As for the section on China (5.6), a specific focus will be set on how the CE and its values were incorporated into the larger ideological value system of the CE. Here again the question is how the chronological sequence of institutional solutions unfolds. A specific characteristic

[11] Next to China, the rationale for selecting Germany and Japan as country cases is based on their role as frontrunners in the institutionalisation of the CE and their respective highlighting in secondary literature (Ghisellini et al.., 2016; EMAF, 2013 and 2014). What furthermore makes all three countries particularly interesting is the establishment of the CE as central institutional element for national development. Additionally, also the institutionalisation of the CE by the EU will be included in the analysis. As a supranational entity, its influence on the CE development in EU member states is particularly valuable in the international context.

in China relates to the dualistic nature of the challenge: Not only is there a clear commitment of the government to resolve the environmental and resource specific problem. Simultaneously the CE is also seen as a useful strategy to maintain a sufficiently high level of economic growth. This ideological premise does directly influence the means of CE implementation in the PRC: Official preferences for top-down enforcement and administrative guidance have significantly shaped the design of institutional structures that are used for the implementation of the CE in China. In this regard a strong analytical focus is put on how institutional solution finding within the formal domain works. While sometimes more sometimes less binding instruments are issued via top-down means, the collection of feedback information is primarily concerned with data based results. The overview on the current state of the CE in China provides the first, essential fundament upon which the next chapter resumes with an investigation into the dynamics of institutional selection within the formal domain (chapter 6).

At the core of the formal institutionalisation efforts are CE related value practices, which will be the primary subject of the final section (5.7). In these concluding paragraphs the central, CE related legislative measures of each country are juxtaposed and evaluated in terms of differing emphasis of the 3R values. The first step will contrast the national CE laws in regard to their different pronunciation of the 3Rs. In a subsequent step the country specific, chronological shifts in 3R value emphasis will be analysed. This is done via a content based assessment of available CE key documents that have been issued over recent years.

## 5.2 China's economic challenge: Economic growth and the costs of environmental degradation

The People's Republic of China (PRC) today faces an ecological challenge that has its origins in an economic development trajectory entailing a particular sequence of events and performance results. During the first 30 years (1949-1978) the leadership of the young People's Republic initiated a transformation aiming to establish a state guided administrative economic system with emphasis on state ownership and economic planning. Via the issuance of five-year plans (FYP) since 1953 one of the primary economic objectives was to set up heavy industry clusters, create capital goods and accumulate financial capital. These efforts primarily served the target of accelerating national industrialisation, which however came at the expense of consumer goods industry and thereby impeded options for economic growth through household consumption (Taube, 2014, 9). Setting aside the various disruptions of economic production due to power oriented political manoeuvres this initial period featured

the establishment of large, state-owned industrial clusters that soon began to take its toll on the environment.

The second transformation began with the abolition of orthodox planning and the initiation of the Reform and Opening process in 1978/9. During this period implemented economic modifications introduced elements of market coordination into the system of administrative planning. The performance of high economic growth which was yielded by this approach led to what is now referred as the Chinese economic miracle: Quite in contrast to the prior, planned economic concept, the primary objective of the Chinese government in economic matters was to encourage public and private economic entrepreneurship so as to promote GDP growth. As a consequence China achieved annual GDP increase rates of 10% during the three decades of 1978-2011 (Taube, 2014, 16). At the polity level, the transformational shift had gradually given rise to the primacy of economic results over political ideology and soon economic performance became the key category for appraising China's national advance. In order to firmly establish this novel orientation within the entire administrative system, economic growth was used as the primary evaluation principle for local cadre performance (Huang, 2015, 8). For the purpose of stimulating the motivation of state actors, those officials, who achieved pre-designated growth targets, were especially favoured in the promotion process. By implication, local governance put an increasing, sometimes exclusive focus on fostering economic productivity which in turn generated a variety of public, private and mixed forms of entrepreneurial activities. While this governance strategy helped to improve the overall livelihood in China's society, the country's environment was severely affected: 35 years after the maturation of the Chinese economic miracle, the country is now facing a looming ecological disaster, which manifests in the severe pollution of air, soil and water resources (Ahlers and Hansen, 2017, 84; He et al., 2012, 28; Su et al., 2013, 216). Moreover, and this is of specific relevance for the CE, China is suffering from a lack of material resources that are indispensible for the production of goods and services. This constellation exemplifies the current obstacle that the PRC's resource-intensive growth model is facing: Economic growth cannot be produced out of nothing, but it requires among other means of production natural resources as productive inputs. Given the environmentally problematic status quo (see section 5.3) it is obvious that China has vastly overdrawn its natural resource account balance and will thus have to adapt its growth model accordingly.

Before delving more deeply into the aspects of pollution and resource scarcities (see section 5.3), the following paragraphs will first address the dimension of environmental costs in

China. As alluded in the above these externalities are primarily the result of the Chinese resource intensive growth model that the country has pursued over the last thirty years. Beforehand, however, a word of caution is necessary: It has become a somewhat popular trend to assess the value of natural resources in pecuniary terms. This particular approach is broadly applied in and promulgated by the school of environmental economics, which emerged from the superstructure of Neoclassical Economics. In contrast to that, the more trans-boundary approach of Ecological Economics, considers human economies as a subsystem of the earth's ecosystem, and thus perceives the 'price-tagging' of nature as a conceptual error (Illge and Schwarze, 2009). The valuation of nature in monetary parameters simply bears the flaw that it only captures the value of natural resources for a given point in time within a particular economic system. The herein borne, conceptual fallacy neglects the causality between extracting a particular resource from the ecosystem and subsequent impacts on symbiotically dependant life forms at present and future points in time. The following discussion thus bears in mind that pecuniary means can at best serve as a weak approximation for environmental losses.

Recent years have produced several studies, which attempted to gauge the environmental externalities of China's economic development over the last two decades (Table 3). What stands out prominently in these figures is that they do not display a discernable pattern in terms of cost increases or decreases over the years. This might to some extent be explained by differences in measurement approaches and data sources available to the respective surveys. Additionally, two other points may help to shed light on the logic behind the fluctuation of pollution damage costs: Firstly, which types of pollution externalities are covered by these figures? Do the authors only consider the typical core aspects of water, soil and air pollution or do they also calculate the losses regarding material resources as well as the effects of pollution on human health? Secondly, the question needs to be raised whether the follow-up costs resulting from pollution have been included. This would for example imply the calculation of output losses in farmland that result from a lack in access to clean water resources.

**Table 3. Environmental costs caused by pollution in China (the author, adapted from various sources)**

| Year of measurement | Pollution damage costs | | Pollution control investments (% of annual GDP) | Reference |
|---|---|---|---|---|
| | relative (% of GDP) | absolute (billion RMB) | | |
| 1990 | 7.5% | 1,325 | 0.69 | US East West Research Center (in Zhang et al., 2007); 360doc.com |
| 1992 | - | 110 | 0.69 | SEPA (in Zhang et al., 2007); http://www.360doc.com/content/11/0625/18/1302411_129527171.shtml |
| 1993 | 5.3% | 182 | 0.69 | UN University (in Zhang et al., 2007); 360doc.com |
| 1993 | 10% | 345 | 0.69 | CASS (in Zhang et al., 2007); 360doc.com |
| 1997 | 7.7% | - | 0.93-1 | World Bank (in Zhang et al., 2007); 360doc.com |
| 1999 | 9.7% | 801 | 1 | CCICED (in Zhang et al., 2007); 360doc.com |
| 2004 | 8-12% | - | 1.4 | Economy, 2004 (in Zhu et al., 2012); Hofem, 2010 |
| 2005 | 10% | 165 | 1.3 | Wang and Lin, 2010; Hofem, 2010 |
| 2007 | 10% | - | 1.2 – 1.4 | Zhang et al., 2007; 360doc.com; Zhu et al., 2015; Hofem, 2010 |
| 2008 | 3.9% | 1,275 | 1.2 – 1.5 | CAEP (in He et al., 2012); 360doc.com; Zhu et al., 2015; Hofem, 2010 |
| 2009 | - | 1,400 | 1.2 – 1.5 | Schroeder, 2014; 360doc.com; Zhu et al., 2015 |
| 2010 | - | - | 1.9 | Zhu et al., 2015 |
| 1990-2010 | 7 – 20% | - | ~ 1% | Wang and Lin, 2010; Zhang et al., 2007 |
| 2011 | - | - | 1.5 | Zhu et al., 2015 |
| 2012 | 10% | - | 1.6 | Liu et al., 2013; Zhu et al., 2015 |
| 2013 | - | - | 1.6 | Zhu et al., 2015 |

Despite possible inconsistencies in calculations and factor choices, the above table highlights two significant aspects: One the one hand side it is shown that pollution damages have entailed high losses for the Chinese GDP, while on the other hand pollution control investments have remained comparatively low. As discerned by the studies cited above the average ratio of GDP invested in environmental protection and pollution control ranges around 0.7 – 1.6% annually, whereas even more conservative assessments would suggest a minimum level of around 2-3% each year (360.doc.com, 2011). In cross-country comparison the negligence of environmental protection by the Chinese government becomes even more obvious: Zhu et al. point out that China only invested 1.7% of its GDP in environmental protection related industries in 2013 while Japan invested 2% in 1975 at a similar stage of per capita GDP (Zhu et al., 2015, 5). Other commentaries have equally indicated that national expenditures into that field need to be raised to at least 2% annually, which depending on the exact assessment would imply a 0.4 – 0.6% increase in spending (Chinadialogue.com, 2011).

Indeed, the above figures indicate that the Chinese government has increased environmental protection spending over the last 20 years. Based on this development and recent announcements in the 13th five-year plan, Zhu and colleagues optimistically expect state spending on the environment to increase by 60% during the period of 2016-2020: Translated into absolute values this corresponds to 8,220 billion RMB compared to the 5,107 billion RMB spent during 2011-2015 (Zhu et al., 2015, 4 and 16).

The environmental destruction, which is reflected in terms of GDP related losses, however only represents the initial element of a larger dimension of problems: Apart from thereby created impediments on economic growth, the ecological deterioration also affects health and stability of China's population (Naustdalslid, 2014, 304). The expression of discontent can in parts be captured by the number of protests and conflicts, which have emerged as a consequence to the degradation of the environment. In 2005, 51,000 of such conflicts have been documented in China (Wang and Lin, 2010, 1707). Despite the difficulties to ascertain specific numbers, the Chinese Society for Environmental Sciences forwards an estimation stating that these events are likely to feature an annual increase rate of 29% (Chinadialogue.com, 2013). These developments in turn increase the probability of social instability in the PRC, which in further consequence exerts pressure on central and local government bodies to ameliorate the situation, i.e. via new governance strategies so as to curtail environmental deterioration.

At this instance it is useful to put China's development path since 1978/9 into the perspective of the model, which has been designed for this thesis: What can be discerned from the above said is the obvious pattern of problem emergence, subsequent solution creation upon which again a new problem occurs. Initially, the Reform and Opening process may be seen as the solution to the problem of lacking economic growth. By implementing reforms and fostering growth, the Chinese Communist Party (CCP) could reinvent its legitimacy as leading entity that could help to bring wellbeing to the Chinese society. However this development model came at the price of gradually worsening ecological destruction, which in turn requires a new type of solution. Given that the economic reforms have to a substantial degree proven to be successful, the concept of path dependence would suggest that the decision making actors in the formal institutional domain will not deviate from this approach. Rather, what seems to be more likely is that the solution creating process will consist of merging smaller innovations with previously successful institutions: The previous GDP growth enhancing solution would now have to incorporate some novel elements that address the current environmental

challenges. With the emergence of the CE in China as new solution-product, it appears that actual developments have in fact followed the evolutionary logic problem emergence and solution creation. Furthermore the path dependency aspect is clearly reflected in the guideline providing Circular Economy Promotion Law (CEPL): While this institution does indeed pick up many resource and energy relevant aspects, at its core it is still primarily addressing the aspect of economic growth (NPC, 2008, art.3 and 6; Zhu, 2008, 2f). The tricky question at hand is how well this new solution is able to combine the old values and interests of increasing economic growth with the relatively novel necessity to realise environmental sustainability.

## 5.3 China's environmental and resource challenges: the need to shift towards the CE

### 5.3.1 Aspects of consumption and pollution: energy, water air, and mineral resources

The shift of China's development model from being primarily growth oriented towards a stronger inclusion of environmental sustainability is exemplified by the increase in environmental legislation during the early 2000s (Steuer, 2016c, 3f). This institutionally buttressed transformation can to a significant degree be traced back to emerging environmental challenges, which are manifested in ever growing constraints of energy, water, air and material resource availability. Given the encompassing nature of these resource challenges, the following paragraphs attempt to sketch a concise overview on this broad subject matter.

Energy use is often taken as a significant indicator for assessing the growth performance of an economy, simply because increases in energy consumption are strongly correlated to the growth in produced goods and services. As a result of China's strong economic growth during the past three decades the country has surpassed the US as the world's single largest energy consumer in 2009/10. Projections estimate that Chinese energy demand in 2030 is likely to double its 2005 levels (Wang, 2010a, 703). Despite the significant reductions in national energy intensity of 30% during 1995-2004 and another 14.4% between 2006-2009 (WB and AusAID, 2010, 87) there are yet several downsides associated with energy consumption in the PRC. Firstly, China still primarily relies on coal (62% in 2010 and around 60% in 2016) and oil (20% in 2010) as primary energy sources compared to the world average in 2010 of around 28% and 34% respectively (ibidem, 28; BP, 2016). Secondly, China's domestic reserves cannot catch up with domestic demand. Coal, oil and natural gas reserves in China only achieve 79%, 6.5% and 6.1% of global per capita availability levels. Given the country's

strong growth dynamic, China became a net coal importer in 2007 and the second largest oil importer in 2005. Especially for the latter, import quantities in 2030 are expected to be four times the size of what was imported in 2006 (from 3.5 to 13.1 million barrels/day) (Wang, 2010a, 703f). Very recently, in 2016, China's energy consumption exhibited an annual growth of around 48%, while energy production only rose by 40% (BP, 2016). Thirdly, the increase in energy demand is primarily the result of the fast growth in China's industry: Steel, nonferrous metals, construction materials, oil processing and chemical industries account for approximately 70% of the industrial sector's overall energy consumption. Herein, the steel industry alone represents around 15% of the entire energy consumption in China (Ma et al., 2014, 506f). Given that many enterprises among these industries are state owned and often exhibit a strong resilience to change, improvements in the reduction of energy intensity may prove to be a difficult task.

Far more critical than the supply and production of energy, the deterioration of water resources has become a major problem for China's environmental sustainability. To begin with, the PRC is home to 21% of the world's population, while it has only access to 6% of global water resources (Su et al., 2013, 216), which equals around 25% of the world's per capita availability (Yang et al., 2012, 311). Similar to the case of energy consumption, total water use increased by 35.8% between 1980 and 2010 (ibidem, 309). Given weak incentives to treat waste water, water pollution has reached alarming levels: On a system of grades that stretches from I to V, 60% of groundwater in China exceeded grade IV in 2013, which is considered unfit for human consumption. As this figure marks a deterioration of 5% compared to measurements in 2012 a tendency towards aggravation can be discerned (Zhu et al., 2015, 26). Additionally, more than 50% of China's cities, which are generally major hubs for water consumption, experience frequent acid rain and about 40% of the country's major rivers are polluted to a degree that their water may only be used for industrial purposes (He et al., 2012, 28). River pollution is however unequally distributed in eastern China: While 60% of northern China's currents exhibit an extremely severe degradation of water-quality, only 30% of the rivers in the south feature a similarly bad state (Yang et al., 2012, 313). This in turn affects water availability in urban areas. More than half of the groundwater in 182 cities tested as IV of V quality and can thus not be consumed (He et al., 2012, 28). Above that water shortages have been on the rise since the late 1980s all over the PRC. Especially in northern cities only 70% of demand can be met during the dry season. Surveys moreover found that out of 600 medium to large-sized cities, more than half have indicated insufficient water supplies while more than 100 are experiencing severe water shortages (Yang et al., 2012, 309).

Responsive efforts by the Chinese government to provide a remedy for this dire situation have so far at best achieved mixed results: As the new head of the Ministry of Environmental Protection (MEP), Chen Jining has stated in his 2016 report on China's environmental state 'improvements in water quality are uneven, some bodies in water are even worsening' (SCMP, 2017b).

Air quality is another point of concern. The dramatic state of air pollution in China's urban areas has recently been highlighted in the documentary of former CCTV journalist Chai Jing (Caixin Online, 2015). Here again, the problems behind China's air quality are in nature similar to the case of water pollution. Industrial growth, transportation and energy production have over the last three decades substantially contributed to the worsening of Chinese air quality. Currently, China accounts for 50% of the entire global coal consumption and thus represents the single largest generator of air pollutants in the world (Ahlers and Hansen, 2017, 84). Even the otherwise euphemising Chinese national statistics document annual $CO_2$ emission growth rates of around 7.5% (Su et al., 2013, 216). In regard to the primary generators of air pollutants more recent analyses put less blame on the 'traditional' energy intensive industries, but increasingly emphasise the role of transportation and motor vehicles: Taking the case of Beijing for example, industrial and coal-fired energy production account for 18% and 22% of air pollution respectively. These emission factors are however surpassed by motor vehicles, which alone emit around 31% of total pollutants in the city. A similar dominance of air pollution generation by combustion engine vehicles has been found in the cities of Hangzhou, Shenzhen and Guangzhou. In Shanghai, Tianjin and Ningbo motor vehicles still rank as second largest source for air pollution (Zhu et al., 2015, 27). In taking a relatively comprehensive perspective, the Asian Development Bank asserts that in 2012 less than 1% of the PRC's 500 largest cities met air quality standards set forth by the World Health Organisation. Furthermore the organisation ranks seven of China's cities among the 10 most polluted in the world (Liu et al., 2014, 24). Up until the very present, urban air quality levels have experienced a gradual deterioration. If measured by numbers of haze days, 2013 marked an unfortunate historical peak as there have been 677 days with very unhealthy or hazardous air quality levels in 74 monitored cities. In a similar fashion there were only 16 out of 161 monitored cities that reached national standards for urban air quality (Zhu et al., 2015, 27). This ubiquitous problem entails severe implications for human health: Respiratory and other diseases triggered by severe air pollution generate costs for Chinese citizens that amount to 5% of the nation's GDP (Liu et al., 2014, 26). What should however be of more concern are findings produced by recent studies according to which each year 1.6 million people are

estimated to die prematurely in China's cities due to severe air pollution (Ahlers and Hansen, 2017, 84).

The above discussed subjects of energy consumption, water and air pollution are only loosely linked to the CE concept, but are primarily associated with the fields of environmental protection, Cleaner Production and renewable energy production. Within the subject matter of the CE a slightly bigger focus is set on the topic material resource management. Here again the PRC is facing a number of challenges. On a per capita level the country has only access to 43% of the world average in mineral reserves (Zhu, 2011, 13). Moreover, in regards to demand for and consumption of mineral resources, the country has vastly overdrawn its resource account balance: In 2013 the country's economy consumed far more than it would have been able to provide through domestic reserves (see Figure 3).

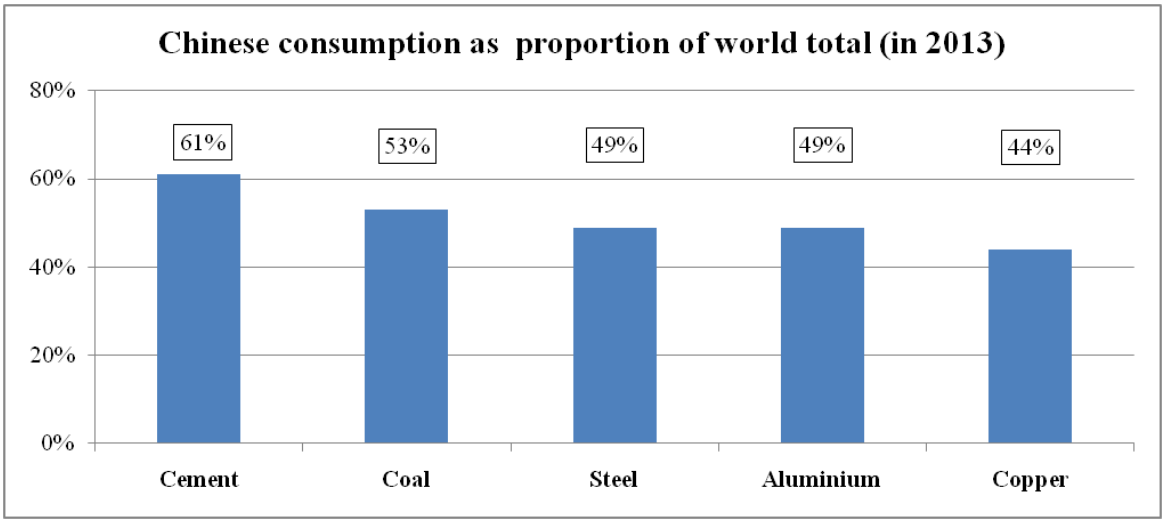


**Figure 3. Chinese consumption of major mineral resources in 2013 (the author, adapted from on Zhu et al., 2015, 24)**

The origins of the resource challenge can be traced back to China's adoption of a resource-intensive growth model. In this context resource specific problems arise from a combination of three interlinked socio-economic patterns: Consumption, production and imports. Firstly, material consumption has doubled between 1980 and 2009 (Dong et al., 2017, 1164). One of the most stunning numbers in this respect is the use of cement, of which China consumed quantities between 2011 and 2013 that alone surpassed overall consumption in the US during the entire 20$^{th}$ century (SCMP, 2017a). This thirst for raw materials is a direct consequence of material-intensive production patterns. In 2011 alone, the PRC accounted for 46% of aluminium, 50% of steel and 60% of cement in global production. Despite China's export-oriented strategy, much of domestically exploited raw materials are also subject to domestic

consumption. The hereto added, additional pillar of material imports is crucial for maintaining production and consumption, but yet very cost intensive. In 2012, fuels and minerals alone accounted for 30% of the nation's expenditures for imports. This stands in stark contrast to the same item costs two decades earlier, which then only amounted to 5% of total import expenditures (Mathews and Tan, 2011, 440). The example of steel production provides another hint on the country's import dependency so as to keep its growth model in operation: Between 2002 and 2011 the average growth rate of crude steel consumption amounted to 14% annually, which in essence implies that consumed quantities in 2011 increased more than threefold over nine years. In order to quench the strong demand of production, around 50% of steel consumed in 2011 had to be provided via imports (Ma et al., 2014, 506f). The huge demand for mineral resource imports and the entailed increase in expenditures to sustain this flow exemplifies the uncontested primacy of China's resource-intensive growth model.

In the light of these constellations two major challenges for the Chinese growth model have emerged: Firstly, there is the pressure to achieve higher efficiencies in resource use and recycling. While China consumed 15% of energy, 30% of crude steel and 50% of cement generated globally, the country only accounted for 5.5% of the world's GDP. In regard to resource recycling and reuse China only achieves 35%, which is 20% below the global benchmark (Dong et al., 2017, 1165). Secondly, the PRC's resource intensive growth model confronts the country with severe scarcities. According to projections by the MEP in 2012, China will face severe shortages in 19 of the 45 most significant mineral resources, while the dependency on imports of strategic resources such as iron, copper and potassium is going to increase. In order to alleviate these pressures the so far relatively weak performance in mineral resource recycling has to be raised significantly (MEP, 2012a, 2).

### 5.3.2 The mineral resource challenge: scarcities, institutional weaknesses and looming risks

The primary aim of the CE is the creation of a regenerative system, in which resource use as well as the generation of waste, emissions and leakages are minimised. For this purpose material and energy loops have to be slowed, closed and narrowed down via increased efforts to realise maintenance, repair, reuse, refurbishment and recycling practices (Geissdoerfer et al., 2017, 759). Therefore, the management of mineral, and more broadly material resources, plays a pivotal role for the realisation of this concept. As the previous section has demonstrated China's development model is highly resource intensive and cannot satisfy this demand through domestic reserves alone. Over 50% of ores consumed in the PC had to be

covered by imports in 2011 (Ma et al., 2014, 507) and historically these quantities have been increasing extremely fast: Since 1995, mineral resources constitute the country's fastest growing import item and while China consumed primary minerals of around 31% of the world's average levels in 1970 this proportion increased to 162% in 2008 (West et al., 2013, 6).

At a closer look it becomes evident that this constellation does not only result from the vast dimension of material consumption in China per se, but also because of a low level of resource utilisation efficiency (Naustdalslid, 2014, 304). This weak performance is in parts owned to poorly developed institutions in regard to the pricing of natural resources. In fact primary resources are in China available at unreasonably low prices, which in turn makes recycling and reuse comparatively costly and thus induces production towards foremost relying on primary instead of recycled materials (Baum, 2011, 21; Geng and Doberstein, 2008, 234). This regulatory distortion should however not be seen as Chinese particularity, as this pattern merely reflects a global trend. Over the 20$^{th}$ century, growth and efficiency gains in advanced economies have been primarily realised via extremely low resource prices in relation to labour costs. The current wasteful system of resource use emerged as a result of under-priced raw materials and the thereof induced tendency to strive for ever more primary material access instead of recovering used materials (EMAF, 2013, 14f). What in consequence emerged as major problem in recent years are increases in price volatility and the general rise in raw material prices: Given that earth constitutes a closed biosphere, within which ever more players reach out for existent global reserves, available supplies not only fall short of satisfying national demands. Moreover slight shifts in demand structures have lead to disproportionally large price swings, especially since the early 2000s (EMAF, 2013, 18f). This again has strong implications for the Chinese development model: As its economic growth is disproportionally dependent on raw material imports, the country's leadership has invested considerable efforts in safeguarding external raw materials via diplomatic contract- and investment strategies (Baum, 2011, 28). Continued economic growth does therefore increasingly depend on factors that are located outside of the direct control of the Chinese government. By implication, gaining an advantageous position thus requires the Chinese leadership to invest a high degree of political, diplomatic and economic efforts.

Under these circumstances realising the CE may prove to be an extremely material and thus cost saving option. In this regard, the potential that China offers is vast, but as of now much yet remains largely untapped: China's economy features a massive generation of waste

products that could be recovered, however in order to do so higher investments are needed to build up adequate waste recovery structures (WB, 2009, 4). When it comes to the aspects of resource reuse and recycling, formal systems in China only reach a respective quota of 35%, which lies quite below the international benchmark (Dong et al., 2017, 1165). When it comes to Municipal Solid Waste (MSW), current levels for paper, plastics and metals amount to 45%, 24% and 11% respectively (Fei et al., 2016 [suppl.data], 1). The fact that these benchmarks are rather low, is demonstrated by yet still improvable levels in Europe, where slightly more than 40% of 2.7 billion tonnes of waste were reused, recycled, or composted in 2010 (EMAF, 2013, 15f).

In search of the reasons that impede a smooth CE development in China, one quickly arrives at the problem of incomplete and in parts adverse institutional arrangements: Up until the first decade of the 2000s, natural resources taxes have been extremely low in the PRC, which induced industries to prefer virgin raw materials over secondary resources, as the latter often requires additional and costly processing. In those cases, in which recycled materials actually proved to be cheaper than primary resources, companies were yet again confronted with additional institutional hurdles. Given the processing and refining operations that arise from the material recovery practices, companies engaged in this process were made subject to higher value added tax (VAT) burdens (Geng and Doberstein, 2008, 234f). This in turn had a strong negative impact on metal recycling enterprises which despite their contribution to economic sustainability were subjected to a 17% VAT and thus faced a major reduction of respective profit margins (Mo et al., 2009, 414). Some industries such as the ship recycling sector were hit by even more rigorous regulatory measures: While having enjoyed a 70% refund on a previously levied 17% VAT (xian zheng hou tui 先征后退) this beneficial measure had been entirely cancelled in 2009 and thus pushed the segment onto a dire path for more than half a decade. Recent research by the author and colleagues has indicated that regulatory rigidity has pushed many enterprises in this field to the brink of collapse (Staudner et al., forthcoming, 15ff). The Chinese central government has however tried to tackle some aspects within this institutional misalignment. Via the issuance of new VAT policy measure in 2015 (MOF, 2015) a 30-70% VAT reduction for recycling companies has been proposed in a 2016 policy note (MOC, 2016, 9). However, nearly one year after its implementation various weaknesses have surfaced: Implementation over the country is unequal, most companies receive a 30% VAT reduction at best, some recycling segments appear to be

exempt from the policy and middle and large registered recyclers are still unable to compete with smaller, informal operators (MOC, 2017, 11).

Amidst these domestic problems, China's material resource scarcities are expected to worsen due to various global trends that equally affect the country. In this regard the Ellen MacArthur Foundation (2013) lists the following impact factors: In first instance there is the nexus between demographic changes and increasing consumer capacities in various countries. In regard to demographic growth China might face less pressure than many countries situated in Africa. However when it comes to per capita discretionary income, increasing purchasing power and consumption trends there are particular triggers that have and continue to induce a high demand for consumer goods and infrastructure. Given the cost intensity for the exploitation of new raw materials, increasing consumer demand would require ever growing expenditures so as to access virgin resources. Political risks pose another difficulty for the acquisition of raw materials. In this context local decisions such as adjustment in oil exports by OPEC states may thus strain budgets for respective imports in countries such as China. A third aspect relates to the degree of globalisation of commodity and resource markets. Single events in resource exporting countries may have an impact on the price balancing in processing and exporting countries, such as China, and thus in further consequence jeopardise profits from the sale of goods to third countries. Finally there is the aspect of climate change, which is in general expected to aggravate in the near future. Despite its lesser impact on raw materials, changes in climate will most likely result in new challenges that in turn will have an effect on the ways and means how material resources are used. In summary these manmade changes to the environment are expected to largely affect resource supply constraints and in further consequence increase material price levels and respective volatilities (EMAF, 2013, 18ff). By implication, a shift towards strengthening CE practices can help to mitigate these dawning global challenges.

## 5.4 The Circular Economy concept

### 5.4.1 Theoretical origins of the CE concept

The first notable aspect regarding the evolution of theories preceding the CE is that the concept itself emerged as a synergy of various schools of thought, such as Industrial Ecology or Ecological Economics (Preston, 2012, 3f; Ghisellini et al., 2016, 14ff). If interpreted through the lens of the model, the CE does not manifest an entirely new solution to a particular problem. Rather, the concept resulted from an accumulated cascade of preceding

approaches that focussed on tackling a dualistic challenge: To cope with an ever growing ecological deterioration and manage the increasing complexity of interrelated economic operations. So what occurred in evolutionary terms was an imitative learning process based on the inheritance stock of preceding solutions that addressed similar problems and challenges. As for the actual novelty of the CE two particular instances can be identified: Firstly, the concept not only features a highly normative tone, but also sets forth a comparatively detailed set of principles and aims for implication. Especially the latter element has been left out in earlier economic-ecological theories. Secondly, as will be discussed in section 5.5, the CE has been successfully incorporated into the governance framework of several countries and in some cases even rose to the rank of a leading industrial policy strategy.

In search of the ideological fathers of the CE Winans and Deng (2017, 825) point out that there is no single inventor. Rather they identify a multitude of contributors, such as John Lyle, William McDonough, Michael Braungart and Walter Stahel, who elaborated on various ecological-economic ideas during the 20$^{th}$ century. But even before that concepts akin to the CE can be traced back to the 18$^{th}$ century (Reike et al., 2017). From the perspective of the methodological model this constellation provides an argument for the significance of variation: The evolution of institutional solutions can only take place at a particular point in time, if a sufficiently broad range in variation emerged from an earlier evolutionary cycle. Once these solutions are applied and thereby generate novel experiences, the subsequently replenished institutional inheritance stock can provide novel insights that enable new designs for institutional solutions.

Probably the earliest evidence of a comprehensive solution approach akin to the CE has been provided by von Bertalanffy in the 1950s. In his General Systems Theory (GST) von Bertalanffy pointed out that systems feature a multitude of interactions between their constituting components and that these interactive patterns exhibit a nonlinear nature (Preston, 2012, 3). Such an assessment may be considered as a crucial step away from the traditional mainstream economic view, which postulates a type of ‘organised simplicity’ in the Newtonian tradition of causality. In contrast to that the GST argued for permanently changing relationships within such organisms (systems), which in turn generate a high degree of complexity and interdependence. Moreover in order to understand the whole organism, it does not suffice to analyse the constituent elements in isolation. Rather it is necessary to first pinpoint one of these components and then clarify its interlinking relationships with other components (Ghisellini et al., 2016, 14). Via gradually continuing this bottom-up directed

analysis, ever more pieces of the overall organism can be discovered. These early theoretical elaborations are relatively akin to the analytical model of the thesis as they call for a dynamic, non-isolated analysis of its key components. In a similar fashion the model of the thesis asserts that the key mechanisms are in a state of constant interdependent change, while only the relationships in-between remain as static nodal connections. In summary, the GST promotes holism, system thinking, complexity and organisational learning and thereby postulates some of the CE's basic theoretical premises (ibidem, 14). Such early ideas have been further extended in the 1960s by Kenneth Boulding. He argued that for achieving sustainability among human systems, their inherent economic structures must be transformed into closed cycles, in which external dependence on the environment has to be gradually reduced (ibidem, 14f). During the 1970s and 1980s further CE relevant concepts were introduced to a broader audience: Notable theories include the 'limits to growth' thesis of the Club of Rome in the 1970s, and works by David Pearce and ecological economist Herman Daly in the early 1980s. What emerged during this period was a variety of theories with slightly different approaches and foci.

Despite a visible degree of interwovenness between different theoretical schools there is no dominant or even linear trajectory that evolved towards the CE. Rather it appears that several concepts independently gained a certain prominence and developed along parallel pathways (Winans and Deng, 2017, 825f). This particularity again bears some resemblance to the herein used model, according to which a given set of variation in applied solutions will increase the institutional inheritance stock and facilitate the emergence of novel institutions. For the case of the CE the most important, inherited components are the preceding solutions of Ecological Economics and Industrial Ecology (Preston, 2012, 3). The former has been devised by Pearce and Turner, who in their 1989 seminal introduced a circular economic system that drew extensively from the ideas of ecological economist Boulding. Herein, Pearce and Turner argue for a shift from the traditional open-ended to a closed, circular economic system. They hereby align the economic with the environmental system and highlight three major economic functions of the environment: The provision of resources, life support systems and a sink for waste and emissions (Ghisellini et al., 2016, 14f). These initial theoretical elaborations established a strong bond between the CE and Ecological Economics: The common denominator is based on the premise that the economic system constitutes a subsystem of the larger ecological system of the earth, which in itself offers only limited resource related and environmental capabilities (Liu et al., 2009, 265).

The second important theoretical predecessor is the school of Industrial Ecology. This heterodox branch aims to surpass the separation of industrial systems as generator and the environment as recipient of anthropogenic activities. Quite differently, the theory conceptualises both subsystems as a joint ecosystem. This system is characterised by reciprocal flows of material, energy and information as well as by a provision of resources and services from the Biosphere to the anthroposphere. In operational terms Industrial Ecology has established three analytical pillars: Firstly and secondly, it aims to inquire how the industrial system works, how it is regulated and how it interacts with the biosphere and in which way its industrial metabolism operates. Thirdly the theory is proactive as it can be used by companies for internal operational improvements and by policy makers for the development of a roadmap towards sustainability. Within this normative approach a central role is dedicated to the topic of waste management and its integration into the industrial production network as a source for materials and energy. Similarly to the idea promoted by the Ecological Economics, Industrial Ecology argues for a transition from open to closed operational cycles that reduce the material and energy waste in industrial processes (Ghisellini et al., 2016, 14). The CE in turn builds on this kind of industrial system operation analysis and optimisation with the aim of gradual up-scaling. For the CE the core objectives are to maximise resource utilisation efficiency in economic operations so as to gradually decouple economic growth and resource use (ibidem, 15).

### 5.4.2 Strategic aims and principles

It is possibly because of the multitude of sustainability concepts revolving around topics of resource management and pollution prevention that the CE is often inconsistently understood and applied by governments and companies (Preston, 2012, 3). In the light of the need for clarification the following paragraphs will outline the broader objectives to which the concept aspires and thereupon introduce its basic operative principles.

Fundamentally the CE has been designed as a concept that should seek to harmonise the relationship between the economic and the natural subsystems. Therefore this new mode of economic development should protect the environment, prevent pollution and in further consequence enable a sustainable mode of economic operation (Ma et al., 2014, 506). Herein, a crucial role is allocated to reducing material inputs as well as to the conservation, reuse and recycling of material resources (Baum, 2011, 18). Thereby pollution and waste generation can arguably be minimised as several studies have shown (Ma et al., 2014, 506). The key to these ambitious targets that are broadly related to environmental conservation, waste minimisation,

energy efficiency and simultaneous economic growth is manifested in the so called 3R principles – reduce, reuse, recycle (Liu et al., 2009, 265). These will be discussed in more detail below (see section 5.4.3).

By implication, a transformation towards this mode of economic operation demands that industrial production becomes realigned with these novel objectives. In this regard the primary task is to modify the industrial economy, so as to redesign it in a way that it operates in a restorative and regenerative manner. The aim of the CE therefore is to generate a 'regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops'. The means for achieving this objective are the implementations of concepts for long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing and recycling (Geissdoerfer et al., 2017, 759). Herein, the operational emphasis is laid on the management of material flows, especially within producing entities: The CE advocates a system in which manufacturers and retailers not produce and sell, but rather produce and retain ownership of their goods. Such an approach not only impedes one-way consumption and waste generation, but leads to a business model in which relatively durable and reusable products are circulated among consumers. This type of extended producer ownership and responsibility thus helps to extend the utilisation life time of goods, increase repair and refurbishment services and in turn reduce the degree of material dependency (EMAF, 2013, 22).

From a methodological point of view, the CE's objective of remodelling industrial systems towards higher levels of recycling and reuse features two noteworthy aspects. Firstly, the solution strategy manifested in the CE's objectives not only aims to solve the current challenge of excessive pollution and material consumption. Moreover the concept strives to avoid future problems of this kind. Via the circulation of energy and material matter, utilisation effectiveness can arguably be increased, which in turn would help to avoid similar challenges in the near future. Secondly, and possibly more importantly, the CE per se represents a nature oriented, imitative approach to environmental challenges. However, this type of emulation does only in parts reflect the outcomes of system-endogenous learning feedback process (i.e. inheritance). Rather, it represents the result of learning, computing and translating system-exogenous inputs into the socio-economic domain. Preston (2012, 3) in this regard refers to the natural environment and its ecosystems, which exhibit a high degree of efficient resource utilisation and recycling. In this sense, the CE does incorporate many environmental principles within its own strategy and as an institutional solution thus promotes

a particular type of biomimicry: Insights from environmental systems are thus applied to the socio-economic context, which is treated as a body with organisms that processes elements in a cyclic, closed loop way such as natural nutrients. The CE thus abandons the traditional linear development pattern and replaces it by a multi-dimensional system of exchanges that is akin to natural, living processes of the environment (EAMF, 2013, 22).

A closer look at the concept of biomimicry further clarifies the familiarity to the CE concept. This strategy is described as innovation inspired by nature, whereby the best ideas and processes of nature are emulated so as to solve human problems. Herein, the three key principles are worth being juxtaposed to the corresponding conceptualisation of operative principles in the CE: Firstly, nature is referred to as the design *blueprint*, which provides forms, processes and strategies for the solution of human problems. Secondly, nature is seen as the *measure* for the sustainability of socio-economic innovations and operations. Finally, nature is the *mentor* from which lessons in regard to the solution finding process can be learned (Biomimicry Institute, 2017). Apart from increasing material utilisation effectiveness, decreasing pollution and waste, the overarching aim of the CE is to establish a closed loop of energy and material flows between generating and consuming entities. In accordance with and as mimicry of the natural system the CE thus requires a set of a feedback process, in which organisation and operation of socio-economic actors and entities are properly aligned. Bearing a resemblance to the learning feedback component in the model of this thesis, the CE feedback loop transports information as well as matter among the involved actors. Via this mechanism materials and their attached information may under perfect conditions be subject to high utilisation efficiency and thereby avoid being prematurely discarded as waste (Geng and Doberstein, 2008, 232).

How can these various aims become translated into operational principles for socio-economic systems? The Ellen MacArthur Foundation as the single most important platform dedicated to the CE has formulated a set of core operative principles for implementing the CE at national and global levels. These may be summarised in the following order: The first and foremost principle is to ‘design out’ waste, which aims at creating products that are subject to a cycle of disassembly and reuse. Herein, circularity introduces the differentiation between consumable (biologically degradable) and durable (non-degradable, but designed for refurbishment and disassembly) goods. Waste that occurs in this cyclic loop thus constitutes a valuable input, or feedstock, for future production. Secondly, the energy required for cyclic operations should be renewable by nature, in order to decrease resource dependence and increase resilience of CE

systems. In a similar fashion the forth principle calls for a shift from selling to lending products. Thereby, the short-time use and disposal of goods will be replaced by a scheme in which more durable goods are rented, leased, repaired and serviced. The fifth principle calls for system resilience to be achieved via building adaptive systems. In contrast to the current uniformity of global systems, flexible CE structures are composed of a variation of modules or building blocks that exhibit a high degree of versatility when it comes to responding to their respective environment. Here again nature provides a useful model that stands in contrast to the relatively uniform structures promoted by humans since the industrial revolution. The final principle emphasises the necessity to 'think in systems', so as to understand how the compositional parts influence one another and how respective relationships emerge among these entities. In order to master CE-like, non-linear systems the identification of feedback providing mechanisms is of utmost importance. Not only do they provide decision-makers with developments that have emerged at the other end of the system's dimension (bottom-up), more importantly feedback loops convey information about how designed approaches play out in the context of problem solving (EMAF, 2013, 7 and 22f).

### 5.4.3 The core value practices of the CE: Reduce, reuse, recycle

In order to further refine the above outlined aims and principles and thus increase their degree of applicability, several key values[12] or value concepts have been defined by proponents of the CE. Most frequently, the core values relate to the 3Rs reduction (or decrement), reuse and recycling of materials and energy (Liu et al., 2009, 265), which are to be applied for the production of services and goods (Su et al., 2013, 216). There are yet some approaches in the relevant literature, which incorporate six core values, i.e. reuse, recycle, redesign, remanufacture, reduce and recover (Winans and Deng, 2017, 825). A notable authority within the CE subject matter, the Ellen MacArthur Foundation, even lists over ten value oriented

[12] The 3R concepts introduced in this chapter have been termed 'values' for the following reasons: Firstly, this terminology corresponds to the methodological model and the theoretical elaborations that are based on the theoretical school of the Old Institutional Economics (OIE). Herein, Groenewegen et al. (2010, 26) state that values represent believes about what is considered to be the most important things in life. Translated into the operative context of the CE, the application of the term values to the concepts above seems to be quite suitable as these concepts constitute the fundamental ideas and most important operational aims of the CE. Secondly, at the legislative level (discussed in sections 5.5 and 5.6), the entirety of CE institutions are strongly permeated by the 3R concepts. This again parallels the logic of the OIE, according to which values are smallest components upon which institutional structures are built. Given these striking ontological parallels regarding function and purpose, the 3Rs are herein interpreted as values or value concepts.

practices[13]. The following paragraphs will therefore be confined to introducing the most important operative values in adherence to the material resource focus of this thesis.

The highest ideal among the various CE practices is **reduction**, which refers to the minimisation of energy and raw material inputs. Reduction can be achieved via improving production efficiency (Su et al., 2013, 216), e.g. through new technologies, manufacturing techniques or product design. Furthermore reduction also addresses consumption patterns, where reductions emerge through adopting a more frugal lifestyle (Ghisellini et al., 2016, 15). Ranking second is the **reuse** of goods and products. Reuse implies that a product or good that does not yet qualify as waste may be used again for the same purpose in its original form with little enhancement or modification. Equally, this value concept may also be applied to the reuse of resources, such as water outputs from one firm can again be used for cooling purposes in a second enterprise (EMAF, 2013, 25). Thus reuse demands to maximise the utilisation capability of a product, good or material, which is to be achieved via frequent maintenance and reclamation (Su et al., 2013, 216). The appealing incentive to engage in reuse practices is that they entail a very low environmental impact (Ghisellini et al., 2016, 15). One point of caution is mentioned in the relevant literature, which emphasises the necessity to distinguish between reuse and other CE practices according to the degree of structural change of the product in question. Therefore, unmodified product reuse as well as a new use of superficially modified (at the surface level) products both qualifies as direct reuse (Preston, 2012, 4). If these modifications exceed the superficial level, the respective practices are called **refurbishment** and **remanufacturing**. The former depicts a process of replacing or repairing components within a product as well as additional activities such as cleaning, painting or fabric changing. The latter on the other hand refers to a process of disassembly and recovery at the component level. Herein, functioning, reusable parts are taken out of a used product and are re-installed into a new one (EMAF, 2013, 25). These deformative, subtractive or additive repair processes have also been dubbed as non-destructive recycling (Preston, 2012, 4) and are thus ranked relatively high along the CE value hierarchy.

Material **recycling** may thus be regarded as the golden middle of the CE value concepts, being hierarchically positioned in-between reuse on the one end and disposal on the other. Generally speaking, recycling designates any recovery operation through which waste materials are reprocessed into products, materials or substances. Here again the negative

[13] A very detailed analysis on the diversity of R-concepts and the in parts contradictory logic in the current academic discourse is presented in Reike et al., 2017. The above discussion on the R-ideals primarily serves the purpose to highlight the most prominent value concepts, which provide the operational fundament of the CE.

impacts on the environment are strongly reduced (Ghisellini et al., 2016, 16). In this regard three types of practices have been distinguished: *Functional recycling* describes the process of recovering materials for original or similar utilisation purposes. *Downcycling* on the other hand indicates a conversion into new materials of lesser quality and reduced functionality, whereas *upcycling* represents the opposite process (EMAF, 2013, 25). Despite the fact that recycling represents a destructive type of change (Preston, 2012, 4) it serves the purpose to reduce the consumption of virgin materials (Su et al., 2013, 216). Below recycling ranks the process of **energy recovery**, which represents the irreversible conversion of materials into useable heat, electricity or fuel through a variety of waste-to-energy processes such as combustion, gasification, pyrolysis and so forth. **Landfilling** stands at the bottom of CE related ideals, whereby waste is disposed in a controlled manner onto or into land (EMAF, 2013, 25).

As indicated above these processes are aligned along a CE-specific hierarchy, in which reduction of resources is the leading value ideal for the realisation of the CE (Su et al., 2013, 216). This type of hierarchical ranking has been adopted by various national institutional systems, such as the German Circular Economy and Waste Management Law of 1996. Herein, it is stipulated that all processes of economic production should aim to prevent and reduce the generation of waste. Second to that, the law demands that the usability of all products has to be maximised – a clear indication of the reuse value concept. Thirdly all waste that was generated has to be recycled or composted. The next best choice is then to strive for energy recovery and for those compounds that cannot be treated in any of the above ways landfilling shall be applied (GBT, 2016). As will be discussed in section 5.7 country specific legislations have to a different degree and manner incorporated these value concepts into their CE related system set up.

In the light of the above discussed strategies, aims, principles and values it is however also necessary to point out that there exist one inherent limitation and one basic constraint for the implementation of the CE at the national and global scale. The limitation is that CE based economic systems cannot realise a 100% recycling rate or achieve a complete level of circularity of materials and energy. In this regard the axiom determining the capacity of CE based systems is the second law of thermodynamics that stipulates the irreversibility of converting generated energy and products back into raw materials within a closed system (Ghisellini et al., 2016, 15; Winans and Deng, 2017, 826). Any such transformation always requires additional energy or material matter from outside the system, whereby especially the

latter is limited due to the finite supply of materials on earth. The constraint on the other hand is that the implementation of the CE has been and still is primarily dependant on the premise of economic benefit. Therefore the realisation of particular value concepts, such as recycling, is usually impaired by considerations relating to environmental or economic costs. In other words, recycling activities are only initiated if they generate a net economic benefit (Ghisellini et al., 2016, 15). By implication, CE practices only emerge on the basis of expected economic improvements.

### 5.4.4 Economic benefits and implementation of the CE concept at different levels

Despite the above indicated limitations for the realisation of the CE, the concept nevertheless offers a range of socio-economic benefits at various levels of implementation. First and foremost the recovery of resources through material recycling and reuse entails direct, cost-saving advantages for industry. This recovery process includes the broader economic system and its consuming actors such as households, public institutions and retail (Naustdalslid, 2014, 303). They may in turn benefit from cost reductions given that recycled or reused products will at a certain level of maturity of the CE system acquire new goods at lower prices. These elaborations have been further extended by the Ellen MacArthur Foundation, who identifies recycling and reuse as cost-saving solutions to counter rising material prices and increasing resource dependency. These global constraints in fact induce companies to adopt innovative and material efficiency-oriented approaches offered by the CE value principles. Overall CE oriented economies will in turn benefit from the mitigation of respective volatilities, potential employment benefits (CE related jobs), reduced environmental externalities (pollution and waste reduction) and long term resilience (reduced dependence from foreign resource markets) (EMAF, 2013, 10). In adherence to the principles of circulation and closed loops, the foundation has further developed some concepts for the creation of economic value via CE based operative systems (see Table 4).

**Table 4. CE concepts for the creation of economic value (the author, adapted from EMAF, 2013, 7 and 30f)**

| Designated principle | Concept description |
|---|---|
| Power of the inner circle | • Minimisation of the comparative material usage<br>• the tighter the circle (less repair, refurbishment, recycling) the faster products return to users and the more material, labour and energy can be saved<br>• CE operations cost less than the linear alternative |
| Power of circling longer | • Develop product design & repair and refurbishment services with the aim of extending the use life time of products, components and material<br>• Substitution of virgin materials |
| Power of cascaded use and inbound material/product substitution | • Diversify reuse across the value chain, e.g. usage of cotton for clothing first, then for furniture, then for insulation….<br>• Substitution of demand for virgin materials<br>• Reduction of marginal costs for material, energy and labour use |
| Power of pure circles | • Increase collection, separation and redistribution efficiency<br>• Consider new product designs (e.g. eco-design)<br>• Extends product longevity and increases material productivity |

These general, socio-economic benefits can be reaped via implementing the CE concept at different levels of the national economic structure. As of now, relevant research distinguishes between micro- or company, meso- or Industrial Park and macro- or city, region and province levels. At the bottom level stands the application of measures that focus on changes within single companies, such as 'Cleaner Production' (CP) measures that enhance energy and resource efficiency in production processes (Li et al., 2010, 4274; Mathews and Tan, 2011, 436). Moreover, CP incorporates means aiming at pollution prevention as well as emission and toxic material use reduction. Despite the initial investment burdens, these environmental improvements can in turn generate direct business benefits such as immediate energy savings or international cooperation options through a 'greened' corporative image (Dan et al., 2013, 9; Zhu et al., 2012, 151f). Highly correlated with CP is Design for Environment and Eco-design, which blend environmental aspects into the design and development of products so as to improve repair and recycling opportunities and thus reduce the product's environmental impact. Both, CP and Eco-design or Design for Environment are the main initial strategies towards realising a company-internal CE system (Ghisellini et al., 2016, 18).

At the next higher tier stand those company clusters that are collocated within a designated area and which form what is frequently referred to as Eco-industrial parks (EIP). These industrial estates feature particular exchange networks, so-called industrial symbiosis chains, in which streams of energy and resources are shared so as to enhance the energy and resource efficiency of all involved parties (Mathews and Tan, 2011, 436). The conceptual purpose of such collective interaction is to combine environmental, resource-supply and economic benefits, which given this cooperative setting are deemed to be larger than the sum of

individual benefits, that each company could realise through optimisation in isolation (Tian et al., 2014, 486).

From the perspective of the evolutionary model the industrial park approach exhibits some noteworthy features. In first instance the herein practiced solution is to overcome economic and environmental challenges via a cooperative approach. Depending on the case specific constellation, i.e. whether the particular industrial park is bottom-up or top-down initiated, the methodological separation between both institutional domains is to some extent suspended. This is because industrial parks per se represent a solution upon which both domains have agreed. Possible variations thus may primarily emerge in day-to-day operative practices, in which formal statutes demand different concepts compared to what is actually implemented by operating actors. Furthermore, given that industrial parks represent well delineated, closed entities, it is possible to imagine that feedback flows can be captured and reintegrated into the inheritance stock with relative ease. Secondly, the industrial park system has incorporated imitative elements, namely to learn from nature, i.e. biomimicry. Based on the idea of industrial symbiosis, in which energy and material flows are identified, the CE industrial park concept aims to imitate cycles of nature, in which the basic requirements for (industrial) life are constantly replenished (Mathews and Tan, 2011, 436). By means of bio-mimicry industrial parks are considered to be capable of reconciling the three dimensions of sustainability, i.e. in respects to economic, environmental and social matters (Qu et al., 2015, 329). Secondly, specific experiences on business and sustainability options are relatively difficult to transfer between the different parks, as each arrangement with its inter-firm synergies is unique to its own set-up. Given the huge variety of CE related industrial parks, benefit assessments are largely confined to case-specific analyses that focus on improvements achieved over time.

At the top of this application hierarchy are Eco-cities or eco-areas, sometimes even dubbed as CE cities or CE regions. As of very recent this type of CE realisation is mainly practiced in China, where recycling activity and company interconnectedness are at the core of administrative, top-down implemented measures (Mathews and Tan, 2011, 436). Herein a special feature relates to the so-called eco-construction measures, which primarily aim at realising three dimensions of sustainability, namely ecological engineering, ecological restoration and ecological cultural remoulding. Typical manifestations are the construction of eco-villages, eco-counties and even eco-provinces. Similar to the case of CE industrial parks, the Chinese government has established a set of indicators to appraise the development of

such eco-regions. Herein, the evaluation of these areas is based on economic development, environmental protection and social progress indicators (Wang et al., 2015, 127). The reasons for China to expand CE practices to this level are in essence the same challenges, which lead to the adoption of the concept at the enterprise level: Rapid urbanisation has entailed straining implications in respect to environmental pollution, resource overuse and energy consumption. Eco-cities or regions are thus seen as a possibility to minimise resource consumption, waste and emission generation and thereby improve healthy living conditions. Therefore the primary aim is to decouple economic growth from its negative externalities on the environment (Yu et al., 2015b, 265). In essence, these particular hierarchies of CE application and thereof expected economic benefits constitute the major motivation behind adoption of the CE concept in China. As Zhu Dajian, one of the early proponents of this economic paradigm in China has indicated, the CE has been perceived by the government as an option to create a win-win relationship between nature and economy. What has been derived from this need was to implement the CE in a comprehensive nature: As it became a crucial industrial policy, the CE is not only deemed as a solution for waste management, but a system that links enterprise production with implications on resource and energy consumption. In order to realise this win-win, the CE has in the view of the Chinese government to be controlled and captured within properly delineated dimensions such as industrial parks, cities and regions (Zhu, 2008, 2f). As can be discerned from this particular approach, the official Chinese perspective depicts the CE as multi-level solution, which is to be applied along different layers of its socio-economic structure.

Such a reshape of economic systems as it is envisaged by the CE strategies in China and abroad however depends on the premise of guaranteeing the generation of economic value. At the corporate level for example, companies that adopt CE measures to cope with resource scarcity and tighter environmental standards expect to benefit economically from such restructuring (EMAF, 2013, 11). So it is in essence economic success that leads to the replication of CE practices among the larger company environment. Therefore, larger systemic changes can only emerge, if the CE is not adopted in some isolated enterprises, but if this pattern of production permeates entire industrial networks and supply streams (Preston, 2012, 8f). For economic profit to be achieved, corporate restructuring efforts basically depend on a gradual, pervasive shift in consumer behaviour and CE product demand (EMAF, 2013, 11). In order to accelerate these bottom-up developments at the corporate and consumer level supportive, top-down implemented governmental measures play a decisive role (Preston, 2012, 9). The motivation for governments like China to formally buttress CE related activities

do in essence originate in the large economic gains that arise from resource saving, pollution reduction and thus enhanced social, environmental and economic sustainability (Su et al., 2013, 216).

## 5.5 The institutionalisation of the CE outside of China

### 5.5.1 Overview on national and EU strategies to realise the CE

Despite similar value ideals on what the CE should achieve, the outcomes of CE efforts in various countries however display different institutional results due to the differing nature of challenges each system faces. Winans and Deng (2017, 826) further attribute different CE outcomes to the diverse cultural, social and political systems. The authors go on by listing particular foci of CE applications in Germany (resource use), China (waste management and production innovation), UK, Denmark, Switzerland, Portugal (waste management and circular use), Korea and Japan (consumer responsibility for material use and waste), as well as the US and EU (3R programs and product life cycle) (ibidem, 826). Equally, there are CE developments that extend beyond the Western hemisphere such as End-of-life (EOL) vehicle recycling in Australia (Soo et al., 2016) or waste reduction in production and recycling in South Africa (Mativenga et al., 2017). While these cases exemplify the diversity of CE applications, all practices are yet founded on the 3R values that stand at the bottom of the larger CE concept. Within the subject matter of CE development in different countries there is plenty of opportunity to go into more depth. However given that the following sections discuss three country examples, I will as of now confine myself to a short overview on the CE strategy promoted by the Commission of the European Union (EC).

In direct juxtaposition to the PRC, CE developments promoted by the EU for application in its member states does in terms of dimension resemble the top-down policy making process by the Chinese central government towards local governments. Despite the many differences in legal, administrative and politico-economic power distribution between the two entities, both systems have established a reciprocal relationship between the centre and its nodes in the periphery. The comparability of both systems is further strengthened as exchanges in both systems take place in a cyclic manner between both administrative layers: Whereas the centre forwards policy strategies with different degrees of binding force, the periphery responds via adopting these measures to varying degrees. What results from this process is a constant feedback on how particular laws, directives and strategies can be translated into actual practice. In the following paragraphs I will provide a short review of key foci for CE

implementation that are stipulated by the EC for its member states. The primary purpose herein is to discern the particular key values which will later on be compared to those promoted by the Chinese central government.

While the earliest CE practices have emerged in the West in the 1970s, the EU has only in recent years adopted a prominent position on this subject. The first significant step to promote the CE among its member states was the EU Waste Framework Directive of 2008, which sets forth the so-called 'waste hierarchy'. Herein, the EC designates a hierarchically descending order of five steps on how to deal with waste based on the environmental impact. Priority is given to the overall prevention of waste materials, following that are reuse, recycling, further recovery options and finally disposal (Nelles et al., 2016, 8). A more comprehensive CE measure followed in 2011 with the flagship initiative on resource efficiency, which 'proposes ways to increase resource productivity and decouple economic growth from resource use and its environmental impact' (EC, 2011). Subsequent steps lead to the formation of a CE policy package in 2014, which comprised laws on waste, packaging, landfill, end-of-life (EOL) vehicles, batteries and electronic waste. Herein, legally binding targets primarily revolved around recycling (70% for municipal waste and 80% for packaging materials by 2030) and the banning of landfill operations for recyclables and organic waste (by 2025) (Orford, 2015). This particular orientation towards waste recycling experienced an evolutionary shift in 2015, which resulted in a broadened strategy to set forth CE goals for EU member states. Via publication of the Action Plan for the Circular Economy (2015) the EC merged various pre-existing policies and legal instruments with novel, up-to-date regulations and initiatives (McDowall et al., 2017, 2). In terms of institutional evolution, this development features an interesting aspect, as the EC adopts a practice of imitation of earlier regulatory institutional solutions, while simultaneously combining these with novel solution approaches. In essence, the overview presented in Table 5 shows that the EC has identified five particular target segments, within which it tries to induce a shift towards the CE.

**Table 5. Core topics of the EC's action plan for the Circular Economy (the author, adapted from McDowall et al., 2017 and EC, 2015)**

| Economic segments | Suggested legislative measures to realise the CE |
|---|---|
| **Production** | • Eco-design: proposal to adapt the existing eco-design work plan to incorporate durability, reparability and recyclability criteria<br>• Cleaner manufacturing: R&D funding, knowledge centres<br>• In production processes: increase material use efficiency and reduce waste generation |
| **Consumption** | • Proposal to introduce product labelling regarding durability, environmental performance and energy efficiency<br>• Pricing: encouragement of member states to use pricing instruments<br>• Consumer protection: product life guarantee<br>• Promotion of "innovative consumption", such as collaborative models based like leasing, lending, and sharing |
| **Waste management** | • New legislative means for waste treatment and landfilling<br>• Recycling targets for packaging materials and waste recyclable<br>• Renovation of extended produce responsibility rules rewarding product design facilitating repair, remanufacture, and recycling<br>• Funding support for "laggard" regions via cohesion policy |
| **Markets for secondary materials** | • Clarifying legal rules defining "waste"<br>• Proposed standards for various secondary materials to foster markets<br>• Recycling of organic materials to substitute chemical fertilisers<br>• Recycling of water to promote reuse in agriculture<br>• Reduce pollutant content in recyclable material circulation |
| **Priority sections** | • Five priority areas: plastics, food waste, critical raw materials, construction/demolition waste and biomass and bio-products |
| **Innovation, investment, and guidance** | • Funding for research and innovation under Europe's Horizon 2020 program and through the Cohesion Policy<br>• Establish platforms for private public partnerships (PPP) for upgrading the CE industry |
| **CE progress monitoring** | • Focus: resource efficiency and raw materials, with commitments to develop new CE indicators<br>• No explicit indicators for the CE |

This Action Plan incorporates various aspects that can be well analysed in regards to the inherent value concepts, such as the 3Rs. As will be shown in the subsequent sections, the prevalence and emphasis assigned to the 3Rs varies substantially in the different country-specific CE systems. The three most representative systems and their different patterns of CE institutionalisation will be subject of the following sub-chapters.

### 5.5.2 Germany

One of the earliest emergences of the CE within the formal institutional framework was in Western Germany, where the Waste Disposal Act was introduced in 1976 (Ghisellini et al., 2016, 15). This regulation bore some of the fundamental characteristics that initially shaped Germany's environmental framework towards the CE. What followed during the early 1990s was a gradual incorporation of CE relevant elements into the country's environmental policy framework. The initial focus in the 1990s was put on aspects of raw material and natural

resource use so as to enable a sustained economic growth process (Winans and Deng, 2017, 826). These ideals were amended by the pollution prevention principle, the polluters pay idea and the concept of cooperation in the economic environmental context (Heck, 2006, 21).

Similar to what has been discussed in the section on the theoretical beginnings of the CE, the actual institutional manifestation of the concept in Germany was preceded by the broader sustainable development paradigm. In 1994 this strategy became incorporated in the constitution and consolidated as a principle pillar for the formation of government policy. The considerations that produced the fundament for this step were primarily related to the preservation of natural resources and nature conservation (ibidem, 22). Along this path the next logical step came in form of the German Circular Economy Law (Gesetz zur Förderung der Kreislaufwirtschaft und Sicherung der umweltverträglichen Bewirtschaftung von Abfällen), which became effective in 1996. In terms of institutional solution creation the German CE law represented a governing framework that extends and supplements the earlier sustainable development paradigm. Whereas the latter addressed the challenges of nature and resource conservation and preservation, the former focussed more on those material streams that were already extracted from nature and inserted into the process of industrial production. Indeed, the German CE law itself states that its primary purpose is to conserve natural resources and in addition protect humans and the environment from improper waste treatment (GBT, 2012, art. 1). This legal foundation combined with actual developments does to some extent explain the often encountered analysis of the German CE as being centred on waste management (WM) (Zhu, 2008, 2f). Indeed, waste and pollution prevention are seen as the foremost aim for realising the German CE (Bilitewski, 2012, 1). Herein, the reuse and recycling of waste are the key tasks, for which especially the productive industry and its design of products was held accountable. According to the law this would have to be achieved via economic tools such as the producer responsibility concept and various fiscal policy measures. In a second, but not explicitly hierarchically subordinated instance the German CE law intends to initiate a shift among the wider society's consumption, reduction, reuse and recycling patterns (ibidem, 1).

Indeed the analysis of the German CE development indicates that the formal institutional setting has initially put more emphasis on the domain of production than consumption. Here again, the concern for WM and the respective allocation of responsibilities play a pivotal role. The CE gradually became consolidated in legislative terms through the Ordinance on the Avoidance of Packaging Waste (OAPW) in 1991 and 1993 and through the issuance of the

German CE law, i.e. the Closed Substance Cycle Waste Management Act (CSCWMA) in 1994. This legislative pivot had set up the basis for the Extended Producer Responsibility (EPR), which has put forth a strong signal towards industry (Davis and Hall, 2006, 3). The EPR represents a modern version of the polluter pays principle, which aims to reduce waste generation through enhancing the circularity of products. In order to achieve this goal the principle demands that all costs associated with disposing and recovering products are to be transferred to the producer. By implication this concept should incentivise producers to reuse, recycle and minimise the disposal of waste materials (Ghisellini et al., 2016, 16). Furthermore, producers are obliged to design their products with the aim to reduce waste occurrence and to enable a sound recovery of materials. Enshrined in the CSCWMA and the OAPW, the EPR concept has contributed to achieve recovery rates[14] of over 50% of municipal and production waste in 2006 (Heck, 2006, 32) and 79% in 2013 (Wilts, 2016, 11). Both regulatory measures exhibit strong elements of obligations for producers, such as free of charge take-back duties, but at the same time they provide space for latitude in as far as how actual collection, and recycling practices have to be executed. According to Davis and Hall (2006, 3f) the particular set of institutional combinations enabled Germany to achieve its high recovery and recycling rates, albeit entailing relatively high operation costs. Despite the issue of cost intensity, Germany's CE initiatives fostered an extensive and powerful economic segment, in which 3,000 CE related enterprises employ almost 200,000 persons and generate a turnover of approximately 40 billion euro per year (Nelles et al., 2016, 7; Wilts, 2016, 11).

As for the current state of the German CE, two aspects are noteworthy: Firstly, the concept has witnessed a shift in value ideals in the last years. Formal institutional measures have indicated that the government aims to re-shape the country's CE operations by moving upwards along the waste hierarchy and putting a stronger emphasis on waste prevention. The 2012 amendment of the German CE law drew up a national waste prevention programme (art. 33) that formulates targets, evaluates current measures and thereof designates future steps (Nelles et al., 2016, 8). Secondly, the German CE is yet still primarily focussed on WM aspects (Table 6), while neglecting a more comprehensive CE dimension as promulgated by the EU. Thus, new business plans, investment strategies and job creation in accordance with the CE's closed loop idea are still largely absent (Wilts, 2016, 9). Furthermore, despite high recycling efficiency (i.e. a high output in recycled material from what has been inserted into the recycling process), only 14% of material feedstock used in production originate from

[14] The recovery rate is expressed through the formula [∑ of material (x) recovered from waste stream] divided by [∑of material (x) within the waste stream] (Worrell and Reuter, 2014, 12).

reprocessed waste materials. Also for materials like copper, aluminium and iron, which are recovered via highly mature practices the ratio only amounts to approximately 40-50%. Despite formal institutional efforts, especially over the last decade, there still is an overcapacity of waste incinerators, while consumers and industry still exhibit little interest in waste avoidance (ibidem, 11, 13). Thus, in order to achieve better performances in line with CE ideals, Germany would be required to devise and implement institutional structures that help to foster an alignment of interests between consumers, producers and recyclers. Furthermore, the German CE has to thematically expand and cover such segments as product design (facilitate product repair, refurbish and upgrade) or new CE business models (use and share instead of own; incentives for long life products) (ibidem, 15ff).

**Table 6. German regulatory measures to promote the CE (the author, adapted from Heck, 2006, 34-37 & individual verification)**[15]

| Name of regulation | Date of implementation | Date of amendment |
|---|---|---|
| Act on the prevention of harmful effects on the environment caused by air pollution, noise, vibration, an similar phenomena | 1974 | 2002, 2017 |
| Ordinance on waste oil | 1987 | 2002, 2012 |
| Ordinance on the avoidance and recovery of packaging waste | 1991 & 1993 | 1998, 2012 |
| Technical instructions on the recovery, treatment and other management of wastes from human settlements | 1993 | 2005<br>(abrogated in 2009) |
| **Close substance cycle and waste management act (Circular Economy Law)** | 1996 | 2012 & 2017 |
| Ordinance on waste management concepts and waste balance sheets | 1996 | 2002<br>(abrogated 2007) |
| Ordinance on the transfer, collection and environmentally sound disposal of EOL-vehicles | 1998 | 2003, 2016 |
| Ordinance on the return and disposal of used batteries and accumulators | 1998 | 2001<br>(abrogated in 2009) |
| Ordinance on the utilisation of bio-waste on land used for agricultural, silvicultural and horticultural purposes | 1998 | 2003, 2012 |
| Ordinance on environmentally compatible storage of waste from human settlements | 2001 | 2007 |
| Act on the disposal of EOL-vehicles | 2002 | 2006, 2009 |
| Ordinance on landfills and long-term storage facilities and amending the ordinance on environmentally compatible storage of waste from human settlements and biological waste-treatment facilities | 2002 | 2004, 2009 |
| Ordinance on the management of municipal wastes of commercial origin and certain construction and demolition wastes | 2002 | 2005, 2012 |
| Ordinance on underground waste stowage | 2002 | 2004, 2012 |
| Ordinance on the management of waste wood | 2003 | 2017 |
| Act governing the sale, return and environmentally sound disposal of electrical and electronic equipment | 2005 | 2015, 2017 |

What can be discerned from the table above is that the majority of German laws with CE relevance has been initially implemented during the early 1990s and mid-2000s. And as outlined by Wilts (2016) and other commentators, these key regulations exclusively address

[15] The English names of herein listed legal measures are adopted from Heck 2006 and from the officially translated versions.

waste and pollution related aspects. In regard to the problem-solution context of the model, the German CE does indeed feature strong innovative characteristics and a very responsive solution feedback cycle: The number and temporal density of legislative amendments implies that institutional solutions receive frequent updates, which presumably results from a limited effectiveness of the antecedent solutions.

### 5.5.3 Japan

The Japanese CE development bears an interesting combination of challenges and responses that in instances resembles the particular experiences of China and Germany. Similar to the environmental and resource specific challenges China began to face in the late 20$^{th}$ and early 21$^{st}$ century, Japanese economic development has been traditionally constrained by its natural geographical limits. Especially in regard to energy resources, domestic extraction is cost intensive, which has lead Japan to become highly dependent on oil resources (EMAF, 2014, 34; WEF, 2014, 26). However in the aftermath of the international oil crisis in 1978, the Japanese government gradually made plans to increase domestic autarky and initiate a shift towards independence and economic sustainability (Silva et al., 2017, 553). This trend might have been reinforced by additional resource and environment specific challenges: Health and pollution concerns have induced environmental protection to be manifested in a set of legislative measures starting with the Waste Disposal Law in 1970. Its establishment can be traced back to the difficulties with finding sufficient space for landfills in the 1950s. This legislative measure however only constituted an interim solution before another major shift in the 1990s tentatively strived to abandon energy recovery through waste incineration. A significant motivation for this step also originated in the challenges posed by Japan's economic and environmental endowments: Despite being a major industrial producer, the country has only limited domestic metal and mineral resources, which underscores the importance of having access to a steady supply of raw materials. This in turn made remanufacturing, reuse and recycling options highly attractive to decision making actors (Benton and Hazell, 2015).

The herein prominent health, environment and material resource related concerns depict a similar and yet more urgent constellation of challenges that lead to the initiation of the German CE. The formalisation of the Japanese CE even occurred within a similar time frame to Germany: Japan implemented its Law for Effective Recyclable Utilisation in 1991 and the Basic Act for Establishing a Sound Material-Cycle Society in 2000, which both put the country on track towards developing the CE (Ghisellini et al, 2015, 15). In contrast to the

German and as will be shown below to the Chinese CE strategy, Japan has put more efforts in merging CE related, top-down regulations with bottom-up practices. This particularity is explained as having its origins in Japanese business culture, which fosters and promotes collaboration between state and non-state actors (Benton and Hazell, 2015).

According to the Ellen MacArthur Foundation, the chronology of the Japanese path towards realising the CE can be divided into three phases: Firstly, the country issued structural adjustments to reduce the dependency on oil as predominant energy source while simultaneous efforts aimed at improving the energy utilisation efficiency in industry. The second step was marked by major institutionalisations, which consisted of establishing a legal system and respective policy measures concerning environmental protection as well as waste and resource management. In third instance top-down efforts aimed to encourage a broader societal participation by means of education and public awareness campaigns (EMAF, 2014, 34). From an institutional perspective this process is quite remarkable: It begins by focussing first on one segment of the socio-economic realm, i.e. industry, then sets forth an overarching governance framework for the entirety of socio-economic actors and finally addresses consumers. In comparison the Japanese CE initiative has at an earlier stage reached a higher level of societal integration than what has been achieved in the German case: Official plans issued by the Japanese government have been targeting to include its citizens since 2005 by raising their CE awareness in WM and actively integrate them into related practices (MOEJ, 2010, 9, 16, 59, 69). These efforts were buttressed in 2014 by the publication of a consumer guide on waste and the CE and how citizens can contribute to the realisation of the CE (NVC, 2014). In fact there are relatively strong legal obligations for Japanese consumers to participate in the CE (Ghisellini et al 2016, 16), while the responsiveness of German citizens to official CE efforts is as of now still unclear (Wilts et al., 2016, 30).

The relatively high level of content comprehensiveness in Japan has been initiated by strong top-down enforced legislative efforts. First measures occurred in the 1970s, while the biggest regulatory advances have been achieved since the 2000s. Herein, WM and resource depletion constituted the central pillars, while in terms of value concepts more attention was placed on reduction practices (WEF, 2014, 26). Beyond the level of legislation, the Japanese government has made strong use of CE related socio-economic plans. Following the issuance of the CE act in 2000, three different plans for the restructuring of the economy according to CE principles have been published in 2003, 2008 and 2013 respectively. Herein, the leading role for the implementation of the CE is assigned to the central government. In particular the

Ministry of Environment of Japan (MOEJ) is responsible for planning and CE enactment as well as for fostering cooperation among relevant stakeholders. In essence this puts the MOEJ into the position of acting as an intermediary, which facilitates partnerships and collaboration between state, industrial, academic and civil actors. Despite the explicit preference for a centralised power hierarchy, the implementation of CE plans bears a strong element of decentralisation as local actors are considered to be more efficient in adapting to and solving challenges according to the local context (Silva et al., 2017, 552ff). In the methodological context of this thesis, this approach indicates a type of two-sequenced solution process, one at the top and one at the bottom, which in theory might offer two advantages: Firstly, this approach overcomes the rigidity issue that would result from enforcing uniform solutions to different (local) problem contexts. Secondly, the resulting feedback from solution variations can in turn contribute to a larger generation of knowledge for the inheritance stock. This in turn offers a larger set of options for the next round of the evolutionary solution finding process. Given that the PRC employs a similar approach in its central to local governance structure, it will be useful to pick up and compare this concept again for analysis of the Chinese case (section 5.6).

As mentioned above the Japanese CE regulatory system does not exclusively focus on industry, but also extends to include its citizens. In parts this is done by directly assigning responsibility to consumers for material use and waste separation (Winans and Deng, 2017, 826). For Waste Electrical and Electronic Equipment (WEEE) the Japanese EPR concept even includes an enforced consumer responsibility for returning products to recycling (Ghisellini et al 2016, 16). The comprehensive integration of actors from industry and society for the purpose of realising the CE has been hailed by commentators as an exceptional characteristic of the Japanese model (Benton and Hazell, 2015). In the context of the methodological model, this constellation would indicate a strong congruency of interest between actors of the formal and informal institutional domain. However what has been documented by earlier research is that this particular achievement did not result from a mere enforcement of a top-down strategy by state actors: Albeit the fact that the Japanese government has put a considerable effort in encouraging societal actors to participate in CE activities, commentaries point out that there has been an institutional basis for this type collaboration. Silva et al (2017, 554) for example allude to the Japanese philosophy of *mottainai*, which embodies a traditional cultural concept that suggests the generation of waste as something regrettable and uncouth. In order to reinvigorate relevant bottom-up induced self-regulating practices this originally Buddhist idea has been taken up in the 3rd Fundamental Plan for Establishing a Sound-Material Cycle

Society in 2013. Herein, several references to the environment and sustainable consumption are made, which aim to promulgate ideals of frugality and emphasise the value concepts of reduce and reuse (ibidem, 554). In essence, the Japanese CE governance strategy builds upon the meta-values of trust and honesty so as to incentivise proper behaviour and collaboration among all socio-economic actor groups (Benton and Hazell, 2015). So in order to advance towards the CE, the Japanese state has installed a type of soft-statist guidance that appeals to societal values among non-state actors so as to nudge them towards the CE.

As has been outlined in the above, elements of the CE are well embedded in Japanese culture and education (EMAF, 2014, 34). In light of this advantage it needs to be asked how well formal institutional measures have performed in realising the emergence of CE practices in Japan. Davis and Hall (2006, 2f) contend that Japanese CE related regulations contain very comprehensive and ambitious goals. Herein, specific roles for state and non-state actors are formulated, but instead of setting forth particular obligations, the legal texts primarily rely on notions such as ‘encourage’ and ‘promote’ to achieve particular goals. The authors proceed by interpreting this approach as effective and influential in societal systems that feature a predominance of values such as consensus-building and personal responsibility. Simultaneously, however, Davis and Hall assert that Japanese CE regulations lack effective enforcement mechanisms, which in turn has produced mixed results (e.g. cost intensity, illegal WM practices) for the achievement of goals (Davis and Hall, 2006, 2f). Overall, Japan exhibits a mixed picture combining success and problems in terms of CE realisation: Similar to the results in Germany, the Japanese CE as achieved high recycling rates for metals, minimised landfilling of wastes to 5% in 2007 and reached recovery rates of around 74-89% for materials from discarded electronic devices (WEF, 2014, 26; Benton and Hazell, 2015,). On the flipside however waste incineration capacities still serve as the primary treatment method for MSW, which stands in stark contrast to the efforts to foster recycling practices since the 1990s (Silva et al., 2017, 555). Similar to the German case the obvious issue for Japan lies in the difficulty of overcoming older WM structures on the path towards material circularity and CE relevant practices.

A short overview on the legal measures issued from the 1990s to the recent present helps to explain Japan’s recycling performance. Similar to the German case, Japan’s government has issued two guideline-providing laws for the CE development, namely the Law for the Promotion of Effective Utilization of Resources in 1991 and the Fundamental law for establishing a sound material-cycle society in 2000 (MOEJ, 2010; Davis and Hall, 2006).

Both, but especially the latter, focus on WM objectives within the larger subject matter of land scarcity and resource depletion (Zhou et al., 2014, 2f) and as in Germany the regulatory framework in Japan features a strong focus on material recovery and recycling (Table 7).

**Table 7. Japanese regulatory measures to promote the CE (the author, adapted from MOEJ, 2010, 3; Yolin, 2015, 3; Silva et al., 2017, 553; Ji et al., 2012, 727f)[16]**

| **Name of the regulation** | **Date of implementation** | **Date of amendment** |
|---|---|---|
| Waste management and public cleansing act | 1970 | Amended in 2002, 2003, 2004; revised in 2006 |
| **Law on the promotion of effective utilization of resources** | 1991 | renamed and amended in 2000 |
| Basic environment law | 1993 | |
| Basic environment plan | 1994 | Reissued in2012 |
| Containers and packaging collection and recycling act | 1995 | 2006 |
| Home appliance recycling act | 1998 | |
| Construction materials recycling act | 2000 | |
| Law concerning the promotion of procurement of eco-friendly goods and services by the state and other entities | 2000 | |
| **Fundamental law for establishing a sound material-cycle society** | 2000 | |
| **Law for the promotion of utilization of recyclable resources** | 2000 | Renamed version of 1991; amended in 2007 |
| Japan environment corporation law | 2000 | amended version |
| Law concerning special measures for promotion of proper treatment of PCB waste | 2001 | |
| Household waste water treatment facility law | 2001 | amended version |
| Law for the recycling of end-of-life vehicles | 2002 | |
| Biomass Japan comprehensive strategy | 2002 | |
| 1st fundamental plan for establishing a sound material-cycle society | 2003 | |
| Basic plan for PCB waste treatment | 2003 | |
| Environmental restoration and conservation agency of Japan act | 2003 | |
| Japan environmental safety corporation act | 2003 | |
| Law on special measures concerning removal of environmental problems caused by specified industrial wastes | 2003 | 2005 |
| The basic directions for systematically and steadily promoting removal of environmental problems caused by specified industrial wastes | 2003 | |
| Wastes disposal facility development plan | 2003 | amended in 2008 |
| Marine pollution and disaster prevention law | 2004 | amended version |
| Action plan for elimination of illegal dumping | 2004 | |
| 3r initiative action plan | 2005 | |
| Biomass Japan comprehensive strategy | 2006 | |
| Law to promote the development of specified facilities for the disposal of industrial waste | 2006 | amended version |
| Law for ensuring the implementation of recovery and destruction of fluorocarbons concerning specified products | 2007 | amended version |

[16] The translations of the legislative measures have been adopted from the cited references.

| | | |
|---|---|---|
| 2nd fundamental plan for establishing a sound material-cycle society | 2008 | |
| Plan 2008 for promoting the construction waste recycling facilities | 2008 | |
| Act for the promotion of driftage disposal for good coastal landscape and environmental conservation to protect rich and beautiful nature | 2009 | |
| Small home appliances recycling act | 2012 | |
| 3rd fundamental plan for establishing a sound material-cycle society | 2013 | |

An interesting detail indicated in the table above is that the core regulatory elements of the Japanese CE also include the broader environmental laws, which are not explicitly referred to in the German CE framework. This interpretation is based on documents issued by the state and earlier studies on the topic, which to some extent implies a pre-selective screening of which regulations have a particular CE relevance and which do not. But the Japanese government's choice to assign a certain CE relevance to environmental laws (MOEJ, 2010, 3), would buttress the earlier argument that indicated the comparatively comprehensive nature of Japan's CE (Davis and Hall, 2006, 3).

What is additionally interesting is that plans for implementing the CE, such as the 'Fundamental Plan for Establishing a Sound Material-Cycle Society' has been considered by the Japanese government as a key regulatory element for the CE development (MOEJ, 2010, 1, 3, 15, 23). Such documents have also been issued by the German government, but there is no evidence they have been assigned with a central role that is comparable to the one of Japan's plans. When it comes to the sheer number of institutional solutions, the Japanese compilation appears to surpass the German regulatory framework. However, this particularity has to be approached with caution: Firstly, while the Japanese framework contains more specific laws and directives for particular challenges, i.e. different waste streams, the institutional structure in Germany appears to have captured these challenges by expanding the comprehensiveness of its individual measures[17]. This approach is directly linked to the second characteristic: For the Japanese case the above table indicates a plethora of annually issued laws and directives, with relatively little amendments and revisions. In contrast to that the institutional approach to the CE in Germany rather exhibits a high frequency to update and revise existing rules. Thus both countries attempt to improve their institutional solutions, but the means vary considerably: Whereas German legislature tends to create 'one-fits-all-

[17] This assessment is based on the premise that the CE frameworks compiled from primary and secondary literature do indeed encompass the entirety of all CE relevant regulations.

challenges' types of institutions, Japan's approach resembles a high degree of specification, in which each new challenge is tackled by a corresponding solution.

In both cases, the notable feature is that the two countries show a high responsiveness to CE related problems, if measured in frequency of their institutional outputs. Along the conceptual lines of the model, the high frequency of institutional innovation indicates a similar intensity in the growth of the institutional inheritance stock. By implication however this development not only implies a constant operation of the information feedback loop, but also raises questions in regard to institutional effectiveness. On the one hand side, the density in developments may either hint to a high frequency in the emergence of new challenges, which in turn require new solutions (Japan) or the upgrading of preceding ones (Germany). On the other hand this pattern may also hint to a lack in effectiveness of these solutions. So frequent institutional updating, especially on one and the same topic, e.g. waste treatment, could either indicate the emergence of changing challenges or that solutions lack effective content coverage and/ or applicability. Given that the political awareness of CE related challenges constitutes a globally novel phenomenon, it might arguably be a combination of both factors. Legislators on both sides seem to tackle the problem via a tentative and experimental institutional approach, in which they frequently renovate or expand earlier issued institutional solutions.

## 5.6 Institutionalisation, application and achievements of the CE in China

### 5.6.1 The incorporation of the CE into the PRC's political agenda

The emergence of the CE in the PRC can be traced back to a dualistic challenge that has been gradually growing over the 20$^{th}$ century: On the one hand, environmental and resource related problems increasingly indicated the limitations of traditional resource-intensive economic practices. On the other hand, the political axiom since economic reform and opening demands the generation of high GDP growth rates. Under these premises, any politically and ideologically viable solution has to serve and address both aspects simultaneously. In this context, the CE is one, and possibly the currently most prominent solution, which is officially presented and perceived as a win-win solution that can tackle both issues simultaneously (Zhu, 2008, 2f; Naustdalsid, 2015, 306).

Here again a review on the chronology of institutional solutions exemplifies the interesting path of an institutional evolution that initially addressed environmental concerns and later on increasingly included economic aspects. The initiation of this process can be traced back to

1973, when the first National Environmental Protection Conference was held. In direct consequence, the Leading Group of Environmental Protection was established in 1974 by the State Council of the PRC (SC) and provided with the mandate to formulate effective policies for environmental problems. Four years later the first Environmental Protection Law was issued and it directly addressed the nexus between industrial growth and environmental sustainability. However, during this early phase the primary intentions aimed at strengthening environmental protection, which in 1983 was elevated to the rank of a national core policy (Dwivedi and Vajpeyi, 1995, 75).

The expansion of the 'green framework' can be considered as the second phase of this development, which was triggered by the United Nations conference on environment and development in 1992. Shortly afterwards in the same year the Chinese central government adopted the China Agenda 21 (Zhongguo 21 shiji yicheng 中国 21 世纪议程) to promote sustainable development and ecological conservation in development strategies (Hofem, 2010, 9; Li, 2016, 13f; Yi and Liu, 2015, 13). Two years later sustainable development (Kechixu fazhan 可持续发展) equally made it into the rank of a core strategy and for the purpose of achieving this goal the CE has in 1996 been designated as a suitable tool. In the wake of these fast paced developments the Leading Group of Environmental Protection was upgraded to the State Environmental Protection Administration (SEPA). In this function, the SEPA preliminarily headed the task of CE promotion and launched a series of pilot projects in 1998.

The institutionalisation of the CE reached the third stage in 2002, when the central government promoted the concept to the country's main development strategy during the 16th Congress of the Communist Party of China (CCP) (Li, 2016, 13f). At this occasion the Chinese leadership decided upon the important conceptual combination of designing a solution for the dualistic challenge mentioned at the beginning of this section: Based on a sustainable development plan is was aimed to quadruple the GDP by 2020 (measured by the GDP base year of 2000), increase social equality as well as recover and protect the environmental integrity. In order to achieve the economic and environmental goals of this development plan the government opted for elevating the CE to the level of industrial policy. In a further step four specific objectives were put forward: the establishment of a CE relevant, scientific regulatory and control system; the formation of a cleaner production system among large and medium-sized enterprises; the organisation of industrial parks and circular chains according to ecological principles; the use of cities as nuclei for industry networks and the

integration of collection, sorting, reuse and a sound disposal of waste (SEPA, 2005b). During the following years, the legislative impetus for the consolidation of the CE further intensified: In 2002, the issued Cleaner Production Promotion Law (CPPL) stipulated company audits for resource efficiency as well as waste prevention and reduction. Suggestions on accelerating the development of the CE were issued by the SC in 2005 and promoted guidance on financial, taxation and investment measures for the CE implementation. Moreover the law clearly defined the responsibility of the government for the CE promotion in China (Li, 2016, 15). Not only does this step reflect the common conception of the Chinese state as being the guiding entity in economy, it moreover provides a methodologically relevant clarification: Hereby, the formal institutional domain and its actor groups assert the position as predominant players in the solution finding process.

The dynamic behind the institutionalisation of the CE further continued and reached an interim zenith between 2005 and 2016, which may be termed as the fourth stage of institutional CE development in China. Herein, the most notable event is the issuance of the PRC's very own Circular Economy Promotion Law (CEPL) by the 11$^{th}$ National People's Congress (NPC) in 2008. During the same period, several key laws were revised and amended such as the CPPL (2012), the Environmental Protection Law (2014) and the Law on Solid Waste Environmental Pollution Prevention and Control (2004, 2013, 2015, 2016). A further indication for the growing significance of the CE in China is the issuance of over 200 CE related legislative measures at the central level between 2005 and 2016 (Li, 2016, 16). A similar CE emphasis is exemplified in the current 13$^{th}$ five-year plan (FYP) for the period of 2016-2020, which dedicated more paragraphs to the topic than any of the preceding plans. If these different facts are taken together and analysed through the lens of this thesis' model, it is possible to discern a Chinese characteristic in terms of CE solution finding: Firstly, there is a high degree of revising old solutions to adapt them to novel challenges. Secondly, this process is accompanied by a gradually intensifying issuance of new institutional solutions. Thirdly, China is ex-ante designating an institutional framework for the country's socio-economic development via issuing FYPs and action plans, such as the Circular Economy Development Strategy and Action Plan for the near future (SC, 2013).

While other governments such as in Japan have equally forwarded plans to promote the CE development, the nature of Chinese planning is unique. Not only do CE specific plans feature a high degree of detail in terms of target numbers and figures, moreover Chinese development

plans tend to prescribe entire industrial sector developments[18]. By implication, the Chinese approach predefines the trajectory and dimension for institutional solution finding based on the state's preference for top-down enforced economic governance and actor coordination. Indeed, this governance strategy of a 'developmental state'[19] has worked well for the purpose of catching-up with economic front runners during the 20th century. In regards to the CE, the PRC is now at the forefront of the global CE movement and has already established a solid institutional foundation to engage respective challenges. At this point of development the crucial question is whether innovation in solution finding can truly be achieved via restricting the institutional development trajectory and the process of institutional solution finding to the formal domain. According to the theory of the model and the findings in Chinese WM practices (chapter 4 and 8) the Chinese state's strategy may to some extent end in a deadlock as it excludes and neglects bottom-up devised solutions. From an evolutionary perspective this implies a reduction in solution output variations, which in turn diminishes the learning feedback and expansion of the inheritance stock. This in further consequence limits the capacity to come up with and devise novel solutions for future challenges.

The above paragraphs depict how the Chinese government has merged the CE into its social-economic development strategy as a response to China's specific challenges. However, the evolutionary development of the CE has also been influenced by system-exogenous elements. Therefore, China's implementation of the CE also constitutes an extension of the inheritance stock, which has been nurtured with experiences on institutional solutions created in other countries. In fact, CE practices in Europe and Japan had a strong inspirational influence on the Chinese government, especially in the field of recycling (McDowall et al., 2017, 2; Ma et al., 2014, 506; Mathews and Tan, 2011, 436). This system-exogenous imitation of the CE solution is especially oriented towards the German and Japanese examples, which resulted in the direct transfer of the 3R value concept and the cleaner production principle (Preston, 2012, 4). In regards to the CE law, which again emulates the precursors of Japan and Germany, the Chinese government has however produced novel variations in institutional solutions so as to

[18] A useful example for elucidating this point can be obtained by comparing the Japanese Fundamental Plan for Establishing a Sound Material-Cycle Society (MOEJ, 2013) and the Chinese Circular Economy Development Strategy and Action Plan (SC, 2013). Despite the fact that the Japanese vision clearly includes guiding indicators and suggestions for sector specific development (MOEJ, 2013, 20-23), it nevertheless exercises caution in terms of stipulating sector-related development trajectories and targets. The Chinese version on the other hand employs a strong normative tone when it comes to raising CE related sector specific efficiency targets.

[19] The term 'developmental state' has been coined by Chalmers Johnson, who in his seminal on the Japanese development miracle showed how statist economic coordination had facilitated the country's industrial catching-up process (Johnson, 1992, MITI and the Japanese Miracle – the Growth of Industrial Policy, 1925-1975, Standford University Press, Stanford).

serve the country specific needs: Not only do CE industrial parks or provincial and regional networks play a much more dominant role in the Chinese concept (Matthews et al., 2011), moreover national planning and centralised coordination have arguably received more emphasis in the PRC (Geng et al., 2013, 1526). On the other hand however, the Chinese solution has so far neglected the comparatively integrative social dimension, which has been highlighted in Japan. In contrast to the Japanese approach of cooperation between the state, corporate sector and society the political leadership of the PRC has concentrated the monopoly for the process of CE solution finding within the formal domain. Here again the argument highlights the problem of reducing the variation in institutional solutions. Through the lens of the model on institutional evolution the approach of the Chinese state implies a curtailment of officially acceptable solutions to a particular set of pre-designated actor groups. While this formal stipulation does leave room for solution practices at the corporate level, it appears to exclude solutions that emerge from non-state, non-corporate civil actor groups.

As the above paragraphs have shown, the Chinese government has invested considerable efforts to integrate the CE into the political-economic strategy of the PRC so as to devise a solution for the ever increasing problem of domestic resource scarcity (Ghisellini et al., 2016, 25). While this characteristic features similarities to the considerations behind the German and Japanese CE concept, China's strategy appears to be more in line with the ideas promulgated by the EU: The institutional CE framework in China does not predominately focus on WM aspects, but strives to broaden CE applications to industrial production and restructuring. The overarching objective has thus been the creation of a synergetic solution that not only tackles WM challenges, but also extends to resource procurement as well as a reduction in emissions, pollution and energy use (ibidem, 15; Li et al, 2010, 4275). Therefore the Chinese definition of the CE and its purpose deviates from what has been set forth in other countries: Firstly, the Chinese CE is in first instance an economic concept aiming to generate a win-win situation, in which the economy has to adapt to the limitations of its environmental context. Secondly, WM plays a significant part in the Chinese CE, but simultaneously other aspects of resource management such as water, land, energy and mineral resources are equally included. Thirdly, China has set up a hierarchy for the implementation of CE practices, which begin at the single enterprise level, extend to industrial cluster structures (industrial parks) and even cover entire regions (cities and provinces). Forth, the Chinese CE encompasses the entire chain from production over transaction to consumption. So while recovering and recycling are significant at the end of a cycle, China's institutional framework also thematically addresses the preceding stages of consumption and production (Zhu, 2008, 2f; SEPA, 2005b).

### 5.6.2 Analysis of institutional synergies: the CE at the core of China's environmental governance ideology

It has been outlined in the theory chapter, every institutional structure is at its very basis composed of single value components. These value components are aligned in a way so as to generate a particular synergy within and thus enable the operation of the institution itself. The 3Rs as the core, but not exclusive, value concepts of the CE institution can be adduced to exemplify this relationship: While reduce, reuse and recycle each represent particular isolated ideals, they can be aligned with each other e.g. by applying a hierarchical principle of preferred operations. So for example according to the waste hierarchy reducing is the preferred option over reusing and so forth. A similar alignment can be imagined for the case of a larger systemic entity that incorporates various, gradually devised and implemented institutional structures. Here again particular institutions are aligned with each other, which partly happens in a conscious and planned, partly in an unconscious and uncontrolled manner. In the context of the CE's institutionalisation in the PRC, the observable process is of the first kind namely that the CE became incorporated into the larger institutional body of the country. Given the significant role that ideology has played for governing the country since the establishment of the PRC, the question is how the government has incorporated the CE into its system of ideological tenets.

What needs to be stated in advance is that the introduction of the CE to China arrived at the highly favourable point in time: Soon after the Chinese government has embarked on the China Agenda 21 and began to promote a sustainable development path in 1992, the CE was relatively quickly (in 1996) identified as appropriate vehicle for achieving these goals (see section 5.6.1). Here again it has to be noted that the transplantation happened within a large institutional void regarding a solution to the challenge of realising sustainability in China. Arguably, the CE entered the institutional framework at a period during which few conceptual concessions had to be made except for fitting into the China's sustainability strategy. By adopting a chronological perspective, it can be discerned that over the first decade of the 21st century three major ideological tenets emerged that indeed helped to consolidate CE ideals within the larger ideological system of the PRC.

The first of these is the vision of a Harmonious Society (hexie shehui 和谐社会), which as part of the Scientific Development Outlook (kexue fazhan guan 科学发展观) was devised to create a new basis of legitimacy for the CCP's rule. Integrated into official policy statues in

2007, it especially highlights the central role social and environmental policy play for the mitigation of conflicts within society and between society and the environment (Heilmann, 2016, 33f). As commentators have pointed out it only requires a small conceptual effort to associate the Harmonious Society with a 'resource-saving and environment friendly society' (McDowall et al., 2017, 3) and a society that supports waste recycling and respectively adapts consumption in a sustainable manner (Winans and Deng, 2017, 826). Thus ensuring harmony between society and the environment builds a solid ideological foundation upon which the CE can be implemented (Ghisellini et al., 2016, 25).

The extension of this concept is the idea of an Ecological Civilisation (Shengtai wenming 生态文明), which goes into more detail regarding the Chinese pattern of industrialisation and economic rise. As this process has taken a high toll on the environment and its natural resources, the Ecological Civilisation concept has been designated as novel development model to counter the negative impacts of economy on nature. At its core lies the challenge of constructing a resource-saving and environment-friendly society that accepts the natural law as guiding rule, while it strives to achieve the three pillars of sustainability (Zhu and Gao, 2014, 873f). In terms of institutional solutions, this concept clearly appears to be the conceptual extension to the Harmonious Society: More emphasis is put on identifying environmental challenges as a man-made problem, which can only be mitigated by reconciling continued economic growth with nature's premises. In a slight variation to the CE, the Ecological Civilisation explicitly states that not stimulating economic activity, but rather its alignment with social and environmental concerns have to be key tasks of economic governance. Therefore, the Ecological Civilisation concept aims to achieve a 'triple-win' target (Sansheng gongying 三生共赢), in which production, social wellbeing and ecology prosper simultaneously. By implication, environmental protection, urban and rural living standards and industrial performance have to be synchronised (Huang et al., 2017, 63). Since 2007 this concept has been promoted by the CCP as its long-term vision for sustainable development in China (McDowall et al., 2017, 3) and at its heart again lies the CE (ibidem, 3; Geng et al., 2016, 76).

The most recent ideological tenet is the idea of a Green Transformation (Lüsehua 绿色化), which emerged as an extension of two preceding approaches: This new political doctrine on industrial production, which establishes a relationship between industrial technology, resource consumption and environmental deterioration, appears to be tacitly related to the earlier the

Scientific Development Outlook and the Green GDP (Lüse GDP 绿色GDP). Especially the latter tenet, which promotes coordination and sustainability in economic development (Weigelin-Schwiedrzik and Ritirc, 2011, 6) appears to feature strong similarities to the Green Transformation concept. This more encompassing political program has received its formal introduction at the 18th National Congress of the CCP in 2012: At this occasion the Green Transformation has been presented as co-strategy to the Ecological Civilisation Vision so as to buttress the resource conserving and environment protective governance strategy of the state (SC, 2016, art.1, sect.1). This new vision of transforming the economy has been further promoted at the CCP's Political Bureau conference in 2015, where the concept has been integrated into the New Four Modernisations (Xinsihua 新四化), namely the New Industrialisation, Urbanisation, Informatisation and Agricultural Modernisation (Xinxing gongyehua, Chengzhenhua, Xinxihua, Nongye xiandaihua 新型工业化、城镇化、信息化、农业现代化). This extension has also been manifested in the very recent 13th FYP, which demands a departure from the exclusive focus on GDP growth towards a more balanced approach so as to alleviate the burdens for the environment (Chinadialogue.com, 2011). Recent state documents as well as commentaries indicate that the Green Transformation is on the path of becoming another central pillar of the PRC's governance strategy (SC, 2016, art.3, sect. 3): Firstly, its targets such as fighting against pollution and ecological restoration become increasingly embedded in the ideological-political principles of the CCP (ibidem, art.2, sect.1 and 2). Secondly, the ecological aspects of the Green Transformation vision are increasingly merged with non-environmental, but socio-economic concepts such as the Moderately Prosperous Society (Xiaokang shehui 小康社会) ideal (Chinadialogue.com 2011).

These political ideologies however represent a cluster of values and ideals, which can only be put into effective practice if they are attached to an operative vehicle for policy implementation. The Circular Economy concept does indeed represent a tool to incorporate values of the larger ideological superstructure: The Chinese CE departs from the WM-oriented CE concepts in the West and pro-actively includes industrial structures and socio-economic clusters. Moreover the 3R values pursue the same ideals such as resource conservation and economic-ecologic synchronisation, which have been stipulated in the political-ideological tenets discussed in the above paragraphs. So can the Chinese CE concept in fact serve as a practical tool for implementation? Commentators contend that it can: Not only does the Chinese CE represent the main part of China's strongly venerated national

scientific development strategy (Geng and Doberstein, 2008, 233). Moreover the CE itself has been elevated to the realm of economic policy (Mathews and Tan, 2011, 437), which vastly increases the concept's impact on day-to-day governance. These steps that helped to consolidate the CE in the policy realm lead some analysts to speculate that the Chinese government embraces the CE as viable economic reform model (Winans and Deng, 2017, 827).

What can be discerned from the above discussion on China's ideological re-adaptation is that the CE has either triggered or coalesced with other strategic concepts that induced a shift in governance ideology: These changes indicate a conceptual departure from the traditional economic growth-oriented strategies, towards a more balanced pattern of sustainable development. While this pattern can be easily identified as an institutional solution finding process in the sense of the model, interpreting it as evolutionary is not that simple: Evidently, the above developments of ideological change clearly indicate a *consciously* selected transformational process in response to certain challenges. However, the herein discussed process of solution finding is confined to the formal institutional domain and its actor groups. The institutional evolution of socio-economic systems on the other hand also include activities within the informal institutional domain, within which bottom-up devised rule systems of non-state corporate and civil actor groups emerge. Only by incorporating this complementary element into the larger 'equation' of institutional change, it will be possible to capture a, in the sense of the EIE, truly evolutionary process: At the stage of selection, institutional evolution includes the sometimes competitive, sometimes complementary institutional dynamics that take place between the formal and informal domain. Selective operations in turn lead to the emergence of solution variations, which in further consequence generate learning feedbacks that replenish and enhance the institutional inheritance stock. So while conscious choices within one domain or the other may be adequately termed as (consciously induced) transformation, these domain confined operations merely constitute a subordinated process of institutional evolution. The bigger picture on the evolution of the CE in China will thus only unfold once the developments of implementation are added to the analysis (see chapters 7 and 8).

### 5.6.3 Application of the CE as institutional solution: Top-down enforcement and administrative guidance

The process of institutionalisation in the PRC and the supplementary efforts for ideological consolidation provide a valuable insight on how the government intends to implement the CE

in the socio-economic context. Since 2008-2011 the CE has reached the rank of a law and was extended to become an industrial policy (Mathews and Tan, 2011, 437). This in turn made the CE subject to the common Chinese approach of top-down enforcement by means of command and control, while little room has been left for marked based coordination (Ghisellini et al., 2016, 18). This adherence to statist intervention and guidance can be traced back to the influential government think-tank 'China Council for International Cooperation on Environment and Development', which has close ties to the current premier Li Keqiang (Chinaembassy.se, 2011). In a 2005 report on the CE, the organisation suggested that any implementation should be conducted on the basis of successful legal institutionalisation so as to initiate state governed pilot experiments and induce the spearheading of the state for ecological-economic innovation. Respectively achieved progress needs to be based on monitoring and evaluation via CE specific indicator systems (CCICED, 2005, 5ff). Based on this statist orientation regarding the implementation of the CE, formal institutional efforts for the realisation of the concept focus on three different domains: The corporate, the industrial park and industrial cluster, and the municipal and provincial levels.

State efforts at the first level target enterprises and centre on the promulgation of initiatives such as eco-design, waste minimisation, cleaner production (CP) and environmental management systems. Given that there is little option for synergies in single producing entities, this first instance initiates the preparation for larger CE systems by means of realising CP, reduction-oriented and sustainable production processes (Naustdalslid, 2014, 307; Geng and Doberstein 2008, 233). In terms of CE coverage the government has targeted a set of key industries, primarily based on their energy and water use intensity (NPC, 2008, art.16). As of now, CP standards have been applied in 30 industries, such as oil refining, chemicals, construction materials, petrochemicals, pharmaceuticals, machine manufacturing, mining, textiles and electronic industry (Winans and Deng, 2017, 827; Geng and Doberstein, 2008, 233). Regarding matters of implementation, the aspect of compulsiveness is critical. So far, compulsory measures are mainly requested for the dimension of CP, which constitutes only one component of the CE. In essence the government has stipulated compulsory standards for enterprises that (1) exhibit high energy intensity in production, (2) discharge pollutant quantities above officially designated threshold levels or (3) use toxic or harmful substances listed in official catalogues (Dan et al., 2013, 8; Su et al., 2013, 217). The lack of obligatory standards for the CE might in turn explain the poor response of enterprises in China. In 2008, studies found only a low applicability of eco-design and design for recycling among Chinese producers of electronic devices (Ghisellini et al., 2016, 19). More recent studies on the other

hand indicate that CE awareness has risen significantly among Chinese producers, however actual practices still lack behind: Interviews among 157 manufacturing enterprises sampled in the Changjiang river delta, the larger Tianjin and Chongqing area indicated that only 22% supported the idea of recycling and reuse, and yet around 90% do not cooperate with other enterprises so as to benefit from material cycling and exchange (Liu and Bai, 2014, 148). So despite the formal institutional efforts of the state, corporate solution finding in the sense of the CE still appears to have only marginally incorporated these guiding ideas.

The second form of CE cycles is designed for applications at the inter-firm level. In order to realise a profitable level in terms of economies of scale and scope the Chinese government has since the 1990s promoted the establishment of Eco-Industrial Parks (EIPs). As of now the PRC is host to over 80 national EIPs (Winans and Deng, 2017, 827). These structures were either entirely planned from scratch or were the result of Industrial Park transformations according to CE principles. Apart from emulating industrial symbiosis models that originated in the West, the Chinese government has since the mid-2000s emphasised the establishment of closed loops for waste recycling within the EIPs. Setting up these industrial structures can be interpreted as a process of institutional solution finding so as to tackle challenges of industrial, CE-oriented modernisation: Profitable product and new technology development, production equipment innovation and improvement of industrial management (Winans and Deng, 2017, 826). Another beneficial aspect of EIPs is the expected reduction in interaction costs and thereof derived benefits that accrue from a shared or extended use of resources according to the principle of industrial symbiosis. A notable feature that distinguishes Chinese EIPs to park estates outside of China is the attempt to integrate production, research and residential areas within one large spatially delineated environment (Naustdalslid, 2014, 307; Geng and Doberstein, 2008, 233f). Despite obvious positive synergetic effects such arrangements nevertheless bear certain risks for local residents. A tragic case exemplifying these dangers happened in 2014 within the Tianjian Bohai Development Zone that broadly resembles the structural features of an EIP. In August that year an explosion of improperly and excessively stored chemicals had claimed the life of 173 residents and left another 800 injured – all were located in direct proximity to the area (SCMP, 2016).

The highest hierarchy of Chinese CE applications encompasses entire municipalities and provinces. The defining operative aims in so-called eco-cities and eco-provinces are the minimisation of resource demand and waste generation so as to provide healthy living conditions for citizens. Thereof derived principles foremost concern resource recycling and

conservation, the reduction of industrial pollution, access to transportation and affordable housing conditions (Yu et al., 2015b, 265). Apart from decoupling economic growth and $CO_2$ emissions, the conceptional aim is to link micro and macro cycles so as to comprehensively adapt and coordinate production with consumption activities. According to the conception of the Chinese government different cyclic systems help to foster reduce, reuse and recycling patterns among all involved actors and thereby theoretically link households directly with enterprises. By implication, state guidance and organisation play a core role in this interplay between materials and actors (Naustdalslid, 2014, 307; Geng and Doberstein 2008, 233). In regards to numbers and respective coordinating entities, the PRC exhibits quite a diverse picture: While the MEP has recognised 103 pilot eco-cities, eco-districts and eco-counties, the National Development and Reform Commission (NDRC) has ratified six eco-provinces and 36 eco-cities. The third important actor in this regard, the Ministry of Housing and Urban-Rural Development (MOHURD), lists another two eco-provinces and 17 eco-cities (de Jong et al., 2016, 32). This display of dispersed power and authority structures within the centre indicates possible interest group conflicts within the formal realm: Given that ministerial bodies (actors) differ in terms of their agency ideals and portfolio, it can be taken for granted that ministries devise and test institutional solutions that may differ vastly and even conflict in their primary, value relevant aims[20]. However what the above example of three involved ministries seems to imply is that even within the formal institutional domains a certain variation in resulting institutions is allowed and fostered. This in turn expands the knowledge inheritance stock of the formal domain and offers new informational input for the subsequent cycle of solution finding.

The implementation of such formal solutions is also subject to evaluation regarding the effectiveness of outcomes. For this purpose, the Chinese government has devised two sets of indicators, one to gauge developments at the industrial park level (12 indicator groups) and one for the municipal and provincial levels (22 indicator groups) (Naustdalslid, 2014, 309). Based on the concept of Material Flow Analysis (MFA), four categories of measurement have been designed: (1) Resource productivity (generated GDP per consumed resource unit), (2) resource consumption (quantity of consumed resources per output of product unit or generated GDP unit), (3) resource use quantities and (4) waste emission quantities (Baum, 2011, 22). As one commentator has correctly pointed out this approach of evaluating CE performance implies a rather mechanical view on socio-economic governance: Based on

[20] The analysis of competing interest groups within the formal institutional domain will be discussed in more depth in chapter 8.

retrieving data centred knowledge of CE performance, state actors appear to be convinced to have captured the full picture. In turn, they respond by issuing particular policy measures and thus can 'engineer' the entirety of CE operations (Naustdalslid, 2014, 309). However this official perception ignores that data and numbers only reflect an abstract picture of the outcome of a complex combination of societal, economic and mechanical operations. Given that these variables interact on the basis of an interwoven network of rules, any effective recalibration of these operations would also have to take the underlying institutional framework into consideration. This mechanistic approach to engineer the CE is not only applied to physical structures such as the EIPs or the eco-cities and –provinces, it also extends to the evaluation of state actors. Based on stipulations in the 2008 CEPL, the CE development should also be promoted via applying the highly binding Target Responsibility System (TRS, Mubiao zeren zhi 目标责任制) to evaluate local officials' performance.

Overall however the systems of indicators for all three levels of CE implementation, except for the TRS, feature a relatively weak binding nature: CE indicators are voluntary in the sense that only entities that apply for CE status need to monitor and report them (McDowall et al., 2017, 7; Geng et al., 2012, 222f). This intrinsic characteristic in fact constitutes a significant weakness for developing the CE in China, given that its implementation and realisation is founded upon a top-down enforced control and command strategy. Rather what would be expected is an evaluation system that incorporates strict targets for enterprises and EIPs so as to achieve particular CE objectives with these socio-economic entities. Earlier commentators have identified several other points of critique regarding China' CE indicator systems. The prominent CE researcher, Geng Yong, has indicated that current indicators do not optimally assess the CE's closed-loop and feedback features as well as the interactions between the natural environment and the socio-economic system. The reason is that currently applied indicators were originally not designed for this task. Secondly, Geng criticises that indicators only assess the value of eco-systems in monetary terms, which neglects the broader ecological impact of resource use. This in turn induces officials to pay less attention to the protection of local eco-systems. Furthermore current CE policies emphasise the optimisation of individual resource use and flows, but make no effort to track the diverse, nonlinear interactions between human society and the natural system. In essence his critique addresses the limitation of policies and indicators being centred on the socio-economic realm, while they neglect its interactions with the larger ecological system (Geng et al., 2013, 1526). Additional points of critique address the lack of comprehensiveness, when it comes to the evaluation on the attainment of the CE's key values. Apart from absent social indicators, the aspects of reduce

and prevent (emissions, energy and material) are missing. Moreover, so far no detailed stipulation of standards and descriptions on how to collect data as well as how to benchmark these against reference values has been set forth (McDowall et al., 2017, 7). A recent notice by the NDRC, Ministry of Finance (MOF), the Ministry of Environmental Protection (MEP) and the National Bureau of Statistics (NBS) has issued an updated CE indicator system and attached notes for the clarification of calculation methods. Yet, critiques on lacking indicator comprehensiveness and data collection standardisation remain unaddressed (NDRC,2016).

This particular state of affairs raises the question of why state actors show little effort to implement institutional remedies for apparent shortcomings. In this regard, the evolutionary institutional perspective of the model presents two possible explanations: Firstly, the problem that lies at the core of these deficiencies is an improperly functioning information feedback mechanism. Hereby, the implementation of institutional solutions only provides a very limited feedback response that primarily consists of data sets and numbers set forth by the official indicator system. This system, which in itself represents an institutional solution, only helps to convey a very limited picture of the actual operation of CE structures. Geng et al. (2013) have pointed out that various aspects such as the impact of socio-economic CE practices on the larger eco-system are not covered by the current indicator set. Therefore the conveyed feedback only treats a very small part of actual dynamics. The second explanation, which appears to be more intriguing, relates to an incorrect framing of the CE evolution in China: Commentators primarily tend to present the problems of the CE's status quo, which in itself is not a flaw, but constitutes an unconscious choice to depict a dynamic process as a static reality.

In contrast to that, the analytical model in this thesis would depict the current constellation as one single stage within a larger evolutionary process. This perspective does in turn help to explain the particular strategy of the Chinese central government: Despite its proclivity for a command and control approach, the central government appears to have so far chosen a mostly voluntary, laissez-faire approach to CE implementation at the company and industrial estate level. This particularity is however only one part of a larger process: In China policy implementation and the creation of laws initially depends on experimentation and pilot projects, which especially in the CE context often include industrial parks and single companies. Under such experimental conditions, solutions are devised and practiced in a relatively less rigid regulatory context und in turn generate a novel, maybe even uncommon learning based feedback. Heilmann has analysed the pilot experimentation process in China

and herein highlights the interdependent role between central and local governments in institutional solution finding: According to him, the main idea is to use experiments to produce local institutional outcomes, which over sequences of up-scaling and generalisation ideally produce nationally applicable institutional solutions. In this process the central government is assigned with the pivotal role of the process-coordinating entity, which evaluates, selects and spreads the experiences and lessons derived from experiences at the local (pilot) level (Heilmann, 2008a, 5ff). These conceptual elements were integrated into the methodological model of this thesis for application to the CE: Experimentation and interim institutional outcomes are hereby considered as pivotal for the solution finding process at the national level. So, despite the many issued regulations and a clear vision within the formal framework on the development of the Chinese CE, the current level of implementation still is at its very beginnings. For example, formal experimentation is frequently practiced in particular CE fields such as WM, where novel challenges continuously emerge (Steuer, 2016a; Steuer et al., 2017a; Schulz and Steuer, 2017). This can to some extent be explained by the fact that modern structures for and practices of secondary resource recycling only emerged in the early 2000s. The same is true for the case of the sustainable industrial park systems[21]. Furthermore, the necessity for state experimentation is also reflected in some recent overarching strategy guidelines issued by the central government, which emphasise the usefulness of trials and pilots in all domains of the CE. The very recent CE Lead Action (Yinling xingdong 引领行动) issued by the NDRC is just one example for this official stance (NDRC et al., 2017).

In the strict sense of the model, this approach of devising provisional and interim solutions in an experimental context can be interpreted as particular efforts of the formal domain to generate a high frequency of learning feedback cycles. Herein, the overarching objective is to arrive at an effectively operating, concluding solution to a multi-layered challenge, i.e. how to overcome resource constraints and pollution in differently sized socio-economic entities (enterprises, EIPs and cities or provinces). Arguably the central government has issued a plethora of regulations and respective revisions over the last years (Li, 2016). This approach may be interpreted as striving towards perfect solutions by gradually amending a few selected institutions. Thus after every cycle of selection, implementation and feedback of a multitude of pilots – so as to guarantee variation – a new cycle begins in which the preceding solution has been correspondingly amended or revised. Once a relatively effective solution has been

[21] Both topics will be dealt with in more detail in the relevant chapters regarding the application of the CE.

devised, one can expect that more binding and obligatory indicators and standards will follow[22].

### 5.6.4 General achievements of CE in China

When it comes to assessing the PRC's CE related progress there is uniform agreement that much has been achieved. The difficulty rather lies in assessing the exact dimension of CE advancement. The herein implied complication not only relates to the above mentioned critique that Chinese CE relevant indicators only capture a limited fraction of reality. Moreover there has been a lot of critique regarding the reliability of Chinese statistics in the economic and therefore also the CE related realm. Intentional falsifications at the local level and difficulties to correct these by central government agencies have increasingly been discussed by commentators and observers (Rawski, 2001; Heep et al., 2016, 188; SCMP, 2017c; SCMP, 2017d). This in fact raises the delicate question as to what extent such data can be taken as a solid basis for analysis. However the following paragraphs foremost aim to assess the broader CE development trend, which cannot but refer to officially provided data sets and thereupon dependent secondary literature.

The major CE relevant achievement has been the improvement in the field of resource productivity. A higher level of resource productivity indicates that a larger output in GDP can be generated by using the same or a lesser amount of resources compared to the referenced base year. Based on the analysis of official statistics scholars found that resource efficiency[23] has gradually increased during 1978-2010 (Yu et al., 2013 cited in: Ghisellini et al., 2016, 24). This improvement has been especially striking in the period of 2005-2010 for mineral resources, water and energy. For the example of coal, which to date constitutes the most significant energy carrier in China, has thus generated a per ton value of 12,400 RMB in 2010, compared to 10,000 RMB in 2005 (Li, 2016, 25). This trend has continued as reflected in resource intensity (quantity of resources used per unit GDP) and waste intensity (waste generated per unit GDP), which declined by 34.7% and 46.5% between 2005 and 2013 (Mathews and Tan, 2011, 441). However, recycling and reuse activities within registered companies advanced more slowly by around 8.2% per year for the same period (ibidem, 411). For key recyclables such as iron and steel, plastics and paper formally recycled volumes range around 58%, 33% and 11% respectively between 2011-2015 (Li, 2016, 29), which on average

[22] This process is relatively easy to track for the field of WM regulations, which will be discussed in chapter 8.
[23] The herein used term of 'resource efficiency' indicates the increase in economic value simultaneously to the decrease in resource intensity. Resource efficient production thus designates a process with low resource intensity and high resource productivity.

yet only ranks around 20% below the international standard (Dong et al., 2017, 1165). Despite the nationally declining resource intensity, China's overall resource consumption however rose fivefold during the last two decades because China's economic boom (Mathews and Tan, 2011, 441). Similar trends have been exhibited in pollutant emissions, i.e. $CO_2$, $SO_2$ and waste water, which have gradually improved in relative terms as GDP growth surpassed emission increases (Ghisellini et al., 2016, 24). Between 2005 and 2013 the comprehensive rate of pollution treatment and reduction increased by 74.6% (Mathews and Tan, 2011, 441). Emission generation furthermore experienced some decoupling effects namely for chemical oxygen demand (COD, a measure to evaluate the quantity of toxins emitted into water) in absolute terms and for waste water, $CO_2$ and $SO_2$ in relative terms (Ghisellini et al., 2016, 24). Furthermore, water intensity for economic production has decreased at a rate of over 70% during the last decade. The aspect of energy efficiency is more difficult to evaluate: While there have been positive externalities due to technology improvements, structural changes driven by heavy industrial output have negatively affected energy efficiency (ibidem, 2016, 24). Here again however the overall developments indicate a positive trend since energy intensity has decreased: For the generation of 10,000 RMB in GDP 1.22 tons of coal were necessary in 2011, while only 0.76 tons were required in 2015 to achieve the same value (Li, 2016, 25). An analysis of the performance in terms of increasing resource efficiency since 2005 (Table 8) indicates that the Chinese government has been very ambitious in the realisation of its sustainability strategies. However, as the table below shows the relative improvements are growing at a marginally declining rate over time, which is explained by the increasing difficulty to achieve higher resource efficiencies at a more advanced stage. This in turn demands that official state actors unlock the potential of so far little employed approaches such as material reduction measured for waste minimisation (Li, 2016, 35) and material reuse practices. So far, the latter has been primarily conducted by the informal WM sector (Steuer, 2016b; Schulz and Steuer, 2017) and has only been addressed by the central government in its CE Development and Action Plan in 2017 (SC, 2013).

**Table 8. Development and projection of individually selected CE key indicators in China (the author, adapted from NDRC et al., 2016 and SC, 2013)**

| Indicator type | Unit of measurement | Achievement(**) | | | | Change in % over 5 year intervals | | |
|---|---|---|---|---|---|---|---|---|
| | | 2005 | 2010 | 2015 (***) | 2020 (projected) | 2005-10 | 2010-15 | 2015-20 (projected) |
| Energy productivity | 10,000 RMB/ TCE* | 1 | 1.24 | 1.47 (1.4) | 1.65 | 24.0% | 18.5% | 15.0% |
| Water productivity | 1 RMB/ $m^3$ | 41.9 | 66.7 | 95.2 (97.6) | 126.8 | 59.0% | 43.0% | 29.9% |
| Mineral resource recycling rate | % | 30 | 35 | 40 | - | 5.0% | 5.0% | - |
| Industrial solid waste comprehensive utilisation ratio | % | 55.8 | 69 | 72 (65) | 73 | 13.2% | 3.0% | 8.0% |
| Main recyclable resources recycling rate | % | - | 65 | 70 (78) | 82 | | 5.0% | 4.0% |

*TCE = tonne of coal equivalent
** % factors indicate relative achievement rates based on estimated generation
*** Red numbers in brackets indicate actual achievements in contrast to projected targets (black).

## 5.7 Comparison of 3R value emphasis in different CE systems

The country-specific and supra-national examples of CE systems discussed in the preceding sections have indicated the broad variation in terms of application and results for this type of institutional solution. Nevertheless there are also institutional similarities that enable a cross country comparison between these cases of CE systems. In the following paragraphs I will adopt an approach that centres on a comparative emphasis of the CE core values, the so called 3Rs. From a methodological standpoint this step is based on the idea that values constitute the most fundamental components of every institution. This in turn enables a certain degree of comparability between the key CE institutions in different systems, i.e. countries. For this purpose two distinct steps of analysis will be conducted. In first instance, I will juxtapose the key legislative pieces of the CE of the EU, Germany, Japan and China. For the three countries the most recent CE laws are taken as object of comparison. As for the case of the EU, I have chosen the EC Action Plan on the Circular Economy, which represents the most recent and most comprehensive institution on the subject matter.

The second instance of analysis addresses the evolutionary shifts of the 3R emphasis within formal institutional structures in each of the three country cases. Given the diversity in terms of ideology and political economic practice, the institutional objects of analysis have been chosen according to their CE relevant significance in each country. In regards to Germany,

the identification of CE relevant key institutions is relatively simple as the country has implemented its CE law in 1996 and forwarded a substantially amended version of the law in 2012. This in turn enables a 3R value related comparison between the two versions. Japan offers similar advantages as its government has issued three consecutive plans on the CE, the so-called Fundamental Plans for Establishing a Sound Material-Cycle Society, which were published in 2003, 2008 and 2013 respectively. As for China the choice is slightly more difficult, but the herein adopted approach is similar to the Japanese case. Given both countries' top-down oriented political ideology the analysis does in both cases focus on strategy and development plans for the CE. However in contrast to Japan, where the fundamental plans were issued by one and the same central government body, the MOEJ, the PRC's plans are published by different central agencies: In 2013 the SC put forth the CE Development Strategy and Short Term Action Plan (Xunhuan jingji fazhan zhanlüe ji jinqi xingdong jihua 循环经济发展战略及近期行动计划). The chronologically following plan was however issued by the NDRC and other central government agencies in 2017, i.e. the Circular Development Lead Action (Xunhuan fazhan yinling xingdong 循环发展引领行动). Both institutional measures fulfil similar criteria in as far as they represent indicative and guideline providing concepts for CE relevant implementation practices at lower administrative levels. However if considered from the perspective of actor specific interest groups both actors may hold different value preferences for institutional solutions: The SC represents the highest executive organ of the National People's Congress (NPC) and thus covers the interests of all central ministries (Heilmann and Rudolf, 2016, 41). The NDRC as entity formally subordinated to the SC on the other hand has a more economic- and financial planning centred interest focus such as macro-economic stability, economic coordination and investment programs (ibidem, 60). The argument in support of a comparison between both entities however is that both share an interest in long term economic planning and strategic development of the economy (ibidem, 41 and 60). Despite the possibility of interest conflicts between both bodies it appears to be feasible to assert a congruence in interests when it comes to the promotion of a long-term CE development strategy for China. Therefore the plans of both bodies have been compared in terms of their respective value emphasis.

Regarding the document text analysis the following method has been adopted. Firstly, in regards to language the comparison has been conducted on the basis of the official English

translations of the laws and plans. An exception was made for the analysis of Chinese legal documents, for which the analysis was conducted on the basis of the Chinese originals. This in turn required a careful assessment in terms of language specific use of the 3Rs: While reduce, reuse and recycling are relatively well differentiated in the EU, German and Japanese contexts, the terminology in Chinese is somewhat fuzzy and in parts overlapping. For the notion 'reduce' the Chinese legal texts employ 'reduce' (jianshao 减少) and 'reduce in quantity' (jianliang 减量). Reuse is a more complicated aspect, as it not only covers 'reuse' (zailiyong 再利用), 'refurbish' (fanxin 翻新) and 'remanufacture' (zaizhizao 再制造), which also appear in the context of the other country cases[24]. Moreover Chinese official documents also devised the notions 'circular use' (xunhuan liyong 循环利用) and 'comprehensive use' (zonghe liyong 综合利用). Whereas the former implies refurbishment and remanufacture, the latter notion implies the comprehensive practice of reuse and recycling. For this reason I have divided the counted quantity of the term into two equal shares and assigned one half to reuse and one half to recycling. In a similar fashion the notion of recycling is reflected in five different expressions, namely 'modify into resource' (ziyuanhua 资源化), 'reprocess and use' (zaisheng liyong 再生利用), 'comprehensive use' (zonghe liyong 综合利用), 'circular use' (xunhuan liyong 循环利用) and 'recover' (huishou 回收). The last term 'recover' alone however only indicates the most initial step of any CE relevant reuse or recycling operation. Therefore 'recover' has only been considered as recycling process, if listed in combination with terms that indicate material transformative processes such as 'treatment' (chuli 处理), 'dimantling' (chaijie 拆解) or 'recycling' (huishou liyong 回收利用)[25]. Another frequently encountered term 'treatment' (chuli 处理) has been excluded from recycling if not combined with recovery (huishou 回收). The rationale behind this step is that treatment per se not only induces recycling operations, but also thermal treatment of waste for energy recovery.

[24] For the particular aspects of terminology see section 5.4.3.

[25] Reycling as huishou liyong is a particular case that implies a material deformative process, despite containing the term 'use' (liyong). According to narrative evidence gathered by the author during visits at several formal recycling yards, huishou liyong constitutes the predominant material transformative process in WEEE dismantling.

After the identification and counting of all 3R notions in the document, the second step for the 3R value emphasis analysis was conducted. The primary aim was to extrapolate the relative proportion of emphasis for the three value ideals in each document. Therefore all notions with reference to the 3Rs have been counted and summed up so as to obtain the total count (∑=100%). In a second step the counted number of each 3R term has been divided by the total sum of all three 3R terms so as to achieve a percentage proportion for each of the 3Rs in every single document. What is thereof derived is the proportional distribution of the 3R emphasis in each document. Based on this extrapolation of relative proportions in each text it was possible to ascertain the shifts in emphasis of the 3Rs within different CE systems (countries). At the country specific level this approach, when applied to subsequently issued key regulations, provides the means to track the shift in emphasis of the 3Rs over time. Here again it needs to be pointed out that not the absolute number of hits in each document is significant. Rather the proportional amount of 3R references is decisive for the analysis of value emphasis.

A comparison of the 3R key values at the international level clearly indicates that recycling is by far the most pronounced value in key legislative pieces (Figure 4). For the case of Germany this is little surprising given that the country's CE has been clearly interpreted as being primarily oriented towards resource recycling. The results for Japan are quite interesting as it seems to put even more emphasis on recycling than Germany. This particularity has however been indicated by secondary research based on the fact that initial CE efforts were mainly directed towards recycling. China exhibits a relatively strong emphasis for reduce, which indicates the concern for resource conservation in order to create a solution for its environmental challenge. The EC's action plan as the sole supra-national institutionalised solution features a relatively balanced emphasis for all three values, and yet recycling still marks the dominant approach.

However, two aspects slightly diminish the validity of this comparison of CE value emphases. Firstly, each CE system is the result of differently evolved, national institutional scaffoldings. Thus the cultural, historical and socio-economic contexts vary significantly, which in turn have lead to different interest preferences for CE design. Secondly the different CE laws and the CE action plan have been issued in different years, which not only implies large time lags in-between the dates of issuance. Moreover, this may affect the content comparisons: As it has been established in the preceding sections international learning spillovers between countries do in fact take place. In the words of the model on institutional evolution, particular solutions in one country have generated learning feedbacks for institutional inheritance stocks. These in turn are not only limited to the particular country, where the solution has been

practiced, but are also accessible to international actors via academic, official and business exchanges. In further consequence it can be argued that late comers such as the EC's CE action plan have in fact adapted their value emphasis to experiences made by frontrunners.

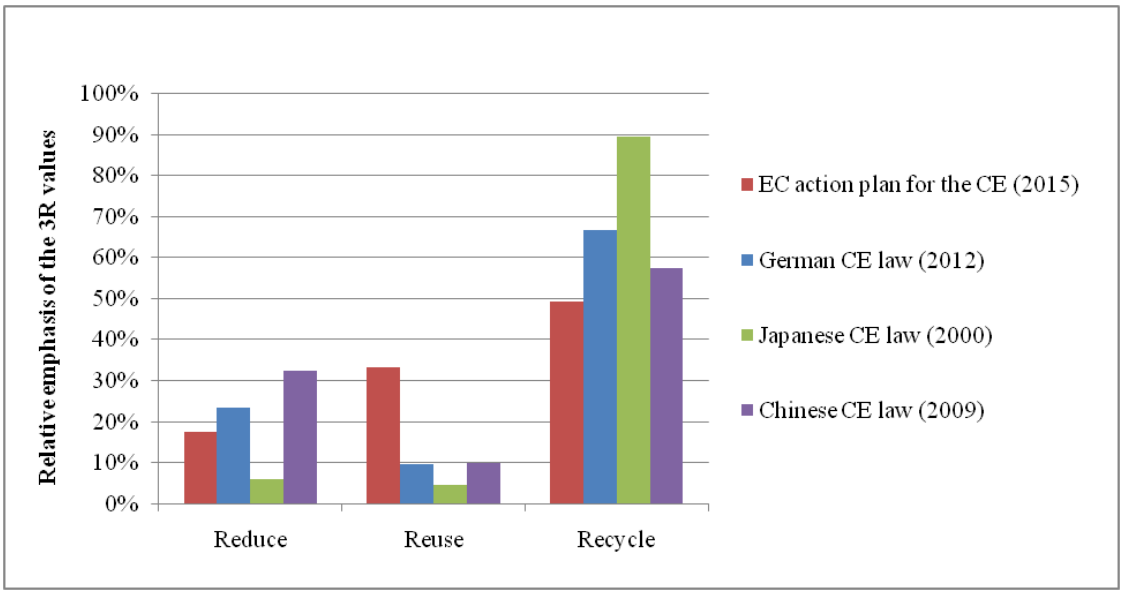


**Figure 4. Comparison of CE value emphasis in the EU, Germany, Japan and China (the author)**

The above conducted analysis on the distribution of value preferences however merely depicts a static constellation and provides little indication regarding the actual evolution of the CE in the investigated socio-economic systems. For the purpose of applying the methodological model it is therefore necessary to take this analysis further to the institutionalisation process within the respective countries as it took place over time. Germany as the first discussed case offers some interesting insights. When juxtaposing the different value emphasis in Germany's CE law and its revised version it can be discerned that the initially dominant emphasis on recycling has been slightly reduced (Figure 5). On the other hand, reduce and reuse values have gained in relative weight, which has been indicated by preceding research commentating Germany's recent CE development (Nelles et al., 2016, 8). These choices for institutional solutions might also imply that the originally recycling oriented focus has not sufficed to properly solve CE related challenges.

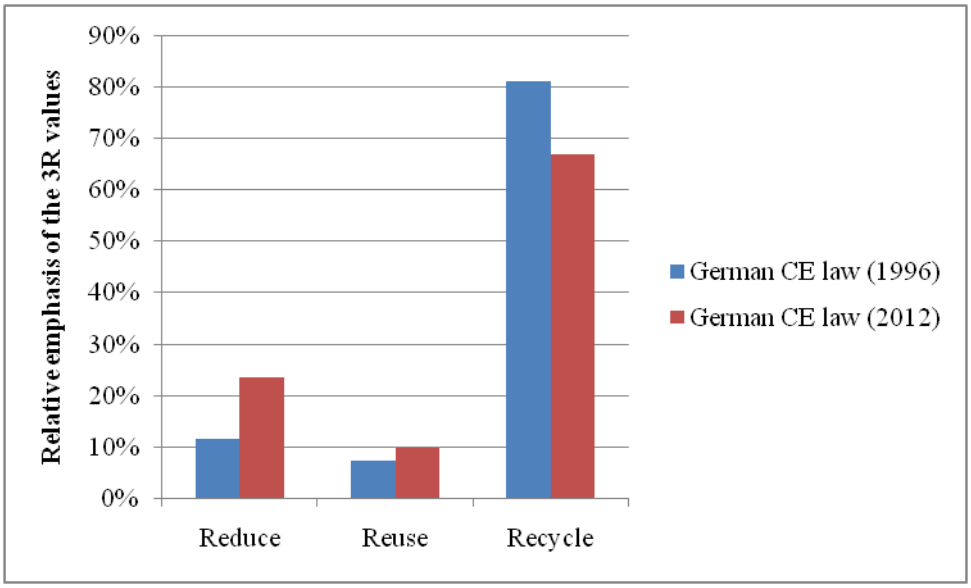


**Figure 5. Changing value emphasis in the institutional setting of Germany's CE (the author)**

A quite different pattern in value pronunciations over time is featured in Japan's CE evolution (Figure 6). Initially, a shift in value emphasis from recycling towards reduce and reuse practices has occurred in the transitional period between the first and the second CE plan. However with the issuance of the third plan in 2013, this trend was reversed and recycling was again reconsolidated in its initial position as the by far most important practice. The document provides country specific reasons for this choice: Despite the fact that the plan underscores the necessity to promote reuse and reduction practices (MOEJ, 2013, 5), material constraints in recent years demanded improvements in recycling and energy recovery of waste (ibidem, 1f). So this shift and its subsequent reversal in value emphasis could indicate the alteration of institutional solutions that were devised on the basis of different priorities: While the promotion of recycling appears to have emerged in response to material shortages, the plans have over time tried to account for the necessity to advance along the CE hierarchy and thus promote reuse and reduce practices. The alternation in emphasis thus seems less bound to the idea of replacing one value practice with another, but rather as an attempt to develop the CE towards a less material destructive level (1st plan to 2nd plan). However, as the reversal towards reinforcing recycling in the third plan has shown, the given set of challenges has denied the realisation of this political strategy.

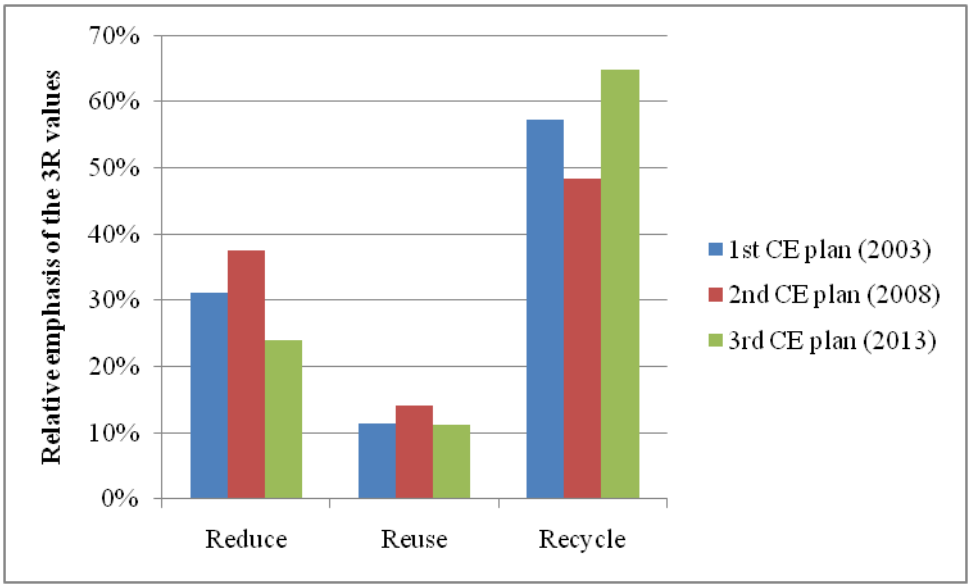


**Figure 6. Changing value emphasis in the institutional setting of Japan's CE (the author)**

The recent institutional CE development in the PRC features a unique highlighting of key values. Contrasted to the Chinese CEPL, the strategy documents issued in 2013 and 2017 indicate a strong shift towards an increasing emphasis of reuse practices. In this regard the 2017 Lead Action is very remarkable as the proportion of notions associated with reuse (refurbishment and remanufacturing) for the first time surpasses the proportion of recycling related concepts (Figure 7).

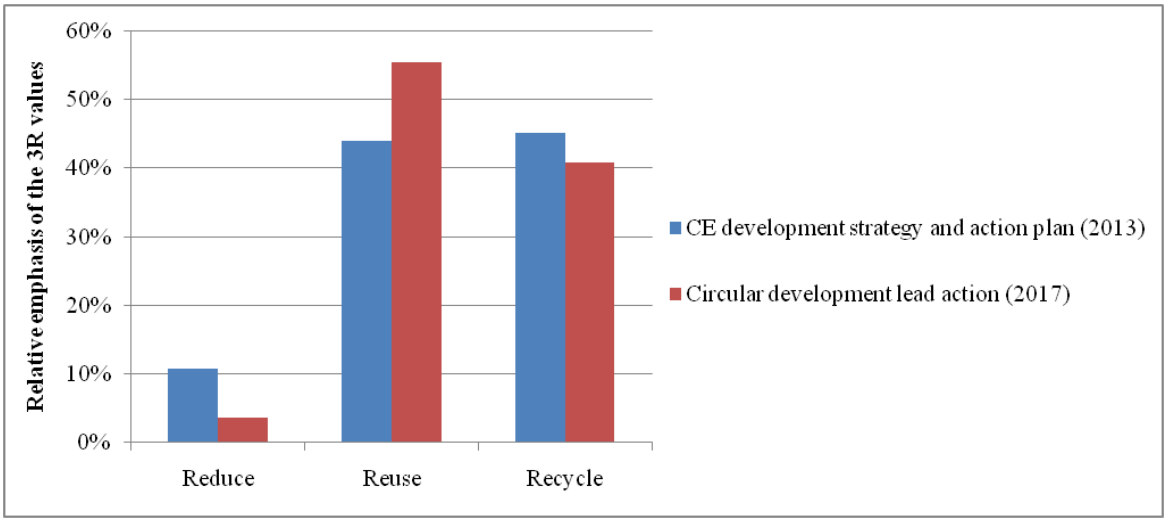


**Figure 7. Changing value emphasis in China's CE institutional setting (the author)**

This turn in trends is especially notable for the aspect of WM, where reuse has so far been largely neglected or underrepresented in legal texts and therefore found very little reflection in documented CE practices (Steuer, 2016b; Schulz and Steuer, 2017). Given that implementation always lacks behind legal institutionalisation it can be expected that future formal CE practices in China may feature a stronger reuse element.

Another interesting feature relates to the differing emphasis in CE systems regarding production and consumption (Table 9). Despite having only an indirect connection to the aspect of values, the degree to which both segments are addressed by respective legislation indicates the attention of decision making actors for particular interest groups. This is not to say that a stronger focus on production necessarily implies the allocation of power to producers for the creation of institutional solutions. Rather, a stronger focus on production or consumption might indicate a tendency to devise a strong regulatory framework for the particular segment. Especially in regards to the evolution of emphasis over time, a projection about future trends in the formal solution finding process can be attempted.

**Table 9. Ratio between emphasis on consumption and production in different CE systems (the author)**

| | **EC action plan for the CE** (2015) | **German CE law** | | **Japanese CE law** (2000) | Japanese CE plans | | | **Chinese CE law** (2009) | Chinese CE initiatives | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1996 | 2012 | | 2003 | 2008 | 2013 | | 2013 | 2017 |
| Consumption | 40% | 7% | 30% | 2% | 19% | 21% | 26% | 16% | 17% | 9% |
| Production | 60% | 93% | 70% | 98% | 81% | 79% | 74% | 84% | 83% | 91% |

As can be discerned from the above table all country specific institutional foci are set upon production and only show limited interest in regulating consumption. The logic behind this development is relatively simple, given that the CE concept evolved on the basis of Industrial Ecology and Ecological Economics, which both focussed on processes of industrial production rather than consumption. On the other hand however, the CE implies the concept of circularity that strikes a bridge between both ends of the traditional linear pattern. With regards to the dynamic of institutional evolution, this cyclic principle seems to have received increasing emphasis over time: Nearly all national frameworks have gradually increased their coverage of the consumption segment. The EC's document, which may be regarded as having incorporated the experience gathered in national CE systems, appears to be especially aware of the need to promote a comprehensive approach to circulation. China on the other hand represents the only case in which consumption has been gradually received less attention for the promotion of its CE. This stance may turn out to lead to a major flaw for future CE developments: If this approach remains unchanged it would mean the negligence of the non-state, civil actor group. Given its size in terms of the entire population, non-state actor groups have a significant impact on how well the CE can be implemented at the national level. In this regard some kind of institutional coverage or even integration into the solution finding process appears to be a highly important task for an effective realisation of the CE.

## 5.8 Conclusion of the chapter

The most important finding to take away from the above discussion is the conceptual closing of a nexus between the various challenges and a corresponding solution: On the one hand, economies around the world face environmental and resource related problems that have originated from the modus operandi of production and consumption at the domestic and international level. The CE on the other hand represents a particular institutional solution to this considerable challenge. In itself this solution stretches beyond tackling the apparent symptoms of resource scarcity, environmental pollution and increasing costs for production. Moreover it aims to induce a system-transformative change that impedes manifestations of the current problem in the future. In this context, the CE can be considered as the intermediate outcome of a larger process of institutional evolution. Firstly, it emerged as a consequence of earlier solution finding processes and thereof derived concepts such as the Ecological Economics and Industrial Economy. Secondly, by being based on specific core value concepts, which find different pronunciations in various economies, the practical applications of the CE are by no means fully predefined or pre-designed. Rather, the concept provides some fundamental value based pillars such as the 3Rs, upon which further institutional structures can be established.

The overall process of CE development in the investigated countries does in essence bear two particular, evolutionary characteristics: Firstly, all three sample countries have implemented CE related institutions, sometimes even with a similar emphasis of CE core values. However, the actual formal institutional scaffolding exhibits a considerable degree of variation. The most visible instance of variation manifests in the distinctive tendency to either amend and revise preceding institutional solutions or simply devise and implement new solutions. Secondly, evolution emerges in the course of solution selection and implementation. While this chapter has predominately dealt with the process of institutionalisation at the formal domain, actual implementation incorporates the larger body of non-state corporate and civil actor groups. Despite the fact that this aspect has not been covered in this chapter, it is nevertheless important to outline that these bottom-up practices are in part shaped by the formal domain and in part determined by their own, group-specific rule systems. Therefore formal solutions can trigger a feedback mechanism that incorporates the responses of the informal domain and is rechanneled back to the formal institutional domain. Some countries like Germany and Japan seem to have taken up these learned lessons and therefore adapted their institutional solutions so as to strike a balance between different actor groups (consumers

and producers). Formal decision-makers in China on the other hand appear to be highly preoccupied with implementing the CE by top-down means, with little interest for feedback that flows outside of the formalised feedback channel. As indicated above and as it will be treated in the following chapters this approach does have significant ramifications for the institutional dynamic of China's CE: Doing so over consecutive cycles can impair the emergence of variation, the growth of inheritance and the creation of novelty.

In regard to the methodological model and the secondary research questions, the chapter also highlighted two significant characteristics. Firstly, it has been shown how the Chinese institutional inheritance stock has been amended by trans-systemic exchange flows. The CE and its precursive solution concepts originated in the Western hemisphere, but made its way to China due to the similarity in the nature of the problem. Secondly, this type of knowledge on an institutional solution had to be translated to the Chinese context and become consolidated as a feasible option. In order to successfully conduct this process, decision-making actors have resorted to practices of imitation as well as experimentation. At the very basic level of adoption, strong elements of imitation have emerged. For example, the evaluation of the 3R value emphasis in Chinese key documents has indicated that China has initially shown a strong preference for recycling over the two other value-based practices (Figure 4). Simultaneously, however, the above discussion has also revealed that the formal domain in the PRC has resorted to experimentation in the sense of devising new forms of CE related applications: The EIPs as well as the eco-provinces and eco-cities may resemble earlier models at the international level. However the particular rigor to implement these solutions through direct state coordination and the endowment of an information feedback system (TRS, CE indicator system) qualify this application as comparatively experimental.

In order to proceed with the methodological investigation along the secondary research questions it is hereafter necessary to delve more deeply into the solution finding process within the PRC. Based on the fact that the CE is applied in China, the subsequent chapter will deal in more detail with the institutional evolution along the formal domain: Firstly, various actors and respective interests that influence the formal solution finding process will be discussed. Thereupon follows an analysis of the selection process, in which state actors and visible, non-state actors collide and conform. Thirdly, an investigation of the formal institutional solution outputs will be presented. This focus on processes within the formal domain provides the necessary background regarding given interest structures for

understanding the institutional dynamics CE industrial estates and waste management (chapters 7 and 8).

# 6 State actors and the formal institutionalisation of the CE: Interest groups, selection processes, outcomes

## 6.1 Analytical method

The preceding chapter's discussion on the CE in China, Germany and Japan has demonstrated that the respective central governments are pivotal players behind this ecological-economic development. Herein, one common denominator appears to be the prevalent use of top-down measures to realise the CE, which renders the nature of the process rather transformational than evolutionary . Assessments in this regard however depend on the respectively chosen perspective: Evolution, as comprehended in this thesis, results from the infinite interaction between formal and informal institutional domains. The thereof produced dynamic entails ever new institutional outputs, which in its entirety escape the control of any actor related, coordinating entity. Nevertheless the state in its proactive function attempts to guide the path of institutionalisation and in the case of the PRC it does so by modifying its national development strategy and through new laws and regulations.

The aim of the present chapter is to achieve a better understanding of the Chinese state's institutional domain and the interest preference constellations within it. Therefore, the main focus of the following paragraphs is to analyse the diverging interest structures within the formal domain and how they shape the formal institutional outcomes of the CE[26]. Herein, three central processes of the model will be discussed : The formal interest group constellations among Chinese government actors, thereof generated selection processes of the formal domain and resulting formal institutional outputs.

The relevance for choosing an analytical approach that centres on the formal domain can be justified by findings of earlier research: Heilmann (2016b) for example has analysed the policy making dynamic that proceeds along vertical feedback cycles between the central and local government hierarchies in China. The pattern that he discerns in these processes do to some extent resemble the repeating horizontal cycles of inheritance – selection – variation, which are presented in the model of this thesis. In essence, Heilmann contends that policy making (Politikgestaltung) in China has to be regarded as '…ein von Ereignissen, Interessen, Interaktionen und fortlaufenden Rückkopplungen angetriebener Handlungsprozess mit

[26] Existing literature on the matter of how formal interest group dynamics shape the CE in China is relatively sparse. In light of this limitation the present chapter has adopted the following approach to compensate for this paucity: Firstly, state actor interest dynamics in the environmental-economic domain are discussed so as to deduce a general assessment for the hereto related domain of the CE. Secondly, official documents on the CE are analysed for the purpose of assessing state actor specific interest constellations and respective changes.

ungewissem Ausgang.', i.e. a 'decision making process that results from events, interests, interactions and continuous feedback and thereby generates uncertain outcomes' (Heilmann, 2016b, 297). In his view, the analysis of policy making in China has to be based on detailed and observable practices and developments. In order to realise a particular degree of comparativeness between different cases of policy making it is necessary to adhere to the following sequence of methodological steps: Identify actors and interests, decision-making processes and conflicts, implementation, results and corresponding adjustments (ibidem, 297). This approach resembles the analytical configuration of the model in this thesis: Along the lines of problem emergence and corresponding solution finding this chapter will focus on the formal institutional realm, in which interest groups determine institutional selection, while thereof generated outcomes will in turn impact the alignment of interest groups for the next cycle of selection and institutional solution finding.

The starting point for the analysis of the formal domain in CE relevant matters is very much centred on collision of interests between and shifts in interests. As indicated in the preceding chapter, the CE represents a novel shift in the formal socio-economic growth paradigm: The concept itself constitutes a solution for two critical and in the past conflicting problems – achieving environmental protection on the one hand and fostering economic growth on the other (Zhu, 2008). In the process of institutionalising the CE, these two, traditionally opposing value ideals have been gradually merged into one overarching institutional solution that addresses the dualist challenge. This however entails a particular issue of conflicts between the respective interest groups that back these value ideals: The departure from solely fostering economic growth thus implies a shift in authority and generation of institutional leeway for actor groups that support environmental and resource protection. Such a shift does in turn indicate a high probability of a conflict of interests between respective actor groups within the Chinese government.

In the light of this change in constellations, the analytical method of this chapter will address the following model specific features: The initial section 6.2 will be dedicated to the analysis of the two opposing interest groups (environment oriented versus economy oriented) and their agency relevant representation. Herein, the main task is to discern the competing actors in the central government as well as to highlight how this conflict is reflected in the relationship between central and local actors. In adherence to the methodological model it is assumed that the values of interest groups constitute the very basic components of institutions and that

interests of actors remain relatively stable over time[27]. However, the analysis will also go one step beyond the model, as it is tried to shed light on the competitive processes that occur within the formal institutional domain. Given the strong signs of inter-agency competition in Chinese politics and in order to better understand the institutional selection process in the case studies (chapters 7 and 8) this dynamic needs to be highlighted. Therefore the first analytical task of the chapter can be formulated as follows: *Identify CE relevant interest groups and conflicts in government as well as indications of a learning process among interest groups and implications on environmental-economic institutional solution finding*.

Second to that, the analysis will focus on the selection process (section 6.3). In the methodology chapter it has been argued that the selection process is propelled by contesting actor groups. In the following paragraphs the main query will address how interests within the formal domain have shaped the formal institutional selection process. If shifts in solution finding occur over time, they most likely originate in realignments of interest groups during prior cycles of solution finding. The main methodological argument explaining this change states that the learning feedback process has an effect on interest groups and in further consequence leads to a reshaping of the selection process. In some theoretical models of the OIE it is assumed that the decision-making power of actor groups is not equally distributed and yet all involved parties participate in the contest for interest realisation. This dynamic does in turn propel and perpetuate institutional change and innovation (Groenewegen et al., 2010, 136 and 151). For the PRC, the reason for formal institutional change often stems from system-inherent crises, such as in the case of fiscal reforms in 1994: Hauff (2002) has shown that conflicts between formal interest groups, emerging from a perceived disadvantage on one side, trigger a solution-finding process. In the context of fiscal policy rearrangements, Hauff shows how efforts to find a solution resulted in an interest compromise determining the redistribution of fiscal revenues between central and local agencies. A more recent example of a compromise based solution finding process is the case of Green GDP accounting. This institutional innovation resulted from the perceived imbalance between continuous economic growth and simultaneous environmental deterioration. While the spread of the latter increasingly affected the performance of the former, central state actors were facing a particular challenge to respond to this problem. Out of this critical context, the SEPA and the NBS (National Bureau of Statistics) as opposing actors for the supremacy in asserting the

[27] The stability of interests of particular actor groups does however not imply that thereof generated interest group dynamics remain stable. Rather these are prone to change, especially if a fundamental change of the development paradigm occurs at the central government level.

statistical dimension of pollution induced loss in GDP growth convened to devise an institutional solution. This collaboration bore the launch of the Green GDP as a means to account for environmental degradation in terms of monetary value level (Weigelin-Schwiedrzik, 2018). Barry Naughton has in a similar fashion analysed formal interest constellations in the domain of policy innovation in the PRC. He contends that institutional change only comes as the result of internal compromise between political actors. Such changes only succeed if vested interest groups are considered respectively in the new institutional outcomes. By implication this requires a certain amount of experimentation and information feedbacks and stretches the entire process of solution creation over several cycles, in which subordinate solutions pave the way ahead (Naughton, 2009, 13-16). In the following chapters, the analysis will thus attempt to discern the selection processes behind institutional outcomes over cycles of interim rule issuance and respective feedbacks. The second analytical task of this chapter can therefore be formulated as: *Discern effects and influence of interest group alignments and policy experimentation on the selection process.*

In third instance this chapter is dedicated to analysing the formal institutional solution outcomes in the Chinese CE (section 6.4). Herein, the first step will be to depict the network of key or pivotal laws, which have been issued by the formal domain. Moreover, the significant evolutionary element of variation in institutional outcomes will be addressed. Given that the analysis in this chapter centres on the formal domain, the possible range of alternating outcomes is relatively limited. Nevertheless, some instances in variation can be discerned: For example differing characteristics of institutions regarding economic coordination or differing governance particularities in institutions that aim to realise CE practices. The third analytical task is therefore formulated as: *Analyse the formal institutional outcomes of the Chinese CE in regard to structural embedding and the characteristics of institutional variation.*

Additionally, some analytical efforts are directed towards highlighting the information feedback mechanism and the corresponding increase of the institutional inheritance stock. Given the ubiquity of this mechanism, its impacts are discussed throughout the entire chapter. As postulated in the methodological section, information feedback flows emerge as the result of new institutional solutions and, in the form of new experiences, generate a learning input for future selection. The crucial question for generating effective institutions in the formal domain is whether this feedback can be captured within the inheritance stock and if actors make use of new experiences in the subsequent cycle of selection. The fourth task for analysis

can thus be formulated as: *How does the information feedback system work and what are its effects on the subsequent selection processes?*

By addressing the above listed tasks, this chapter also touches upon several research questions. A notable exception is that this chapter in parts sidelines evolution in its full form, as the herein chosen focus is primarily set on the formal domain and thus only captures one part of the evolutionary process. Rather, what will be highlighted are those processes of institutional change that take place within the formal realm and which are subordinate features of evolution. In this regard, the chapter touches upon the first of the secondary research questions regarding the formal informal dynamic and its impact on selection. Despite the fact that the question was originally designed to address the dynamic between the formal and informal institutional domains, it is useful to adapt this query to the formal institutional context in which different government actors interact: Also within the formal domain, government actors sometimes deviate from formal institutional rule prescriptions, if they do not see their interests realised by the formal institutional framework. A divergence in interests among actors of the same domain will thus affect the selection process emanating from this domain. Herein, the limitations for analysis stem from the relatively opaque and secretive operations of the Chinese government as well as from the relatively little research on the Chinese CE. Therefore the investigation in the following sections will also include those observable developments documented by preceding research on the Chinese economic-environmental problem nexus.

The next question that will be taken up in this chapter relates to the effectiveness of outcomes. Again the scrutiny will be only related to formal institutional outcomes of the CE and subordinated or associated fields such as waste management. In adherence to the two features of effectiveness delineated in the model, the following paragraphs will investigate into the problem solving effectiveness of formal institutions as well as into the degree of interest inclusiveness. Here again certain limitations relate to the aspect that only state actor dynamics within the formal domain are discussed in this chapter, while formal and informal enterprise activities will be exempt. In final instance the two intertwined secondary research questions on the prevalence of experimentation or imitation and on the prediction of future institutional change will be treated: Indications that help to provide answers to both queries can be discerned from the Chinese pilot and experimentation projects on the CE. Herein, trends in pilot choices and experimentation intensity offer some room for the interpretation of the CE development in the near future.

In conclusion of the analytical method for this chapter, the two key analytical tasks for the subsequent sections will be outlined. Firstly, the aim is to analyse the collision of interests between state actors and thereof derive a feasible assessment on what propels selection within the formal domain. The point of analytical departure will thus be centred on the novel context created by the formalisation of the CE: The concept itself represents a realignment of the traditionally growth-oriented vis-à-vis the environmental interest groups within the government. Secondly, there is a paucity of CE related literature, especially when it comes to such fundamental aspects as interest groups and thereof generated selection processes. Therefore the following paragraphs will tackle this issue by analysing official actor group behaviour in documented policy cases, where environmental and economic interests collide. Here we find a context that is relatively close to the CE and thus enables some generalised assessment on the dynamics of formal solution finding.

## 6.2 Actor groups and interests in the formal institutional domain

### 6.2.1 State actors and corporate interest lobbying in China

One of the explicit assumptions forwarded in the methodological chapter of this thesis refers to the institutional dynamics initiated by a multitude of actor groups involved in the CE. They devise and apply institutional solutions to given ecological-economic problems on the basis of particular interest and value preferences. The reason why institutional evolution occurs is rooted in the fact that no single actor group fully dominates the institutional creation process. As there are many actor groups simultaneously engaged in this activity, the outcome manifests as a variety of mutually intertwined, but differing institutional solutions that have emerged as a consequence or response to preceding solutions. This evolutionary process of institutional solution finding depends on the dynamic between numerous interest groups, who compete for their interest realisation in the form of beneficial solution outcomes. This particular constellation of a multitude of interests can be directly translated to the political system of the PRC: Within the formal institutional realm several interest dichotomies have emerged such as central vis-à-vis local groups, or competing agencies within the central and local levels.

The shift of the analytical perspective towards actor related interest competition is also useful to debunk the frequently proposed view that categorises communist regimes as monolithic. As early as 1966, Franz Schurmann has highlighted the emergence of conflicts of interests within state-actor groups. Based on the analysis of documents and conference protocols, Schurmann

shows that such collisions already occurred in the early 1950s within the highest echelons of the party. The author notes explicit criticisms of lacking cohesion and political coordination as well as vested interest group formation and reluctance for cooperation. Another dimension of conflict of interests has also surged between more politically oriented factions and technocratic actor groups within the party (Schurmann, [1966] 1968, 99). This dynamic of competing interests is however not confined to the party centre, but also permeates party structures at the lower levels of the CCP hierarchy: Among cadres at the provincial and municipal level, such conflicts emerged from the desire to strengthen individual or group specific ambitions for more power within the higher levels of decision-making (ibidem, 330). A similar assessment is presented by Yongshun Cai, who identifies the differences in actor group specific values and interests as the reason for conflict and competition between actor groups within the party (Cai, 2014, 110). The analysis of Schurmann and Cai have been further extended by Sebastian Heilmann: In his view the PRC is not an uniform entity, but rather represents a composed conglomerate of institutions, which arise from specific organisational traditions, interests, internal rule systems and network relationships between economy and society (Heilmann, 1999, 290).

Interest-based actor dynamics in turn entail a substantial impact on the formation of the institutional scaffolding. As the methodological chapter has indicated, each institution is at its very fundament composed by particular values and interests. Thus it can be argued that the direction of institutional change in China is highly dependent on which interest groups dominate the leadership, the solution finding process and how well they realise their respective ideals in the form of institutional outputs. In the light of the last ten years of China's economic developments, Deng Yiwen discerns a high degree of formalised institutional solutions that have emerged as the result of particular interest group lobbying. Water and electricity provision, the expansion of stock exchange trading, the real estate market and the rise of financing vehicles are some manifestations of institutional solutions originating from lobbying efforts of particular interest groups. In an effort to categorise the most influential interest groups in China, Deng identifies seven major players, i.e. ministerial bodies and their leading personal, local governments and their leadership, powerful state-owned enterprises (SOEs) at central and local levels, transnational corporations, businesses groups in real estate development, private enterprises and private capital as well as research bodies and special consultants that influence the above listed groups (Deng, 2013). In regard to the solution finding process, preceding research however indicates that there are only a few instances in which one group fully dominates the institutional outcome. Despite the fact that

the degrees of power and thus influence on policy making differ from case to case, the selection itself is strongly determined by the achieving of a consensus between competing actor groups. This principle applies to decisions among state actors (Naughton, 2009, 13-16) as well as for those achieved between state and corporate or social actors (Cai, 2014, 112).

One particularly decisive nexus in interest group dynamics is the constellation between SOEs, potent family clans and the administrative branches of the Chinese government[28]. State owned corporations in China are systemic remains of the planned economy and have been subject to reforms since the PRC has embarked on the process of economic transformation in the 1980s. Especially in the course of the country's accession to the WTO in 2001, smaller and less profitable SOEs have been weeded out, whereas larger, systemically important units have been gradually transformed into holding and joint-stock companies. During the last decade this latter group achieved a monopolistic position in their respective, domestic markets such as energy, raw materials and banking. Thereof generated high profit levels and increasing successes of capital accumulation within and outside of China during the 2010s helped to maintain their system relevant role (Heilmann, 2016a, 148). Maybe more importantly is their institutionally embedded influence on economic policy in China. Given that chairmen of SOEs enjoy a full or a vice-ministerial ranking and are members of the CCP's Central Committee, the companies benefit from a high degree of independence and influence on economic policy-making (Downs, 2008, 42f). This in turn enables these corporate players to conduct state-internal lobbying within the elite of the political leadership and thus exert significant influence on matters of resource allocation, economic policy making and industrial policy formulation (Heilmann, 2016a, 148f). It is needless to say that these three aspects are highly relevant for the institutional development of the CE.

In regards to the interest realisation, it has been observed that SOEs broadly resort to two institutionalised strategies: Firstly, they proactively use their institutional influence to improve their access to various resources. Firstly, SOEs enjoy preferential access to financial and material resources due to their systemic relevance. By implication this in turn includes the impediment of competing private enterprises to enjoy the same material and financial benefits (Deng, 2013). Secondly, SOEs benefit from the fragmented authority between central government players and their struggle for influences on the economy (Downs, 2008, 42). In

[28] The various interest networks between corporate entities, family clans and the government have been highlighted in secondary literature, e,g. Heilmann (2016, 47, 56, 141 and 1999, 288-298), albeit in a relatively general and non-specific manner. Given that this topic has so far received only limited attention, especially for the economic-environmental field, the subsequent analysis is confined to the comparatively general assessments provided by preceding research.

this regard Deng and Kennedy point out that policy developments in some sectors have been less determined by a coherent plan, but rather by the struggle of corporate influences to shape the formal framework according to their interests (Deng and Kennedy, 2010, 102). One interesting case that also bears a strong relevance for the CE is the moulding of energy policy by SOEs. During the first decade of the 2000s, SOEs profited from bureaucratic infighting over energy decision making within the central government: In the light of an increasingly complex landscape in China's energy market, various stakeholders in the central government promoted the rise of the National Energy Agency to the rank of a ministry. This attempt to establish a new, coordinative mediator between contesting interest groups was effectively impeded by the aspirations of the NDRC to safeguard macroeconomic control over energy pricing. This countervailing measure was supported by involved SOEs, which valued the reliable connection to the NDRC and thereby buttressed the Commission's role in the energy sector (Downs, 2008, 45). The above example of interest cooperation explains how reciprocal interest dependencies between corporate and state agency actors are forged in the PRC. Such exemplifications furthermore help to explain the vast causality chain that stands behind every selection of institutional outcomes: Instead of merely being a result of contests in interest between decision-making state actors, institutional outcomes in the formal domain are in second instance also influenced by corporate and social actors. Such interest dynamics have been documented since the mid-2000s for the field of telecommunications, oil, electric power and automobiles (ibidem, 121).

Clearly, corporate vested interests and their lobbying have a major impact on the institutional selection process. For the Chinese case, commentators tend to highlight the negative influences of enterprise lobbying on the PRC's socio-economic development. In reference to the analytical basis set forth by Mancur Olson, Deng Yiwen identifies four major risks for the Chinese economy caused by vested interest groups' influence: Firstly, corporate interests create impediments for the society and future reforms by impeding necessary policy reforms or by curtailing already issued measures. Driven by the attainment of respective interests this could lead to unjust outcomes for the broader society. Secondly, vested interests erode the power of the state, obstruct the relation between state and society and further weaken political capacities of the government. Thirdly, particular corporate interests may lead to large inefficiencies in economic performance, especially in regard to the state sector's allocation of capital and resources. Finally, Deng sees the risk that deeply embedded interest groups actively ostracise weaker groups from influencing the policy decision making process (Deng, 2013).

In this context the implementation of the CE concept in China marks an interesting caesura for interest group alliances: The hereby induced shift in development paradigms manifests a clear deviation from the traditional resource-intensive development model. By implication, this means that strong corporate players that for a long time benefitted from cheaply available resources are now subject to the theoretically more rigorous resource management policies of the CE regime: The concept's formal institutional solutions that promote resource-efficiency and reductions in resource intensity thus run counter to corporate vested interests. Preston in this regard points out that losers of the CE are to find among those heavy industry and resource-intensively operating enterprise groups to which many SOEs belong. Realising the CE in China thus requires a massive shift in production and consumption patterns that have for long permeated the entire Chinese economy. Herein, resource pricing constitutes one of the most sensitive topics: The implementation of the CE does for example imply the abolishment of all kind of subsidies and fiscal measures that maintain the operation of resource-intensively producing enterprises. Moreover, the 13th five-year plan, which highlights many CE related themes, has proposed measures to tighten resource pricing[29]. The thereof emerging challenge is that particular interest groups tend to oppose such institutional changes as they are faced with losing those advantages derived from the previous institutional constellations (Preston, 2012, 14). The near future will show how this conflict between the state's administration and producing entities is going to affect the implementation of the CE[30].

### 6.2.2 CE relevant interest groups within the central government

From the interaction between government and business interests, the analytical focus will now shift to CE relevant state actor interest dynamics within the central government. In the CE related field of environmental protection, collisions of interests have been well documented in recent decades. Within this subject matter, the very crucial pivot of conflict manifests in the divergence between actor groups in favour of economic growth vis-à-vis those that demand improvements in environmental protection. According to Björn Conrad, two opposing actor groups can be discerned: On the one side, there are industrial sectors backed by the Ministry of Industry and Information Technology (MIIT), which strive for short term economic interest realisation. The MEP and its pro-environmental orientation the other side derives legitimacy

[29] In the 13th five-year plan fiscal measures such as taxation have been further promoted by the central government so as to curtail the excessive use of mineral resources (see: 13th Five year plan of the PRC, chapter 14, section 4).

[30] The relatively theoretical analysis of the interest dynamics between corporate and state actors in the field of the CE and the environmental domain is owed to the absence respective research on this topic (see footnote 28). In this regard, especially the interest linkages between powerful SOEs in CE relevant domains and the party leadership are far from being sufficiently investigated in secondary literatures.

from a general dissatisfaction in society regarding the deterioration of the environment (Conrad, 2016, 356; in: Heilmann, 2016). As for the CE, the circle of key players is extended to the NDRC and the Ministry of Finance (MOF), wherein the former is considered as the most active and powerful actor guiding the MOF and the MEP in policy decisions (Jiao and Boons, 2017, 17). Additionally, a third tier of actors with varying influence on institutional selection has to be considered: This includes the NPC as law-making body with its commission for environment and resources; the internal cabinet of the State Council, who issues particular action plans and programs; the Ministry of Science and Technology (MOST), which promotes environmental protection technology and serves as connecting link between environmental and innovation policy; the Ministry of Housing and Urban Rural Development (MOHURD), which plays a major role in eco-city and eco-province design; various other ministries involved in the selection of environmental protection measures; research institutions and think tanks with direct links to the central government, to which they provide consulting services regarding environmental and CE related targets, regulatory and incentive measures. (Conrad, 2016, 357; in: Heilmann, 2016; de Jong et al., 2016, 32).

A clarifying assessment in regard to the ministerial hierarchy in the CE has been presented by Jiao and Boons in their research on the policy durability of China's CE. Via an analysis of issued institutional measures and inter-ministerial communication the authors find that the NDRC represents the by far most dominant player, followed by the MEP and the MOF (Jiao and Boons, 2017, 18). There are two reasons that seem to account for this particular outcome: Firstly, the CE primarily embodies an economic development model, which in turn explains the leading role of an economically oriented government body such as the NDRC. Secondly, Arthur Mol has pointed out that environmental duties are often allocated to state actors with a predominately economic duty portfolio. This can in parts be explained through struggles for authority between environmental and economic interest groups. In this process, the latter successfully asserted it as dominant player and thereby claimed much of the authority for decision making in environmental matters. Notable examples are the 2002 Cleaner Production Promotion Law (CPPL) and the earlier energy conservation policy, which were both authorised and coordinated by the precursor of the Ministry of Commerce (MOC). The same applies to the allocation of roles for implementing China's Agenda 21 program, which in the end was coordinated by the MOST and not by the SEPA (Mol, 2006, 39; Mol and Carter, 2006, 156f).

In contrast to environmental protection, the specific interest group dominance in the CE is slightly different, as depicted by the analysis of Jiao and Boons (2017). Here again it is useful to assess interest dominance changes over a longer time interval. A quick analysis of issued legislative measures on the CE indeed shows that the MEP has since 2002 only initiated or co-authored 17 CE measures, whereas the NDRC has been contributing to 37 policy measures since 2005 (Pkulaw.cn, individual search by the author). However in direct comparison the MEP is the ministerial body, which over recent years achieved a larger increase in authority and thus influence on environmentally related institutional selection. The fast growing number of environmental laws and regulations over the last three decades was accompanied by the gradual upgrading of this significant actor in environmental decision making: Founded as a national bureau, it has risen to an agency in 1998, only to become a ministry in 2008 (Mol, 2006, 35). This has been interpreted as a clear sign of the political centre's increased emphasis on environmental protection (Heberer and Sentz, 2011, 92). And the MEP did by no means hesitate to convey a self-confident program: Directly after its rise to the ministerial level, the MEP released a notice regarding its work strategy. Therein it asserts the position as main responsible body for environmental protection within the State Council in charge of macro-regulation, coordination, supervision and public service regarding all matters of environmental protection (CCICED, 2010, 217). This confidence in its own authority in environmental matters is reflected in how the MEP (then SEPA) embraced the CE as the first actor within the Chinese central government. Already in 1999 the agency initiated a serious of projects, wherefore it issued CE guidelines for industrial parks, with a specific focus on waste recycling, promoted closed loops between companies and Cleaner Production (CP) practices (Park et al., 2010, 1496; Jiao and Boons, 2017, 18; Li, 2016, 18). Since 2002, the SEPA further broadened its field of operation towards developing industrial structures, reforming industrial policy and promoting new CE technologies (Park et al., 2010, 1496).

Probably this final step may have somewhat infringed the operative realm and interest domain of the NDRC. Formally speaking this body is a ministerial actor of the State Council, which houses several departments that mirror other ministries such as environmental protection (Heilmann et al., 2016, 60; in Heilmann, 2016). Furthermore, and that constitutes the significant feature in this conflict of interest, the NDRC is the dominating central player in Chinese industrial policy as it takes the leading role in industrial program formulation (Meissner, 2016, 346: in Heilmann, 2016). Earlier documentation such as on the energy sector developments in China have shown that the NDRC is very sophisticated in maintaining its capacity to steer institutional selection: By means of controlling prices and coordinating major

players in the market the NDRC could persevere its decision making power to a significant degree (Downs, 2008, 44). Adverse efforts by the SEPA to extend the agency's political influence on industrial policy formulation might in fact have triggered a conflict of interest between the two actors. However, out of this conflict, the SEPA only came out second: Current research finds that the NDRC and not the MEP is responsible for the implementation of the CE (Geng, 2011, 7; Winans and Deng, 2017, 827). Given that the CE is currently upheld as a viable reform model for the Chinese economy by the political leadership (Winans and Deng, 2017, 827), the role of the NDRC on CE relevant institutional selection cannot be underestimated. Especially since 2005, the year that the NDRC began to engage in China's CE development, the institutional selection process features the body's pervasive influence: In that year the Commission announced eight initiatives to facilitate the implementation of the CE. These include the initiation of the respective legislation process, pilot projects, the application of economic instruments, research and development measures, industrial restructuring, performance indicators and a financing mechanism (Su et al., 2013, 218).

### 6.2.3 Asserting leadership over formal CE development: A shift of CE authority from the MEP to the NDRC

The above depicted developments regarding the shift of authority over the CE leadership revealed that the formal institutional development of the CE has since 2005 been dominated by the NDRC. This begs the question for the reasons behind this particular reallocation of responsibility. In his analysis on the changing importance of environmental protection in China, Björn Conrad states that this field has increasingly gained in standing among the central leadership of the PRC. The main argument here is that continued economic growth dominated by massive industrialisation has long neglected the environment. In recent years however the central government has made gradual changes in favour of environmental protection by including it into the PRC's long term strategy: Due to this change in provisions, economic growth has now to be achieved in accordance with ecologic targets. By assigning a larger role to environmental protection, the direction of China's economic growth model gas thus received a substantial modification. Nevertheless, the central government did not go so far as to put environmental protection over economic growth. Rather support for the former ends at that point, where it begins to curtail the latter (Conrad, 2016, 356).

What on first sight appears to be a relatively unbinding provision for the overall development agenda does in fact indicate an interim result of learning on how to strike a compromise between opposing environmental and economic interests: On the one hand the government

holds on its traditional strategy for legitimising its rule via generating economic growth. On the other hand however it seems to have realised that this traditional growth model has severely strained China's environment and if continued may impede further growth. Given that a purely pro-environmental policy program would be prone to fail, if enforced on the primacy of economic interests, the solution was to include environmental protection into the larger economic growth strategy. In essence, this approach seems to be perfectly embedded in the CE concept. The herein manifested learning achievement is that pro-environmental values have not been implemented as a stand-alone complex, but rather as an addition to a new economic development model. Conrad has attributed this delicate act of balancing between environmental and economic interests to the workings of the NDRC and the State Council (SC): On the one hand, the NDRC combines both interests via its dominant role in the formulation of long-term development plans. The central leadership and thus the SC helped to promote the standing of so far disadvantaged environmental actors, e.g. via the promotion of the SEPA into the rank of a ministry in 2008 (Conrad, 2016, 356).

In regards to how the CE authority shift took place, the period between 2003 and 2005 is of particular importance. While the SEPA lead the CE relevant pilot project process up until 2003, the NDRC began to set up a research group with Qinghua University in 2004 on how to establish a CE development strategy in China. Thereof derived reports were handed over to the central government by the NDRC and approved as useful by the latter. In turn the SEPA organised a workshop, so as to provide experiences and learned lessons as a feedback to the NDRC. The most significant consequence of this event was that the NDRC and not the SEPA was regarded as major coordinator of the CE, assumedly because the former seemed to have won the SC's approval for overtaking this task: In the 2005 programmatic document on the CE, the SC appointed the NDRC as the primary coordinator for the CE development. It was only in the course of these protracted events that the CE became a concept of economic sustainability instead of a purely environmental one (Jiao and Boons, 2014, 21). Thus the shift of authority over the CE entailed a shift in values: Environmental concerns were once again submitted to economic ones. While this development may indicate the product of a pragmatist approach, it may as well hint to the learned lessons of earlier failures: Purely environmental policy agendas were often subject to poor implementation and watered down at the benefit of economic interests, which were perceived to be at stake (van Rooij, 2006, 60f).

As a consequence of the authority shift in the CE leadership from MEP to NDRC, commentators have indicated a stronger recognition of the CE as significant development

paradigm among state actors. This has also directly influenced the decision to include the CE as strategic policy program in the official agenda with the launch of the 11th five-year plan (Naustdalslid, 2014, 305). Additionally, it has been noted that the CE developed faster once the role of primary coordinator was assigned to the NDRC. Here again the crucial factor was that the concept has been promoted as an economic one, which in turn appealed to the dominant, economically oriented actor groups, who expected to profit from CE practices (Jiao and Boons, 2017, 22). The crucial and remaining question that will be taken up further below is how the interim consolidated alignment of interests will affect the selection process (see section 6.3).

### 6.2.4 The translation of central interests to the local level: challenges and solutions

In order to provide a comprehensive picture on interest group interactions within the official, formal domain the following paragraphs discuss two aspects of the central-local governance dynamic in environmental and CE policy. The analysis revolves around how collisions of interests within the centre are reflected at the local level and how interest alignments between locality and centre are achieved.

The initial starting point, which had set forth the core interest direction of local governments for the past four decades, was the premise of reform and opening to achieve rapid economic growth rates. The local administrators' aim to facilitate growth and thereby improve their chances to rise along the political hierarchy came at the expense of social and environmental sustainability. Social injustice and enormous, short-term gain oriented environmental destruction and resource depletion were the direct consequences of this new paradigm (Heilmann et al., 2016, 73). The centrally directed realignment of interests towards increasing environmental sustainability since the 2000s is thus met with severe opposition, which notably manifests at the local level: The essential starting point of this challenge to realign interests is that local governments enjoy a vast authority over policy implementation, while only weak control is retained by the centre. Given that enforcement is primarily a matter of interest, local governments prefer to see their interest of economic growth realised, while the centre's increased emphasis on environmental protection remains neglected and often becomes sidelined. Moreover resource-intensive industrial production often lies at the core of local economic growth, which for the matter of CE transformation constitutes a particularly tricky issue (Ran, 2013, 18 and 24).

A crucial element in regard to central control of local activities is rooted in the issue of weak administrative capacities along the vertical governance hierarchy. The MEP for example has no direct control over local Environmental Protection Bureaus (EPBs), which are under direct control of local governments. These and other weaknesses are exploited by economic interest alliances between local official actors and enterprises to doge a more rigorous implementation of environmental protection (Conrad, 2016, 359). With the exception of the three domains foreign relations, defence and taxes, there is no vertically integrative control structure that obliges local actors to exercise central directives in a *unified* manner. Superior government bodies thus only convey 'professional guidelines' (yewu zhidao 业务指导), which in turn provides local authorities with significant leeway in terms of policy implementation. This is not say that local governments may simply ignore the authority of the central leadership: In fact the latter can resort to effective forms of intervention, which in cases of severe conflict are applied to revise and revoke local regulations (Heilmann et al., 2016, 66f). Nevertheless, central government ministries cannot issue binding orders to the provincial leadership, because both are ranked at the same hierarchical level. As a consequence of these power and control constellations between centre and locality, there is a tremendous need to generate consensus based results via negotiations so as to make the system operate effectively (Lieberthal, 1997, 3). Thus the solution finding process that takes place within central actors does in the further consequence, i.e. during implementation, also entail related efforts to align the interests at the local level.

In regard to solving the issue of environmental and economic interest alignment between centre and locality, three institutionalised, interlocking procedures have been discerned in secondary literature. Firstly, there is an approach that may be loosely termed as a leeway provision strategy. In principle the centre sets forth an environmental agenda with particular policy foci it deems as most important. However instead of precisely specifying regulatory applications it leaves a certain leeway to local actors so as to adapt the measures to local conditions. Local actors will in turn conduct discussions and implementations according to their needs, interests and capacities. In order to convey preferences and priorities the central government resorts to formulating 'hard' and 'soft' policies, which serve as guiding indicators conveying different degrees of urgency regarding policy objectives. Environmental policies have however too often been marked as soft issues, which in turn may convey the sense of a relatively low priority for implementation (Heberer and Sentz, 2011, 85f).

The second instrument for interest alignment has been established in the form of a policy-target based contracting system. Since the initiation of the reform and opening process the central government has gradually cut back on its overwhelming coordination of the economy. However in order to maintain a certain grip on local cadre performance a system of setting binding targets for local administrators has emerged. This concept of contracting, also known as Target Responsibility System (TRS), has been especially emphasised in the 11th five-year plan (Heilmann, 2011a, 35). The primary reason for the TRS to take effect is that the central government is able to establish a type of 'yardstick competition' among local officials to reward or punish them based on achieved objectives (Liu et al., 2012, 107). During the five years of the plan the system was subject to refinements, which shifted the task of pollution control from the relatively weak EPBs to local governments. The item of pollution control thereby entered the TRS evaluation system and became a significant criterion for the promotion of local cadres[31] (ibidem, 108). By implication, a failure in achieving such environmental targets could entail the denial of career advancement. This new regulatory step has increased the centre's leverage and pressure on administrators to comply with central interests on environmental protection (ibidem, 108). Furthermore, the refinements have produced two significant innovations: On the one hand the TRS functions as a crucial tool to realise the alignment of interests as it permits the shifting of responsibilities from the central to the local level. Respective performances are evaluated on an annual basis and respective reports serve as significant feedback mechanism to the centre (SC, 2016, art.10, section 1).

While this feature represents a type of feedback induced learning for the centre, there is on the other hand also a type of learning process created for local administrators. With their eyes set on career advancement, the TRS provides incentives for local cadres to comply with central interests. Under the pressure of target fulfilment local leaders gradually learn how to minimise deficiencies and how to adapt to central demands (Heberer and Sentz, 2011, 81). However without question this system exhibits advantages and deficiencies: Heilmann finds that the system has achieved remarkable successes in CE relevant matters such as emission trading and energy conservation during the 11th five-year plan period (Heilmann, 2011a, 35). Simultaneously the TRS is also prone to create a form of institutional lock-in: While the system conveys certain environmental priorities, local execution might focus only on the most important challenges, while others remain unaddressed and neglected (Liu et al., 2012, 108).

[31] The most recent step regarding the institutionalisation of responsibility for pollution control and environmental quality at the local level came with the new Environmental Protection Law in 2014 (art. 26).

This is especially problematic in the environmental realm, in which problems such as air pollution require a comprehensive approach for their solution.

A third approach to achieve the interest alignment between the central and local governments is a form of contractual planning that is applied in joint development programs. Heilmann and Melton (2013) have dedicated a comparatively broad analysis on such 'macro-regional, cross-provincial plans', which like the Yangzi River Delta Program of 2010 also incorporate the CE related low-carbon transformation efforts (Heilmann and Melton, 2013, 11f). In regards to institutional solution finding these programs feature an interesting feedback loop for conveying particular interests: While being dominated by core agencies such as the NDRC, local governments are also requested to submit their interests, which in turn shape the selection over program contents. The hereof emerging process of interest alignment between the centre and localities takes place over a sequence of several plans: Quite often a rather general plan is issued by the centre first, which in a second step is replicated and specified by provincial and city governments. Thereupon several waves of implementation guidelines, target promulgations and spending plans follow (ibidem, 14f). This process may be interpreted as a gradual, but selective adaption, during which localities align their interests with those of the central government (ibidem, 29).

The authors indicate that one successful example of a planned program was the Thousand Enterprise Initiative, which was conducted in the wake of improving energy efficiency during the 11$^{th}$ five-year plan. The initiative and the energy efficiency efforts performed exceptionally well because of two key features: Firstly, they constituted an extremely high priority for the leadership and were situated within the 11$^{th}$ five-year plan's hierarchy of targets. Secondly, the 'energy efficiency plan was comprehensive, well coordinated and adaptive': Trials that succeeded were expanded and replicated; those that failed were improved via re-design. In summary, the key premise for successfully adapting local to central interests requires an alignment of central environmental aims with local economic interests: Pollution control technologies are adopted at the local level, if they do not impede economic growth. Similarly, local governments appear to be generally willing to adapt to central plans – possibly also in environmental and CE related respect – if central funds or special loans are provided by the centre (ibidem, 20 and 35). This in essence resembles the premises of interest alignment within central government actors: Environmental interest realisation is accepted by actor groups with economic interests, once they are merged into the larger development trajectory of furthering economic growth. In regard to this premise the CE

appears to be a relatively promising solution: Not only does the concept address environmental and resource specific concerns, its explicit economic orientation also accounts for economic interests at the local and central level. Under the primacy of advancing economic growth, central government actors behind the CE agenda may use this constellation so as to induce local state actors to embark upon the path of resource sustainability.

## 6.3 Formal institutional selection in the CE and interest group contests

### 6.3.1 The premise for effective selection outcomes: Reaching a consensus between environmental and economic interests

Preceding research ascertained that the political centre of the PRC has decided to initiate a shift towards increasing pro-environmental values and interests at the expense of solely pursuing economic growth. The crucial premise for strengthening the influence of these values in policy making, however, is that economic growth has to be sustained in the long run. In order to achieve this objective the central government intends to solve environmental and resource related challenges via a transformation of its economic model: In essence the idea herein conveyed is to strive towards increasing the added value in production, while reducing the use of resources and the economy's impact on the environment. By adhering to this strategy the central government intends to unite environmental and economic interests within a set of compromise featuring solutions (Conrad, 2016, 355 and 360). This analytical assessment puts forth a direct link to the Chinese CE: The concept can be understood as a new model of economic growth, which still gives priority to economic interests, but has increasingly incorporated values of environmental sustainability.

The question at hand is how formal institutional selection is conducted in the unfolding course of developing the CE. In many instances analytical assessments are difficult as the legislative and regulatory drafting in the PRC is perceived as secretive and opaque (Clarke et al., 2008, 397) and only a few stable mechanisms are discernible. Firstly, there are instances of interest lobbying between law-makers and consulted corporate or civic actor groups. During the drafting process the relevant bureaucracy may release draft versions of laws to selected audiences (ibidem, 397). Since 2004 the inclusion of certain actor groups becomes obligatory, once a regulation or a law directly affects their interests. This feedback process may take a formalised form, i.e. if the consultation serves to discuss or correct previously drafted versions of a rule. Simultaneously, such consulting interest groups may also exert influence during the early phase of policy formulation and implementation. In this case, informal

lobbying through personal networks constitutes a significant way to influence solution outcomes (Heilmann, 2016a, 180). By implication this process enables an information feedback from other interest groups to policy makers and may in turn lead to interest realignments in the final version of the regulation. As Zhang and colleagues (2015a) have highlighted the new Environmental Protection Law (EPL) has gone through several, in parts substantial revisions because of the strong interest inputs from consulted actor groups.

Secondly, the drafting of institutional solutions does in many cases entail collision of interests, which not only causes repeated revisions of a draft, but moreover lead to the delay in the issuance of laws over several years (Heilmann et al., 2016, 112). Finally, the process of formal institutional selection is time-consuming and complex as it includes different, often opposing actor groups that constantly learn and adapt on the basis of experiences from preceding cycles of solution-finding. This has been especially evident in the PRC since the reform and opening process in the 1980s when new business forms have emerged and policy makers as well as entrepreneurs constantly moulded and re-moulded their own practices in response to the respective actions of the other side (Hitt and Xu, 2016, 590). Solutions selected within the formal realm can thus only be effective if they to a relative degree solve an emerging challenge and appropriately align involved interests within. In their analysis on the Chinese energy sector Lema and Ruby (2007, 3880) highlight this issue by citing Lieberthal and Oksenberg's discussion of 'fragmented authoritarianism' in the PRC: Given that each ministerial unit has its separate mission and strives to amass sufficient executive power, particular forms of competition for influence and authority emerge. This in turn often leads to a protracted, disjointed and incremental policy process, in which each single achievement can only arise from a sufficiently strong cooperation between central actors. For state actor cooperation a basic consensus of interests is necessary. Heilmann describes this informal consensus achieving process for decision-making, i.e. institutional solution finding, at the apex of China's political system as a sensible procedure: Not only is it impossible to push through controversial policy proposals, even if they are backed by the CCP's general secretary or by a majority of the Politbureau. Rather selection on institutions is postponed until a consensus can be reached. As alluded in the above, achieving a consensus in the centre is aggravated by ministerial rivalries and emerging new players in national policy making, such as the standing committee of the NPC as aspiring legislative body (Heilmann, 2011b, 95f).

For the case of environmental protection it appears that there is a basic fundament for cooperation and compromise within the central level: The NPC's Committee for Environmental Protection and Resources and the MEP share a congruency in interests (Hofem, 2010, 19f). So does the MEP and the NDRC when it comes to the CE. However, as soon as it comes to the issuance of laws, there is strong opposition from other ministries, industry and provincial governments, which have set their operational focus on safeguarding their economic interests. The premise for successes in institutional selection within the formal realm is based on bargaining processes that generate a balanced trade-off in interests between all involved actors. For the case of the CE securing the strong support of the NDRC is thus inevitable. However successful institutional selection at the central level does not imply that the actual challenge can also be tackled appropriately. Hofem (2010) does in regard to environmental law point out that in some instances collisions of interests are neglected in the legislative process, but are postponed to be resolved during the implementation stage (Hofem, 2010, 20). So institutional selection has, at least in the domain of environmental protection, often sidestepped the inclusion of interests of implementing agencies at the local level. Ran (2013, 26) finds that this in consequence hampered a full implementation of institutional solutions at the local level simply because institutional selection was too centralised. The question then is why some selected institutional solutions related to the CE such as improving energy efficiency and reducing $CO_2$ emissions have been successful during the 11$^{th}$ five-year plan (Heilmann and Melton, 2013, 8f)? On the one hand this can be attributed to mechanisms such as the TRS discussed in the preceding section. On the other hand however, the political economy of the PRC as produced a very effective mechanism of policy experimentation, which over several cycles facilitates the alignment of interests between central and local government levels. This approach has been especially practiced during the advent of relatively new socio-economic policy strategies in China and the CE does in fact fall into this category.

### 6.3.2 Policy experimentation in the PRC: General mechanisms and application in the CE context

#### 6.3.2.1 The characteristics of policy experimentation in China

As the preceding paragraphs have highlighted competing vested interests exert a significant influence on formal institutional selection. In this regard, the biggest obstacle for generating institutional innovation to cope with new challenges is rooted in stalemates between interest groups. In such constellations, two or more actor groups impede each other in fear of seeing their respective interests sidelined. The difficulties in devising and issuing new solutions in

environmental policy have exemplified to which extent institutional selection is affected by competing interest groups. From the perspective of the methodological model these structural impediments may only be resolved over several cycles of problem emergence and respective solutions. The selection process and respective outputs may thus only change through the impact of learning from preceding solution results and thereof generated learning feedbacks. Such new inputs can in first induce a change in values and interest alignments, which subsequently affects the actor group specific authority constellations in the selection process within one institutional domain.

As outlined by Naughton (2009) and Heilmann (2008, 2011a, 2011b, 2016) the political-economic governance system of the PRC has developed a mechanism for the formal institutional realm that facilitates and accelerates this learning process: According to Heilmann (2011b) The PRC's concept of policy experimentation (zhengce shiyan 政策试验) can indeed be seen as a type of 'policy learning' in which the state's local and central actors cooperate so as to find solutions for novel challenges. Policy experimentation provides test-runs for novel institutional practices, initiates a learning process, triggers behavioural change and may thereby undermine '…entrenched ideologies, attitudes and interests. In short, policy experimentation helped to smuggle changes into the system' (Heilmann, 2011b, 97). The general idea is to generate variation in terms of locally implemented pilots, which conduct experimental solutions for pre-defined tasks or novel challenges under varying local conditions. This type of experimentation is not freewheeling trial and error, but rather represents a coordinated activity so as to produce novel policy options. If successful, the results are to be replicated on a larger scale and may even be formally institutionalised as a national law. Political bargaining and ideological strategies dominate the unfolding of experimentations, which subsequently provokes collisions of interests out of opposition. The completion of the process in turn requires a certain amount of time and efforts. The herein overarching motivation is to identify workable solutions to a particular challenge, whereby the innovation itself begins with local implementation and concludes with national institutionalisation as universal law or regulation (Heilmann, 2008b, 3f; Heilmann, 2010).

Historically, this practice dates back to the early years of the CCP. Already during the CCP's Jiangxi Soviet period (1931-34) the implementation of agrarian policies varied from place to place. The main reason was that the party leadership was divided and insecure about how to initiate agrarian revolution in the countryside. Therefore it encouraged local party organs to experiment and devise diverse models that could later be emulated by other localities

(Heilmann, 2008b, 5). Given the multitude of and variation in these model experiments, Mao Zedong allegedly created an organisational technique, which consisted of dispatching work teams to selected sites so as to test and demonstrate land reform methods in one small spot. Via training and education local cadres were then set out to adjacent areas in order to spread those practices determined as effective by the leadership (ibidem, 6).

In terms of methodology, the development from experimentation to national legislation is sequenced along the following steps: Firstly the establishment of experimental nodes (shidian 试点) or experimental zones (shiyanqu 试验区). Within these pilots successful model experiments (dianxing shiyan 典型试验) are identified and selected for an extension from point to surface (you dian dao mian 由点到面) so as to verify to which extent these policy options can be generalised or need to be modified. Herein, the central government plays an indispensible role for the scaling up and generalisation of local innovation. In doing so it is the centre that provides coordination to policy innovations by evaluating, controlling and re-feeding the learning feedback into institutional selection. Once this process of what Heilmann designates as 'staged replication' has ended in other localities after several years, and if pilots and demonstration sites proved to be successful the experimentation process concludes: The respective institutional solutions are upgraded and codified as a national regulation or law (Heilmann, 2008a, 5; Heilmann, 2016b, 301f). With regards to the concepts of selection and solution output, the experimental regulations in pilots represent quasi-laws (ibidem, 6) or interim institutional solutions. In the sense of the model, this means that the PRC experiments with short-term valid institutions that are subject to repeated modification and innovation. Thus for the purpose of solving a larger challenge, the state actors resort to interim solutions that gradually resolve the subordinated elements of this larger challenge. In theory this implies that larger institutional solutions emerging from experimentation can be designed in a way so that various instances of a challenge are adequately tackled.

In terms of the forms and shapes of Chinese policy experimentation, Heilmann distinguishes between three different categories: Firstly, there are experimental regulations, i.e. provisional rules for trial implementation. This form has been especially prevalent during the early years of economic reforms, with thousands of regulations being issued by the central government and which conveniently bypassed legislative bodies. Despite still being applied today, China's access to the WTO and subsequent legislative harmonisation with international standards has reduced the occurrence of this type of policy innovation. Second to that are

experimental points, which manifest in model demonstrations and pilot projects that are limited to a specific policy domain. Such types of experiments are initiated by central as well as local governments alike, but still the centre takes the function of the overarching coordinator when it comes to upgrading pilots into national reform initiatives. The nature of pilots has changed insofar as provisions regarding establishment, objectives and legal embedding have become increasingly detailed and elaborate. Additionally, pilots are in most cases conducted in several locations simultaneously. The third category of experimentation manifests in experimental zones, in which local administrations are endowed with broad discretionary powers regarding legal matters. This includes the authority to draft and enact legislative measures, streamline the (economic) bureaucracy or to promote foreign investment. The most notable example for such a case of regional experiments is the Shenzhen Special Economic Zone, which has issued over 400 pieces of economic regulations between 1979 and 1990 and over time exerted a strong influence on national legislation regarding foreign trade and investment. Here again the significance of experimentation in the Chinese context cannot be understated: Practically all substantial reform measures – decollectivisation in agriculture, management reforms in SOEs, the establishment of equity markets and the reforms of the rural health care scheme – were derived from locally conducted experiments in which the central government maintained a coordinative and sometimes interventional role (Heilmann, 2008a, 5-9; Heilmann, 2016b, 301f).

From the analytical perspective of the model, policy experimentation in the PRC constitutes a significant mechanism to nurture innovation within the formal institutional domain: Selection can only generate alternations to old solutions or produce novel ones, if it is nurtured by information and learning feedbacks from preceding institutional application. Via policy experimentation decision makers at one level learn more about how to align the interest from other state actor groups. This is because the experimental dynamic is multidirectional, i.e. in some phases decentralised (initiation and execution) and in others more centralised (setting forth objectives, identification of successes, initiative to upgrade experiments to a broader scale) (Heilmann, 2016b, 302). In the political-economical field, Heilmann indicates that there are no purely top-down enforced and bottom-up induced experiments as most of them feature both elements to a similar degree. Nevertheless, even if the selection of local experiments is initiated by local state actors they will in advance secure informal backing of higher-level policy patrons so as to avoid risking their career prospects (Heilmann, 2008a, 9f). In order to guarantee a minimum of coordination and possibly also interest alignment frequent information and learning feedbacks take place between both sides: Once there is a consensus

over initiating policy experimentation, top-level actor groups try to broaden support for the process within their layer of governance. Additionally they will support the executing lower levels by providing expertise form advisors and researchers. Once inter-actor persuasion efforts at the central level have been successful and gained other actors' support for the experimental draft, national guidelines for pilots in a larger number of experimental points will be formulated. While the centre thereupon begins to provide subsidies to the local authorities in charge of experimentation, they in turn demand regular reports to be returned to the centre. In order to buttress this documentation, inspectors are dispatched to localities so as to evaluate pilot processes. Furthermore feedback and consultation are strengthened through official conferences during which experiences and results are communicated between central and local actors. In the case that these processes are met with success, the phase of proceeding from point to surface begins. Herein, emulation campaigns are initiated, and in the sense of spreading the learning feedback, a 'veritable policy tourism' sets in, during which outside delegations visit the model sites. Even before the transformation of a pilot into a law or regulation, complex processes of inter-ministerial reviews and consensus finding are conducted. Only if these do not lead to major objections, the final process of selecting an appropriate, nationally applicable regulation can be concluded (Heilmann, 2008a, 11). A good example regarding the evolution from a pilot to a national solution that (at least temporarily) overcame a conflict of interest between state actors is the Green GDP program. Based on initial pilots set out to assess environmental damage in terms of GDP loss, the idea gained a foothold within the central government under the leadership of Hu Jintao. As a consequence to his tacit approval for the concept the SEPA and the NBS joined forces to devise a new calculation method, i.e. institution, for assessing the impact of economic growth on the environment. The notable feature in this regard is that both agencies stood in initial contest for the supremacy of statistically interpreting the extent of the problem. It can thus be argued that the acceptance of the idea exerted sufficient pressure for finding an institutional compromise on a field stricken by contesting interests[32] (Weigelin-Schwiedrzik, forthcoming).

From what has been stated above, policy experimentation in China can lead to interest alignments between initially opposing actors, which in turn enables effective solutions regarding interest congruency. On the other hand however, the crucial question is whether this mechanism may also generate truly innovative and path braking results. In regards to the

[32] For the sake of completeness it should be noted that the article by Weigelin-Schwiedrzik also underscores the continuation of the contest between the NBS and the SEPA after the launch of the Green GDP in 2004. Nevertheless, the first instance of a compromise in interests and the temporary cooperation of both agencies constitute an interim solution to a particular problem that emerged on the basis of institutional experimentation.

analytical model of this thesis it must be asked whether policy experimentation can overhaul institutional selection within the formal domain, i.e. to fully address the challenge at hand, while ignoring vested interests. There a two viable answers to this query: On the one hand, Heilmann's analyses have shown that policy experimentation as it is currently conducted relies on compromises and consensus building within the centre as well as between central and local government actors. Under these conditions, radical innovation will be subjugated to the compromise process. On the other hand Heilmann also forwards the suggestion that experimentation under forceful leadership can result in a formal selection process that generates substantially new institutional outcomes. To buttress this argument Heilmann adduces the era of Premier Zhu Rongji (1992-2002) as example: Under his aegis, Zhu made extensive use of experimental point programs in the guise of incremental policy measures so as to push reforms while reducing risks of opposition from conservative actor groups. He thereby 'applied experimental schemes to smuggle changes into the system and …achieve objectives that would have been politically obstructed if revealed more explicitly beforehand' (Heilmann, 2008a, 21). An even more notable example for institutional change that was 'smuggled' into the system is the Household Responsibility System in agriculture: First tested at the local level, the concept was thereupon presented to central actors, who subsequently codified it as an institutional solution at the national level. A more recent case that however evolved top-down, is the Green GDP. The institutionalisation of this measure started as an initiative of central agencies, was launched in the form of a pilot and after its acceptance by the leadership local governments gradually began to pick up on this concept (Weigelin-Schwiedrzik, forthcoming). By implication, policy experimentation may sometimes facilitate selection by minimising consensus finding efforts and directly address the challenges at hand. So in regard to the above formulated question, policy experimentation may depending on the context satisfy both standards of effectiveness for institutional outcomes: On the one side it may achieve a realignment of interests between local and central actors. This in turn may lead to a balance in interests for selection and thus institutional outcomes (at least in political-economic domains). On the other side, experimental programs can also used to circumvent collision of interests at the central level, which in turn produced innovative and effective institutional solutions that overcame interest related deadlocks (Heilmann, 2008a, 22).

#### 6.3.2.2 Pilot programs and policy experimentation in the Chinese CE context

For the implementation of the CE in China, pilot programs and policy experimentation play a crucial role. A clear indication that confirms the pivotal function of experimentation for the

CE, is the high number of launched pilots in recent years: Up until 2012, central and local governments have implemented over 190 CE relevant pilot programs in China (Wang and Chang, 2014, 132) and there are strong signs that the trend of CE experimentation is going to continue. The NDRC has issued a CE Development Lead Action in 2017 (Xunhuan fazhan yinling xingdong 循环发展引领行动), in which much emphasis is given to pilot and demonstration projects regarding their role in advancing the CE development (NDRC et al., 2017).

The push for further experimentation comes as no real surprise: The challenge of maintaining high economic growth rates and simultaneously countering resource scarcities and environmental pollution still constitutes a novel and unique constellation for the PRC. So in order to advance the development of the CE, selecting the most effective institutional solutions must in essence follow a piecemeal approach. Formal institutional selection does in turn require involved actor groups to have a proper understanding of the situation and therefore pilot experimentation represents a highly suitable technique for two reasons: Firstly, experimentation creates vast amounts of learning feedback flows, which enrich the centre's understanding regarding local conditions and the effects of interim institutional outcomes. Herein, the above discussed variation in pilot types is especially valuable as it reflects how slight modifications in context and problem specific institutional responses manifest in solution performance. The most successful of these results are then submitted to the centre, which positively impacts the institution finding process at this level. Secondly, as a subordinated effect to the learning feedback, local pilots provide valuable lessons to actor groups on how selection works. Instead of first facing selection related collision of interests during the law-making process at the central level, pilot involved actor groups learn about how differing interest and value constellations affect selection in the course of the pilot. Trial procedures and pilot experimentation with interim solution outcomes do in turn enable all involved actor groups to gradually learn and adapt their expectations over the entire institutional selection process. .

These theoretical elaborations, on how policy experimentation creates beneficial effects for learning about institutional selection and outcomes, are bolstered by findings in secondary literature: McDowall and colleagues find that central policy makers perceive pilot experimentation as highly useful for the purpose of advancing the CE. The State Council has for example in a 2013 note emphasised how lessons from experimental CE projects can be used to inform future policy making. One of the most decisive insights herein revealed was

how pilots may help to overcome implementation gaps, which often occurred in the related field of environmental policy. In response to that decision-making actors in centrally issued CE pilots resorted to establish subsidy and funding mechanisms so as to incentivise local actors' achievement of CE targets. Despite some remaining challenges in implementation, CE related pilot programs at the city and the EIP level have nevertheless produced various successes in resource and energy efficiency (McDowall et al., 2017, 5f). CE pilots in Beijing have for example managed a 62% reduction in energy intensity and a 45% increase in waste water recycling. Notwithstanding the significance of the impressive figures, it has to be mentioned that these achievements emerged from very low baseline values. Similar trends have also been reported for pilots in the cities of Dalian, Shanghai and Tianjin. Here again the provision of substantial financial means proved to be pivotal for success (EMAF, 2014, 35).

In the above example, institutional solutions that were promoted via CE pilots originated from a selection dynamic, in which economic interests clearly dominated. Historically seen, dominating interests behind the selection of CE pilots were not always economic in nature. In fact the initial pioneering force behind CE pilot programs was the SEPA, which in 2002 set forth the basic administrative and managerial guidelines for CE experimentation (Baum, 2011, 21). In the 2003 Provisional Guideline for the Application, Designation and Management of Circular Economy Demonstration Zones the agency had put a strong focus on pollution management, resource and energy use as well as on supervision and management procedures. The document however remains silent on economic considerations such as profits, added value synergies or fiscal support measures (SEPA, 2003c). This particular actor dominance ended in 2005, when the NDRC assumed the lead role in initiating CE pilots and thus began to dominate the institutional selection process in CE experimentation. This particular shift in decision making power appeared to have originated in a consensus finding process, which was directed by the State Council. In 2005, it issued *Several Opinions on Accelerating the CE Development*. Therein, the section on 'principles and targets' (yuanze he mubiao 原则和目标) combines economic with environmental and resource related value ideals. While pollution and waste reduction and recovery are prominently highlighted in the first paragraph, economic considerations dominate the remainder of the section. The central elements of this initial section are requirements for increasing resource productivity, advancing new industrialisation, designating enterprises as pivotal actors and giving lead to the market, while reducing the government to the position of coordinator (zhengfu tiaokong, shichang yindao 政

府调控，市场引导).The orientation towards resource efficiency and economic performance is further buttressed by target indicators that exclusively focus on combining resource productivity with economic value generation, while environmental protection remains unaddressed (SC, 2005, section 1, par. 1-4).

The SEPA apparently acknowledged this shifting of authority regarding the guidance over the CE development. In the same year the agency issued its Guiding Opinions of the State Environmental Protection Administration on Promoting the Development of the Circular Economy. Herein, the SEPA requests all local EPBs to actively cooperate with local DRC on the development of the CE (SEPA, 2005a, section 2, paragraph 3), which essentially equals a ceding of parts of its authority over to the NDRC. In the same year, the NDRC took the initiative in matters of advancing the CE. With support from the SEPA, the Ministry of Science and Technology (MOST), the Ministry of Finance (MOF), the Ministry of Commerce (MOC) and the National Bureau of Statistics (NBS) it launched a new round of pilots. Herein a strong focus was laid on developing the CE in industry, establishing EIPs and eco-regions, whereby all segments were gradually expanded in size and numbers between 2005 and 2010 (Mathews and Tan, 2011, 438). The primary drive buttressing this growing coverage came mainly from providing subsidies from the central government to all pilot entities (Jiao and Boons, 2014, 21). As of now, the NDRC is the leading central state actor in China's CE pilot experimentation, while the SEPA and the MOF often act as supportive facilitators (Jiao and Boons, 2017, 17).

In regard to the selection of institutional solutions in China's CE – be it in the form of pilots or national regulations – Jiao and Boons (2017) have identified three different forms of actor group constellations: Firstly, the single agency approach for administrative implementation. From the very beginning this process is marked by an authoritative policy decision by a single governmental agency, which is also in charge of implementing, subsidising and monitoring the respective measure. This approach (for institutional selection) is chosen, if 'heavy-handed state regulations are needed'. Secondly there is administrative implementation in agency cooperation. Hereby several agencies decide jointly over a measure, while one acts as major coordinator. The coalition itself is based on a serious of actions conducive to achieve a compromise via negotiation, persuasion or power-play. Once such an alignment of interests is reached, the detailed selection of institutional solutions begins. Finally there is the single agency approach for experimental implementation. Herein, the guiding factor is uncertainty regarding the challenge and how to tackle it. The starting point is similar to the first case in so

far that one single agency pioneers the action through designating experimental sites. While different policy instruments (command and control, non-monetary incentives, subsidies) are used the agency is learning over the course of the pilot and in turn adjusts its goals and means accordingly (Jiao and Boons, 2017, 14). For this latter case of selection the dynamics in the PRC reveal a highly interesting element: Despite the acknowledged CE leadership of the NDRC, the MEP equally conducts its very own and independent CE pilot programs. Since 2005, both actors have sometimes in cooperation sometimes under individual aegis initiated pilots so as to develop CE principles and explore possibilities for industrial symbiosis (Mathews and Tan, 2011, 440). One notable distinction between the two is that the MEP is in charge of the National Pilot Eco-Industrial Park Program, while the NDRC is the main responsible actor behind the National Pilot Circular Economy Program (Su et al., 2013, 218). Here again emerges the question, whether these two fields of experimentation are clearly separated from each other or whether overlaps in terms of cooperatively selected projects occur as well.

One instance of overlapping, probably also competing responsibilities is represented in the experiment-ridden field of Eco-cities: Not only did the MEP and the NDRC independently recognise 103 and 36 pilot eco-cities respectively, moreover MOHURD listed another 17 eco-cities (de Jong et al., 2016, 32). There is a multitude of possible reasons that could account for this phenomenon, but in essence it can be argued that this outcome is related to the topic of institutional selection: Central actor groups may have learned over preceding cycles of institution finding that the implicated efforts for consensus finding and interest alignment are extremely high. Thus they may in some cases tend to go separate ways in finding and testing experimental solutions. The major benefit of such unilateral approaches is the particular actor's ability to dominate selection and thereby achieve a higher degree of interest realisation. An interesting insight on this aspect is found the pilot programs for Eco-Industrial Parks (EIP) and CE park estates (see chapter 7[33]). Despite the fact that both programs are conducted in a cooperative manner, there is a clear hierarchy in decision making, i.e. selection, which impacts the respective outcomes: While the EIPs program is lead by the MEP and foremost focuses on environmental aspects, the NDRC coordinated CE development zones centre on economic performance. However in both cases selection is not solely decided by the lead actors as they are supported by subordinated ministerial players. While this is in part owed to

[33] In chapter 7 the analysis will be set on the indicator systems and key documents for both types of CE park estates.

the complexity of both pilot schemes, the particular actor arrangement entails an impact on selection and thus implies a broader inclusion of actor-specific interests.

#### 6.3.2.3 Quantitative analysis and future outlook of CE pilot experimentation

In a concluding assessment of CE pilot experimentation in the PRC the following paragraphs will deal with two aspects: Firstly, a quantitative analysis of so far conducted CE pilot experimentation programs and secondly an interpretation of indications for future CE piloting will be conducted.

In regards to the first aspect, the main purpose is to highlight how central and local government selection processes reflect interest alignments and institutional feedback responsiveness. This analysis is based on the various CE pilot related regulations issued by the central and local governments, which can be accessed on http://www.pkulaw.cn/law. This platform has been established by the Faculty of Law at Beijing University in 1985 and stores the entirety of all publicly issued legislative pieces of central and local government levels since 1949. This includes laws (falü 法律), administrative rules and regulations (xingzheng fagui 行政法规), regulatory documents (faguixing wenjian 法规性文件), judicial interpretations (sifa jieshi 司法解释), ministerial regulations (bumen guizhang 部门规章), local rules and regulations (difangxing fagui 地方性法规), local government regulations (difang zhengfu guizhang 地方政府规章) and commonly used normative documents (changyong guifanxing wenjian 常用规范性文件). Furthermore, the archive is updated on a daily basis and incorporates newly issued regulatory documents of the central and local government within seven and fifteen days, respectively (see http://www.chinalawinfo.com/help/index.html?item=CLDWFLSW).

In order to extract the entirety of pilot regulations with CE relevance from this data base, the following approach has been taken: In an initial step, all centrally and locally (i.e. province and city level) issued legal documents were selected, which had the term ‘Circular Economy’ in their title. In second instance, out of these results all regulations were chosen that indicated a reference to pilot experimentation. Herein, the following selection criteria were applied: ‘demonstration’ (shifan 示范), ‘experimental point’ (shidian 试点), ‘trial implementation’

(shixing 试行), 'experimentation' (shiyan 试验) and 'provisional implementation' (zanxing 暂行). The thereof derived regulations relate to pilot experimentation insofar that they either initiate a pilot or demonstration project or that they provide administrative amendments to a particular (set of) pilot(s).

Several results can be obtained from this method. First of all the quantitative assessment of pilot regulations reveals a relatively high degree of CE related experimentation at central and local levels. This becomes evident if the quantities of CE and CP pilots are compared (Figure 8).

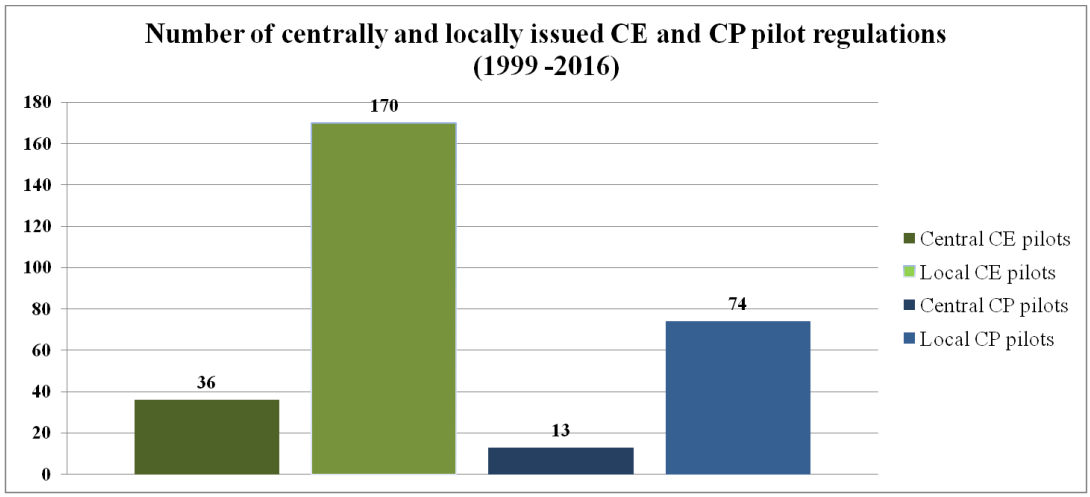


**Figure 8. Comparison of pilot quantities in the CE and CP (the author based on pkulaw.cn)**

As can be discerned from the above figure the number of regulations for CE experimentation by far exceeds the amount of pilot related regulations for CP. Among these regulations, as is the case for the subsequent figures below, some initiate a pilot or demonstration project, whereas others provide some administrative amendments or revisions to particular pilots. So what can be derived from the above finding? In essence, some arguments and interpretations are feasible: Firstly, within the subject matter of policy experimentation, the CE has received much more attention than CP. Given that the earliest CP pilot was issued in 1999, three years before the first CE pilot, this aspect is particular revealing in regards to the PRC's national economic strategy: The focus on CE related experimentation may be attributed to the concept's significance as a national development strategy. The CP scheme, on the other hand, has received much less emphasis in the national policy agenda[34]. There is yet a second

[34] A useful indicator that exhibits the different emphasis of both concepts is the current 13th five-year plan: Therein, the CP idea is mentioned only once (art. 44, sect. 2), whereas one entire section is dedicated to the CE (art. 43, sect. 5).

possible explanation to this particular difference. The high pilot numbers in the CE could stem from the relative more complex concept of the CE. This is not to state that realising the CP is anywhere near of being a simple task. However given that the CP focuses on industrial production, its applicative dimension is relatively limited if compared to the encompassing scope of production, consumption and recovery addressed by the CE. By implication a higher degree of inherent thematic complexity might thus explain the demand for more intensive experimentation.

When assessing this quantitative peculiarity over a timeline that encompasses the earliest pilots as well as the most recent ones, first indications of a local-central correlation in institutional selection become visible. Figure 9 depicts the number of annually issued pilot specific regulations for the CE and CP at central and local government levels. Additionally, the figure displays the implementation dates of two national key regulations – the CEPL and the CPPL.

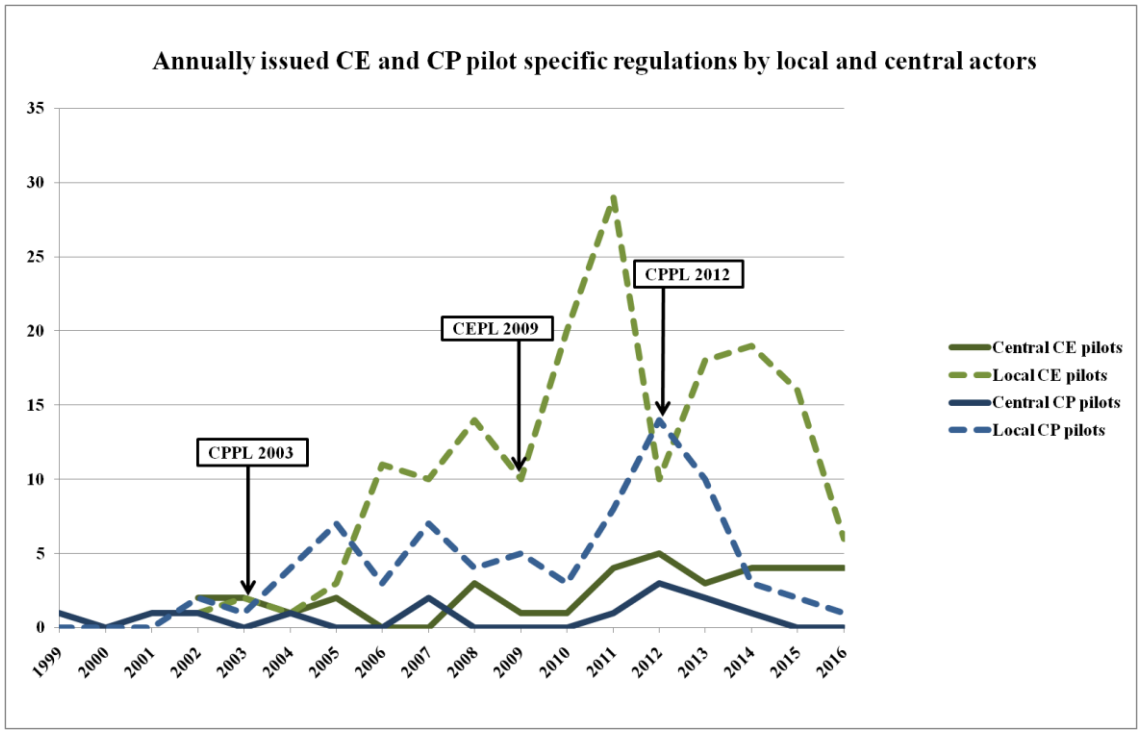


**Figure 9. Annual numbers of CE and CP pilot regulations issued by central and local governments ( the author, based on pkulaw.cn)**

The first observation to take away from this depiction is the distinct pace in the issuance of pilot regulations by central and local administrations. While CP and CE pilot regulations at the centre only exhibit slight variations in terms of annually issued numbers, local regulation quantities fluctuate quite extensively. In fact, it appears that periods with a more intensive pilot regulation output were in two instances triggered by national key laws: After the 2003

CPPL and after the 2009 CEPL the number of respective pilots at the local level featured a notable surge in annual output. What seems to be manifested herein is a responsive dynamic between local pilot experimentation and national law-making, which operates in reverse to Heilmann's tenet 'experimentation first, laws later' (2008a and 2008b). This analytical gap can however be bridged by the methodological framework of this thesis: In first instance, institutional solutions are selected at the national level after preliminary (pilot) experiences on problem-solution cycles have been gained at the local level. After an institutional solution is selected at the national level, local governments are faced with the challenge of how to implement the new solution within their administrative borough. In order to adapt the national solution to local requirements (yindi zhiyi 因地制宜) further trial efforts are required. The hereby generated institutional variation produces information feedback flows to local as well as central decision-makers, which in turn further propels institutional innovation at both levels.

The subsequent question then is why annual CP and CE pilot regulation quantities at the local level feature a significant decline after 2012 and 2013, respectively. In this regard, three possible interpretations can be offered to explain this development: Firstly, the incorporation of CP into CE pilots; secondly, the achievement of an effective institutional framework for the implementation of both concepts; thirdly, the revision of both national key laws, which entails a reluctance among central actors to support local experimentation; The first interpretation is based on legal amendment processes and the thereof resulting revision of the CPPL in 2013.Herein, an indication for the merging of CP with CE practices stands out: Article 19 of the amended version for example states that 'cyclic use' (xunhuan shiyong 循环使用) should be applied to all types of waste generated in the production process (NPC, 2013, art. 19, sec. 3). Albeit representing the only reference to the CE in the entire law, one thereof derived argument could be that CP piloting has been increasingly incorporated in CE pilot processes. While this development may explain the reduction in CP pilots, it yet does not account for the simultaneous decrease in CE experimentation. More convincingly therefore is the second interpretation derived from the methodological model of the thesis, namely that institutional selection strives towards achieving relatively effective solutions. By implication, the amended CPPL of 2013 may imply such a type of effective solution: Be it either in terms of tackling a particular challenge, or achieving a sufficiently high degree of interest alignment, or even both. This in turn vastly reduces the need to conduct pilot experimentation and issue respective regulations, except for the above described necessity to adapt central rules to local conditions. In fact a similar explanation can be applied to the developments in CE

experimentation: After the SC has issued its 2013 CE Development Strategy and Action Plan, which the Pkulaw platform categorises as administrative rule, CE pilots first experienced a short surge and then a relatively steep decline after 2014. However in contrast to the CP, no revised CEPL has been published, which begs the question of why pilot experimentation has been reduced to this extent. And yet there are some indications that would suggest the occurrence of a similar process for the CE in the near future: Between late 2016 and early 2017 several reports – some from government websites – have surfaced that indicate a revision of the CEPL in the near future (Qqddc.com, 2017; Chinacace.org 2017; EPRC, 2016). Thus the third interpretation regarding the reduction in CE relevant experimentation might be of a pre-emptive nature, namely in response to a looming revision of the CEPL. This assumption is based on Heilmann's analysis according to which local experimentation often requires the backing of central stakeholders. By implication, such support could be denied if central government stakeholders were to know that a particular policy field is going through modifications at the central level. The announcements regarding the revision indicate substantial changes, e.g. in waste management, and thus presents a strong argument for an interim stop of pilot experimentation. Once the amended version is in place and thereby provides updated institutional orientation and guidance, pilot experimentation can be expected to increase again.

A third example of central-local coordination in institutional selection is reflected in the thematic focus of the CE: the CEPL has designated various possible applications for CE practices and herein three major resource-specific domains stand out: Waste materials are discussed in 20 out of 58 articles (NPC, 2008, art. , 4, 9, 10, 15, 17, 19, 22, 23, 26, 29-31, 33-38, 46), water in 18 (ibidem, art. 10, 13, 16, 17, 20, 22-27, 29, 31, 44-47, 53) and energy in 11 (ibidem, 10, 16, 17, 23-26, 29, 44, 45, 47). The respective search of the three topics in central and local pilot regulations has shown that this composition is mirrored in the particular thematic choice of local and central CE pilots (Figure 10): Clearly waste related challenges have received the most attention in policy experiments, followed by water and then energy. These results might either be mere coincidence, or demonstrate another indication for interest alignments between the central and local government actors. At the same time, this pilot selection preference could also reflect the actual urgency of CE specific challenges: While water and energy intensity in production constitute significant challenges, there have been several measures in the past to address these. Waste and respective recycling operations on the other hand constitute a relatively new challenge, and have so far received comparatively

little official engagement. For this reason, pilot experimentation may have therefore been especially vivid in WM.

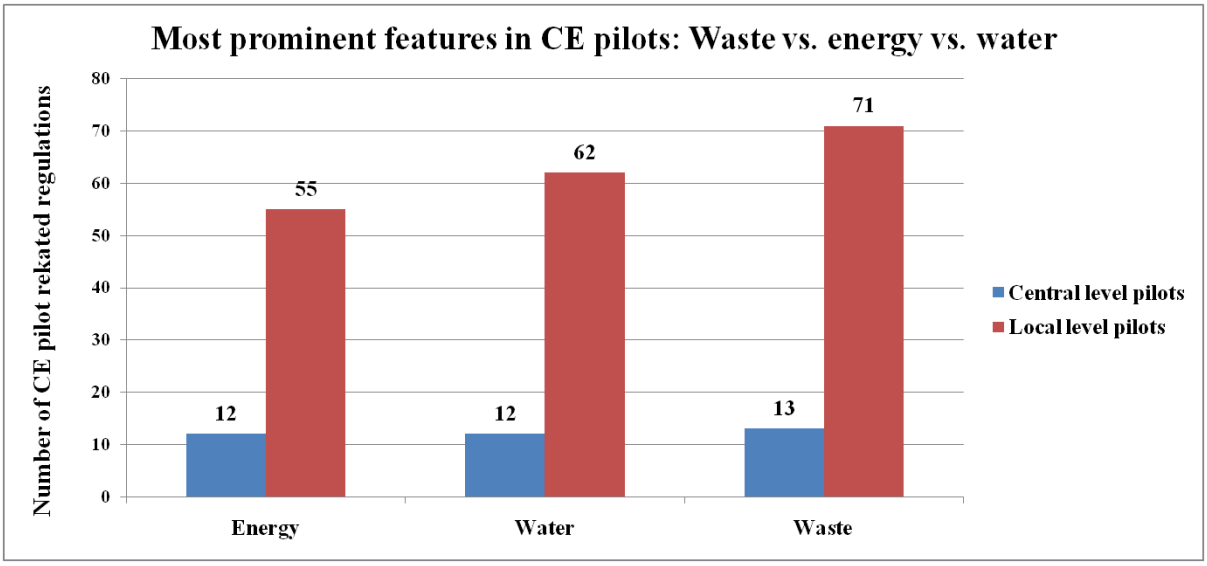


**Figure 10. Comparison of most prominent features in pilot experimentation (the author, based on pkulaw.cn)**

A final example of local and central correlation is shown in the utilisation of the 3Rs. For this purpose all CE pilot regulations issued by the centre have been analysed with regards to their use of 3R related notions[35]. As can be seen from Figure 11 below, recycling clearly dominates central and local pilots, while reuse and reduce come second and third, respectively. Moreover the figures show that the proportions of the respective CE values are relatively similar at central and local levels. This in fact reflects the particular priorities that have already been expressed in the CE Development Strategy and Action Plan issued by the SC in 2013 (see chapter 5, Figure 7).

[35] The method for this procedure is the same as applied in section 5.6 of the preceding chapter: Basically all pilot regulations have been examined in regard to the use of 3R related notions.

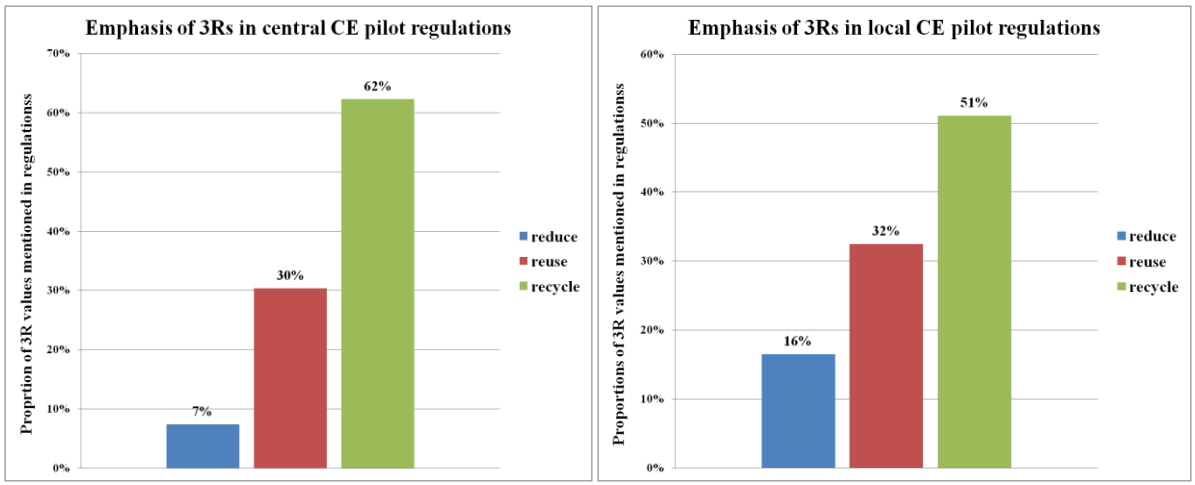


**Figure 11. Emphasis of the 3Rs in central and local regulations on CE pilots (2002-2016) (the author, based on pkulaw.cn)**

The second part of this analysis is centred on interpreting recent policy documents of the central government in regards to the role assigned for policy experimentation in the future. In a notice on the ecological and environmental protection plan, which is published within the scope of the 13th five-year plan, a promotion of policy experimentation is clearly discernible: In order to realise an ecological civilisation in China, the document emphasises the need for an increase in the build-up of experimentation zones (shiyanqu 试验区) such as EIPs. The rationale behind this step is to advance 'system innovation, the supply of institutions and model exploration', which should be conducted along the *selection criteria* (yi…wei mubiao, 以…为目标) of improving ecological and environmental quality and promoting green development. In regards to the shape of these experimentation zones, the same paragraph states that pilot structures should be established in a 'unified and standardised' form (tongyi guifan 统一规范) (SC, 2016, art.10, section 4). If translated into the language of the model, this guideline can be interpreted as a search for new institutional solutions with preselected value categories. However the provision to establish unified and standardised structures indicates a curtailment in terms of the variation of outcomes: Therefore, the request for coherent initial results may be interpreted as the need to gain normative experiences first, before engaging in subsequent cycles with more leeway for variation. By implication, these provisions would imply that the ecological civilisation concept is still in its very beginnings.

In direct comparison, most recent strategy positions on the future of policy experimentation in the CE convey a more elaborate picture. A highly notable document within this subject matter is the 2017 CE Development Lead Action (Xunhuan fazhan yinling xingdong 循环发展引领

行动). It arguably constitutes a highly authoritative strategy paper as it has been lead-authored by the key player in China's CE, the NDRC. The entire document comprises 43 articles, out of which 40 are content related. The need for pilot experimentation is explicitly stated in 22 of these articles (NDRC et al., 2017). If grouped into broader categories, six thematic clusters can be discerned (see Figure 12).

| Waste | Industry | EIPs | Cities and provinces | Product | Macro institutional changes |
|---|---|---|---|---|---|
| Collection and recycling of low value waste (organic waste, construction waste) | CE synergy between industry and agriculture | Eco-Industrial Parks: Transferring industry from cities to EIPs | Eco-Cities – evaluation of so experiences | green design – combine product design, production, user and recyclers | Summarise and propagate CE pilot experiences |
| MSW and Industrial waste | CE indicator system in key businesses | | Eco-cities – resource productivity indicators and evaluation of performance | CE innovation in green design, recovery alliances, extended product use, cooperation in sharing systems | Reforms in resource pricing: energy, water |
| Mineral reuse and recycling | Demonstration projects for the synergy analysis of industry and agriculture | | Trans-boundary CE system in the Beijing, Tianjin, Hebei area | | CE education for society |
| Urban mining – sunk waste materials | | | | | |
| Recycling of waste from modern products (solar panels) | | | | | |
| Remanufacturing of electronic products | | | | | |
| Extended Producer Responsibility-pilots with collection targets | | | | | |
| Resource circulation systems in cities – focus on waste material flows | | | | | |
| Industrial resource reuse and recycling | | | | | |
| Promulgation of remanufacturing efforts | | | | | |

**Figure 12. Thematic clusters for pilot experimentation in the 2017 CE Development Lead Action ( the author, adapted from NDRC et al., 2017)**

As shown in the above depiction, the topic of waste constitutes nearly 50% of suggested pilot experimentation for the future development of China's CE. According to the logic of the theoretical model, institutional experimentation represents a proxy for the search of new institutional solutions to particular, yet unresolved problems. By implication, a relatively pronounced emphasis to conduct pilots within a specific thematic field indicates a certain priority for institutional solution finding. Within the subject matter of WM, the lead action puts a strong emphasis on reduce and especially reuse (refurbishment and recovery) activities, which indicates a shift from the previously salient, unilateral promotion of recycling. Particularly the aspect of reuse is reflected in such items as 'mineral reuse and recycling', 'remanufacturing of products', 'industrial resource reuse and recycling' and 'promulgation of remanufacturing efforts'. Given that waste related piloting is particularly prominent in the lead strategy, it can be assumed that future pilot efforts in the CE will to a major extent revolve around the topic of WM.

## 6.4 Formal institutional outcomes

### 6.4.1 The institutional evolution of the CE and the function of pivotal laws

According to the methodological model, institutional outcomes of a singular cycle of institutional solution finding are the result of particular interest group constellations and thereof generated selection processes. For the broader subject matter of the CE, institutional solutions moreover represent results of a longer, ongoing learning process. The following paragraphs in this section aim to discuss two questions regarding institutional outcomes of the Chinese CE: Firstly, the section will concisely summarise which other sources, apart from domestic experimentation, influenced the institutional outcomes in China's CE. Secondly, the investigation centres on the key or pivotal laws within the CE framework in the PRC to highlight their role for the evolution of this system.

With regards to the first query, a general feature of formal institutional solution finding in China is the tendency to consult and emulate foreign regulatory systems. After the official acknowledgment of the PRC as a 'socialist market economy' in 1992, policy makers have referred to foreign legal structures so as to remodel the PRC's commercial law (Heilmann and Stepan, 2016, 111). A similar trend can be discerned for the CE: In the field of WEEE management the most fundamental regulations are the 2009 China WEEE directive ('The Regulation on Management of Waste Electrical and Electronic Equipment, Recycling and Disposal') and the 2006 China RoHS ('The Regulation for the Control of Pollution caused by Electronic Information Products')[36]. In terms of content and function both legal pieces emulate the preceding versions issued by the EC (Salhofer et al., 2016, 28). In terms of institutional solution finding this learning process constitutes a transfer of foreign experience to the Chinese institutional framework. In fact, the Chinese CE concept itself has been inspired by and in many instances introduced on the conceptual basis of the German and Japanese CE (Zhu, 2008, 2f). The obvious rationale for such legal imitations is based on their appealing characteristic as tested and certified solutions to particular problems in country-specific institutional contexts. On the other hand, however, borrowing and translating exogenous institutional solutions entails issues such as value dissonance and thus a possible incompatibility for the domestic legal system. Their application may in turn require additional experimentation so as to properly synchronise the solution's function with the conditions of the actual challenge.

[36] The dates of both laws indicate the years of issuance, not of their legal effect.

Apart from introducing systemically alien rule solutions, the institutional outputs of China's CE and the broader domain of environmental protection feature another notable characteristic. Over the first three decades of reform and opening, environmental law has constituted the most rapidly developing legislative field. Wang Canfa attributes this particularity to the severity of China's environmental problems and the urgency to remedy these (Wang, 2010, 495). Indeed the Chinese central government has responded rigorously to the environmental challenge: Since the early 1990s, the quantity of annually issued normative legal documents has been constantly increasing and reached a temporary peak of over 600 regulatory documents published in 2014 alone (see Figure 13).

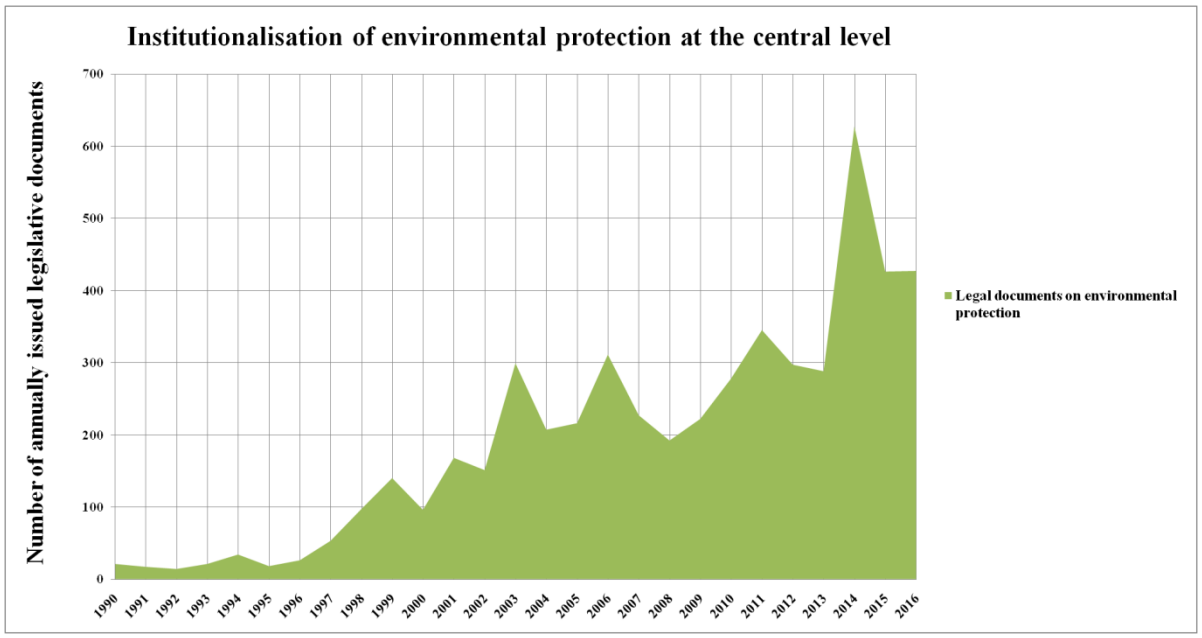


**Figure 13. Normative documents on environmental protection issued by the central government (1990-2014) (the author, based on pkulaw.cn)**

This dynamic of institutional responses to environmental challenges has also been extended to the domain of the CE. During the same timeframe, the central government has equally strengthened the institutional build-up of natural resource protection and the CE, within it most prominently WM. Casting aside the aspect of institutional effectiveness, this sheer strengthening of the institutional framework can be seen as a major success of China's CE development.

As can be discerned from Figure 14 this regulatory growth does not follow a linear trajectory. Rather, the legal development resembles a fluctuation in annually issued regulations, which at times exhibits periods of sudden increase vis-à-vis periods of decline. This pattern appears to be linked to the emergence of what can be termed as key or pivotal laws of the CE. These

legislative measures of the highest order appear mostly as triggers for and in some instances as results of increased regulatory issuances in the domain of the CE: Key laws thus either emerge as a result of preceding, increased regulatory build-up or trigger a new wave of regulatory measures. By implication, they represent decisive nodes that structure the path of formal CE institutionalisation and in further consequence shape the larger process of CE evolution. Clearly, there is some ambiguity to the question of whether these pivotal institutional outputs guide or rather *are* guided by the broader regulatory development. However, the perspective of the methodological model offers a much simpler explanation to this conundrum: Any solution to a particular challenge simply marks the beginning of a new problem-solution cycle. Such a challenge might be tackled by interim (trial) regulations first, which subsequently give rise to a broader and encompassing solution, such as a pivotal law. In further consequence such pivotal laws might also constitute a challenge for implementation, which then requires subsequent regulations to clarify the detailed procedures for solution application. What this continuous cycle of formal institutional innovation in the environmental and economic domain depicts is the larger process of sequential learning.

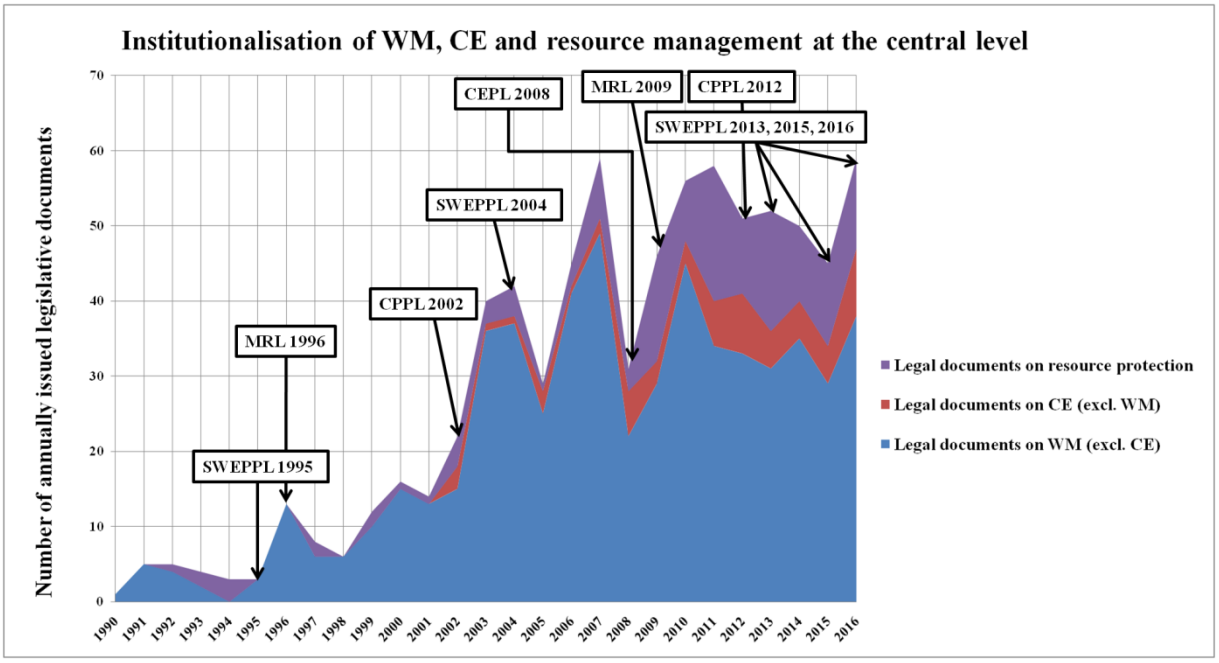


**Figure 14. Annual numbers of legislative documents on the CE, WM, environmental protection and resource management (the author, based on pkulaw.cn)**[37]

[37] The dates of herein listed laws and regulations are those of issuance, not of their legal effect. The abbreviations of these laws are: Law for the Prevention of Environmental Pollution through Solid Waste (SWEPPL), Mineral Resource Law (MRL), Cleaner Production Promotion Law (CPPL) and Circular Economy Promotion Law (CEPL).

Within this continuous cycle, the CE constitutes one pioneering, but yet only interim result. By implication, formal institutional innovation in economic-ecological domain in the PRC may well develop beyond the CE. It might for example be safe to assume that an entirely new paradigm that is derived from the CE and other preceding concepts may emerge in the near future. The institutional pillars upon which such a new development agenda arises are the various key laws established during the development phase of the preceding development strategy. So while the CE may provide the conceptual values for the new political concept, its respective institutional scaffolding might be built upon the key laws of the CE. A piece of evidence for this hypothesis is the institutional inheritance or progeny, which manifests in the sequential emergence of the CP and the CE. Albeit that the CP concept has never reached the same level of political significance as the CE, it comprised ideas of WM and sustainable production that subsequently were also incorporated in the CE.

Any such paradigm tends to address a broad range of fields and challenges. Hence, the capacity to represent an effective solution to the various challenges depends on the particular institutional subcomponents of this agenda, such as laws and regulations. In the case of the CE with its plethora of regulations, some central or key laws have through their very issuance strengthened the institutionalisation of the concept. Since the 1990s those laws with high CE relevance encompass: The Environmental Protection Law (EPL, 1989 and 2014); the Law for the Prevention of Environmental Pollution through Solid Waste (SWEPPL, 1995, 2004, 2013, 2015, 2016); the Cleaner Production Promotion Law (CPPL, 2002, 2012); the Energy Conservation Law (ECL, 1997, 2007, 2016); the Renewable Energy Law (REL, 2005, 2009); the Mineral Resources Law (MRL, 1986, 1996, 2009); the Water Law (WL 1988, 2002, 2009, 2016); the Water Pollution Prevention Law (WPPL, 1984, 1996, 2008, 2017)[38].

In regard to these, secondary literature has identified the SWEPPL and the CPPL as most significant for the promotion of CE related ideals: The former provides an operative foundation and playing field for subsequent CE initiatives in WM (Su et al., 2013, 218; Winans and Deng, 2017, 827) as it pioneered the regulation of a domain that was previously guided by policy measures alone (Steuer et al., 2015, 3). The latter established regulatory solutions, such as Eco-design and Cleaner Production principles, which are designated to facilitate implementation at the enterprise level (Geng et al., 2010, 1503). Such complementary features that strengthen the overall solution effectiveness of the CE are also provided by the other key laws and respectively subordinated regulations. In fact a content

[38] The dates of the above listed laws are those of issuance, not of their legal effect.

analysis of these pivotal laws regarding their emphasis of the 3R values indicates their strong connection to the CE (see Figure 15). Regarding this institutional system from a macro-perspective, it does seem that the CE effectively combines economic with resource and environment related legal rule structures within one encompassing framework. By implication, the 3R key values of the CE also influence the revision of these key laws and thereby extend their regulatory scope and impact.

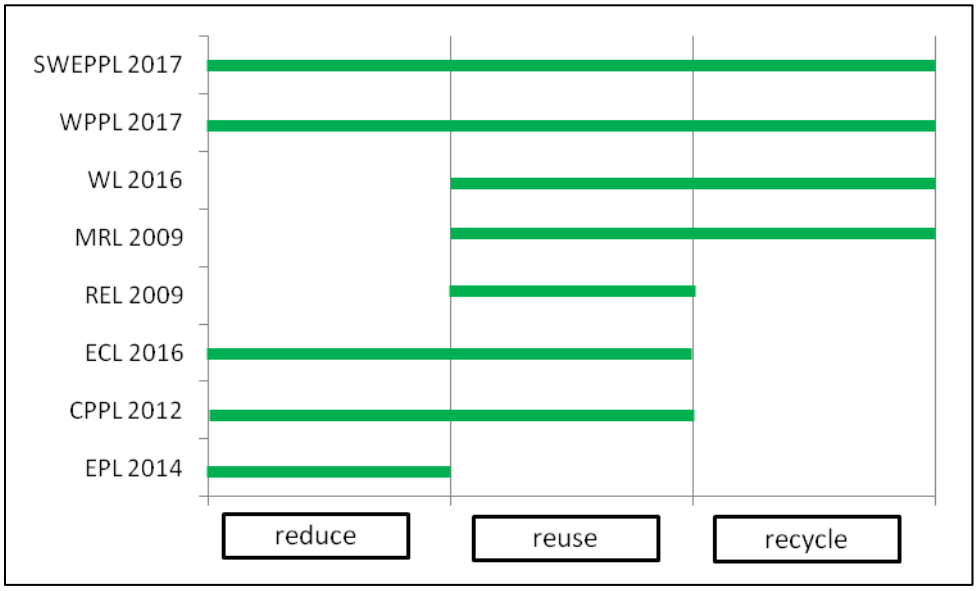


**Figure 15. Occurrence of the 3Rs in pivotal laws of the CE institutional framework (the author)**

Within this institutional framework that has been built in support of the CE development, one important feature is the frequent revision of the key laws. This particular dynamic is exhibited in the four revisions of the SWEPPL, the three revisions of the WL and the WPPL and the two revisions of the ECL and the MRL. On the surface it would appear as if these significant legal pillars of the CE development paradigm are in themselves anything but stable. From the perspective of the methodological model these modifications however hint to a very active learning and adaption process, which assumedly originates from overall information feedbacks within the system.

Particularly the case of the SWEPPLs demonstrates that a higher temporal frequency of amendments is positively correlated with a more intensive feedback flow of information. This information either conveys new value concepts promoted by the government or constitutes the learning results of earlier practiced institutional solutions. By implication, the formal institutionalisation process towards the CE that currently occurs in the PRC constitutes a complex process of institutional revaluation and thereof resulting adaption of institutional

outputs. The SWEPPLs serve as a good case to exemplify that the overhauling of an existing solution serves its closer alignment with CE principles: The reuse concept, which has received only marginal emphasis in the initial version of 1995, has become ever more prominent in the revised version of 2013[39]. According to the logic of the model, these modifications can be traced back to a change in awareness levels of policy makers from practical experience, e.g. through the application of pilots. What thereupon manifests in the form of legal revisions and amendments can be interpreted as the result of an institutional learning process. The anticipation of such a need for changes, which can be safely imputed to central policy-makers, entails significant implications for the matter of solution output design, i.e. selection: Novel institutional solutions have to feature a particular degree of latitude so as to enable flexibilities in the process of implementation. Over several cycles of application and via the execution of pilot programs valuable learning feedback cycles can, and in the above cases have, lead to revisions of the initial institutional solution or to the issuance of supportive legal measures. For the formal domain, the ultimate goal at the end of this process is to create institutional solutions exhibiting the two dimensions of effectiveness: The 'finalised' solution output should on the one hand solve the designated challenge and on the other hand constitute a compromise in interests of the involved actor groups[40].Zhang et al. (2015a, 2f) have documented the difficulties of this cumbersome process of solution-finding that unfolded during the issuance process of the new EPL in 2014. Herein, the double focus of compromise and challenge solution effectiveness can be clearly discerned. However, because of the fact that the entire institutional realm with formal and informal domains of rule making is constantly changing along an unforeseeable evolutionary trajectory even finalised solutions are in essence only of an interim nature. Hence, it can be expected that the central pillars of the CE institutional framework will continue to be subject to modifications as was the case for the past years..

The pivotal laws not only serve the particular purpose of strengthening the CE paradigm at the horizontal level, but also exert a guideline-providing function along the vertical governance hierarchy of the CE. According to a theoretical analysis on the PRC's legal system, institutional outputs can be classified along a hierarchy of significance. Herein, a cardinal law such as the constitution ranks higher than fundamental and general laws, which again take precedence over by-laws and regulations. In this context it is important to note that lower-

[39] In the 1995 version the reuse concept occurs in 10 articles, whereas the 2015 features 22 mentions.
[40] For a more detailed analysis of the feedback process from pilots and subsequent amendments of the national institutional framework the reader is referred to the dynamics in WM, which are treated in chapter 8.

level regulations play a more important role for actual policy implementation and guidance as they feature a higher degree of specificity and detail (Zhang et al. 2015b, 501). These institutional tier systems that vertically focus on one specific topic within a broader domain also occur within the CE. Mo et al. (2009, 411) have for example outlined a vertical institutional tier structure for WM within the CE context. Despite some arbitrariness in regard to the organisation of their tier hierarchy, the analysis nevertheless provides a useful impression on how more fundamental laws manage to embed a plethora of subordinate regulations within one functional body. Similar examples are also found in other domains of the CE, such as WEEE management (see Figure 16). At the top, three fundamental laws define the conceptual basis for WEEE management, i.e. the CPPL, the CEPL and the SWEPPL. The WEEE directive (2011) at the next lower level can be seen as a refined result serving two purposes. Firstly, it incorporates the institutional value concepts of the pivotal laws: This includes the CPPL's thematic highlighting of hazardous substances (NPC, 2002, art. 28), the 3R ideals of the CEPL and WM strategies of the SWPPL. Secondly, the directive also provides a thematic superstructure that consolidates management measures and regulations at the next lower tier, which emerged from preceding or subsequent institutional solution finding cycles.

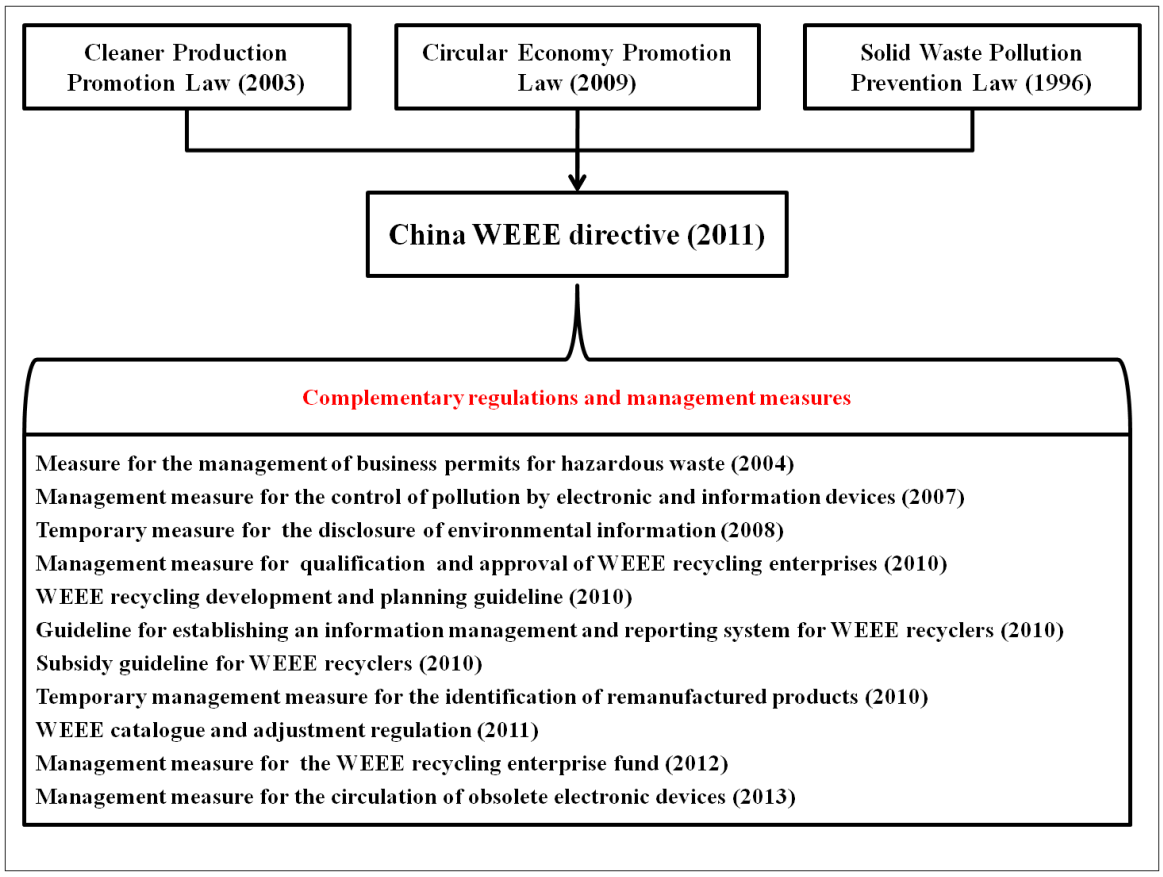

**Figure 16. Overview of China's regulatory body for WEEE management (source: Steuer, 2016b)**[41]

This type of structuring institutional outputs along horizontal and vertical tiers facilitates the integration of otherwise isolated management measures, which in the case of the CE are organised around an inner network of pivotal laws. As depicted by the intensity of revisions, this interior scaffolding of key institutional solutions may from time to time receive upgrades and modifications. Nevertheless, it constitutes an orientation-providing and flexible system that can be expanded in terms of new institutions at lower or higher tiers, should the constellation of challenges require such. In regards to problem-solving capacity, developments in China's formal institutional CE set-up have so far shown that the system increases in solution outputs and thereby theoretically strengthens its inheritance portfolio for tackling respective challenges. These tier-laws therefore establish a legal network that provides a structure and regulatory orientation, which over evolutionary sequences of solution-finding expands and subsequently strengthens the formal institutional framework of the CE.

### 6.4.2 Variation in institutional outputs within the CE

The primary challenge of the central government in the context of the CE is to devise institutional solutions that fulfil two functions: On the one hand, such solutions need to advance CE practices in the economy and thereby promote economic growth, which constitutes the central focus of the Chinese CE. On the other hand such institutional outputs also need to at least partially account for the broad variety of interests of state and non-state actors involved in the CE. Together with the broad array of different challenges that exist within every domain of the CE, such as WM, formal solutions within one particular realm are likely to exhibit degrees of variation in their particular characteristics.

In regard to the analysis of variation in the formal domain, two aspects need to be taken into consideration: Firstly, the herein discussed types of solution variation in the formal domain only constitute one side of the evolutionary coin as the informal or bottom-up domain is mostly excluded in this chapter. Therefore the below presented discussion on formal solutions deals with variation in outputs that emerge from and are constrained by pre-defined and preset combinations of vested interests of state-actor groups. Secondly, the variation of formal institutional outcomes in the formal domain is confined by the array of those political-economic governance strategies that are available to state actors. Based on the analysis of the

[41] The herein given dates for the regulations indicate the respective years of legal effect.

CEPL, it can be discerned that the central government particularly emphasises two dimensions of operative mechanisms for the realisation of the CE in China. The first mechanism manifests in the forms of economic coordination, i.e. coordination through the market vis-à-vis a top-down, statist type of coordination. The second mechanism manifests in the characteristic of policies and regulations, which can be either coercive and obligatory or normative and voluntary in nature. Herein, each dimension is confined by two antagonisms that define the array of possible solutions. For example in regard to economic coordination, the market is one, whereas the state is the other. By implication, in both dimensions the variation in institutional outputs is limited to an array that is preset by these in nature antagonist mechanisms or characteristics. This does however not imply that solution outputs only make use of one alternative, while excluding the opposite one. Rather variation in outputs occurs, because institutional solutions combine features from each of the opposing mechanisms or characteristics.

The first aspect to discuss relates to the forms of economic coordination in the CE. Given that the PRC's CE strategy exhibits a multitude of policy documents that propose varying institutional outcomes, this paragraph will focus on variations in one element, namely market-based economic coordination. In this regard, the CE has been hailed by commentators as being the first notable economic-ecologic paradigm in China that promotes the market mechanism and economic incentive measures for the purpose of realisation. The latter for example includes fiscal, financial and pricing policies (CCICED, 2010, 227). Xue and colleagues attribute this shift to a change in government philosophy at the central level (Xue et al., 2010, 1297). However, these assessments neglect that the CE is primarily an economic development strategy. Given this particularity, the concept had by design to be aligned with economic interest groups (see the discussion in section 6.2). In contrast to these assessments more critical observations actually reveal the as of now still existing dominance of command and control approaches in China's CE compared to CE practices in the EU and Japan (Ghisellini et al., 2015, 18). Despite the fact that the CEPL highlights market orientation and the coordinative function of markets in waste recovery and exchange (NPC, 2008, art. 3 and 37) the general theme of the law however alludes to a preference for statist means of coordination (ibidem, art.5 and 6). In fact, the options for employing market coordination for the material flow focussed CE in China were to some extent thwarted by an irrational natural resource pricing system: The pricing mechanism only considered acquisition costs, neglected environmental externalities and thus lead to environmentally and economically inefficient allocation processes (He, 2012, 19). Since 2016, however, the government has begun to

implement a comprehensive tax reform: This measure abandoned the 20 year old quantity based pricing principles in favour of an ad valorem tax approach, which ascertains the real, market determined value of the resource in question. Apart from this strengthened consideration of actual value and fluctuations of the resource market price, provincial governments have now been allowed to adjust tax rates within a preset margin determined by the central government (Chan and Li, 2016). Altogether these steps indicate a more decentralised, market based approach to resource pricing. Additionally, the reforms also include preferential policies for those enterprises that engage in the recovery of secondary or waste resources (Shira, 2016).

These legal changes exemplify that China's official CE development strategy, at least rudimentarily, opens up institutional space for a market-based coordination of the economy. Moreover, as already indicated in the CEPL, WM related activities appear to be one field of application for such market coordination. In order to pinpoint the range of variation in this particular domain, it is worthwhile to analyse policy documents on WM and clarify the suggested use of market principles. Within this subject matter, it needs to be emphasised again that different interest group specific actors have different opinions on the institutionalisation of the market in solution outputs. The SC for example identified the market as a means to improve the recovery rate for discarded products (SC, 2012, art. 1, sect. 1). At the same time however, the SC calls for the implementation of strict monitoring, control and registration measures so as to curtail too excessive and unrestrained market forces. Instead the aim is to create an orderly form of market environment for the take back and recycling of discarded goods (ibidem, art. 7, sect. 16). In terms of explicitness, this stance appears to be as good as it gets, when compared to many other regulations issued by SC as well as individual ministries. For example, in the 2013 notice on the strategic development of the CE, the SC only assigns the role of resource allocation to the market as well as mentioning the market's price building potential for resource goods (SC, 2013, art. 2. Sect. 2 and art.8, sect. 1). Equally the MIIT sees the market as main mechanism for effective resource allocation (MIIT et al., 2016, art. 2) and so does the NDRC in its opinions notice regarding the accelerated development of the recycling industry (NDRC et al., 2017, art. 2). Both however see the market only as pars pro toto, which has to be supplemented by the statist coordination of the economy. So far there is little indication for variation, when it comes to state actors' institutional outputs including market coordination.

This impression however changes, once WM relevant, institutional solutions of the MOC are investigated: In 2010, the ministry has issued ideas for a guideline of the recycling industry. Herein, it demands for a perfection of the market mechanism's capacity for so called collection and distribution markets (jisan di 集散地) for recyclables, especially in regards to transactions and information management (MOC, 2010, art.3, sect.1). This stance towards market coordination marks a significant deviation from what has been presented in institutional outputs from other ministerial actors. However, the MOC goes even one step further. In the same article it furthermore suggests to use the market dynamics combined with regulatory measures to organise and consolidate household enterprises (getihu 个体户) so as to align them with the overall recovery network (ibidem, art.3, sect. 3). In the context of Chinese WM, household enterprises are used synonymously with the informal sector, which in turn makes this document especially notable: Not only does it mark the first attempt of state actors to address and engage with the informal sector. Moreover this particular solution output has selected the market as institutional means to coordinate the segment. Instead of representing a single variation to the otherwise relatively uniform approach, the MOC has in 2016 released another normative document on the upgrading and transformation of the recycling industry. Herein it again calls for market coordination as the primary governance tool for recycling enterprises and now explicitly states that informal waste pickers (shihuangzhe 拾荒者) should be integrated into formal market operations (MOC et al., 2016, art.6). In summary it can thus be ascertained that despite the as of now still marginal role of market coordination in the CE, some instances of variation are visible in formal institutional outputs. Moreover, it appears that the occurrence of variation in institutional solutions is very much dependent on the particular interest group specific actors that are in charge of selecting and devising the solution.

A second instance of variation in outputs occurs in the form of institutions that either feature characteristics of coerciveness or voluntariness. For the verification of these characteristics in institutional outputs, the above used method to analyse regulation contents has only yielded limited results[42]. However findings by preceding research provide some indication on variation in outputs regarding the two characteristics. In general, the domain of environmental policy in the PRC by and large features laws and regulations that take normative and

[42] An attempt to analyse the variation of coercive and voluntary characteristics in governmental regulations has been conducted in the same manner as for the case of economic coordination. However, results were not sufficiently strong to establish an argument for the interpretation of variation

voluntary instead of a coercive tone. Relevant provisions are held relatively vague, i.e. they frequently ‘encourage’ rather than ‘require’, which is seen by some as impediment for effective implementation (Wang, 2007, 202f). The CE concept, which is in parts rooted in the environmental law domain, also exhibits similar attributes: The CEPL per se does feature no obligatory provisions regarding 3R practices in the fields of energy, water or mineral resource management. Moreover, the law only stipulates very low pecuniary sanctions for non-compliance and concepts rewarding voluntary participation are hardly existent (Li, 2016, 34). The absence of both not only implies a fundamental weakness for realising the CE. Moreover, the apparent lack of variation in the law does in turn provide relatively little inspiration for the creation of subordinated, supplementary solutions in the formal domains.

Within the subject matter of successful CE implementation in China, especially at the corporate level, secondary research suggests various approaches and thereby confirms the possibility of variation in outcomes. Some proponents of coercive measures highlight the function of state pressure for increasing resource efficiency and emission controls in companies (Liu and Bai, 2014, 150; Liu et al., 2010; Yu et al., 2008). One option to create coercive and thus effective institutional measures would be to implement indicator systems paired with administrative evaluation structures. However, as of now the indicator sets established for the purpose of realising the CE only feature a weak binding nature. In essence, only producing entities that apply for a CE status are required to monitor and report indicator values (McDowall et al., 2017; 7; Geng et al., 2012, 222). Alternatively, there is also research that emphasises the effectiveness of voluntary, bottom-up driven company-internal CE practices. Such tendencies may occur once companies are either forced by international down-stream partners to adopt more environmentally sustainable practices (Zhu et al., 2012, 150) or if CE practices simply turn out to be economically effective and are thus imitated (Zhu et al., 2013, 234). Especially this latter aspect highlights the significant institutional feature of imitation and emulation of institutional solutions at the corporate level. However, for voluntary solution outputs to become effective, the formal institutional domain needs to establish supportive institutional structures that encourage enterprise and industrial actors to cooperate.

In the context of coercive vis-à-vis voluntary institutional outputs one additional aspect has to be discussed: While some particular key laws may maintain a relatively unspecific tone and thereby exclude any particular coercive or incentivising measures, the issuance of complementing, subordinate regulations can help to fill this void. In this regard a direct

comparison between the CE and CP offers some useful insights[43]. In regard to enterprise activities, both institutional solutions were implemented for the purpose of changing current operations towards a more environmentally sustainable mode. However, as Zhu and colleagues (2013b, 234) indicate, the respective key regulations behind these strategic initiatives are both termed as 'promotion' laws. By implication, the purpose is to promote CP and CE efforts rather than coercing corporate actors into compliance. Yet, in order to encourage enterprises to adopt CE or CP practices the formal domain has established supplementing economic incentive mechanisms that relate to fiscal policy measures. For example in matters of CP, the state has set up funds and VAT exemption policies (Peng and Liu, 2016, 1140). Exactly the same approach has been chosen for segments of the CE: In WEEE management, the most decisive policy measures of recent years was the WEEE fund, which aims to support formally registered recycling facilities by providing a category-specific, fixed sum per dismantled WEEE unit (Schulz and Steuer, 2017, 317). In the field of green ship recycling, the government had provided a reimbursement of VAT for domestic (up until 2008) and a 50% VAT reimbursement for imported vessels (up until 2010) (Staudner et al., 2018). So a broad overview of both domains seems to indicate that there is relatively little variation in solution outputs: Both of the pivotal institutional outputs appear to bear a voluntary characteristic and both are supplemented by fiscal policy mechanisms of state funding and VAT reductions or reimbursement. The sole instance of variation appears on the side of the CP concept. The CPPL contains a clause in article 31, which can force companies to publish emission data (Mol et al., 2011, 171). Moreover the law promulgates a set of provisions that enable compulsory CP audits within those companies that either discharge pollutants above specified threshold levels or use or discharge toxic and harmful substances (Geng et al., 2010, 1503). However, apart from this particular exception variation in regard to voluntariness and coerciveness is little if at all existent.

The crucial question at this point is to ask for the reasons behind the emergence or, on the other side, absence of variation in solution outcomes. As discussed in the above sections, variation in solution outputs crucially depends on the interest group specific dynamics of the selection process. If however the constellation of interest groups within the formal domain were to remain relatively constant, the variation in outputs is likely to be reduced. This particular stalemate has over several decades affected the domain of environmental legislation,

[43] Merging the CE and the CP into one analytical framework for institutional variation follows the argument that both concepts individually constitute thematic extensions to each other. This assessment can be justified by the fact that CE and CP share a common set of value ideals, e.g. the norms of reduce and reuse.

where compromise processes have often lead to disadvantageous results for environmental institutional outputs: Chinese officials quite openly addressed weakness in environmental institutional performance and relate these to the necessity of compromise finding in the legislative process, which emerged out of concerns about curtailed economic growth (Wang, 2007, 204). Van Rooij (2006) has addressed this issue in the environmental legal domain and states two broad options of how conflicting interests pose a challenge for legislation: Either laws are based on interest compromises, which in turn generates vague and less influential institutional outputs. Or only one particular interest group is considered in the process, which thus leads to relatively specific laws. According to Rooijs assessment China's environmental law before 2000 fell into the former category, when environmental interests were effectively kept at bay by for the benefit of economicperformance. However for the period after 2000, van Rooij asserts that environmental legislation has changed and become 'clearer' and 'tighter'. By implication this would indicate that environmental interests increasingly gained in foothold in the legislative bargaining process. The author relates these changes to an increased environmental awareness among top-level policy makers (Van Rooij, 2006, 60f).

More recent research however doubts whether this upward trend for environmentalist interest groups in the centre will continue: Despite the increased promotion of sustainability in the 12$^{th}$ five-year plan there are still many central interest groups that support economic over environmental interests (Zhang et al., 2013, 1029). These forms of conflict however happen behind closed doors and are difficult to trace for outsiders (Conrad, 2016, 357f; in: Heilmann, 2016). What these analyses on the collision of interests and changes in dominance constellations show, is highly significant for the aspect of variation in outcomes: Evidently, variation in formal outcomes does not necessarily occur in the course of one evolutionary cycle of institutional solution generation. Rather variation emerges when the interest dynamics in selection change. This is also true for one domain analysed in isolation: Arguably a shift in interest constellations after 2000 marked by the 10$^{th}$ five-year plan (van Rooij, 2006; Conrad, 2016) gave rise to environmental solutions that differed in their characteristics to what was issued before. Thus if the selection process is dominated and led by a single interest group, variation is more likely to emerge over several rather than from one single cycle of institutional solution finding. This particularity has to some extent occurred in the realm of the CE: Section 6.2.3 has shown that a shift of authority between dominant actors at the central level has had an impact on formal institutional selection. In this regard the leadership of Hu Jintao and Wen Jiabao has for example induced a significant change to the previously dominating paradigm of exclusively promoting economic growth. The then promoted

Scientific Development Concept as well as the notable shifts towards more environmental awareness in the 10th and 11th five-year plan have induced a significant step towards ecological-economic modernisation (Heilmann et al., 2016, 33). As for the CE, the current status resembles a type of plurality of interests in selection, in which the MEP and NDRC sometimes coalesce and sometimes individually lead the institutional selection process. If this constellation continues to prevail, it is safe to assume that variation in formal institutional outputs for the CE will rather increase then decrease.

### 6.4.3 The role of variation for formal institutional solutions: A cyclic interplay of feedbacks between local and central levels

The final section of this chapter aims to depict how the interaction between central and decentralised[44] solution finding efforts propels the larger process of institutional change in the formal domain. So far the analytic inquiry focussed on the creation of institutional solution outcomes as they unfolded along the two horizontal levels of the formal domain: Institutional solutions for the purpose of implementing the CE are devised by central as well as local state actors. In this regard the crucial question is to which extent the outcomes of such horizontal processes are linked with each other. As discussed in section 6.3.2.3 there clearly exists a feedback link between central pivotal laws and (local[45]) pilot solution finding process. The present section will further explore this dynamic of vertical feedback cycles between central and local levels and assert the following assumption: While local institutional outcomes generated through experimentation only play a subordinate role, their function for the larger solution finding process is extremely valuable. Only via the variation of local pilot outcomes – be it within one or over the course of several cycles – a sufficiently large information feedback emerges. Once this information stream is conveyed to the centre, national CE solution finding will pick up in pace.

However, tracing this process in the CE is confined by the paucity of available research in this field. This can be explained by the difficulty to observe, categorise and interpret these processes over consecutive cycles. One of two notable analyses within this subject matter has been published by Jiao and Boons (2014), who discuss the CE's policy evolution along

[44] In this section, the term 'decentralised' denotes the process of pilot experimentation and solution finding, which does not take place at the national level. The reason for not using the term 'local' can be explained by the intention to avoid a conflation between non-central solution finding processes and locally initiated pilots. Given that also centrally initiated pilots are conducted outside of the central realm of solution finding, the usage of 'decentralised solution finding' appears to be more appropriate.

[45] As established in section 6.3.2.3, CE pilots are initiated by local as well as central governments. However in regard to the juxtaposition of pivotal laws and pilot experimentation outcomes, the above chosen emphasis of local over central pilots stems from the larger degree of variation imputed to the former.

central institutional outcomes vis-à-vis local and central pilot experiments. The process itself was initiated by the SEPA in 2002, which formally endorsed the National Demonstration CE Zone Program. The process thus began with pilot experimentation and was only in second instance buttressed by management regulations, i.e. institutional solution outputs, at the central level. Over a period of 12 years, four CE pilot batches and several regulations were issued in an alternating manner (see Figure 17) (Jiao and Boons, 2014, 22). The development pattern not only depicts the vertical feedback cycle between pilots and central solution outputs, but moreover shows how both horizontal solution finding processes proceed in a synchronised and interdependent manner.

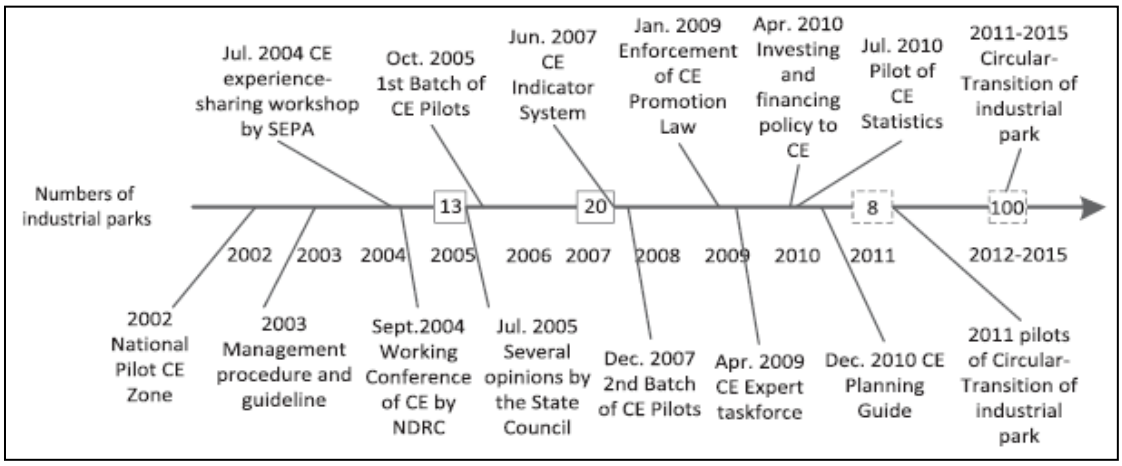


**Figure 17. Institutional output dynamic in the CE: the alternation of pilots and central regulations (source: Jiao and Boons, 2014, 22)**

In a second publication, the authors presented a more detailed analysis on the central-local feedback nexus. Here again, Jiao and Boons emphasise that local CE initiatives preceded central solution finding: Shanghai's Agenda 21 trial action and Eco-Zone Demonstration Programs that, albeit being promoted by the centre, were independently taken up by local governments. These local experimentation efforts played a crucial role for central policy makers, in this case the SEPA: Not only could these programs provide the so far relatively inexperienced central government actor with information on the CE, local attempts moreover offered some variation, which in turn increased the innovative value for central solution finding. In order to increase these two effects, the SEPA promoted experimentation and in the second phase of the process attempted to promote policy experimentation in the form of pilots via the issuance of pilot relevant regulations. This clearly represents an effort to foster local variation so as to achieve a more comprehensive knowledge basis for central solution finding. This impetus was further accelerated in the subsequent phases, when the NDRC replaced the SEPA as main authority in the development of the CE and gradually introduced more key

ministerial actors into the process. Via the issuance of central regulations, pilot experimentation was further promoted in two batches, which increased the variation of experiences and thereof generated feedbacks.

According to Jiao and Boons, the significant feature of the subsequent CE development phases, which continue up until today, is the simultaneous and synchronised solution finding process at central and local levels: While experimentation cycles at the decentralised level were continued and regularly updated, the central level correspondingly incorporated the thereof generated learning feedback for the creation of institutional solutions. These solutions did in turn provide an impetus for subsequently issued pilots (Jiao and Boons, 2017, 16f). From the perspective of the model, this vertical interaction process can result in relatively effective solution outcomes at the central level, if decentralised pilots exhibit a sufficiently large degree in variation. In other words, a broad array of variation increases the probability of generating a large pool of experiences, which in turn facilitates the creation of relatively effective solutions.

This connection between central solution outputs and decentralised experimentation in the CE was addressed previously in section 6.3.2.3. Apart from this relatively general pattern, it can be assumed that the CE also features more detailed instances of reciprocal interaction between central and decentralised solution finding. In this regard, the institutionalisation of WEEE management does exemplify a very illustrative case, in which nationally initiated pilots provided experiences and learning feedbacks to the centre. Central state actors capitalised from these results and began to issue solution outputs, which aimed to improve the overall management of discarded electronic devices. The onset of this process can be traced back to the early 2000s, when nine different regions began to initiate pilot regulations on WEEE management. Over time the number of annually issued solutions with pilot relevance exhibited a gradual, yet non-linear increase, which peaked in 2011 and 2012 and thereafter experienced a steady decline (see Figure 18).

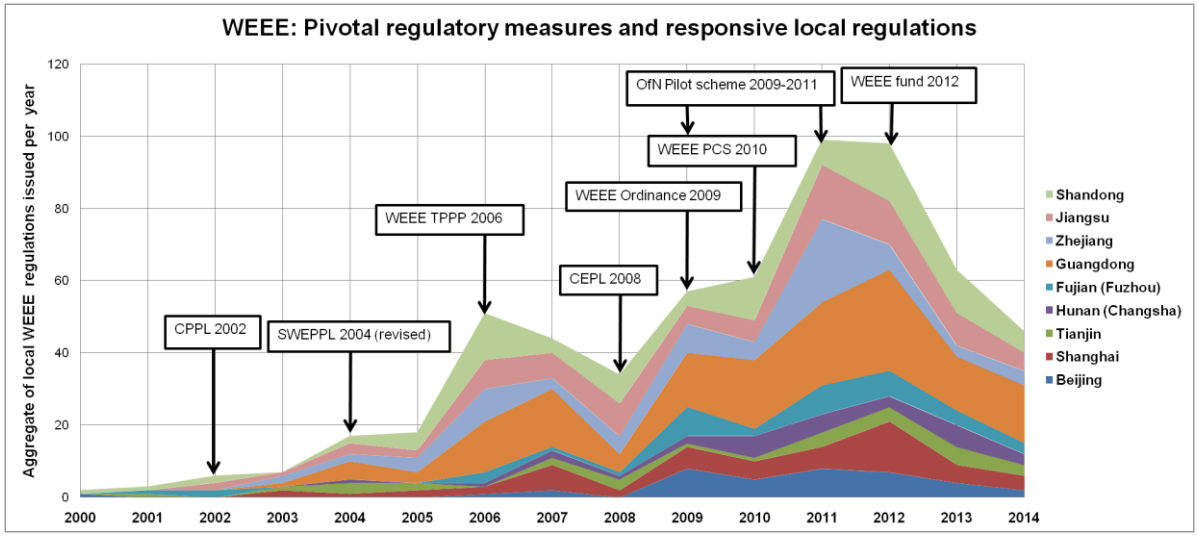


**Figure 18. Regulatory intensity of local WEEE legislation in pilot areas (the author, adapted from Schulz and Steuer, 2017, 319)[46]**

This particular development was tightly linked to solution finding processes within the central government and featured three particular characteristics: Firstly, the nine regions were designated as specific pilots so as to identify best institutional practices for managing the WEEE problem. Central decision-making actors were thus dependent on local experiences, which could be rechanneled to the centre so as to devise a nationally effective solution. For this purpose nine pilot areas were selected, which, in the sense of the model, would guarantee a solid degree of variation in decentralised outcomes.

Secondly, the central government has in the course of the entire process issued supplementary institutional solutions, which seem to have an accelerating impact on the advancement of the pilots. These centrally issued measures include pivotal laws such as the CEPL (which also addresses WEEE) and supplementary regulations such as the WEEE Technical Pollution Prevention Policy (WEEE TPPP) and WEEE Pollution Control Standard (WEEE PCS). In this regard the figure above seems to indicate a particular effect of the key laws: Nearly after each issuance, local pilot activities appear to be reinvigorated, if measured in numbers of annually issued pilot regulations. Over the period of eleven years, this reciprocal dynamic seems to increase up until achieving a peak in 2011/12.

This latter particularity constitutes the third aspect worth discussing. Decentralised experimentation and central solution finding within one specific domain appears to continue

[46] The dates of the regulations indicate the year of issuance. The respective abbreviations of the regulations are as follows: Solid Waste Environmental Pollution Prevention Law (SWEPPL), Cleaner Production Promotion Law (CPPL), Circular Economy Promotion Law (CEPL), WEEE Technical Pollution Prevention Policy (WEEE TPPP) and WEEE Pollution Control Standard (WEEE PCS).

up until a point, at which a temporarily effective and encompassing institution is found. It is quite difficult to discern any general characteristics or premises, which such a type of institutional solution has to fulfil. For example in the case of WEEE management the establishment of the WEEE fund for formal WEEE recyclers in 2012 represented such an institutional outcome that would constitute an end to experimentation[47]. In regard to the above analysis prudence needs to be exercised, as it only takes one single case of vertical interaction between centre and pilots into account. However, it can be argued that the use of pilot experimentation is conducive and in parts indispensable to finding effective solutions at the central level: Without the variation of decentralised experiments, learning and experience feedback would not be available to the centre. Under such conditions, the selection of solution outcomes would be much more burdensome as decision-making actors would be less informed about which measures can effectively tackle the challenges at hand.

## 6.5 Conclusion of the chapter

In conclusion of this chapter the following paragraphs will review the findings with respect to the analytical questions formulated in section 6.1. Herein, the first point of discussion concerns CE-specific interest groups and their conflicts as well as thereof generated implications for solution finding. Generally, the analysis in the above sections contends that interest group constellations have a significant impact on selection and solution finding processes. Under circumstances in which one actor group dominates, the selection appears to proceed in a relatively non-protracted manner and thereof generated outcomes are more likely of a decisive and detailed nature. Actor constellations that entail complex and sensible compromises are more prone to induce prolonged selection processes and unspecific institutional outcomes. In the context of the CE, both types of cases are existent. Traditionally, the related realm of environmental solution finding has been hampered by the dominance of interest groups that are in favour of economic growth. Such interest collaborations occur between state actors at the central and local levels as well as in combination with corporate actors. This in turn has impeded the creation of effective environmental measures. In this regard the CE is theoretically able to surpass this stalemate as the concept incorporates strong elements of environmental protection and resource preservation. However, in essence it is formulated and presented as economic development strategy. This characteristic provides a suitable foundation for equalising the often opposing interest groups in the process of

[47] This assumption has been confirmed by one official of the REWIN project (see project acknowledgment section), in which the author participated during 2012-2016 (personal communication, Zhang M. September 2013).

institutional selection. The possibly most crucial example in this regard was the shifting of authority over the CE development, which was transferred from the MEP to the NDRC. Indications for the compromise in solution finding are reflected in joint solution outcomes, which in fact prove the unifying capacity of the CE regarding collision of interests. Nevertheless, there are also signs of unilateral solution finding activities by ministerial interest groups. The impact on the CE is that such approaches may help to increase the variation in outcomes, which in turn expands the experiences and learning process for decision-making actors at the central level. In a similar manner, the CE concept may also help to facilitate compromise finding between central and local government actors. This nexus is particularly crucial, as it determines implementation and thus the effectiveness of institutional outcomes in the CE. In this regard, the central government can resort to governance tools such as leeway provision in regulations, target based contracting or contractual planning so as to advance the CE development. Here again the concept offers the possibility to incorporate economic growth oriented interest groups into a larger process of shifting the economy towards a more environmentally sustainable pattern of growth. In essence, effective solution outcomes in the environmental-economic as well as in other domains depend on a balancing of interests (van Rooij, 2006, 70). In light of this particular challenge the CE appears to have achieved a groundbreaking success insofar that it theoretically bridged traditional interest antagonisms.

The second focus of analysis was centred on the dynamic of selection in the formal institutional domain. In this regard the guiding query was to discern the effects and interest group alignments on subordinated selection processes at the pilot level as well as the respective primary processes at the centre. As outlined in the above, actor groups with specific interests constitute the fundamental elements for the dynamic of selection. By implication, the degree of protraction in selection increases with the variety of interest groups included in the process. In order to overcome or at least mitigate herein implied conflicts the SC has highlighted the importance of decentralised experimentation for selection and outcome generation at the centre. However, in this context the challenge appears to feature a causal nature: Pilot initiation is in many cases induced by central government actors, while pilot feedbacks in turn only inform about the success of the particular, agency-specific strategy. For the purpose of realising the CE with its broad environmental and economic agenda a unilateral dominance over pilot selection could prove to be detrimental for the future of the CE. However within the PRC emerged a constellation, in which several ministerial players initiate pilot experimentation either in cooperation or out of individual motivation. This in

turn enables the emergence of a broader variation in pilot induced feedbacks and thus learning results, which increases the growth of institutional inheritance. Pilot and experimentation practices have moreover shown that the efforts of aligning central and local interests have in matters of promoting the CE been met with relative success: Not only were focal topics of central selection overtaken by local pilots, moreover it appears that central decisions of interest groups are to some extent accepted at the local level. The reasons for this positively correlated adaptation processes might to some extent be found in the elimination of interests collisions at the centre as well as in the CE concept per se. Whereas the former aspect impedes a translation of interest conflict from the centre to the localities, the latter offers enough interpretative leeway for the interest focus on economic growth that as of now is still dominant at the local and still significant at the central level. Finally, the quantitative trends exhibiting increase or decrease in pilot experimentation within a particular domain of the CE may provide indications for two specific aspects: Apart from problem solving effectiveness, which is discussed in the subsequent paragraph, quantitative trends may also inform about the degree of interest group support for continued piloting in the chosen domain. In other words, the selection of pilots and the choice to continue experimentation programs also indicate the willingness of interest groups to continue searching for new solutions. This in turn implies that potentially promising paths for finding new, challenge-solving institutional outcomes may be impeded by interest groups that dominate the selection over pilot programs. The rationale for doing so may be founded in the fear of harming the vested interests of the respective groups. For the case of the CE, such a point might be arrived once environmentally oriented pilots infringe vested economic interest realms.

The third and final analytical query centred on the topic of institutional outcomes in the CE with regards to their structural embedding and the characteristics of institutional variation. As the third section has shown, one of the notable CE achievements are the rapidly growing number of legal outputs, which up until today manifests in a steady upward trend. Amidst these institutional outcomes the role of key laws is particularly significant, as they guarantee a fundamental institutional framework to which complementary institutional solutions can be added. In terms of the function for the CE, these key laws have successfully established an embedding institutional framework that provides orientation and direction for the future development of the CE agenda. A herein peculiar feature is the high degree of modification, i.e. amendments and revisions, of these laws which might induce speculations about the instability of this system. From the perspective of the methodological model however these changes rather imply a continuous learning and adaptation process that originates from overall

feedbacks within the system: The higher the temporal frequency of these amendments, the more intensive is the information feedback flow. Moreover the pivotal laws within the CE system also generate vertical tier structures so as to link lower regulations with key laws within a thematic superstructure. Thereby overall institutional effectiveness for the solving of problems in respective domains can be strengthened. Regarding the matter of institutional variation in the formal domain the analysis has shown that current CE legislation still lacks a plurality in governance approaches for the solving of challenges. There are however also elements in the current CE development that indicate a broadening of variation in formal solution outcomes. Firstly, several central state actors are involved in the CE, who in parts unilaterally engage in the selection of institutional solutions. As they promote their particular interests, respective solution outcomes bear a variation in terms of content. If state actor numbers in the CE increase, say via the initiation of local CE activities, variation will subsequently grow. Secondly, the creation of variation in outputs is not only a matter of simultaneous developments. Rather variation also features a temporal nature, as it may occur in the form of different institutional outcomes that were accumulated over time. Herein, one aspect that accounts for the difference in outputs is the change of interest group dominance deciding over the selection of CE outputs. In this regard pilots play an especially crucial role: Only if a sufficient degree of pilot schemes and pilot locations is chosen, a variation in outcomes can be guaranteed. This particular approach has been chosen in the field of WEEE management: In order to find a solution for this challenge, subsequent batches of pilots with different characteristics were implemented in a consecutive order in different local environments. This in turn generated a substantially broad learning effect that influenced the selection process and institutional outcomes at the central level.

Overall this chapter has highlighted the process of institutional change in the formal domain and the dynamics that guide the generation of rule outcomes. Understanding the contextual dynamics of the formal domain is highly relevant for the analytical steps in the subsequent chapters. In the discussion of two thematic realms of China's CE, the formal domain will be challenged by the informal institutional domain of corporate and civil actors. The thereof unfolding evolutionary dynamic primarily focuses on rule selection and the interaction between institutional outcomes of both domains. Given the herein provided interpretation of the formal domain thus provides a thorough basis for understanding the institutional dynamic between both domains as depicted in the following chapters.

# 7 The CE in practice – Case 1: The evolution of state-guided industrial clusters

## 7.1 Analytical method

After the discussion of China's CE institutionalisation and the interest dynamics within the formal domain, this chapter presents the first of two cases on actual CE practices in the PRC. Herein, the objects of inquiry are industrial clusters, also called industrial parks (IPs), which constitute a significant component of China's official CE development agenda. These park estates are devised by state actors with the aim to fulfil a dual purpose: CE park structures have to operate in accordance with the 3R value principles and simultaneously generate high economic growth rates. As institutional systems, CE-oriented parks are neither unique to the PRC, nor do they represent a particularly new concept[48]. However, these sustainable ecological park estates feature aspects of institutional evolution, which in turn suggests a closer inquiry by use of the analytical model.

In this regard, the first particularity to note is that IPs – be it in their traditional or in their CE specific form – have always been experimental units in the PRC (Geng and Zhao, 2009, 1290). In other words, these estates were set-up as a means to solve particular problems in industrial production. Given their designated boundary as parks these entities can be conceived as large-scaled laboratories. From the perspective of institutional analysis, this implies that the experimental nature of IPs entails a high degree of institutional trial-and-error solution finding. According to the political-economic principles of the PRC, the experiments (in parks) aim to identify effective outcomes, which subsequently are to be translated to the national level (Heilmann, 2008a, 5; Heilmann, 2016b, 301f). For the purpose of realising the CE in China, IP experimentation plays a crucial role for aligning the entire industrial structure with the core principles of this development concept.

Secondly, the experimental nature and the development pattern of CE-oriented parks in China exhibit discernible elements of evolution: Not only do these systems feature sequences of inheritance, selection and variation, there are moreover clear indications for information and learning feedbacks that propel the entire process. Interestingly, the evolution of these systems takes place under the context of state-guidance. Hereby, state actors predefine the development trajectories of parks via a set of top-down stipulated target criteria to which companies as non-state actors have to adhere. In other words, the selection of parks is

[48] The concept of ecological IPs first came to prominence in 1995: In their analysis of the 'industrial ecosystem' in Kalundborg, Lowe and Evans identify practices of industrial symbiosis, which they discuss in the context of the newly emerged theories of industrial ecology and industrial sustainability (Lowe and Evans, 1995, 48).

dominated by the formal domain and its formal rule-systems, whereas the informal domain, i.e. the operative rules of corporate actors, has to adapt to these conditions. By implication, this constellation implies a partial elimination of the evolutionary principle, as the formal and informal domains do not interact in full opposition, but rather on the basis of aligned interests.

Nevertheless, institutional evolution yet occurs under these relatively rigidly preset operative conditions due to three particular features: Firstly, several state actors with differing interests have created different park types, which in turn resulted in a degree of variation in institutional solution outputs. Apart from the most famous Eco-Industrial Parks (EIPs), which are guided by the Ministry of Environmental Protection (MEP), there are also Circular Economy Demonstration Zones (CEDZs). These are implemented by the National Development and Reform Committee (NDRC). Additionally, the Low-Carbon Industrial Park (LCIP) program has been jointly spearheaded by the Ministry of Industry and Information Technology (MIIT) and the NDRC. This involvement of a multitude of state actors to devise solutions to a similar problem not only constitutes a degree of diversity in selection elements due to differing ministerial interests. Moreover, the variation in outputs, i.e. park types, is vastly increased and has in the case of the MEP program even generated a second tier of variation in EIP types. Secondly, the participation in all CE-related IPs is voluntary (Thieriot and Sawyer, 2015, 3; Shi et al., 2012a, 9), which implies that companies may not only choose to participate in such experiments, but can moreover opt for the particular park type in which they participate. Thirdly, the official selection criteria determined by state actors and expressed in particular CE related standards and indicator systems offer different degrees of leeway. Depending on the park type, the park management and in further consequence the companies may in some cases need to achieve preset indicator benchmarks. In other instances the achievement of indicator target values and benchmarks is not obligatory. In essence, these elements of top-down latitude provide companies with a certain freedom to select their own solutions (bottom-up) within the particular parks and thus propel the overall variation in institutional outputs.

The final notable feature of evolution that occurred in the course of CE related IP development in China relates to the aspect of learning via information feedbacks. The experimental efforts in industrial clusters have been initiated in the PRC in 2001 and since then generated a certain amount of learned lessons: Not only did initial experiments generate learning effects that resulted in the emergence of new park types, state actors moreover adapted their selection characteristics over several solution finding cycles. Given that CE

relevant IPs constitute experimental zones for the purpose of remodelling the national industrial structure, maintaining this learning feedback constitutes an indispensable task for involved state actors. For this purpose IP structures are endowed with several institutional structures that aim to increase the flow of information feedbacks to state actors. Typical examples are evaluation systems on park performance as well as administrative committees (ACs) installed in parks so as to manage informational exchange between and compliance of park-internal enterprises. Via these forms of information feedback systems the practical results generated in CE related IPs are rechanneled to decision-making actors and thereby perpetuate institutional solution finding cycles.

As outlined in the above paragraphs the main task of this chapter is to highlight the evolutionary process of institutional solution finding in CE-oriented industrial parks. In terms of structure, the following discussion is organised along the three key elements of institutional evolution, namely inheritance, selection and variation. The overarching analytical objective is to show how state guided CE experimentation has propelled the development of IPs and that these clusters feature significant patterns of institutional evolution as outlined in the methodological framework of the thesis.

The analysis in the initial sections (7.2 and 7.3) centres on the aspect of institutional inheritance. Herein, the aim is to discern the major influences that stand behind the current CE practices in Chinese IPs. The related paragraphs will therefore first deal with the origins of park specific industrial symbiosis (IS) forms that emerged in the Western hemisphere and highlight their characteristics. In a second step, the focus will be shifted to the traditional IP practices in the PRC, which can be considered as a precursor to modern, CE-oriented IS forms in the country. These two sets of experiences can be considered as inheritance blocks that have built the foundation for Chinese CE-related IP development. Moreover there are also elements of inheritance that resulted from earlier IS practices and subsequently influenced later IS experiments. These aspects will be taken up in the appropriate sections when discussing the evolution of IS practices over several cycles. Overall, the first analytical task of inquiry in this chapter can be formulated as: *What are the experiences and learned lessons that influenced IS-practices in Chinese CE-oriented IPs*?

The second and most prominent theme in this chapter centres on the selection mechanism that determines CE IP development. In this regard, the specifics of selection in the CE's political-economic realm at the central level that were discussed in the preceding chapter are again taken up here to analyse selection mechanisms in parks (sections 7.3, 7.4 and 7.5): Firstly,

there is the aspect of interest groups that determine selection. China's CE related IP development has been guided by various central state actors, who in different constellations have initiated and now oversee different CE park types. Given that these actors differ in terms of their interest preferences, the selection process characteristics consequently vary for the respective park types. Secondly, in order to analytically pinpoint these differences in selection, park specific indicator systems, entry standards and evaluation systems will be contrasted to each other. Given that the selection processes also evolve over time, an additional task is to analyse changes in the selection mechanisms of parks. These changes in fact indicate that there is an information and learning feedback process between parks and central state actors, which in essence propels the evolution of the CE park system. Thirdly, the inquiry in this section will also engage in the topic of bottom-up selection. Although state actors prescribe the conditions of park operations and thereby appear to dominate the selection process, it has to be kept in mind that CE IP participation is voluntary. By implication, the companies entering or forming a park may either choose to adhere to this top-down set of selection specifics or to leave the park. During the entry/ formation process as well as at later stages of operation, park-internal companies by means of affirmation also select particular institutional solutions that correspond to their interests. The analysis will therefore also deal with the principles of company-based bottom-up selection in cases that provide insight into such corporate decisions. In summary, the second analytical task can be formulated as: *How do selection particularities in different park types change over time and why do these changes occur?*

The third focus of this chapter is set on the aspect of variation in outcomes (section 7.4 and 7.5). Within this subject matter, the first notable feature is manifested in the different types of CE-oriented IS parks that have emerged under the different leadership of central state actors. The analysis of variation will centre on the types of IPs, which are relatively well discussed in secondary literature. Determined by different selection criteria, CE related IPs have evolved into three different categories, namely on EIPs, CEDZs and LCIPs, which constitutes the first instance of variation. Furthermore, a second instance of variation can be observed in the EIP program, for which central state actors have developed different EIP categories. At a yet more detailed level, variation also occurs in IS linkages between individual enterprises. This means that even parks of the same type exhibit differences regarding industrial-ecological enterprise cooperation for material and energy by-product exchange. According to the methodological model, this multitude of variation is a direct result of top-down and bottom-up selection mechanisms. Therefore the analytical tasks for this subject matter can be formulated as: *How*

*do selection characteristics determine variation in park types and industrial symbiosis? Is variation at the park level curtailed by top-down selection?*

The final topic of inquiry relates to the crucial feature of information and learning feedbacks which occur along the cycles of institutional evolution. Given the omnipresence of this evolutionary element, information feedbacks and learning cycles will be addressed at all relevant instances throughout the entire chapter. The initial instance of learning occurred with the transfer of IS ideas and practices from foreign countries to China. Additionally, another form of feedback based learning resulted from the political-economic transformation of the PRC. Since the 1980s, the Chinese government has experienced with 'traditional' IP systems so as to attract foreign capital and foster a more competitive, domestic manufacturing sector. With the emergence of the CE concept in China, the experiences from these 'traditional' parks served as an important fundament for the establishment of CE-oriented park estates.

Despite the obvious difference between these two park types there is one common characteristic that permeates both systems: Traditional IPs as well as modern ecological parks are designated as experimental pilots or zones that are either initiated via top-down (central government) or bottom-up (local government)[49]. In essence, the experimental role of these industrial estates serves two important functions. Firstly, during the early stages the aim is to yield new experience and knowledge so as to adapt selection determinants for the next cycle. Secondly, at a later stage the ultimate objective is to extend successful institutional outcomes, such as CE practices, and apply these to China's industry at large. As for the CE oriented park estates, the achievements so far would suggest that the development is still in its initial or experimental stages in China. Therefore, instead of extending CE practices to the industry sector at large, central state actors currently still focus on a top-down approach. Thereby central state actors sideline the interests of local state actors and simultaneously try to increase feedback learning from these experimental sites. Thereof gained knowhow and information is then used to update selection characteristics in the following cycles of park experimentation. This in turn leads to ever new institutional finding processes and subsequently new variations in park outcomes. Consequently, the research task for this

[49] The question of which actor level initiates industrial park estates in China is primarily dependent on the specific park category: While traditional IPs were established by the central as well as local governments alike, the CE relevant EIPs and CE parks are categorised as national demonstration zones and are thus solely initiated by the central state actors (Thieriot and Sawyer, 2015, 3). More complicated is the case of transformed parks: Initially, these parks were established as traditional IPs (either by central or local state actors). However with the advent of the CE, these parks transformed their modus operandi in accordance with respective provisions and thereby became EIPs. So while some transformed IPs may have initially been established by local governments, their operations have to follow centrally stipulated guidelines and monitoring.

particular aspect can be formulated as: *Which institutions are implemented in parks so as to facilitate the flow of information? To which extent do information feedbacks change selection characteristics?*

## 7.2 The institutional inheritance: Industrial symbiosis practices in the west and industrial park traditions in China

### 7.2.1 The concept of industrial symbiosis and its application in industrial parks in the West

CE oriented parks operate on the basis of the IS concept, which is rooted in the theoretical school of industrial ecology (IE) that has been outlined in chapter 5. Basically, IE suggests redesigning industrial systems according to the principles of ecosystems. The guiding idea is to tackle the negative externalities of industrial performance by adjusting production in accordance with ecological sustainability (Lowe and Evans, 1995, 48). Herein, the significant determinant prescribed by IE is that the operations of an industrial system need to be put in concert with and not in isolation from its surrounding systems (Chertow, 2000, 315). Within the IE framework, the core concept of IS promotes the establishment of synergetic links between industries within a geographic proximity for the exchange of materials, energy and by-products as feedstock for production. The thereof emerging benefit is that all corporate participants can realise a cost-saving, and thus, competitive advantage (Yu et al., 2015a, 340). This kind of arrangement in itself can be seen as veritable system innovation as it creates entirely new links of industrial interaction (Dong et al., 2014, 389). In order for such types of IS structures to emerge, IE related theories have exhibited similarities to institutional economic ideas: On the one hand, IS forms require bottom-up types of self-organisation based on rules and norms between enterprises aiming to operate in an resource-efficient manner. On the other hand, a suitable formal institutional setting that is enforced via top-down means by state actors is necessary so as to realise and guide IS systems into desired directions (Yu et al., 2014b, 441). These herein proposed governance forms also bear clear characteristics of the two opposed selection mechanisms for institutional solution finding defined in the theoretical model of this thesis. The essential question for each IS system is to which extent both mechanisms are existent and if one dominates the system's constitutive, i.e. IS forming, process. As will be shown below, Chinese and Western approaches to IS practices in industry differ considerably.

With regard to the geographical particularities of IS practices, it must be noted that such practices are not necessarily confined to strict boundaries designated by an IP structure (Ghisellini et al., 2016, 20). Rather there are also examples in which IS networks span far beyond a designated area and may thus connect to adjacent socio-economic structures such as cities (Dong et al., 2014, 389). However given that increasing distances induce increases in energy and material demand, e.g. for infrastructure construction, practice limitations to the dimension of a park have gained dominance as most suitable application forms for IS networks (Ghisellini et al., 2016, 20). This particular application of IE in industrial parks has led to the emergence of the so-called Eco-Industrial Parks (EIPs) – a concept first proposed by Ernest Lowe in 1995 (Li et al., 2017, 267). According to Lowe, the EIP system represents the realisation of the IE's industrial ecosystem, in which companies interact by sharing their residuals and turn them into feedstock for production (Lowe and Evans, 1995, 48). This essentially means to set up a park-internal, secondary material and energy transaction system that buttresses the park internal production of primary goods (HKGCOC, 2010, 19). Relatively soon after EIP practices emerged, the United States Environmental Protection Agency formulated a comprehensive definition of EIPs in 1996: It defines these parks as a community of businesses that seek to enhance their environmental and economic performance via collaboration in matters of environmental and reuse issues. Essentially, the thereof yielded collective benefit is greater than the sum of individual benefits that each company would achieve under optimised performance (Thieriot and Sawyer, 2015, 2). This definition is particularly important if seen through the lens of the CE development agenda in China: There as well the overarching aim is to achieve environmental improvement while economic performance is increased. This in turn may indicate the reason why this international concept of IS parks was deemed to be a useful model for transfer to and imitation in the PRC.

When it comes to applications of IS within industrial park structures it is interesting to note that practices actually preceded theory[50]. Whereas Lowe discussed the EIP idea in 1995, EIP practices have had their first occurrence in the Kalundborg industrial complex in the late 1960s. In the fashion of a bottom-up approach initiated by a few managers, the aim to yield economic benefits from by-product exchange was put into practice. Thereof resulted a dual, positive externality as cost minimisation went hand in hand with effective efforts to reduce environmental impacts and thereby abide to more rigorous environmental regulations

[50] This assessment implies the idea that the EIP concept per se is considered as a theoretical component of the IE tenet.

(Ghisellini et al., 2016, 20). The particular institutional element in this formative process is constituted in the bottom-up and unplanned nature in the creation of IS links. According to one manager involved in the Kalundborg model, there was no planning or strategy involved, but material and energy synergies evolved over time. Lowe and Evans (1995, 49) termed this process 'spontaneous evolution': Originating in the intention to reduce waste by seeking profitable uses IS practices gradually emerged, which in turn made managers realise the dual benefits of environmental protection and business profits.

When it comes to feedback flows and learned inheritance, the particular time lag between practice and actual reception of benefits needs to be highlighted. In Kalundborg, participant enterprises only recognised the positive environmental effects after more than a decade (in the 1980s) (Ghisellini et al., 2016, 20). Furthermore, this knowledge only spread to the international level in the 1990s during the Conference for Sustainable Development of Rio de Janeiro (Chertow, 2000, 316). These delays in terms of learning from practice of unintended IS experiments has also been documented for other EIPs in Styria (Austria) and Jyväskylä (Finland), where involved companies remained unaware of the IS-specific benefits of their practices (Ghisellini et al., 2016, 20). In contrast to such bottom-up developments, most international EIP cases however emerged as results of national initiatives and programs initiated by state actors: In the USA, EIPs were fostered via a national initiative to develop applications of IE in IPs. In a similar fashion the UK has initiated its national Industrial Symbiosis Program in 2005, the Japanese government launched a national program for the development of Eco-towns and South Korea implemented its national EIP program in 2005 (Liu et al., 2016, 418). In contrast to the Kalundborg model these examples, albeit not being sufficiently comprehensive of the entirety of international examples, indicate a strong prevalence of top-down, state guided IS initiatives of EIPs. As will be shown in the following sections, this strategy approach constitutes the dominant form adopted in the PRC.

### 7.2.2 Industrial parks: The domestic inheritance of industrial symbiosis in China

IS practices in the PRC evolved on the basis of a particular institutional fundament: Since the mid 1980s China has established industrial estates and industrial parks for the purpose of attracting capital and concentrating industrial production. The first generation of these entities was built in 1984 and 1988 in coastal areas such as Tianjin, Shanghai and Guangzhou (Yu et al., 2015a, 339). This first set of IPs already exhibited an initial level of institutional variation according to the differentiation of Winans and Deng (2017, 827): While Economic and Technological Development Areas emerged since 1984, High-Tech Parks followed in 1988.

From an institutional evolutionary perspective, IPs fulfil a particularly significant purpose: These structures were initially installed by the government as showcases and bases for the development of the export-oriented industry. In that regard, attracting foreign capital only constitutes one reason behind their existence. Possibly more important is the role of these parks to demonstrate the government's experiments with economic reform and foster a sector related diversification in industry (Geng and Zhao, 2009, 1290). Traditional IPs as well as the succeeding types of CE-oriented IPs thus constitute different institutional outcomes along one particular cycle of institutional experimentation. In both cases, the foremost objective of experiment-directing state actors was to devise institutional solutions for given problems, e.g. capital acquisition and later sustainable production. The noteworthy feature is that both experiments were conducted within relatively large geographical and financial dimensions, which in turn bears higher risks in the case of failure. By implication and because of the strong government involvement, the necessity to achieve particular success rates can be considered as an unspoken rule.

A glimpse at the hard economic facts appears to confirm these requirements: During the 11$^{th}$ five-year plan, industrial parks were estimated to have contributed 50% of China's industrial output value in the eastern regions (Shi and Chertow, 2017, 2). Other analyses moreover assert that IPs have generated more than 60% of the gross industrial output value and 50% of China's entire GDP in 2013 (Liu et al., 2015a, 1071). Further assessments indicate that the GDP growth rate of IPs (30.3%) was over three times as fast as the national average (9.2%) in 2011, which makes park estates to major contributors to China's economic growth performance (Yu et al., 2015a, 339). As for the numbers of these industrial estates, the post-reform era has witnessed a continuous rise that peaked in 6,866 units in 2003 (Shi et al., 2012a, 8), of which only 113 were government-approved national, provincial or municipal parks (Geng and Zhao, 2009, 1290). In response to this lively IP development driven by fierce competition for capital, the central government re-evaluated so far approved IP forms and reduced the total number to 1,568 in 2011 (Shi et al., 2012a, 8; Yu et al., 2015a, 339).

IP forms in China also exhibit certain elements of institutional variation and selection. In contrast to Western models Chinese IPs are not only manufacturing based entities, but typically encompass areas for industrial production, research and development, business and services as well as residential housing (Geng and Doberstein, 2008, 234). This constitutes a notable difference to Western IPs, which are exclusively hosting industrially productive entities. Out of the initial two types of industrial estates China has currently developed several

new categories of parks that are governed under different authority levels. IPs can be directed by central government actors, provincial or municipal state actors, local or town state actors, or even result from private investment. In regard to variation in category, China's IPs are composed of Economic and Technological Development Zones (Jingji jishu kaifaqu 经济技术开发区), High-Tech Development Zones (Gao xin jishu kaifaqu 高新技术开发区), Bonded Areas (Baoshui diqu 保税地区), Export Processing Zones (Chukou jiagong qu 出口加工区) and Border Economic Cooperation Zones (Bianjing jingji hezuoqu 边境经济合作区) (Geng and Zhao, 2009, 1290; Bai et al., 2014, 5). What needs to be kept in mind in regard to the variation in IP outputs, is that different park types emerge on the basis of different selection criteria set forth by state actors. In general, these formal criteria encompassed the following four aspects: (1) Convenient infrastructure for material and product transportation; (2) existence of abundant water resources; (3) sufficient environmental carrying capacity; (4) reasonable geographical distribution of the parks (Geng and Zhao, 2009, 1291). Despite these reasonable balancing of selection characteristics, actual selection practices were mostly focussed on economic considerations, which to some extent reflects the key interest preference of the relevant decision-making state actors: Due to the fierce competition for capital investments by local governments, IP developments were often pushed at the benefit of economic growth criteria vis-à-vis the expense of environmental sustainability (Shi et al., 2012a, 8).

The growing problems in regard to pollution, environmental degradation and resource use can be seen as important learning elements that decisively shaped the institutional inheritance stock. On the basis of these learned facts, initially responding institutional solutions to these challenges emerged as early as in the mid 1990s: First regulatory steps primarily aimed to strengthen pollution prevention and environmental protection in Chinese IPs (Shi et al., 2012a, 8). These measures however centred on emission discharge and pollution control – so called end-of-pipe approaches – which yet left out the dimension of resource management (Geng and Zhao, 2009, 1293). With looming environmental issues and increased calls for a sustainable management of China's industry, IPs quickly came into the centre of ecological-economic transformation strategies embodied in concepts such as the CE and Cleaner Production. The rationale for targeting industrial estates with such concepts is that they host more than half of the country's manufacturing activities and thus serve as ideal test object for the CE: Not only are these hubs significant contributors to economic growth, they moreover

offer opportunities to effectively lower resource intensity and emission quantities in a concentrated manner (Mathews and Tan, 2011, 440). The question at hand is how the key state actors set about the process of IP transformation to realise a higher level of sustainability.

## 7.3 The evolution of industrial parks under the CE framework

### 7.3.1 The first cycle of evolution: Industrial symbiosis parks as solution to environmental challenges

Faced with the ecological problem caused by IPs and the simultaneous necessity to maintain economic growth performance, state actors engaged in a search process for adequate institutional solutions. As a result of these efforts, the application of IS practices, most notably embodied in the EIP concept, were identified by Chinese state actors as key strategy for effective counteraction (Geng et al., 2008b, 546). In this regard, the chronological context of emerging IS/ EIP systems vis-à-vis the promulgation of the CE agenda in China is particularly remarkable: State-initiated activities to remodel traditional IPs into modern IS-based structures began in the late 1990s (Shi et al., 2010, 191), while the CE as new development concept only emerged in the political centre in the early 2000s. This can be interpreted as a particular evolutionary pattern of institutional solution finding: The emergence of such encompassing solution concepts, like the CE, depends on how effective preceding solutions, such as the CP or the IS concept, have performed. What is important for the Chinese CE context, is that ecological IPs generated effective results (within and outside of China), which were conveyed to decision makers via information feedbacks. Among other factors, such as policy strategies, the IS park estate performance may thus have spurred the development of the CE in China.

The most famous and best documented IS parks in China are the so-called EIPs. Chinese state actors first came into contact with this concept in 1997 through a United Nations Environment Program in which the PRC participated. Applied to existing IP structures, the concept offered several advantages: Firstly, it provided a remedy for pollution and resource attrition within IPs, while sustaining further economic growth. Secondly, international EIP practices represented a rich inheritance stock to which the PRC could refer for the purpose of developing its own EIP network (Yu et al., 2015a, 339). The State Environmental Protection Administration (SEPA) became the key state actor in matters of CE development in China and thus also developed an interest in the ecological transformation of IP structures: The SEPA initiated the EIP concept in 1999/ 2000 with the aim to force the so far non-conforming,

environmentally polluting parks into compliance via more strict environmental standards. Herein, the key factor to facilitate the cooperation with industrial estates was to align the interests of businesses with those of the SEPA: For corporate actors, IS approaches offer an enhancement of competitiveness via improving resource efficiency and saving costs. Simultaneously, IS systems further the aim of the SEPA to reduce environmental pollution (Shi et al., 2010, 191f). In order to promote an encompassing ecological transformation in parks, the SEPA adopted the experimental point-to-surface strategy (you dian dao mian 由点到面) by launching EIP pilots in 2001 first and then extending the system to the national level in 2003 (Yu et al., 2015a, 339). Over the following years, the formalisation of IS practices in Chinese IPs continuously increased: More state actors and thus more interests were included, which led to the emergence of new selection categories and thus a variation in established park types. As will be shown in the subsequent sections, this learning by doing process of solution finding evolved over several institutional cycles. In this respect, the important feature to note is that despite the strong coordinative dominance of Chinese state actors in this process, the diversity of interest group constellations has induced evolutionary processes within Chinese IPs.

The premise for institutional evolution to occur has been set forth in the methodological model of this thesis: Evolution is based on the dynamic between two institutional domains, which emerges due to the responsiveness of interest groups in one domain to the institutional changes of the opposite domain. This dynamic can be adequately exemplified by the formation of and interactions in China's IS based industrial estates. In this regard, the essential question centres on how the elements of top-down and bottom-up organisation and formation are brought into play within CE-oriented IPs.

International experience has shown that IS in industrial estates either emerges as a result of top-down (planned) or bottom-up (spontaneous) efforts (Ghisellini et al., 2016, 20). In the PRC, the political agenda behind the establishment of IS parks has clearly favoured the former over the latter: Not only did the SEPA promote the EIP concept so as to curtail pollution from and resource intensive production in industrial clusters (Shi et al., 2012a, 9). The CE Promotion Law (CEPL) moreover strongly proposes the realisation of the CE via top-down means (Mathews and Tan, 2011, 450). Indeed, a look at official indicator systems for the park- i.e. meso-level would suggest that Chinese IS parks are strongly driven by top-down coordination and evaluation systems (Thieriot and Sawyer, 2015, 2). And yet, the official

regulatory system on CE related IPs exhibits indications of some leeway so as to enable bottom-up dynamics in park organisation and management: First and foremost, the participation in IS-based IPs is voluntary (Thieriot and Sawyer, 2015, 3; Shi et al., 2012a, 9), which by implication means that enterprises when entering these parks may at least initially select the means of participation and involvement (e.g. choosing the forms of symbiosis with other companies). Secondly, earlier research has found that local governments and park-internal enterprises have considerable incentives to engage in CE-related parks: According to Geng et al. (2012, 219f) promoting a 'green image' has become a key objective for many local state actors and their subordinate park managers. The guiding idea is that joining national CE initiatives, e.g. via the process of transforming IPs into EIPs, is thought to entail comprehensive economic as well as environmental benefits. For the purpose of facilitating IS park development local actors have in some instances created an institutional mechanism to further self-organisation and bottom-up coordination with central state actors: In order to include corporate actors within the parks into this dynamic, some CE-related parks have been equipped with administrative committees (ACs) by local governments, so as to transfer responsibilities and coordination duties directly to the actors within parks themselves. Although ACs have to ensure adherence to environmental protection regulations and cannot issue regulations with legislative power, these committees can still with relative liberty influence companies decisions and shape institutional developments in the park according to their judgement (Yu et al., 2014b, 442f and 454). Given the particular degree of institutional leeway, ACs in cooperation with enterprises are thus able to strengthen the bottom-up development of IS-oriented IPs. This particular circumstance has thus led some researchers to interpret the ecological transformation of IPs into EIPs as strongly shaped by bottom-up efforts (Yu et al., 2014b, 441; Winans and Deng, 2017, 827). The resulting constellation thus implies that interests of the formal state domain at different levels are aligned with those of corporate actors in the informal domain. This in turn creates a particular shape of the selection mechanisms on both sides, which, in the case of EIPs, operate in cooperation rather than opposition to each other. This particular institutional environment of top-down preset interest alignment implies that variation in EIPs is less the result of competing selection mechanisms driven by opposing interest structures. Rather, as will be shown below, the thereof emerging forms of variation emerge because of different park categories and forms of IS among enterprises.

### 7.3.2 The second cycle of evolution: Emergence of different IS-park types

#### 7.3.2.1 Different actor agendas and their influence on IS park variation

After the first cycle of evolution, namely the translation and implementation of IS practices to China's IPs, the landscape of the country's industrial estates has begun to evolve along deviating, yet parallel trajectories. Herein, the primary drivers that realised these evolutionary developments were several state actor groups. Following respective political strategies under the CE agenda, these actors initiated the second cycle of evolution of IS practices in China. The time frame of this process covered the period of 2003-2006 and, after a short intermission, continued in 2013. Central for this diversification of development paths, i.e. institutional variation, were the multitude of central state actors, who pursue different interests in the realisation of IS concepts in park estates. As a result of this diversity, three overarching categories of CE-oriented IPs came into being in the PRC: (1) Eco-Industrial Parks (EIPs); (2) Circular Economy Demonstration Zones (CEDZs); (3) Low-Carbon Industrial Parks (LCIPs). All of these parks are experimental in nature, company participation is voluntary and therein conducted IS-strategies aim to simultaneously strengthen economic performance and reduce industrial-ecological impact (Thieriot and Sawyer, 2015, 3; Zhang et al., 2010, 504; Liu et al., 2016, 418).

The most recent and so far little researched of these park types are the LCIPs, which were officially launched in 2013[51]. These industrial estates emerged as a joint project of the MIIT and the NDRC aiming to accelerate low-carbon performance in production and thereby increase international competitiveness of China's industrial sector. In comparison to the other two programs, the innovative focus is less set on creating new forms of IS or CE patterns, but rather to reduce greenhouse gas emissions (Thieriot and Sawyer, 2015, 5 and 9; Huang et al., 2016, 373). Due to a lack of secondary research on LCIPs and because of the program's recentness the process of institutional evolution is difficult to assess. However, judging by the quantity and number of batches of so far established parks it appears that central state actors are most likely to intensify the institutional solution finding process in this field: Not only did the MIIT and NDRC establish 50 experimental zones from scratch by 2016, i.e. three years after the initiation of the program. Both central actors have moreover issued three pilot

[51] Despite the significant time lag between the emergence of EIPs and CEDZs (launched in 2003) on the one hand and the LCIPs (initiated in 2013) on the other hand, all three park types belong to the same cycle of institutional evolution. There are two arguments that buttress this rationale: Firstly, all three types represent outcomes that result from preceding IS practices. Secondly, while the first two types have certainly influenced the formation of the LCIPs, all three types are distinct in their functional nature, evolve along respective trajectories and encompass the entirety of IS-related IP variations in the PRC.

batches within a very short time period, namely in 2013, 2015 and 2017. Such activities would hint to very effective learning and information feedbacks in the course of each evolutionary cycle. This assessment is buttressed by two features: Firstly, the respective policy documents issued by the two actors have incorporated elements from the earlier EIP and CEDZ programs. This hints to effects of learning and imitation from successful predecessors. Secondly, the time span between formally issued notifications on respective LCIP batches by both agencies is very short, namely at a maximum of one year (pkulaw.cn, individual search results). This again would indicate that information feedbacks, dissemination and thereof created learning effects are relatively effective, which in turn propels further institutional innovation and evolution.

The relatively rapid advancement of the LCIP program can be interpreted as a learning result from experimentation in IS, which was conducted in the two earlier and most notable pilot schemes: The EIP program and the CEDZ program. These two exhibit a relatively long history over several institutional cycles, which can be traced back to the year 2001. Initially it was the SEPA, which hosted both demonstration programs with the interest to reduce pollution and environmental burdens of IPs on the one hand and to increase sustainable economic performance on the other. However, following the rise of the CE as national development agenda between 2002 and 2005, the NDRC curtailed the sole monopoly of the SEPA in CE-pilot experimentation and received authority over the CEDZ program (Zhang et al., 2010, 504). Moreover, the SEPA soon began to invite the Ministry of Science and Technology (MOST) and the Ministry of Commerce (MOC) as co-guiding agencies for the EIP pilot zones (Bai et al., 2014, 5; Liu et al., 2016, 418). These developments in essence broadened the possibility for institutional evolution to take place: On the one hand, the level of involved, in parts competing interests has increased, which in turn leads to modified selection characteristics compared to the preceding evolutionary cycle. On the other hand, the reallocation of CE-oriented parks under different state actors guarantees a different operation of selection mechanisms and thus a variation in outcomes. The discussion in the following paragraphs will focus on the two main forms of IS-oriented IPs in China, as they feature the elements of institutional evolution over several cycles.

#### 7.3.2.2 EIPs and CEDZs: Differing fundaments for patterns of institutional evolution

EIPs and CEDZs represent the most prevalent examples of CE-oriented park estates in China and both exhibit various characteristics, which in some respects overlap and in others deviate. For an analytical comparison regarding the institutional evolution of both IP categories, the

most suitable aspect to begin with is the historical background and the rationale for establishing these experimental entities.

As indicated in the above, EIPs emerged as solution to the environmental and resource related issues entailed by the operation of traditional IPs. In fact, the government built strongly on foreign expertise to realise this new IP concept in China: Not only has China 1999 invited UNEP to initiate a project of environmental management in China's industrial parks on the basis of IE concepts (Bai et al., 2014, 5; Zhang et al., 2010, 505). Moreover, the EIP pilots were also designed on the basis of foreign EIP models practiced in Japan and Germany (Winans and Deng, 2017, 827). In this sense, inherited or learned institutional experiences played a significant role in this particular strand of evolution. In order to complement and extend this institutional template, Chinese state actors applied substantial elements of experimentation to the EIP development program: Not only were most EIPs developed on the basis of transforming pre-existing IPs (Yu et al., 2014b, 442), which given the lack of theoretical blueprints implies a significant degree of experimentation. Moreover, EIPs were also used as the basis for testing various policy elements of environmental management and eco-transformation (ibidem, 443). Within this experimental setting, state actors also seem to have taken the necessity of variation for further learning into account: Very soon after some initial, yet isolated batches proved effective (2001-2006), state actors raised the EIP program to the national level and carefully selected different parks in different regions. The thereby intended goal was to summarise relevant experiences and lessons from the first group of EIP pilots (Geng and Doberstein, 2008, 234; Bai et al., 2014, 5; Zhang et al., 2010, 505)

As for the CEDZs, slightly less information on their initial purpose is available. Interestingly their establishment as pilot demonstration program occurred in close chronologic proximity to the EIPs: In 2003, the SEPA issued a national planning guideline for both park types in one and the same notice (SEPA, 2003a). However soon after, in 2005, the CEDZs fell under the control of the NDRC, which as highlighted before, became dominant in China's CE development. This entailed several significant implications: The selection of CE practices in industrial estates was since then also determined by a state actor with foremost economic interests, which stand in direct contrast to the SEPA's interest portfolio. In terms of variation in outputs, CEDZs may thus be seen as a deviant extension to the EIP program (Jiao and Boons, 2014, 20f). Moreover, CEDZs have similar to the EIPs experienced several cycles of pilot batches, namely in 2005, 2007 and 2011. Thereof, the NDRC came to a similar conclusion (i.e. institutional solution) like the SEPA/ MEP, namely to increasingly focus on

the transformation of traditional IPs into CEDZs. What constitutes a major difference between the two programs is that the CEDZs, despite the high-level backing from the NDRC, has not yet been upgraded to the same level of policy significance as is granted to the EIP program (ibidem, 21).

One crucial element for the selection process in CE relevant IPs is the aspect of actor-specific interest constellations and value preferences. As has been outlined in the preceding chapter, the SEPA/ MEP strongly emphasises values of environmental protection, whereas the NDRC puts more focus on economic performance and resource efficiency. The interesting aspect for both park types is that management and coordination of the programs is conducted by a consortium of central state actors and not by the two agencies alone. For the EIPs, the current initiative is guided by the MEP (as lead), the MOC and the Ministry of Science and Technology (MOST) (Thieriot and Sawyer, 2015, 3; Winans and Deng, 2017, 827). Despite the evident loss of authority for the MEP, this step to cooperate with two other agencies can be well explained by the evolutionary-institutional aspects of learning and experimental solution finding: On the one hand the MOST and the MOC have had experience with the management of IPs before as both agencies were in charge of Hi-tech Development Zones and Economic & Technology Development Zones respectively, which constitute the primary forms of IPs in China (Zhang et al., 2010, 505). Secondly, via this corporation the selection mechanisms for EIPs experienced various changes (see section 7.3.3 below) (Shi et al., 2012a, 9), which may be interpreted as improving the solution finding process through additional experience inputs.

The CEDZs, which were originally managed exclusively by the SEPA, exhibits a slightly different set of actor constellations: Whereas the EIPs seem to embody a mix of environmental, technological innovation, and commercial value preferences, the CEDZs are strongly dominated by economic interests. Moreover this CE-oriented IP system is built upon a much larger stakeholder basis, which arguably poses a challenge for finding a consensus in interests and thus hampers institutional selection. After the responsibility transfer from the SEPA to the NDRC in 2005, the latter sought the cooperation of the MOST, the SEPA, the MOC, the Ministry of Finance (MOF) and the National Bureau of Statistics (NBS) to develop the program (Zhang et al., 2010, 506). While this approach surely guarantees a very broad collection of experiences, the lack of secondary research on CEDZs makes it difficult to ascertain if and to which degree interest conflicts have affected the CEDZ development. However as will be discussed below (section 7.4.3), the evolutionary cycle in CEDZs

stagnated for the first eight years under NDRC leadership, which might suggest that over-boarding interest conflicts had impeded the development of these parks. Another argument that buttresses this assumption is found in the actor re-arrangement when the program extended to include transformed IPs in 2012: Whereas the CEDZs' selection procedures and indicators remained almost identical, only the NDRC and the MOF remain as the sole responsible agencies (Thieriot and Sawyer, 2015, 6).

Apart from actor constellations, the official objectives stipulated for each park type have significant implications for the selection characteristics. These aims are conveyed through the various official, park-specific documents issued by the guiding actors and therein find expression in the 'key principles' (zongze 总则) section. According to preceding research, the basic difference between the two park types is that EIPs are bound to realise ecological principles, whereas CEDZs should emphasise economic and resource specific performances (Geng et al., 2008b, 546). This distinction however overlooks the more detailed value concepts that constitute the operation of these parks. The EIPs are based on the principles of industrial ecology, Cleaner Production and the Circular Economy so as to realise an ecological evolution in China's industry (Bai et al., 2014, 5). In practical terms, this implies the realisation of closed material loops, waste minimisation, and eco-efficient production (Thieriot and Sawyer, 2015, 3; Ghisellini et al., 2016, 21). In contrast to these objectives, the CEDZs focus more on economic and resource efficiencies: Despite similarities with the EIPs, in terms of key concepts such the promotion of industrial symbiosis and thereof derived waste minimisation practices (Geng et al., 2008b, 546), resource productivity, eco-efficiency and the comprehensive utilisation of resources (i.e. reuse and recycle) are the key objectives of CEDZs (Zhang et al., 2010, 506; Li, 2016, 20).

However, a closer analysis of the key objectives and principles in relevant strategy documents on EIPs and CEDZs[52] present a slightly more complex picture (Table 10) than suggested by preceding research.

[52] For the compilation of this table the policy documents on park development and planning were chosen. Therefore all official documents on EIPs and CEDZs designated as 'guide' (zhinan 指南), program (fang'an 方案) and plan (guihua 规划) were reviewed. The respective sources are listed in footnote 53.

**Table 10. Analysis of key principles for EIPs and CEDZs as stipulated in official documents[53]**

| EIPs | | CEDZs | |
|---|---|---|---|
| **Year** | **Key principles** | **Year** | **Key principles** |
| 2003 | Eco-efficiency<br>Product life cycle concept<br>Technological innovation<br>Regional development<br>Infrastructure and information | 2003 | 3Rs |
| 2007 | Society and nature in harmony<br>Ecological efficiency<br>Product life cycle concept<br>Adaption to local conditions<br>Technological innovation<br>Infrastructure and information<br>3Rs | 2005 | Economic growth and transformation<br>Reduction of resource consumption<br>Reduction in waste generation<br>Increase resource productivity |
| 2009 | Reduction of carbon energy sources<br>Green industrial innovation<br>Improvement of energy efficiency<br>Innovation of clean technology<br>Strengthen economic incentives<br>Low-carbon economy | 2005 | Increase resource productivity<br>Reduce resource intensity per product (water, energy, material)<br>Comprehensive utilisation of resources<br>Control waste generation<br>Cleaner production |
| 2011 | Innovation in technology and management<br>3Rs<br>Circular Economy<br>Experimentation<br>Low-carbon development<br>Combine policies, market guidance and public participation | 2009 | 3Rs<br>Setting up a CE standards system<br>Energy, water, material saving<br>Reuse and recycling of waste<br>Material cycling networks within and outside of parks<br>Develop CE information platforms and networks |
| | | 2010 | 3Rs<br>Resource saving<br>Coordination between economy and resource use<br>Environmental protection<br>Consider local conditions<br>Advance innovation |
| | | 2014 | Industrial chains<br>Double win - environment and economy<br>New pilot forms<br>Improve reporting |

Firstly, in terms of content, also EIPs do feature several, economically oriented objectives. Indications are not only the mentioning of the CE concept or the Low-Carbon Economy (in 2011). Moreover, objectives stipulated for EIPs also highlight regional development (2003), the strengthening of economic incentives (2009) and the combination of market, societal and administrative dynamics (2011). The relative prominence of economic objectives in EIP-

[53] The official documents used for the compilation of this table are: SEPA, 2003a; SEPA, 2003b; SEPA, 2007; MEP, 2009a; MEP et al., 2011; NDRC et al., 2005; NDRC, 2005; NSC and NDRC, 2009; NDRC, 2010; NSC, 2014;

guiding documents in fact also embodies the interest and value preferences of the MOC as one of the central state actors involved in this program. By implication, selection characteristics for parks – in this case embodied in the strategic development aims/ principles – can generally be assumed to adhere to the interests and values of the decision-making state actors. Secondly, the herein stipulated principles/ objectives in Table 10 also help to trace particular interest (and thus selection specific) changes over time. On the side of the EIP program, a notable development in that direction is the continuous content-specific extension of key principles: Nearly every document presents a multitude of novel key principles, while only the CE, its 3Rs and the Low-carbon concept appear as recurring topics. On the side of the CEDZs, this pattern of amending novel objectives is comparatively limited, as resource management and economic growth ideals represent the dominant themes. A viable interpretation of this pattern could be that CEDZs did not achieve or only insufficiently achieved the objectives forwarded by state actors. This could in turn have induced the latter to repeat these aims in subsequent documents for the sake of increasing emphasis. A further indication for potential operative problems in CEDZs is the repetition of key principles regarding information management and organisation (in 2009) and reporting improvements (in 2014). From an institutional perspective, a repeated emphasis to strengthen this information feedback mechanism could indicate a lack of communication and thus learning effectiveness between coordinating state actors and executing park entities. Finally, the high degree of changing key principles in the EIP program also indicates a high degree of willingness for experimentation with new concepts among involved state actors. This tendency is to some extent reflected in the initiation of a further cycle of institutional evolution, which will be discussed in the subsequent section.

### 7.3.3 The third cycle of evolution: A further variation of EIP types

Despite the relatively short history of IS-practices in China beginning in 1999-2001, one of the most remarkable results is the degree of experimentation and thereof resulting new forms of pilot types. The so far achieved outcomes, which up until now culminated in a third cycle of institutional evolution, can be regarded as a successful form of state-guided industrial innovation. If measured by the benchmark of the model in this thesis, China's success is manifested in one single fact: Relatively little elements have been imitated, i.e. translating foreign experiences to the Chinese context, while relatively much effort has been spent on experimentation. This approach has in turn led to a high degree of variation in outputs, i.e. a multitude of park types, which in turn provides a substantial basis for information feedbacks

to enhance the institutional inheritance stock. Furthermore, the IS-based park programs also feature a high degree of institutional effectiveness, if seen in the context of problem emergence and institutional solution finding: Not only did the different programs effectively combine a multitude of interest groups in the form of central state actors (ministries). The different park types have also been established with the objective to resolve different CE related problems. As stated above, the EIPs are designed to foremost but not exclusively tackle ecological issues, whereas the CEDZs focus on the nexus between material utilisation and economic performance.

The most recent step of this lively dynamic was marked by a third cycle of institutional evolution, namely the further refinement of the EIP program into three distinct park categories. Via the establishment of three new, respectively differing indicator sets in 2006 the central state actors around the SEPA initiated a diversification of the EIP program: Thereof emerged the sector-integrated EIPs (zonghelei 综合类), sector-specific EIPs (hangyelei 行业类) and venous industry-based EIPs (jingmai chanyelei 静脉产业类). The first group of EIPs comprises a variety of industrial sectors, while the second group is centred on one or more tenant or anchor industrial sectors or enterprises. The third type depicts a cluster combining producing and recycling companies, in which waste generated from production and consumption activities is transformed into resources and products (Geng et al., 2008a, 17; Zhang et al., 2010, 506; Jiao and Boons, 2014, 20; Thieriot and Sawyer, 2015, 3).

The evolutionary process of the EIPs did however not stop at this point, but continued to proceed further via the modification of the respective indicator sets. These indicators systems can be seen as a proxy for the selection mechanism, as they define certain threshold levels that the EIPs are required to fulfil[54]. In this regard, an interesting observation is that after the issuance of all three indicator systems in 2006, only the set for the sector-integrated EIPs continued to evolve with in parts substantial changes in 2009 and 2012. This development is correlated with the fact that as of 2015 most of the EIPs also belonged to the sector-integrated category (Thieriot and Sawyer, 2015, 3). Given these circumstances and due to the scarcity of official explanations on this subject matter, it is necessary to interpret these developments on the basis of the following assumptions: Firstly, as stated above, the EIP program emerged as a response to remodel traditional parks according to IS principles. Because of the compositional

[54] A more detailed discussion on the changes in the selection mechanism via the modification of the indicators will be discussed in section 7.4.2.

diversity of these industrial estates, the sector-integrated EIP type might have be chosen as the most suitable category for transformation towards an IS-based operation. Secondly, this process must have led to a relative prevalence of the sector-integrated EIP type, which in turn might have spurred the SEPA to particularly promote this EIP category. This again explains the eager development of the respective indicator system, which manifested in its amendments in 2009 and 2012. However, for the process of institutional evolution, this development could imply a probable caesura: With more institutional efforts focussed on one EIP type, experimental interest among coordinating state actors for the other two park types might reduce and thus curtail the overall variation in outcomes.

Overall, the institutional evolution of IS-related parks in China has over a period of just 17 years featured a high degree of intensity in change (see Figure 19).

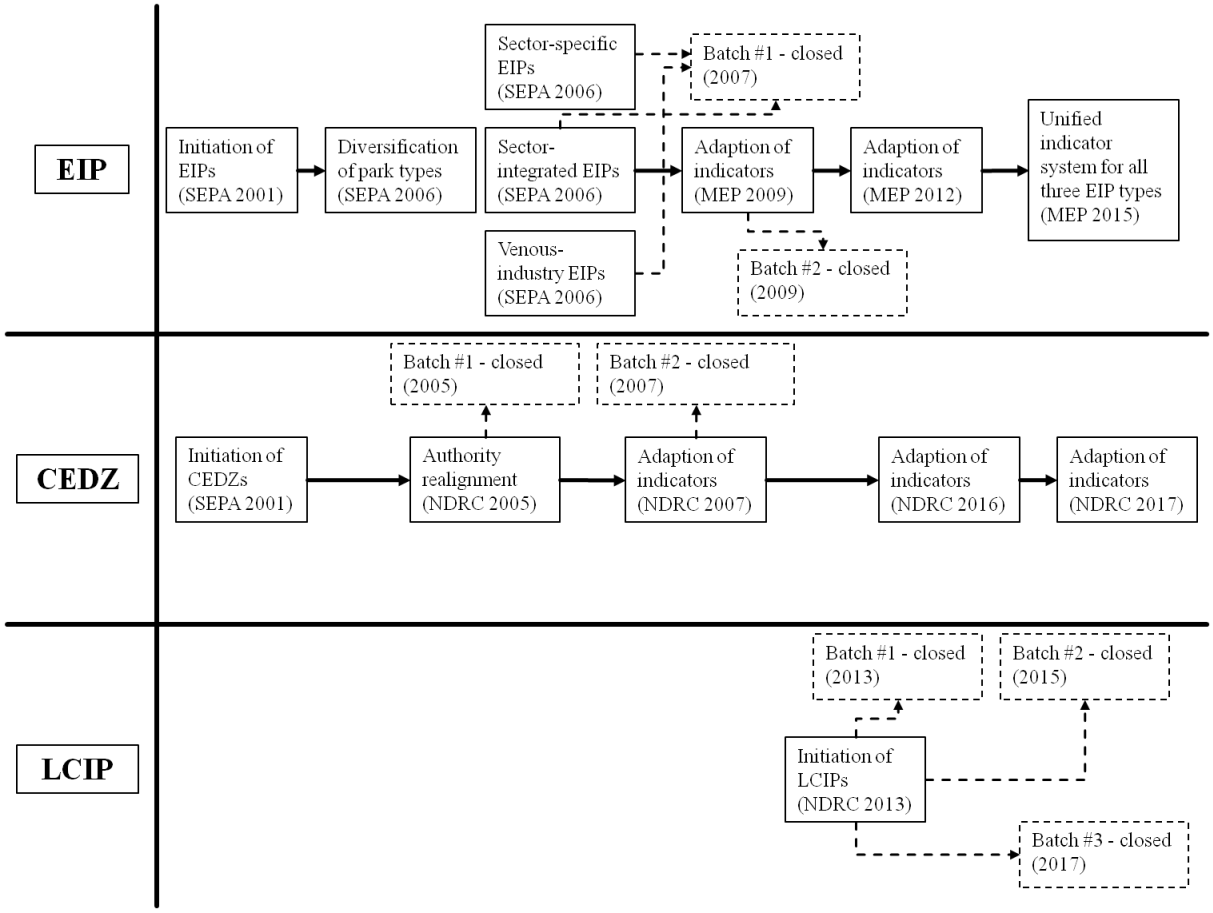


**Figure 19.The process of institutional evolution in China's three IS-oriented park estates (the author)**

As shown in the figure above, the EIP and CEDZ programs have experienced several modifications in regards to the selection mechanism. This is reflected in amendments and changes of park development strategies and indicator systems, which are stipulated in the

respective policy documents[55]. Another noteworthy aspect concerns the variation in park types. Whereas CEDZs appear to evolve along a linear trajectory that exhibits several cycles of indicator modifications, the EIP program has shown a stronger trend towards diversification, represented in the establishment of three EIP types. This did in turn create an interim increase of the variation in outcomes. However, due to the very recent issuance of a unified and comprehensive indicator system for all three parks in 2015, the range of variation has been rolled back significantly. Finally, there is the element of park batches, which have been implemented in all three park types. Despite the openness of all programs for new park entries, the batches indicate specific evolutionary cycles in which the updated selection characteristics are applied for the first time. Such batches would thus function as a means to test the modified selection mechanism and thereof create a feedback for evaluation. For the EIPs and CEDZs it is interesting to see that no new batches have been launched recently, which could be interpreted in two ways: Either, respective batches are in preparation and may be initiated in the years to come. The alternative possibility is that the absence of new batches implies a state of interim perfection of the indicator system, i.e. the selection mechanism. In that case the selection system will remain in operation for the establishment of parks up until the emergence of new challenges requires a further modification. The LCIPs constitute the youngest of all three programs and the launch of three different batches indicates a first, ongoing cycle of experimentation and feedback generation. Once sufficient information is gained, the subsequent cycle will lead to either modification or consolidation of the current indicator system.

When judged by the numbers of established parks, the experimental programs of EIPs and CEDZs appear to be an effective process of institutional solutions. For the purpose of reiteration it should be pointed out that the main objective of both programs was to establish ecologically and economically sustainable replacements for the traditional resource-intensive and polluting IPs in China. Given the steady growth in both park types (Figure 20) and the condition of voluntary participation, it appears that this solution implemented by state actors has fulfilled both categories of institutional effectiveness: Not only does the increase in numbers indicate an effective solution to replace traditional IPs. Moreover, this growth trend also implies the realisation of interest compromises between coordinating state actors as well as between state and corporate actors.

[55] Section 7.4 will go into more detail on how indicator systems and strategy documents define park relevant selection mechanisms.

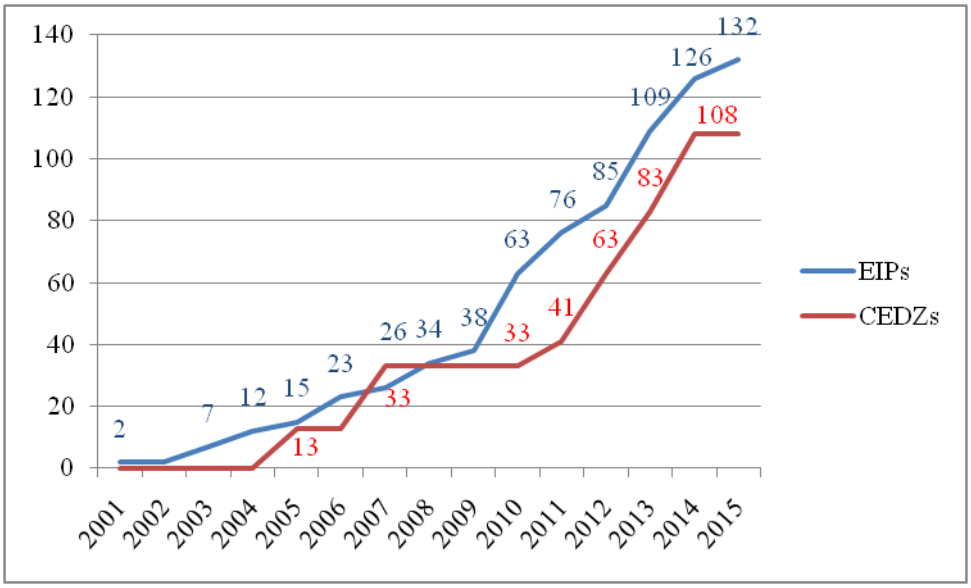


**Figure 20. Accumulated number of officially approved EIPs and CEDZs (source: Thieriot and Sawyer, 2015, 4 and 7)**

A notable feature displayed in the figure above is the sudden increase of approved parks in 2009 and 2010. According to Thieriot and Sawyer (2015, 3), this particular trend can be ascribed to the strengthened emphasis of the CE in the 12th five-year plan. An additionally buttressing element might be the CEPL, which became effective in 2009, and might in its function as a pivotal law have spurred the institutionalisation process within the domain of CE-oriented park estates. As for the variation in outputs in the EIP categories, the state-actors' focus on the sector-integrated EIP type has also been reflected in actual developments: While around 80% belong to this particular group, less than 17% are sector-specific EIPs and venous-industry-based types only constitute round 3% (Ghisellini et al., 2016, 20f). Regionally speaking, around 80% of EIPs are situated in the eastern provinces with a particular focus on Jiangsu, Shandong and Shanghai (Bai et al., 2014, 10).

## 7.4 Evolution of the selection mechanism in EIPs and CEDZs

### 7.4.1 The initial selection characteristics in EIPs and CEDZs

The significant key to understanding the variation in park outcomes is found in the respective selection mechanisms that are applied in both programs. As outlined in the methodology chapter, the operation of the selection mechanism is based on the interest and value preferences of decision-making actors in the two institutional domains. Each domain then develops its respective selection procedures with the aim to generate an institutional solution that tackles a particular problem in accordance with the interests and values of the respective actor groups. In this regard, the analysis of Chinese IS-parks needs to account for two

significant aspects: What are the interests of state actors, who dominate the selection process of the formal domain and what are the interests of corporate actors, who constitute the informal domain[56]? Both aspects have already been discussed in the preceding sections of this chapter, but deserve a short reiteration at this point so as to elucidate the particular outcome dynamic of IS-parks in the PRC. Firstly, enterprise participation in both park types is voluntary. By implication, any application of an existing park to join either the EIP or the CEDZ program means that participating companies subject to the selection mechanisms of the formal domain. By doing so, corporate actors cede most of their decision-making power to the formal domain for this initial cycle of institution finding. In further consequence, the first sequence of selection in park development and thereof generated institutional outcomes, i.e. the forms of EIPs and CEDZs, is primarily shaped by the formal domain. Therefore the subsequent paragraphs of this section will focus on how the formal selection mechanism has evolved in the course of IS-park operations.

Within the subject matter of formal selection, two instances can be distinguished: Firstly, the state actors' auditing of and approval for the establishment of a park and secondly the coordination of park development via respective indicator systems. In regard to the first phase of selection, a comparison of the two park types reveals similarities and differences of both auditing and approval procedures (Table 11).

[56] For the sake of clarity, it should be pointed out that corporate actors participating in the respective park programs are not only governed by informal rules alone: Indeed, when looking at company internal operations, one may encounter a multitude of formal rule structures stipulated in company specific management procedures and the like. However, in the context of IS-park operations, companies decide to join these parks according to their individual preferences and requirements (i.e. selection). These particular value and interest constellations give rise to certain rule systems of behaviour and interaction, which, due to their spontaneous and non-codified nature, can be seen as informal institutions. Therefore it can be argued that participating companies occupy the informal, bottom-up directed institutional domain that operates in juxtaposition to the state actor dominated, formal institutional domain.

**Table 11. Characteristics of initial selection procedures for EIPs and CEDZs (the author[57])**

| Approval and auditing stages | EIPs (SEPA/MEP, MOST, MOC) | CEDZs (NDRC, MOST, SEPA/MEP, MOC, MOF, NBS) |
|---|---|---|
| Qualifications required for application | Support promise from local government | **none** (NDRC screens all applications and devises a list of eligible parks for participation in the CEDZ program) |
| | Fulfilment of operative requirements | |
| | developed foundations for IS-chains among companies | |
| | Enforcement of respective national regulations | |
| | No pollution incidents in 3 years | |
| | Environmental impact assessment & ISO14001 management system | |
| Submission of park development plan and technical report | Socio-economic & environmental conditions | Basic conditions regarding economic development, resource utilisation, environmental protection |
| | Development framework on major objectives | Strategy for achieving CE development |
| | Eco-industry development | CE specific objectives |
| | Control of main pollutants | Key projects of CE practices |
| | Key projects & Cost-benefit analysis | Supporting institutional systems: Leadership & financial policies |
| | Supporting institutional systems: Leadership, organisation, policies, environmental management systems | Support of local government for CE key projects |
| Verification | Evaluation of plans by respective leading group of involved ministries | Evaluation of plans by respective leading group of involved ministries |
| | Either acceptance as EIP pilot or rejection with requirement for amendments | Either acceptance as CEDZ pilot or rejection with requirement for amendments |
| Post-acceptance stage | Evaluation via indicator benchmarks | Evaluation via indicators (no benchmarks) |
| | | Decision of funding amount & allocation of 50% |
| | | If 90% of objectives are achieved, allocation of remaining 50% |

The first notable similarity is that both park types feature the same sequence of application and approval stages. After the application procedures, parks willing to participate in the

[57] This table has been compiled on the basis of Geng et al., 2008a, 17; Zhang et al., 2010, 505ff; Bai et al., 2014, 6; Thieriot and Sawyer, 2015, 7f.

respective programs have to submit development plans and respective technical reports, which will be verified and evaluated. Upon passing the first instance of selection, the further park development will be monitored and evaluated via indicator systems in the post-acceptance stage. During this second stage, the selection process conducted by central state actors aims to coordinate the further development of the parks. In institutional terms this constitutes the formal domain's guidance of institutional outcomes over subsequent cycles[58]. Another similarity appears in the development plan submission and verification stages. In the first phase, the coordinating central state actors demand that participating parks submit a status-quo analysis, respective objectives for IS forms in the park as well as strategies for developing institutional mechanisms. A small, but notable difference is that the EIP program puts more focus on environmental aspects, whereas the CEDZ program tends to emphasise resource- and CE-specific targets. According to the observation of Zhang and colleagues this distinguishing feature is also reflected in the respective indicator systems of both parks: Based on the difference in the NDRC's and the MEP's interest preferences, the CEDZs' indicators focus on the efficiency of resource utilisation, whereas those of the EIPs emphasises pollutant reduction and energy conservation (Zhang et al., 2010, 508).

In regard to the substantial differences in the accreditation procedures of both programs, two accreditation phases stand out: Firstly, the EIP program stipulates comparatively rigid entry benchmarks in the qualification stage, whereas the CEDZ program has no provisions in that regard and thus offers a broad leeway for participant parks. The same observation is valid for the post-acceptance stage. Here again, the MEP sets forth normative indicator benchmarks, whereas the NDRC's program only provides indicative benchmarks for parks[59]. In comparison to his strong coercive type of cooperation mechanism implemented in the EIPs, the CEDZ chose to employ an incentivising fiscal policy mechanism. Approved CEDZs will thus be awarded with financial subsidies for their adaption of operation to the interests of state actors. Herein, the decisive feature that encourages effective cooperation with top-down provisions is to provide 50% of the subsidies once the park has achieved 90% of its objectives. In contrast to that, the sole economic incentive for participating in the EIP program is that parks may foster a corporate image of economic sustainability. In turn the EIPs can increase their attractiveness for domestic and foreign enterprises that bank on the prospects of the green economy (Shi et al., 2012b, 290).

[58] This second stage of selection and its dynamics are treated in sections 7.4.2, 7.4.3 and 7.4.4.
[59] Zhang and colleagues (2010, 506f) have come to a similar assessment and thus conclude that the CEDZ program '…relies much less on checks, acceptances, and supervision'.

### 7.4.2 The evolution of the indicator system in EIPs

As noted above, the EIP program has experienced a substantial path of diversification in regard to the forms and operative aims of the parks, which stands in some contrast to the CEDZ program. This evolution is also reflected in the modification of the respectively established indicator systems, which can be considered as elements of the selection mechanism aiming to guide the EIP development and outcomes. From the very beginning, the crucial element behind the evolution of the EIP program is the information feedback system that has already been in operation during the initial pilots implemented between 2001 and 2003 (Jiao and Boons, 2014, 20). Thereof two basic lessons were learned: Firstly, the SEPA realised that formal and transparent procedures for the application (initial selection) of EIPs was necessary for the extension of the program (Shi et al., 2012a, 9). When taking a closer look on the evolution of application requirements it can be seen that these have become increasingly rigid over time (Table 12): While energy saving, environmental management systems and IS features were amended in the second version of 2009, the emphasis on continuing economic growth stands out in the most recent version of 2012. Such novel additions to the list of program entry requirements would indicate a learning element based on shortcomings noted in EIPs that were approved in preceding accreditation phases.

**Table 12. Application conditions for sector-integrated EIPs (the author, adapted from SEPA (MEP), 2006, 2009 and 2012)**

| Application conditions for sector-integrated EIPs | Entry conditions |
|---|---|
| Version: 2006 | • No severe pollution accidents or ecological disasters<br>• Environmental protection must adhere to national or local levels, pollutant emissions must not surpass thresholds<br>• Approval of EIP construction plan by local government |
| Version: 2009 | • No severe pollution accidents or ecological disasters<br>• Environmental protection must adhere to national or local levels, pollutant emissions must not surpass thresholds<br>• Approval of EIP construction plan by local government<br>• Establishment of independent environmental monitoring unit& implementation of evaluation mechanism<br>• Park management has to achieve ISO 140001<br>• After approval of EIP construction plan, newly added constructions have to adhere to the energy saving standards of the local government<br>• Main industries have to establish clusters featuring a notable Eco-industrial chain |
| Version: 2012 | • No severe pollution accidents or ecological disasters<br>• Environmental protection must adhere to national or local levels, pollutant emissions must not surpass thresholds<br>• Approval of EIP construction plan by local government<br>• Implementation of independent environmental monitoring agency& implementation of evaluation mechanism<br>• Park management has to achieve ISO 140001<br>• After approval of EIP construction plan, newly added constructions have to adhere to the energy saving standards of the local government<br>• Main industries have to be build clusters featuring a notable Eco-industrial chain<br>• Continuing economic growth has to be achieved<br>• EIP's water recycling should adhere to local policies and standards |

* Amended application conditions are marked in red

A second learning based insight of the SEPA was that it had to set up clear standards for evaluation (indicator based selection) in the park estates. In consequence, it promulgated different indicator systems for the three EIP-types in 2006 (Shi et al., 2012a, 9). Herein the initial focus was set on the closure of material loops, waste minimisation and the improvement of eco-efficiency according to the principles of CP, the IE and the CE (Geng et al., 2008b, 546f). What hereof resulted were three sets of indicator systems for the respective parks with correspondingly specified indicator items (see Table 13, Table 14 and Table 15).

**Table 13. 2006 indicator system for sector-integrated EIPs (the author, adapted from SEPA, 2006a)**

| Category | Indicator number | Indicator | Unit of measurement | Inidicator target value |
|---|---|---|---|---|
| Economic development | 1 | Industrial added value per capita | 10,000 RMB/capita | ≥15 |
| | 2 | Industrial added value growth rate | | ≥25% |
| Material reduction and circulation | 3 | Energy consumption per unit of added industrial value | tce/10,000 RMB | ≤0.5 |
| | 4 | Fresh water consumption per unit of added industrial value | m3/10,000 RMB | ≤9 |
| | 5 | Waste water generation per unit of added industrial value | t/10,000 RMB | ≤8 |
| | 6 | Solid waste generation per unit of added industrial value | t/10,000 RMB | ≤0.1 |
| | 7 | Industrial water reuse rate | | ≥75% |
| | 8 | Comprehensive utilisation rate of industrial solid waste | | ≥85% |
| | 9 | Recovered waste water utilisation rate | | ≥40% |
| Pollution control | 10 | Chemical Oxygen Demand discharge quantity per unit of added industrial value | kg/10,000 RMB | ≤1 |
| | 11 | SO2 discharge quantity per unit of added industrial value | kg/10,000 RMB | ≤1 |
| | 12 | Hazardous waste treatment and disposal rate | | 100% |
| | 13 | Concentrated treatment rate of household waste water | | ≥70% |
| | 14 | Safe treatment rate of household waste | | 100% |
| | 15 | Waste collection system | | existent |
| | 16 | Central facilities for waste treatment and disposal | | existent |
| | 17 | Environmental management system | | complete |
| Park management | 18 | Degree of information platform establishment | | 100% |
| | 19 | Release of environmental report | volumes per year | 1 |
| | 20 | Extent of public satisfaction with local environment quality | | ≥90% |
| | 21 | Extent of public awareness regarding Eco-industrial development | | ≥90% |

**Table 14. 2006 indicator system for sector-specific EIPs (the author, adapted from SEPA, 2006b)**

| Category | Indicator number | Indicator | Unit of measurement | Indicator target value |
|---|---|---|---|---|
| Economic development | 1 | Industrial added value growth rate | | ≥12 |
| Material reduction and circulation | 2 | Energy consumption per unit of added industrial value | ton/10,000 RMB | |
| | 3 | Fresh water consumption per unit of added industrial value | m3/10,000 RMB | |
| | 4 | Waste water generation per unit of added industrial value | t/10,000 RMB | reaching the same level |
| | 5 | Industrial water reuse rate | % | as similar enterprises at |
| | 6 | Comprehensive utilisation rate of industrial solid waste | % | the national level |
| Pollution control | 7 | Chemical Oxygen Demand discharge quantity per unit of added industrial value | kg/10,000 RMB | reaching the same level as similar enterprises at |
| | 8 | SO2 discharge quantity per unit of added industrial value | kg/10,000 RMB | the national level |
| | 9 | Hazardous waste treatment and disposal rate | | 100% |
| | 10 | Discharge quantity of sector-specific pollutants | | lower than the overall controll indicator |
| | 11 | Compliance rate of sector-specific pollutants | | 100% |
| | 12 | Waste collection system | | existent |
| | 13 | Central facilities for waste treatment and disposal | | existent |
| | 14 | Environmental management system | | complete |
| Park management | 15 | Industrial technology level | | reaching the same level as similar enterprises at the national level |
| | 16 | Degree of information platform establishment | | 100% |
| | 17 | Release of environmental report | volumes per year | 1 |
| | 18 | Extent of local residential area's statisfaction with the park | | ≥90% |
| | 19 | Awareness rate of park employees regarding the eco-industry | | ≥90% |

**Table 15. 2006 indicator system for venous-industry based EIPs (the author, adapted from SEPA, 2006 c)**

| Category | Indicator number | Indicator | Unit of measurement | Indicator target value |
|---|---|---|---|---|
| Economic development | 1 | Industrial added value per capita | 10,000 RMB/capita | ≥5 |
| | 2 | Contribution rate of venous industry to the industrial added value of the park | | ≥70% |
| Resource recycling and reuse | 3 | Waste treatment quantity | 10,000 t/a | ≥3 |
| | 4 | Household electronic waste recycling rate | | ≥80 |
| | 5 | Waste vehicle recycling rate | | ≥90% |
| | 6 | WEEE recycling rate | | ≥80% |
| | 7 | Waste tire recycling rate | | ≥90% |
| | 8 | Waste plastic recycling rate | | ≥70% |
| | 9 | Other waste recycling rate | | corresponding to respective regulations |
| Pollution control | 10 | Safe disposal rate for hazardous waste | | 100% |
| | 11 | Waste water discharge quantity per unit of added industrial value | t/10,000 RMB | ≤7 |
| | 12 | Pollutant discharge compliance rate of enterprises in the park | | 100% |
| | 13 | Central facilities for waste treatment and disposal | | existent |
| | 14 | Central facilities for waste water treatment | | existent |
| Park management | 15 | Environmental monitoring system of the park | | complete |
| | 16 | Manufacturing and waste product dismantling technology of enterprises in the park | | same as the international advanced level of respective sectors |
| | 17 | Green area coverage rate | | 35% |
| | 18 | Degree of information platform establishment | | 100% |
| | 19 | Number of people participating in park visits and tours | persons per year | ≥ 5000 |
| | 20 | Release of environmental report | volumes per year | 1 |

Given the diversity in EIP concepts, the indicator systems exhibit particular differences, which for better comparison have been highlighted red in the above tables. The first notable element is that the segmentation of categories is nearly the same for all three EIP types. Only venous-industry park indicators have replaced the item of 'material reduction and circulation' with 'resource recycling and reuse', which corresponds to the functional feature of this park type. Another important element is that economic development only plays a very marginal role in the entire system, as this category only incorporates two, relatively broad indicators. When taking a closer look at indicator target values, the sector-specific EIPs (Table 14) appear to have set the most flexible indicator target values as they are mostly bound to provisional measures of the local government. Moreover, the indicator system in this EIP type has dropped several waste and recycling related items such as 'solid waste generation quantity per unit of added industrial value' or 'industrial water reuse rate'. Apart from these differences the sector-integrated and sector-specific EIP indicator systems resemble each other to a high degree. Venous industry-based EIPs clearly feature a strong recycling-based orientation, with vastly differing indicator items that make this EIP type more akin to the concept of CEDZs.

As indicated in the above, the strong element of variation created via the establishment of three different EIP types has been abandoned in the subsequent cycles of EIP evolution.

Instead of continuing to develop new indicator systems for all three types the MEP has during 2009 and 2012 exclusively focussed on the sector-integrated EIPs, and only in 2015 promulgated a new indicator system for all EIP types (see Table 16, Table 17 and Table 18).

**Table 16. Amended indicator system for sector-integrated EIPs in 2009 (the author, adapted from MEP, 2009b)**

| Category | Indicator number | Indicator | Unit of measurement | Indicator target value |
|---|---|---|---|---|
| Economic development | 1 | Industrial added value per capita | 10,000 RMB/capita | ≥15 |
| | 2 | Annual industrial added value growth rate | | ≥**15**% |
| Material reduction and circulation | 3 | Industrial added value per unit of used land | 100 million RMB/km2 | ≥9 |
| | 4 | Energy consumption per unit of added industrial value | tce/10,000 RMB | ≤0.5 |
| | 5 | Elasticity coefficient of comprehensive energy consumption | | <0.6 |
| | 6 | Fresh water consumption per unit of added industrial value | m3 /10,000 RMB | ≤9 |
| | 7 | Elasticity coefficient of fresh water consumption | | <0.55 |
| | 8 | Waste water generation per unit of added industrial value | t/10,000 RMB | ≤8 |
| | 9 | Solid waste generation per unit of added industrial value | t/10,000 RMB | ≤0.1 |
| | 10 | Industrial water reuse rate | | ≥75% |
| | 11 | Comprehensive utilisation rate of industrial solid waste | | ≥85% |
| | 12 Recovered waste water utilisation rate | Annual per capita water resource recovery for units below or equal to 1,000 m3 | | ≥40% |
| | | Annual per capita water resource recovery for units larger than 1,000 m3 and below or equal to 2,000 m3 | | ≥25% |
| | | Annual per capita water resource recovery for units larger than 2,000 m3 | | ≥12% |
| Pollution control | 13 | Chemical Oxygen Demand discharge quantity per unit of added industrial value | kg/10,000 RMB | ≤1 |
| | 14 | Chemical Oxygen Demand discharge elasticity coefficient | | ＜0.3 |
| | 15 | SO2 discharge quantity per unit of added industrial vale | kg/10,000 RMB | ≤1 |
| | 16 | SO2 discharge elasticity coefficient | | ＜0.2 |
| | 17 | Hazardous waste treatment and disposal rate | | 100% |
| | 18 | Concentrated treatment rate of household waste water | | ≥80% |
| | 19 | Safe treatment rate of household waste | | 100% |
| | 20 | Waste collection and central treatement and disposal capacities | | existent |
| Park management | 21 | Environmental management systems and **capacities** | | complete |
| | 22 | Degree of Eco-industrial information platform establishment | | 100% |
| | 23 | Release of environmental report | volumes per year | 1 |
| | 24 | Pivotal enterprises Cleaner Production auditing rate | | 100% |
| | 25 | Extent of public satisfaction with local environment quality | | ≥90% |
| | 26 | Extent of public awareness regarding Eco-industrial development | | ≥90% |

The first cycle of innovation in evaluation indicators in 2009 shows several modifications marked red in the above table: Amendments primarily focussed on the categories of material reduction and circulation as well as in pollution control. These changes have also been documented in secondary literature: According to preceding research, new provisions for waste utilisation, by-product exchange and pollution abatement can be interpreted as learning results and the intention to strengthen particular interests of coordinating state actors (Zhang et al., 2010, 505; Yu et al., 2014b, 442).

Surprisingly, the next remodelling of the sector-integrated indicator system in 2012 (Table 17) features relative little modifications and is only labelled as updated version (xiugai fang'an 修改方案). Therein the items 'annual growth rate of industrial added value' and 'industrial water reuse rate' have been deleted and transferred to the official application requirement section.

**Table 17. Amended indicator system for sector-integrated EIPs in 2012 (the author, adapted from MEP, 2012b)**

| Category | Indicator number | Indicator | Unit of measurement | Indicator target value |
|---|---|---|---|---|
| Economic development | 1 | Industrial added value per capita | 10,000 RMB/capita | ≥15 |
| Material reduction and circulation | 2 | Industrial added value per unit of used land | 100 million RMB/km2 | ≥9 |
| | 3 | Energy consumption per unit of added industrial value | t/10,000 RMB | ≤0.5 |
| | 4 | Elasticity coefficient of comprehensive energy consumption | | <0.6 |
| | 5 | Fresh water consumption per unit of added industrial value | m3/10,000 RMB | ≤9 |
| | 6 | Elasticity coefficient of fresh water consumption | | <0.55 |
| | 7 | Waste water generation per unit of added industrial value | t/10,000 RMB | ≤8 |
| | 8 | Solid waste generation per unit of added industrial value | t/10,000 RMB | ≤0.1 |
| | 9 | Industrial water reuse rate | | ≥75% |
| | 10 | Comprehensive utilisation rate of industrial solid waste | | ≥85% |
| Pollution control | 11 | Chemical Oxygen Demand discharge quantity per unit of added industrial value | kg/10,000 RMB | ≤1 |
| | 12 | Chemical Oxygen Demand discharge elasticity coefficient | | ＜0.3 |
| | 13 | SO2 discharge quantity per unit of added industrial vale | kg/10,000 RMB | ≤1 |
| | 14 | SO2 discharge elasticity coefficient | | ＜0.2 |
| | 15 | Hazardous waste treatment and disposal rate | | 100% |
| | 16 | Concentrated treatment rate of household waste water | | ≥80% |
| | 17 | Safe treatment rate of household waste | | 100％ |
| | 18 | Waste collection and central treatement and disposal capacities | | existent |
| Park management | 19 | Environmental management systems and capacities | | complete |
| | 20 | Degree of Eco-industrial information platform establishment | | 100% |
| | 21 | Release of environmental report | volumes per year | 1 |
| | 22 | Pivotal enterprises Cleaner Production auditing rate | | 100% |
| | 23 | Extent of public satisfaction with local environment quality | | ≥90％ |
| | 24 | Extent of public awareness regarding Eco-industrial development | | ≥90％ |

The 2012 version has also neglected particular critiques regarding the sole focus on EIP eco-efficiency (material use intensity reduction) at the cost of neglecting significant features such as elements of industrial symbiosis and the socio-economic context of EIPs (Geng et al., 2008b and 2012). In this regard the issuance of the most recent indicator system of 2015 (Table 18), which applies to all three EIP types, constitutes a remarkable adaption. Not only have the coordinating state actors designed four new categories, i.e. industrial symbiosis, resource conservation, environmental protection and information disclosure. Moreover, the new system combines indicators from all three sets issued during 2006-2012. This new system appears to have emerged as a learning result from particular shortcomings of the

earlier versions, which is reflected in the choice of particular items: In the economic development category, two new indicators attempt to strengthen the economic proportion of high-tech and recycling companies in the context of overall economic park performance. Secondly, the category of environmental protection appears to reaffirm the particular interest focus of the MEP regarding EIP development. Finally, indicator target values have experienced an adaption towards lower benchmark levels and some of the indicator items have been set forth for selection by the parks. By doing so the formal institutional domain has not only decreased the degree of rigidity in selection, it moreover generates more leeway for bottom-up selection by the informal domain (i.e. park based enterprises). This in turn offers more experimental latitude for parks to focus on particular objectives, which in further consequence increases the variation in institutional outcomes: It can be assumed that different parks with diverging corporate actor constellations will focus on different objectives and thereby generate different forms of EIPs.

**Table 18. Novel indicator system for all EIPs in 2015 (the author, adapted from MEP, 2015)**

| Category | Indicator number | Indicator | Unit of measurement | Indicator target value | Comments |
|---|---|---|---|---|---|
| Economic development | 1 | Proportion of GDP: High-tech enterprises to overall park | | ≥ 30% | Minimum |
| | 2 | Industrial added value per capita | 10,000 | ≥15 | requirement: |
| | 3 | Annual industrial added value growth rate over three years | | ≥15% | choose 1 out of 4 |
| | 4 | Proportion of GDP: Recycling industry enterprises to overall park | | ≥ 30% | |
| Industrial symbiosis | 5 | Number of new Eco-industrial projects built after finalisation of construction plan | units | ≥6 | obligatory |
| | 6 | Comprehensive utilisation rate of industrial solid waste | | ≥70% | Minimum requirement: |
| | 7 | Renewable resource recycling and reuse rate | | ≥80% | choose 1 out of 2 |
| Resource conservation | 8 | Industrial added value per unit of used land | 100 million RMB/km2 | ≥9 | |
| | 9 | Annual industrial added value growth rate over three years for used land | | ≥6% | Minimum requirement: choose 1 out of 2 |
| | 10 | Elasticity coefficient of comprehensive energy consumption | | If average annual industrial added value growth rate >0, then ≤0.6 If <0, then ≥0.6 | obligatory |
| | 11 | Energy consumption per unit of added industrial value | t/10,000 RMB | ≤0.5 | |
| | 12 | Proportion of renewable energy source utilisation | | ≥9% | Minimum requirement: choose 1 out of 2 |
| | 13 | Elasticity coefficient of fresh water consumption | | If average annual industrial added value growth rate >0, then ≤0.55 If <0, then ≥0.55 | obligatory |
| | 14 | Fresh water consumption per unit of added industrial value | m3 /10,000 RMB | ≤8 | |
| | 15 | Industrial water reuse rate | | ≥75% | Minimum |
| | 16 | Renewable water recovery rate | | 10-30% depending on the region | requirement: choose 1 out of 3 |
| Environmental protection | 17 | Compliance rate of stable discharge of heavy pollutants | % | compliant | obligatory |
| | 18 | Overall quantity of stable discharge of heavy pollutants Completition rate of control indicators for locally specific pollutant discharge quantity | | complete | obligatory |
| | 19 | Number of major pollution incidents in the park | | 0 | obligatory |
| | 20 | Completion of environmental management systems and capacities | | 100% | obligatory |
| | 21 | Pivotal enterprises Cleaner Production auditing rate | | 100% | obligatory |
| | 22 | Concentrated treatment installation for waste water | | existent | obligatory |
| | 23 | Environmental risk prevention and control | | 100% | obligatory |
| | 24 | Industrial solid waste (including hazardous waste) reuse and disposal rate | | 100% | obligatory |
| | 25 | Elasticity coefficient for discharge of major pollutants | | If average annual industrial added value growth rate >0, then ≤0.3 If <0, then ≥0.3 | obligatory |
| | 26 | Annual average reduction rate of CO2 discharge quantities per added industrial value | | ≥3% | obligatory |
| | 27 | Waste water discharge quantity per unit of added industrial value | t/10,000 RMB | ≤7 | Minimum requirement: |
| | 28 | Solid waste generation per unit of added industrial value | t/10,000 RMB | ≤1 | choose 1 out of 2 |
| | 29 | Green area coverage rate | | ≥15% | obligatory |
| Information disclosure | 30 | Information disclosure rate of pivotal enterprises | | 100% | obligatory |
| | 31 | Degree of Eco-industrial information platform establishment | | 100% | obligatory |
| | 32 | Propaganda activities on Eco-industrial aspects | times/ year | ≥2 | obligatory |

### 7.4.3 The evolution of the indicator system in CEDZs

In comparison to the indicator specific learning process of the EIPs, the dynamics behind the modifications of indicator changes in the CEDZs are much more obscure. This can in parts be explained by the relative opaqueness of this program, for which, as Zhang and colleagues note, only relatively little regarding gathered experiences and encountered problems is published

(Zhang et al., 2010, 507). From what has been documented, the initially most significant step was the NDRC's indicator set for the CE at national and meso (park) levels, has been developed with the help of external expertise: According to Geng et al. (2012, 218), experts were employed to gather information and experience from other IS projects in China and beyond. Additionally, the NDRC also invited the SEPA and the NBS to comment on the conceptual effectiveness of the indicator items. On the one hand, this instance exemplifies efforts by state actors to use available information and learning feedbacks. On the other hand, this step shows a seldom openness to extend the selection mechanism to external interest groups within the formal domain.

The participation of the SEPA in the design of CEDZ indicators and respective implementation of the program apparently also entailed the consequence that indicator categories and items exhibit overlapping characteristics (Zhu et al., 2014, 358). Specifically the initial set encompasses the four categories resource productivity, resource consumption, comprehensive utilisation of resources and waste discharge. Quite clearly, the orientation of this indicator system towards the CE is as close as it can get. In comparison to the EIP program, preceding research has criticised the CEDZs' indicator system as lacking comprehensiveness (Su et al., 2013, 218), e.g. in regards to environmental pollution.

Since the initiation of the program, the NDRC has similar to the MEP issued several sets of indicators, the first being published in 2007 (Table 19).

**Table 19. The 2007 indicator set for CEDZs (the author, adapted from NDRC, 2007)**

| Category | Indicator number | Indicator | Unit of measurement | Target value |
|---|---|---|---|---|
| 1. Resource productivity | 1 | Main mineral resources productivity rate | 10,000 RMB/ton | none |
| | 2 | Energy resources productivity rate | 10,000 RMB/ton | |
| | 3 | Used land productivity rate | 10,000 RMB/ha | |
| | 4 | Water resource productivity | 10,000 RMB/$m^3$ | |
| 2. Resource consumption | 5 | Energy consumption per unit GDP | ton sce/10,000 RMB | none |
| | 6 | Amount of extracted water per unit GDP | 10,000 $m^3$/ 1 RMB | |
| | 7 | Energy consumption per generated product | ton sce/ ton | |
| | 8 | Water consumption per generated product | 10,000/ ton | |
| 3. Comprehensive utilisation of resources | 9 | Comprehensive utilisation rate of industrial solid waste | reused and recycled quantity/ total generated quantity (%) | none |
| | 10 | Industrial waste water reutilisation rate | reused quantity/ total generated quantity (%) | |
| 4. Waste discharge | 11 | Quantity of disposed industrial solid waste | tons | none |
| | 12 | Quantity of discharged industrial waste water | tons | |
| | 13 | SO2 emission quanity | tons | |
| | 14 | COD emission quantity | tons | |

In terms of item coverage this initial version can be seen as the most comprehensive indicator system issued for CEDZs: Centred on the concept of the CE, the indicator categories cover all resource-relevant aspects such as productivity, consumption, recycling and waste generation. In stark contrast to the EIP indicators, the CEDZ program does however not put forth any

particular benchmark or threshold levels for the individual indicators. This in turn renders the entire mechanism into a solely indicative, but not coercive guiding element. By implication, the state actors behind the CEDZ program provide relatively much latitude to bottom-up induced selection and outcomes, which not necessarily leads to the realisation of the CE. Secondary research on the topic has further indicated several points of critique: Firstly, the CEDZ program seems to lack any provisions on data collection, calculation and submission procedures. This in turn impairs the monitoring and auditing capacities of the guiding state actors and opens the door for data falsification by corporate or managing actors within the park. Secondly, the entire program is voluntary and given the apparently lax entry standards for participation, the application of parks may be motivated by distorted incentives: Instead of genuinely attempting to improve their CE-specific performance, aspirants may rather be motivated by the desire to obtain financial subsidies (Geng et al., 2012, 222f).

The remedial response to such institutional shortcomings came in the subsequent cycle of institutional selection applied to the CEDZs. In 2015, the NDRC issued a draft version of new indicators (Table 20). Herein, the most notable change is the reduction of the entire indicator system to only two categories, which feature three new indicator items. Due to the paucity in official explanations on this topic, it is only possible to interpret this development on the basis of assumptions: As stated by secondary literature presented above, the original version of indicators stipulated for the CEDZs features several overlapping instances with the MEP's EIP program, however without achieving the former's level of comprehensiveness. This in turn could have motivated the NDRC to reshape its indicator set towards a more distinct, CE-oriented focus. And yet there are also indications for improvements that respond to the critique forwarded by Geng et al. (2012). The new draft version has designated some, yet only indicative benchmarks, i.e. indicator reference values, and one obligatory requirement for the item of industrial waste water reutilisation. Additionally, the draft version for the first time stipulated various park entry conditions for enterprises, which feature a high resemblance to the standards set forth by the EIP: Among others, these are the adherence of parks to relevant national and local regulations and policies, the absence of environmental and pollution incidents over a period of three years, the improvement and safeguarding of data collection and quality, the achievement of local environmental standards and obligatory CP audits (GB, 2015). These steps may, however unconfirmed, imply a learning effect from the preceding, first cycle of CEDZ-specific selection and the concurrent, alternative solutions as applied in EIPs.

**Table 20. The 2015 (draft) indicator set for CEDZs (the author, adapted from GB, 2015)**

| Category | Indicator number | Indicator | Unit of measurement | Indicator reference value | Requirements |
|---|---|---|---|---|---|
| 1. Resource productivity | 1 | Energy resources productivity rate | 10,000 RMB/ sce ton | 3 | |
| | 2 | Water resource productivity rate | RMB/$m^3$ | 1500 | |
| | 3 | Soil productivity rate | 100 mio RMB/ km3 | 15 | |
| 2. Resource utilisation | 4 | Comprehensive utilisation rate of industrial solid waste | % | 100 | |
| | 5 | Industrial waste water reutilisation rate | % | 100 | obligatory |
| | 6 | Connectivity degree of Circular Economy industry chain | % | 75 | |
| | 7 | Waste heat resource recovery and reuse rate | % | 60 | |
| | 8 | Waste gas resource recovery and reuse rate | % | 100 | |

However with the issuance of the 2016 indicator set it became clear that the more rigid approach of the draft version has been largely discarded (Table 21). Instead of stipulating particular indicator target values or requirements for the achievement of benchmarks, the new set focussed on renaming categories and introducing a variety of new indicators. The latter primarily centre on resource reuse and recycling related aspects.

**Table 21. The 2016 indicator set of CEDZs (the author, adapted from NDRC, 2016)**

| Category | Indicator number | Indicator | Unit of measurement | Target value |
|---|---|---|---|---|
| 1. Comprehensive indicators | 1 | Main resources productivity rate | 10,000 RMB/ton | none |
| | 2 | Main waste materials recycling rate | % | |
| 2. Specific indicators | 3 | Energy resource productivity rate | 10,000 RMB/ sce ton | |
| | 4 | Water resource productivity rate | RMB/ton | |
| | 5 | Construction land productivity rate | RMB/ ha | |
| | 6 | Comprehensive utilisation rate of agricultural crops material | % | |
| | 7 | Comprehensive utilisation rate of general industrial solid waste | % | |
| | 8 | Reuse rate of waste water from enterprises above designated size | % | none |
| | 9 | Recovery rate of main recyclable materials | % | |
| | 10 | Recycling and treatment rate of urban kitchen waste | % | |
| | 11 | Recycling and treatment rate of urban construction waste | % | |
| | 12 | Utilisation rate of reclaimed water | % | |
| | 13 | Total value output of resource recycling industry | 100 mio RMB | |
| 3. Reference indicators | 14 | Quantity of disposed industrial solid waste | 100 mio tons | |
| | 15 | Quantity of discharched industrial waste water | 100 mio tons | none |
| | 16 | Quantity of landfilled and treated municipal solid waste | 100 mio tons | |
| | 17 | Quantity of discharched heavy pollutants | 10,000 tons | |

One year later in 2017 yet another indicator set was published, which by itself hints to the strong experimental dynamic behind the CEDZ program in recent years. In fact, this very recent indicator system for CEDZs is officially stipulated to serve for another trial period so as to evaluate its functionality in over 50 CEDZs (GB, 2017). What this approach shows, is that state guiding actors behind the program intend to increase the information and learning feedback effectiveness with the aim to produce a solid set of indicators for the CEDZs.

The objectively positive result manifested in the 2017 indicator system is that it has incorporated some of the learned experiences from the operation of the preceding indicator selection mechanisms: Firstly, the respectively chosen items are clearly designated for the purpose of measuring the CE performance in parks. This also implied that several

subordinated or highly specific indicators were condensed into more general ones. So instead of measuring recycling and reuse rates of particular material streams, the 2017 version uses relatively encompassing items such as the recyclable material recovery and reuse rate. This decision may also reflect measurement difficulties for particular material flows. By implication, however, the relatively small item scope of this set indicates a certain degree of latitude permitted to parks as this form of top-down selection and coordination does not prescribe too many tasks to corporate actors. Secondly, and maybe more importantly the 2017 version has established indicator reference values as well as required benchmarks. In parts, this step may represent a learning result from the practice applied in EIPs as well as from former park operations that might have not sufficiently well performed in this field of CE activities. Nevertheless the stipulated reference values are rather low and more easily to achieve than the reference value levels proposed in the draft version of 2015.

**Table 22. The 2017 indicator set of CEDZs (the author, adapted from GB, 2017)**

| Category | Indicator number | Indicator | Unit of measurement | Indicator reference value | Requirements |
|---|---|---|---|---|---|
| 1. Resource productivity | 1 | Energy resource productivity rate | 10,000 RMB/ sce ton | 3 | obligatory |
| | 2 | Water resource productivity rate | RMB/$m^3$ | 1500 | obligatory |
| | 3 | Soil productivity rate | 100 mio RMB/ km3 | 15 | obligatory |
| 2. Resource recycling | 4 | Comprehensive utilisation rate of industrial solid waste | % | 95 | obligatory |
| | 5 | Industrial waste water reutilisation rate | % | 90 | obligatory |
| | 6 | Reclaimed water reuse rate | % | 30 | one out of three obligatory |
| | 7 | Waste heat resource recovery and reuse rate | % | 60 | |
| | 8 | Waste gas resource recovery and reuse rate | % | 90 | |
| | 9 | Recyclable material recovery and reuse rate | % | 80 | one out of two obligatory |
| | 10 | Connectivity degree of Circular Economy industry chain | % | 75 | |

Overall the evolutionary development of the CEDZ indicator system appears to show less consistency in terms of retaining afore conducted modifications over subsequent institutional cycles. In stark contrast to the SEPA's/ MEP's EIPs, the CEDZs still appear to be in the process of substantial experimentation, during which a discernable trajectory towards a clear performance objective is still missing. This particular trend with its frequent shifts in stipulated indicator sets could hint to an approach of open innovation adopted by the NDRC. By implication, the substantial overhauls of the indicator systems would thus suggest an open-end search for the most suitable combination of resource circulation and economic growth. One clear indication for the future aspirations of the program is reflected in the choice of indicator categories, which over time appear to be increasingly geared towards the economic and material based domain of the CE. The aspect of reduction, which is strongly represented in the EIP indicator system, has however been sidelined in the CEDZ program.

### 7.4.4 Feedback systems and learning in EIPs and CEDZs

The preceding chapter has highlighted to which degree evolution in general and selection in particular is dependent on information and learning feedback flows. As has been indicated in the above, the two park programs have implemented different mechanisms to generate such feedbacks. In direct comparison, the CEDZs appear to have neglected this significant institutional element for a relatively long time span. Previous research has attempted to shed some light on the program internal feedback loops. According to Thieriot and Sawyer (2015, 7) the NDRC has only in 2008 commenced to conduct an evaluation of the CEDZs. By implication this would lead to the assumption that there is no constant reporting system implemented in this park type. Indeed, a look at the CEDZ indicator versions shows that no single one addresses the topics of internal documentation, information platform operation or reporting aspects[60]. In contrast to that, EIP indicator systems have from the very onset on demanded such information and reporting features and over time gradually increased emphasis.

In order to make up for this shortcoming, the NDRC has independently conducted efforts to collect experiences made by the CEDZs. This procedure aimed to initially ask parks for an internal evaluation of the index system, the degree of conformance to this system, safeguarding measures to achieve CE-relevant goals and suggestions for future pilot work. Further steps following this internal self-evaluation came in the form of top-down dispatched investigation teams that would conduct in-situ assessments. Here again the aim was to identify the various development outcomes and existing challenges (Thieriot and Sawyer, 2015, 7). Unfortunately, however, the results of this information gathering and evaluation process have not been made public by the NDRC (Zhang et al., 2010, 507)[61]. What nevertheless can be assessed is that the recovery of feedbacks by central state actors has led to substantial changes in indicator sets with every new amendment cycle: Instead of linear amendments and gradual exchanges of indicators – as practiced in the EIPs – the CEDZ

[60] A similar observation has been made in regard to the New Rural Co-operative Medical System, which was implemented as a pilot scheme in rural China since 2004. Also in this program, feedback and reporting systems from local to central government instances were absent (see Klotzbücher et al., 2010. What is New in the "New Rural Co-operative Medical System"? An Assessment in One Kazak County of the Xinjiang Uyghur Autonomous Region. The China Quarterly, vol. 201, pp. 38-57. Doi: 10.1017/S0305741009991068)

[61] Independently to this assessment by Zhang et al. (2010) the author has conducted an online search for assessments of CEDZs. Unfortunately the results of this query only revealed that the NDRC has especially since 2013 increased its efforts to investigate and assess CEDZ program performance. The outcomes of this process are presented in a relatively limited manner by the NDRC, which only states that investigations have lead to the confirmation and continuation of some CEDZs, while others were simply terminated (pkulaw.cn, individual search results).

program appears to a adopt a more disruptive approach. This most likely implies that the gathering and incorporation of information feedbacks has been less coordinated due to the lacking of internal reporting and information transmission mechanisms.

The approach adopted in the EIP program is quite different and in some regards comparatively more effective. Already in 2006, three years after the initiation of the EIP program, the general assessment standard has been modified by the provision put a strong emphasis on establishing efficient feedback mechanisms. These initial steps facilitated the first comprehensive evaluation round of the EIPs in 2008 and helped to further extend the program to an increasing number of parks (Jiao and Boons, 2014, 20). Herein, one of the most significant results was the decision to form a leading group to conduct on-site inspections and verification of EIPs after their approval. This practice is set to be repeated every three years so as to continuously monitor the individual achievements of the investigated parks. In cases of failure, this top-down initiated feedback mechanism would force the respective EIP to make improvements with a strictly stipulated time period (Zhang et al., 2010, 506).

Furthermore, the SEPA/MEP and the other coordinating state actors established a specific mechanism within EIPs to foster information feedbacks from the parks. So-called administration committees (ACs) were installed within each EIP so as to establish an intermediary coordinative hierarchy that directly monitors and guides the development of the respective park estate[62]. Broadly speaking the coordinative role of the ACs already begins during the planning stage. Once an applicant park is approved by the MEP, the ACs are endowed with the authority to make provisions for park management and enforce regulations on participating companies (Geng et al., 2008a, 16). The institutionalisation of the committees within an EIP constitutes the establishment of a dual, park-internal feedback cycle between park enterprises on the one hand and park leadership, i.e. the AC, on the other: While the AC enforces regulations and requirements, conducts supportive measures and disseminates information to the enterprises, they report their environmental and CE specific performance back to the central state actors (Zhu et al., 2014, 458). The coordinative capacities of the ACs are outlined in Table 23.

[62] The CEDZs are equally equipped with park managing entities, however in contrast to the EIPs, this agency has not been endowed with the same authority as enjoyed by the ACs in EIPs.

**Table 23. Mechanisms granted to the ACs for the management and coordination of enterprises in EIPs (the author, adapted from Yu et al., 2014b, 444)**

| Mechanisms | Function and purpose |
|---|---|
| Administrative organisation | • Coordinative leadership of the EIP<br>• Recruitment of enterprises for EIP |
| Environmental management | • Arrangement of recycling and recovery facilities in the EIP |
| Economic incentives | • Tax cuts and subsidising of individual enterprises' CE performance |
| Regulatory instruments | • Mandatory CP mechanism enforcement<br>• Examine emission intensity<br>• Execute penalties for poorly performing enterprises |
| Voluntary instruments | • Knowledge dissemination via information platforms,<br>• Discern IS-opportunities and encourage cooperation<br>• Offer trainings |

This EIP-specific meso feedback cycle has led some commentators to evaluate the EIP program as particularly effective (Zhu et al., 2014, 458; Shi et al., 2010). In order to refine this rather general assessment, the methodological model on institutional evolution provides some useful insights: Firstly, the ACs essentially shorten the feedback distance between higher and lower decision making echelons. Figuratively speaking, the establishment of an AC positions both institutional domains relatively close to each other and thereby realises a dual effect: Not only does this direct link eliminate any intermediary actor levels that would in one way or the other filter information flows from both sides. Moreover, this spatial proximity also exerts a positive influence on the velocity of the entire information feedback loop. Secondly, through their direct installation within the park boundaries the ACs as proxy of the central, formal institutional domain are also situated more close to the actual process of solution application. This further improves the quality of information and learning feedbacks. So in summary, it can be argued that effective park performance in regards to CE relevant indicators is less significant than the EIPs' inherent institutional information system. The role of feedback and reporting mechanisms is particularly significant in cases when top-down initiated regulations do not create the desired effects within the parks. In these circumstances information feedback systems, such as manifested in the ACs, can serve as corrective for the identification of flaws in top-down implemented institutional solutions.

## 7.5 An assessment of outcomes in CE related industrial clusters

### 7.5.1 General challenges and achievements of IS-parks in the PRC

This final section is centred on the institutional outcomes of CE-oriented practices in industrial estates. However, the analysis of these outcomes is curtailed by two significant

factors: Firstly, the discussion in the following paragraphs is primarily based on findings presented by earlier research on this subject matter. While this per se does not constitute any particular inconveniences, it should be noted that most of the relevant literature focuses on the EIP program, while the CEDZs have received only limited attention. One explanatory reason for this circumstance is that the NDRC as leading state actor behind this program only provides very little documentation and reporting to the public. This in turn makes it more difficult for research to engage in the topic. Secondly, most of the data on EIPs and CEDZs presented and analysed by preceding research stems from official sources, such as the ACs, whereas individual investigations of parks only constitutes an exception to the rule. Given that EIPs as well as CEDZs represent important national showcases for CE practices, it is safe to assume that official data, if disseminated to the public, are intended to create a positive image for the programs. This in turn may reduce the reliability of the various data sets as it is highly improbable that less optimal results will be published. Even given the case that officially published data fully corresponds to the data sets conveyed to state actors by the parks, the latter has a strong incentive to report positive performance results. In this regard, the propensity of political-rent seeking by parks and respective corporate actors plays a decisive role[63].

Nevertheless, secondary research has produced a valuable discussion on institutional challenges that hamper the development of CE practices in EIPs. The first and particularly relevant issue for institutional evolution in park estates relates to the coordination of information flows and their impact on industrial symbiosis. For example, the case of Economic-Technological Development Area (TEDA) shows that without proper information coordination, synergies among companies are difficult if not impossible to achieve. During the early years of the park (2000-2005), i.e. when the estate was undergoing the transformation from a traditional to an IS-oriented park, IS-related practices hardly existed. The main impeding factor was the lack of inter-firm communication between individual corporate actors, which arose due to the absence of the AC as main force to disseminate information and thereupon coordinate and encourage IS practices (Yu et al., 2014a, 471). However in 2006, the SEPA issued the first version of EIP indicators and application standards, which not only stipulated the establishment of ACs in EIPs, but also put particular

[63] Despite the paucity of research regarding the aspect of data reliability in the CE, some like Geng et al. (2012, 222f) have voiced similar concerns regarding data reliability: For example, the authors explain that in the absence of clear monitoring and auditing mechanisms, data based results conveyed from the parks to the centre may fall victim to modifications due to expected gains in political capital.

emphasis on the topic of information management. This particular learning result did directly address information related problems such as reported in the case of TEDA.

Another, more substantial institutional challenge, relates to the institutional dissonance that has emerged between single institutional solutions along the path of evolution towards the CE: Several findings indicate a compatibility problem in EIPs that exists between the CP and the IS concepts. Since the issuance of the CPPL in 2002, CP audits on waste and pollutant discharges have been widespread among enterprises in IPs (Tian et al., 2014, 492). The direct effect of CP audits and subsequently implemented, company-internal improvements is that material and energy flows in companies had changed so as to reduce such emissions (Liu et al., 2015b, 326). However by doing so, a direct conflict with the ideal of IS-practices has emerged in Chinese EIPs: The CP-oriented reduction of by-products such as waste water, waste energy and solid waste, does curtail the opportunities to use these outputs as feedstock for other companies within the park. Analyses on developments in Chinese EIPs have shown that the obligatory CP-audits and thereof resulting improvements have caused a discontinuation in pre-existing symbiotic transactions in many parks (Shi et al., 2012b, 290f). For example in TEDA this change in top-down enforced solutions had led to a disruption of 11 IS exchanges from the pre-established 81 symbiosis chains (Shi et al., 2010, 196f). This in turn leads to a much more complex problem nexus within the institutional solution finding process at the national level: While the CE and the CP appear to feature a relatively high degree of convergence at the theoretical level, practical applications such as in EIPs exhibit a certain potential for conflict. In this regard, a solution for the clarification of concept primacy would have to be decided within the formal institutional domain at the central level. Here again, experimental projects with a particular focus on this problem constellation could help to devise respective solutions.

Another, yet highly significant bundle of problems has arisen from the conflict of value preferences that exist between CE ideals and the focus on economic growth. Within this subject matter, the first issue relates to park formation and establishment if the process of company selection is guided by local government actors. Early findings on EIPs from the first decade of the 21$^{st}$ century have indicated that initial park transformations towards IS have often resulted in relatively poor IS-performances (Steuer, 2010, 439). These inefficiencies can to some extent be traced back to the decision making process of local governments, who conducted selections based on their economic interest preferences: Instead of aiming to achieve ideal constellations that would result in substantial IS exchange networks, local

administrators have in some cases primarily focussed on attracting enterprises that generate high turnovers (Wang and Yin, 2007, 27). Such selection practices were rather oriented towards the traditional performance aim to enhance local economic performance, instead of fostering substantial CE systems.

A further problem in the economic domain that affects CE practices in EIPs is the conflict between market and administrative economic coordination. The Hong Kong Chamber of Commerce has in its analysis of the PRC's EIPs stated that this program is too much guided by top-down coordination and planning. Instead, the chamber suggested that the positive effects of market coordination should be brought into play so as to enhance the economic benefit of EIPs (HKGCOC, 2010, 3f). Indeed, a relatively recent finding suggests that too much top-down enforced pressure on firms participating in EIPs may not always produce effective results. The reason is that expected cost savings from IS and the use of by-products or recovered materials may not always produce higher profit margins than traditional business models (Yu et al., 2014a, 470). Additionally, the rigid framework and thus the interest preferences of the MEP and other central actors, which are manifested in the EIP indicators, do not necessarily correspond to the interests of corporate actors in the parks. In this respect, the value preference for short term return on investments might in many cases constitute a determinant role for corporate actors. By implication, simply enforcing the establishment of IS forms in parks may not yield too much enthusiasm and thus effective CE performance among the involved enterprises. Corporate actors might yet be inclined to engage in IS activities, if they expect a positive recognition and subsequent preferential treatment by political actors. On the other hand, also too strong exposure to market forces may bear risks for IS practices in parks. For example an EIP in Inner Mongolia had created an IS network between mineral extracting and respective by-product utilising companies, which broke down due to insufficiently competitive prices. In fact, other producers on the Chinese market were able to manufacture the same outcomes with a relatively more positive cost-benefit ratio (Li et al., 2017, 267). Prices indeed play a significant role when it comes to material based IS networks: Once by-product prices in EIPs rise beyond the average market level, companies that use these inputs either shut down their operation in the park or go elsewhere to acquire the same feedstock at a lower price (Shi et al., 2010, 196f).

A third challenge for EIPs is related to the lack of fiscal policy measures and other state financing mechanisms. While the ACs to a limited degree have the capacity to issue smaller subsidies and limited tax breaks to individual companies, there is as of now no national,

comprehensive funding or beneficial tax system for EIPs (Yu et al., 2014b, 444; Jiao and Boons, 2014, 21; Thieriot and Sawyer, 2015, 7). As mentioned before, this constitutes a significant difference to the NDRC's CEDZ program (Geng et al., 2008b, 546; Thieriot and Sawyer, 2015, 3). Given the voluntary nature of the EIP program, its main aim is to create a good public reputation and woo for environmentally responsible investors. In order to increase attractiveness in the corporate world, EIPs promote the idea of a win-win by which environmentally sustainable production does entail economic benefits, e.g. due to the rising international demands for environmentally friendly products (Shi et al., 2012b, 290). However, because of the often costly initial investments that accompany the entry of new enterprises in EIPs, financial incentives and subsidy mechanisms can play a crucial role for this initial step. With the rise of awareness regarding this topic and due to lacking local EPB funding, ACs have begun to set up special energy conservation and environmental protection funds so as to keep the momentum of EIP growth going (Shi et al., 2012b, 291). As indicated in the above, this is not the only observation of efforts in EIPs to set up individual financing mechanisms (compare Yu et al., 2014b, 444). By implication, if there is a bottom-up trend in efforts to create supplementary financing institutions, then it can be argued that financial mechanisms are a significant element, or even an imperative, for the effective operation of CE-oriented industrial parks.

As for the achievements of EIPs in the PRC, secondary literature abounds with praise on the ecological-economic performances of the parks. According to a nation-wide analysis on these estates conducted for the period of 2007-2010, the environmental performance of EIPs increased by around 90%, the added industrial value rose by 61%, while COD and $SO_2$ discharges were reduced by approximately 7% and 11% respectively. Additionally, the consumption of freshwater and energy merely increased by around 10% each, while only solid waste generation exhibited a relatively large increase of around 35%. The same analysis also presents a very interesting perspective on the qualitative change that occurred over the chronological development of the EIP program: According to the authors, the later EIPs, established in adherence to the more recent indicator systems, feature a better eco-efficiency performance than the earlier parks (Liu et al., 2015a, 1076f). This would in turn imply that the innovation in standards did effectively further the national goal of spreading CE practices in some of the designated park estates.

A relatively more nuanced picture of the CE performance in Chinese EIPs has been presented by Bai et al. (2014). Similar to the study of Liu et al. (2015), Bai and colleagues resort to the

evaluation of EIPs via data provided by the various park managements. However their study attempts to compare the regional variances of parks and therefore juxtaposes EIPs in eastern, central and Western China regarding economic performance, resource consumption and utilisation as well as environmental performance (see Table 24, Table 25 and Table 26).

**Table 24. Economic development of EIPs in China's three regions (Bai et al., 2014, 10)**

| Region | Categories | Economic development | |
|---|---|---|---|
| | NO. | 1 | 2 |
| | Unit | $10^4$ Yuan/person | $10^8$ Yuan/km$^2$ |
| | Indicators & (Abbreviation) | Per capita industrial value added (PC) | Per land use industrial value added (PL) |
| EIP standard | | ≥ 15 | ≥ 9 |
| Eastern | Range | 9.78–51.43 | 4.35–45.8 |
| | Mean | 22.17 | 17.00 |
| | Median | 27.44 | 15.9 |
| | Skewness | 0.46 | 0.92 |
| Central | Range | 5.7–51.8 | 4.5–38.8 |
| | Mean | 25.74 | 18.44 |
| | Median | 24.53 | 15.75 |
| | Skewness | 0.80 | 0.71 |
| Western | Range | 5.47–25.75 | 11.79–28.8 |
| | Mean | 16.17 | 16.17 |
| | Median | 16.74 | 12.04 |
| | Skewness | −0.38 | 2.00 |

**Table 25. Resource and energy consumption and utilisation of EIPs in China's three regions (Bai et al., 2014, 10)**

| Region | Categories | Resources and energy consumption and comprehensive utilization | | | |
|---|---|---|---|---|---|
| | NO. | 3 | 4 | 5 | 6 |
| | Unit | t ce/$10^4$ Yuan | m$^3$/$10^4$ Yuan | % | % |
| | Indicators & (Abbreviation) | Total energy consumption intensity (EC) | Fresh water consumption intensity (WC) | Ratio of industrial waste water utilization (RW) | Ratio of industrial solid waste reuse (RS) |
| EIP standard | | ≤ 0.5 | ≤ 9 | ≥ 75 | ≥ 85 |
| Eastern | Range | 0.13–1.09 | 1.47–50.3 | 51.88–97.00 | 85.43–100.00 |
| | Mean | 0.26 | 6.35 | 73.39 | 78.17 |
| | Median | 0.24 | 5.53 | 90.4 | 92.37 |
| | Skewness | 2.41 | 4.00 | −2.77 | 0.18 |
| Central | Range | 0.09–0.5 | 0.7–22.19 | 24.94–95.2 | 68.2–98.6 |
| | Mean | 0.23 | 7.99 | 58.87 | 87.00 |
| | Median | 0.2 | 5.67 | 54.5 | 88.6 |
| | Skewness | 1.18 | 1.03 | 0.08 | −0.82 |
| Western | Range | 0.021–2 | 0.53–20 | 10.22–73.13 | 40–97.44 |
| | Mean | 0.61 | 9.03 | 48.38 | 69.38 |
| | Median | 0.21 | 7.8 | 55.09 | 70.04 |
| | Skewness | 1.93 | 0.88 | −1.29 | −0.11 |

**Table 26. Environmental performance of EIPs in China's three regions (Bai et al., 2014, 10)**

| Region | Categories | Environmental performance | | | |
|---|---|---|---|---|---|
| | NO. | 7 | 8 | 9 | 10 |
| | Unit | t/$10^4$ Yuan | t/$10^4$ Yuan | Kg/$10^4$ Yuan | Kg/$10^4$ Yuan |
| | Indicators & (Abbreviation) | Waste water generation intensity | Solid waste generation intensity | COD generation intensity | $SO_2$ emission intensity |
| | | (WW) | (SW) | (COD) | ($SO_2$) |
| EIP standard | | ≤ 8 | ≤ 0.1 | ≤ 1 | ≤ 1 |
| Eastern | Range | 1.15–31.95 | 0.003–0.33 | 0.07–3.15 | 0.0004–6.33 |
| | Mean | 4.52 | 0.06 | 0.42 | 0.62 |
| | Median | 3.7 | 0.05 | 0.235 | 0.33 |
| | Skewness | 3.62 | 2.85 | 3.57 | 3.88 |
| Central | Range | 0.56–14.48 | 0.006–6.87 | 0.051–3.6 | 0.068–2.45 |
| | Mean | 6.85 | 0.84 | 1.16 | 0.86 |
| | Median | 6.3 | 0.08 | 0.259 | 0.17 |
| | Skewness | 0.31 | 2.99 | 1.01 | 0.70 |
| Western | Range | 0.38–14 | 0.005–8.33 | 0.052–1.3 | 0.01–1.8 |
| | Mean | 5 | 2.21 | 0.43 | 0.48 |
| | Median | 2.82 | 0.25 | 0.19 | 0.05 |
| | Skewness | 1.43 | 1.98 | 1.82 | 2.00 |

The overall relatively good performance, if measured against the respective EIP standard benchmark levels, seems to confirm that the EIP concept has proven its effectiveness in terms of realising CE practices in China's industry. Only in matters of industrial waste water utilisation (item 5), industrial solid waste reuse (item 6) and solid waste generation (item 8) some EIPs in central and Western regions appear to fall short of stipulated benchmarks.

### 7.5.2 Assessing park performance via industrial symbiosis networks

It is beyond doubt that numerical facts and data on the performance of industrial structures are vital for proper evaluation. And yet, in order to understand and interpret such 'hard facts' it is moreover important to grasp the underlying factors that generate these outcomes. This query inevitably leads to the institutional determinants that shape the performance of CE-oriented parks. However in contrast to the preceding subchapters, the following section centres on the various, internal institutional features of selected IS-parks. Adopting an institution-centred approach not only establishes a sound traceability and useful link between cause and effect. Moreover, applying institutional analysis can sidestep the issue of limited data or independently obtained data, which impedes the research on the EIP program (Dong et al., 2014, 396). At this point it should be noted that preceding research has primarily focussed on the study of individual EIPs and by and large sidelined developments of the CEDZ program.

Therefore the following paragraphs focus on interpreting IS-patterns in EIPs from an institutional perspective.

The decisive characteristic of an IS linkage is that by-products (solid, fluid and gaseous) of one company are used as feedstock for the production of another company. With regards to the measurement of EIP performance, IS connections offer the advantage that such patterns are easily discernable and can thus be taken as a useful proxy for the assessment of a park's CE capacity: The circularity performance of individual EIPs therefore improves, the more such material and energy connections emerge within its companies (Mathews and Tan, 2011, 437). In respect to the particularities of IS networks in EIPs, a recent analysis states that material symbioses are as of now prevailing over energy symbioses (Dong et al., 2014, 395). China's current EIPs exhibit a multitude of IS links among companies of different industrial sectors (Ghisellini et al., 2016, 26). This achievement not only speaks in favour of this concept's practical feasibility, it moreover entails important implications for evolution: The more IS connections emerge between enterprises, the more likely it is that also variation in IS forms increases. Moreover, and that is significant in terms of institutional selection, IS patterns had already emerged in traditional IPs without distinct top-down requirements: Some companies evidently chose to engage in by-product exchanges (selection) as a means to operate more cost effectively (solution), without being aware of the larger CE relevant impact (Liu et al., 2015b, 322). Soon after the initiation of the EIP program such symbiosis networks have gradually grown in parks and led to complex exchange linkages between several corporate actors (Figure 21).

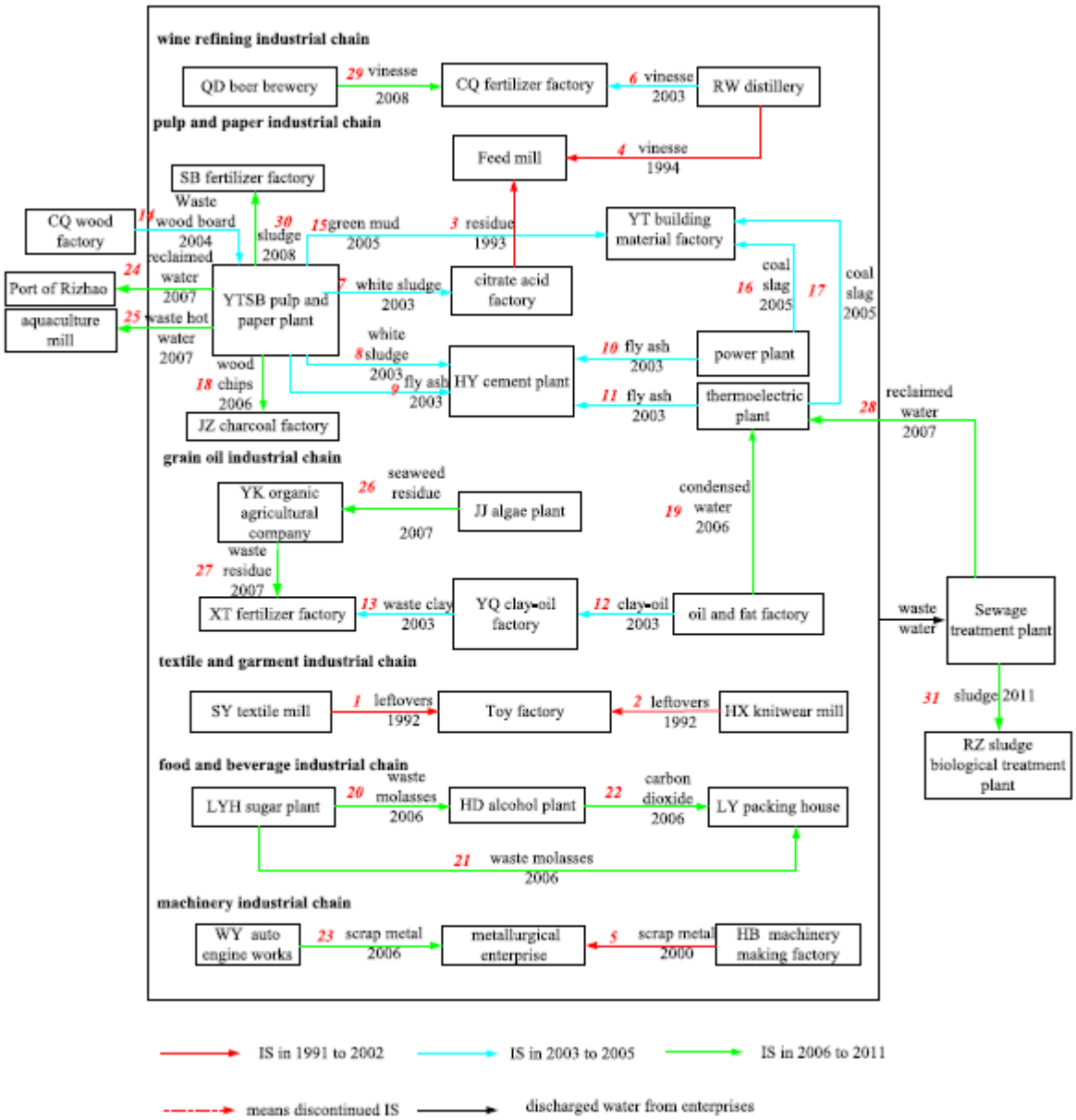


**Figure 21. Industrial symbiosis network in REDA (EIP) established between 1992 and 2011 (Yu et al., 2015a, 342)**

For the broader objective of realising CE practices in EIPs, IS relationships turned out to be one of the pivotal drivers (Bai et al., 2014, 4f). Just as the CE concept aims to align environmental and resource specific concerns with economic priorities, IS linkages entail direct (e.g. revenues from selling by-products) and indirect (e.g. supply security) economic benefits (Ghisellini et al., 2016, 20). In itself this causality adheres to the ideals of the CE, while simultaneously providing incentives for corporate actors to join EIP structures.

Given this obvious win-win element, the question emerges how well the Chinese EIP program has performed, if measured against IS capacities of international EIPs. In overall terms, previous research finds that Chinese park estates feature a comparatively lower number of IS

links, while they are simultaneously more dependent on government support and coordination (Mathews and Tan, 2011; Ghisellini et al., 2016, 22). However in this regard, the strong regional diversity of the PRC has to be taken into account as basis for a more differentiated assessment: Some parks only feature a relatively weak IS network strength such as Guitang park with 17 synergies (Shi and Chertow, 2017, 5), Jinan city park with 13 (Dong et al., 2014, 392) or Suzhou New District with 14 IS linkages (Wen and Meng, 2015, 213). Other more developed estates however exhibit much stronger links such as Rizhao Economic Technological Development Area with 31 (Yu et al., 2015a, 345) or Tianjin Economic Development Zone with 81 (Shi et al., 2010, 195). If these figures are compared to international levels, the Chinese EIP program can indeed hold pace: The international frontrunner in Kalundborg only achieved 13 synergies among 11 firms in 2005 and the EIP in Kawasaki established 14 symbiotic exchanges in 2009. Frontrunner cases such as Kwinana (Australia) achieved over 50 IS connections in 2010 and Ulsan park in South Korea mastered 70 in 2008 (Mathews and Tan, 2011, 446-449). In light of these benchmarks, the Chinese EIP program can, at least in regard to IS network capacity, be in parts considered as international leader. In the following section, the analysis focuses on discerning some of the key institutional factors and dynamics that were essential for successful EIP performance in China.

### 7.5.3 The IS outcomes of bottom-up and top-down selection dynamics in Chinese EIPs

#### 7.5.3.1 Rizhao Economic Technological Development Area (REDA)

The first CE-oriented park presented in this section is the Rizhao Economic Technological Development Area (REDA), which emerged as the result of strong top-down coordination as well as spontaneous bottom-up responses by corporate actors (Yu et al., 2015a, 345). Overall REDA has generated 31 IS linkages, out of which material by-product exchanges constitute 90% of the entire IS network (Ghisellini et al., 2016, 21). For the formation of this structure, coordination by and institutional solutions of the formal domain were crucial: 9 of the IS practices emerged due to state actor initiated information campaigns, while another 19 resulted from subsidies and tax exemptions provided by the park's AC and the central government policies[64] (Yu et al., 2015a, 345).

[64] In regard to the subsidies and fiscal policy measures that took effect in this EIP, it must be emphasised that other than in the CEDZs no general financing scheme exists for EIPs. However REDA's AC can independently provide subsidies to companies. The herein mentioned tax policy measures of the central government targeted not only EIPs, but all industries that were engaged in resource recycling and reuse.

By and large, the development process of REDA can be interpreted as fluctuating between periods of corporate self-organisation and state coordination. Initially, during 1991 and 2002, CE and other related ideas sprouted in China, which led some companies to spontaneously engage in resource utilisation and waste management. Within the boundaries of REDA, respective companies thus began to organise their practices in terms of IS patterns (Yu et al., 2015a, 343). Quite clearly, this development depicts a bottom-up response of corporate actors to the overarching, institutional solution finding in the political centre. The AC of REDA then began to implement the increasingly stricter standards and indicators for company entries and evaluation in the park that were issued by the SEPA between 2003 and 2006. Park-internal companies responded positively to this change, which was manifested by an increase in further IS linkage formation in the park. During a third stage (2007-11) another wave of IS connections emerged. However, during this period, corporate actor initiatives for cooperation constituted the driving force, albeit being somewhat incentivised by formal institutional solutions: Firstly, environmental regulations at local and central levels became more rigid implying a change towards increasingly coercive governance characteristics in the near future. Secondly, fiscal policy measures adopted at the central level played a positively incentivising role: Due to the notice on VAT reimbursements for companies engaged in comprehensive resource utilisation in 2008, corporate actors in the park were encouraged to form IS connections. Thirdly, the AC established a platform promulgating waste minimisation and other CE ideals with the aim to spread the concept among park enterprises. Finally, REDA's AC also established a special fund, which was dedicated to supporting high-tech industry development, energy conservation as well as emission reduction programs in companies (ibidem, 343).

After the initial process of corporate, bottom-up self organisation, the top-down implemented institutional measures and selection procedures seem to have successfully maintained the momentum of IS-generation in REDA. Overall, the measures of the formal domain – some more coercive, others more incentivising – effectively appealed to corporate actors in REDA, who were primarily driven by economic considerations (Ghisellini et al., 2016, 22). In this regard, Yu and colleagues (2015a, 345) have identified the following determinants that led to the emergence of IS practices. Firstly, increasing environmental regulations entailed increasing costs. In order to compensate for these, companies saw by-product exchanges as a viable option to offset these costs via new return streams. Secondly, the incentives arising through the tax refund policies further fostered this trend to engage in resource recovery. Thirdly, the raw material substitution through material-based IS linkages offered a possibility

for cost savings. And finally, the green label ‘awarded’ through the participation in an EIP offered new business opportunities with downstream enterprises that would value sustainable business practices (ibidem, 345). The case of REDA thus amply exemplifies how top-down selection elements can foster adhering bottom-up responses, if a common denominator in the interests of both domains is found.

#### 7.5.3.2 Suzhou New District (SND)

The case of the Suzhou New District (SND) represents an example of an EIP that has achieved success through a comparatively more intense top-down guided coordination. As stated by Wen and Meng (2015, 213), the 14 IS key chains encompassing by-product and product exchanges as well as ecological protection and respective services were primarily achieved through efforts initiated by the AC.

Another decisive feature is that interest preferences and thus the selection mechanism of the formal domain were clearly focussed on environmental sustainability instead of economic growth. Therefore approvals of new company entries to the park or respective projects between companies were subjected to environmental impact and energy consumption benchmarks. By implication, companies or projects that fell below these requirements would not be permitted to the park notwithstanding their economic profit rate. Given these standards, around 400 projects and investments of 3 billion USD during 1995-2012 were rejected due to their potential harm to the environment (Yu et al., 2015b, 267). Furthermore the park’s AC continued to raise the pressure via the issuance of ever more rigid environmental regulations since 2007: Freshwater consumption and wastewater discharges were conformed to the national standard with the aim to eliminate energy- and pollution-intensively operating enterprises from the EIP. Additionally, energy audits were made mandatory for all companies that consumed over 3000 TCE (ton of coal equivalent)/year. In order to encourage companies to reach these targets the AC employed a sophisticated financial incentive system in 2007: While it increased quota pricings for water and energy if individual consumption exceeds EIP benchmarks, the committee simultaneously implemented a reimbursement system connected to audits and investigations. If companies could thereby show that they have improved internal performance, i.e. reductions in material and energy intensity, they would be eligible to reimbursements of 10-50% of the originally paid fees (ibidem, 267). These findings on SND quite clearly show the difference in institutional solution finding to REDA: Given the much more rigid top-down selection specifics, corporate actors merely have the choice to align with formal interests or leave the park.

This ‘sink-or-swim’ mentality adopted by state actors so as to streamline enterprise activities within SND is however not without risks. Given that EIP program participation is voluntary, corporations may theoretically leave the park and continue their polluting, yet more profitable operations under a less rigidly controlled environment. In this regard three factors influence corporate decision making in favour of state actors’ interests: Firstly, the aspect, or rather danger, of sunk costs generates a disincentive for companies to leave a park. The more investments are made, the higher the level of sunk costs. Since these investments grow over time, so does the level of potentially sunk costs. For the case of SND, environmental standards increased gradually, which for companies may have in turn rendered leaving the park more painful than staying. Secondly, while top-down enforcement of IS concepts is seen as problematic in literature, research on SND acknowledges the possibility that financial rewards and incentives by local state actors may have encouraged companies to participate (Mathews and Tan, 2011, 441). Thirdly, the local management has also used voluntary approaches, such as green CE labels to distinguish company performance (Yu et al., 2015b, 267). The hereby ‘greened’ image of particular companies can be beneficial for establishing business linkages with international business partners, who value sustainability in production. Overall, it is quite clear that increasingly rigid institutional control exercised via top-down means, also requires some compensatory institutional solutions so as to strike a balance between state and actor interest value preferences.

#### 7.5.3.3 Tianjin Economic-technological Development Area (TEDA)

A direct comparison of REDA and SND would suggest that the respective IS-network size of EIPs depends to a significant degree on the latitude conceded by the formal to the informal institutional domain: While the relatively open REDA framework realised 31 IS linkages, the more rigid formal scaffolding of SND only produced 14 connections. Apart from the fact that this general assessment omits various other determinants such as the number of participating companies, there are also cases like TEDA that have achieved a large IS network despite strong features of top-down guidance and coordination.

The Tianjin Economic-Technological Development Area (TEDA) is one such example: Not only has it been ranked as the most attractive economic development zone in the PRC for 10 consecutive years (1998-2007) (Shi et al., 2010, 192). Since its eco-transformation from IP to EIP in 2000, TEDA encouraged IS practices among its large and highly diversified industrial actor structure (Yu et al., 2014a, 467). Out of these efforts, 81 symbiotic relationships

emerged over a period of 16 years (Shi et al., 2010, 195). Herein, material exchanges accounted for 76% of all IS connections (Ghisellini et al., 2016, 21).

In terms of actual realisation of IS linkages, the dominant theme in TEDA's development is top-down guidance. Such measures as ISO14001 certifications and administrative instruments in essence resulted from pressures to counter environmental pollution and water resource scarcities (Yu et al., 2014a, 468). So in order to foster IS connections that would especially focus on water management, energy and resource efficiency as well as solid waste management, TEDA's AC established a funding and subsidy system in 2007. Not only did these funds amount to the relatively high sum of 100 million RMB in the year of initiation, secondary research moreover indicates that the fund exhibits an annual growth rate of around 40% (ibidem, 468). Maybe the most crucial use of these funds is that the AC subsidises companies with 30,000 RMB, if they publish their environmental records for 3 consecutive years. The hereby induced bottom-up feedback cycle has not only increased the volume of information flows, but also led to an improved IS formation coordinated by the AC on the basis of these company records. In comparison to REDA and SND, TEDA appears to have the most prominent financing mechanism as it appears to allocate subsidies to even the slightest performance improvements by corporate actors (ibidem, 471).

An equally vigorous dynamic is displayed in the EIPs efforts to foster information flows between the AC and the companies as well as in-between the enterprises. The top-down measures to improve information feedbacks originated from a fundamental problem that burdened the emergence of IS practices at the very beginning of TEDA's IS development: Efforts behind the reclamation and recovery of by-products were primarily curtailed by the lack of available information and insufficient information dissemination services (Yu et al., 2014a, 468). In response to this challenge, one rather straightforward institutional solution initiated by the AC came in form of internet websites, which aimed to inform companies on IS-related practices and opportunities. The herein promoted concepts revolved around eco-efficiency, energy saving, environmental monitoring and low-carbon production. Via these measures information asymmetries were reduced to some degree (Liu et al., 2016, 420)

The possibly most striking top-down implemented solutions for the improvement of information flows are TEDA's Waste Minimisation Club and the park's Eco-centre. The former system was established in 2004 as a sub-project of the EU-China Environmental Management Cooperation Program. The primary aim is to foster spontaneous cooperation between companies so as to reduce the generation of waste that is not repurposed as feedstock

for companies. Initial participants were first investigated by EIP program representatives and the AC in regards to their energy, material and water use efficiency. Subsequently, the Club leadership would propose potential solutions to the company aiming at reducing the generation of waste. Over a period of three years over 50 company-specific solutions were proposed and in summary entailed total capital savings of approximately 8.8 million RMB. Given these results, the Waste Minimisation Club became institutionalised as a permanent platform in the park so as to provide training and knowledge dissemination on the topics of waste minimisation and IS (Yu et al., 2014a, 468ff).

The second notable innovation is TEDA's Low-Carbon Economy Promotion Centre, generally called TEDA Eco-centre, which was established in 2010. The primary rationale behind institutionalising this hub was to disseminate knowledge and information about IS, energy saving and environmental protection (Yu et al., 2014a, 469). It can further be assumed that much behind the impetus to establish the Eco-centre originated in the positive results achieved with the Waste Minimisation Club a few years earlier. However in contrast to the former, the centre mainly focussed on organising so-called matchmaking workshops for enterprises so as to encourage them to discover opportunities for IS cooperation. For this purpose, participants are asked to fill in forms regarding their generation of by-products and waste. Thereof resulting IS opportunities are subsequently evaluated by the centre so as to unite matching parties for cooperation (ibidem, 470). However, the actual identification of cooperation potential is conducted by the companies themselves during the work-shops in face-to-face discussions on IS-relevant aspects (Wang et al., 2017, 1579). Additionally, the Eco-centre provides consultancy services so as to help enterprises identify alternative IS practices. By the end of 2011, the Eco-centre had organised 6 match-making workshops and 8 IS conferences. Compared to 2009, the number of events has increased by a stunning 85% within two years (Yu et al., 2014a, 470f). Together with the effective use of economic incentives, the information dissemination and management efforts substantially spurred the spontaneous disclosure of company environmental information records (Yu et al., 2014b, 451). The combination of these two top-down enforced solutions triggered a strong interest among corporate actors and furthermore led to the formation of 27 IS linkages since 2010 (Yu et al., 2014a, 471). In conclusion, the TEDA model offers some interesting insights on effective, park-internal top-down applied institutional solutions: Obviously the combination of fostering information feedback loops and supplementing these with financial incentives offers an appealing institutional environment for enterprises to independently devise bottom-up types of IS solutions.

## 7.6 Conclusion

IS practices in park estates constitute the most prominent showcases of formal efforts to implement the CE in the PRC. The institutionalisation process of CE parks, as depicted in existing research literature, in essence appears to be a top-down driven process[65]: In the herein presented context, selection and decision-making is dominated by the formal domain (authority for approval and evaluation), to which the informal, corporate domain has to adapt (voluntary participation).

From the perspective of the methodological model, this apparent dominance of one single domain in the solution finding process would on first sight imply that freewheeling institutional evolution is severely curtailed: Herein, bottom-up selection merely seems to play a marginal role, which has very little impact on the opposite selection forces. However, a more detailed look reveals that Chinese IP structures do indeed feature more evolutionary processes than the system set-up would imply: Firstly, the involvement of a multitude of central stakeholders with different interest preferences in the formal domain has led to a variation in park program outcomes. Secondly, the individual park types have left open substantial institutional latitude for park-internal enterprises to organise their operations, which in turn has led to unpredicted forms of IS-linkages, i.e. variations. This constellation has in further consequence created information feedbacks that first enable a learning process among central state actors. Based on the herein acquired new knowledge it can be assumed that interest differences within central state actors will induce a discussion and assessment process. Once a compromise on how to respond to particular challenges in parks (e.g. absence of IS linkages or underperformances) is reached subsequent modifications to the formal selection mechanism will be applied, i.e. the adaption of approval standards and indicator systems. So while Chinese IS park development initially appeared as a relatively rigid, top-down guided institutional transformation, a closer inspection in fact reveals a substantial degree of institutional evolution of these structures.

An initial indication for evolutionary patterns towards CE-oriented park estates in the PRC occurred at the very outset of the entire process. In this regard, the first analytical step revolved around the question of experiences and learned lessons that had influenced IS

[65] The significant limitation for this assessment is constituted by a possible bias that may permeate secondary research on the topic of CE related parks: The primary focus in the consulted articles is either set on the most prominent showcases of parks or presents comprehensive assessment of IS performances in parks. By implication failures as well as IS patterns that exist outside of the national program remain virtually unaddressed. This in turn may convey the idea of an uncontested primacy of the top-down coordinated IS projects.

practices in China's CE-oriented IPs. Within this subject manner, two significant aspects constitute the institutional inheritance behind China CE park development.

Firstly, the learning from and transplantation of experiences from other countries constitutes a substantial impact, upon which subsequent developments were based. Western and Japanese IS park practices clearly demonstrated that the transformation of traditional parks towards more ecological forms can serve as solution to a dual challenge: While these parks were able to guarantee continued economic growth, emerging IS patterns of by-product use between park-internal companies helped to reduce the environmental impact of such estates. This management of two challenges quite clearly corresponds to the dual institutional objective of the CE concept in China: The institutional solution searched for by the Chinese government and hereby represented in the form of sustainable IPs enables the creation of economic growth and environmental and resource specific sustainability simultaneously. This particular characteristic would suggest a reasonable argument for why this new park concept has been embedded in the institutional inheritance of the formal domain in China. What may have moreover facilitated the process of concept translation to the PRC is the fact that the international park governance mainstream suggested an explicit top-down management strategy for such parks. This aspect may have equally benefitted the translation of the concept to the practiced realities of the PRC's political economy.

The second aspect relates to the lessons and experiences gained from traditional IP forms in the PRC. In this regard, three elements have provided a beneficial basis for the adoption of CE-oriented parks. Firstly, the political governance of IPs did in many cases feature elements of top-down guidance and coordination. In these cases state actors prescribe and therefore select the circumstances of park development. Over time, the formal domain could therefore gather sufficient experience on how to implement and develop such systems to achieve economic objectives, i.e. attracting investments for the purpose of economic growth. Moreover, recent legislative provisions on how to develop CE IPs, such as the CEPL, perpetuated the idea that top-down coordination via institutional means, e.g. evaluation procedures and indicator systems, is a necessity for success. As for the reason why this approach has been consolidated by the central government, several political-economic interpretations are possible: Central state actors might have deemed this strategy as useful for asserting dominance over local governments in promoting the CE, demonstrate their expertise in the ecological-economic domain or simply gain a stronger foothold in economic matters. For all these aspects the strengthening of political legitimacy of the centre appears to be the

fundamental common denominator. Secondly, the Chinese government has been confronted with the challenge of environmental pollution and excessive resource consumption, which has been especially rampant in Chinese IPs. The recognition of information feedbacks and proof that a learning process occurred manifests in early efforts of the government to tackle these challenges: Already in the mid-1990s first regulatory steps were initiated to strengthen pollution prevention and environmental protection in Chinese IPs. Thirdly, the development of this new form of IPs has been designed and implemented as a process of policy experimentation. This strategy mirrors the approach already adopted in the 1980s for the purpose of developing traditional IPs. Based on a particular challenge – addressing the paucity of capital and the need to foster economic growth – Chinese policy makers had developed IPs in a piecemeal manner. Beginning in the 1980s and given thereof achieved successes, the program has gradually expanded and led to the establishment of ever more parks. The modern IS parks appear to adhere to the same trajectory: In parts this can be identified as an organic extension to the traditional park experimentation, as many of the new park estates simply emerged from the transformation of old IPs. In parts this process is also driven by strong provision to engage in policy experiments stated in the CEPL.

The second query of this chapter asked for how the selection particularities in different park types change over time and why these changes occur. In this regard, the above analysis has highlighted three significant sources of change, namely top-down and bottom-up determinants as well as learning and feedback processes.

Initially, the top-down operated selection mechanism had established very clear benchmarks for IP development, which unilaterally revolved around the generation of economic growth. At that time, the prevailing economic interest preferences can be identified as the most significant driver behind IP development. The first change to this arrangement resulted from the accumulated challenges related to environmental deterioration and increasing resource scarcities. Given this novel problem and subsequent efforts to devise respective solutions, the top-down selection mechanism experienced the first instance of modification, which was to transform traditional parks into CE-operating IPs. Under this novel context, changes in formal selection however continued to take place. The first reason for such modifications is correlated to changes in participating state actors. Herein, one apt example is manifested in the CEDZ program, which was initialised by the SEPA and participants were selected according to SEPA's set of standards and indicators. Selection however changed in 2005, as

soon as the NDRC took authority over the program. Similar elements of change also occurred in the EIP program after the initial pilots in 2001 ended: Wit the inclusion of the MOC and the MOST as decision making actors, selection criteria changed again (most notably in the indicator systems) so as to comply with the interest preferences of both actors. Such an increase in the actors and subsequent adaption of selection specifics can however also amount to growing complexities: The selection mechanism in the CEDZs for example has for a long time been stalled due to an enormously vast group of involved actors. This has been reflected in an unaltered indicator set between 2007 and 2015. The modification of selection so as to devise new solutions for looming challenges in the parks only resumed after 2012 and then experienced a high intensity of changes namely in 2015, 2016 and 2017. During this period only the NDRC and the MOF remained as sole responsible actors for the program.

Besides actor-relevant changes in the formal domain, the modification of selection may also occur over time if particular objectives of CE park estates have not been achieved. This has been evident in the case of approval standards of EIPs. The key principles of EIPs have been expanded with every new cycle of issued park indicators, which substantially indicates that particularly desired, actor interest bound objectives had not been achieved in the preceding cycle of park approvals. The same is true for the indicator systems themselves, which in their function as part of the selection mechanism that coordinates and guides the ongoing development of parks, exhibit a high degree of modification. Within this subject matter both park types feature substantially different trajectories of indicator modifications: Firstly, the adaption of the indicator system in EIPs clearly features changes that in first instance exhibit efforts of state-actor (MEP/SEPA) related interest alignment. Second to that changes in indicator systems result from learning inputs emerging from preceding cycles. Therefore the initial changes in indicator items (2006-2009) focussed on strengthening the aspect of environmental protection vis-à-vis economic performance. However the most recent modification (2015) gave economic performance a more important role and also lowered the benchmarks of the compulsory target values. These steps in the recent amendment can be interpreted as providing more leeway to park-internal enterprises in terms of IS formation as well as a more preferential assessment of their economic contribution. Such concessions to corporate actors are in essence a necessary premise for the effective operation of EIPs: Otherwise they would not fulfil the ‘economy first, environment second’ concept of the Chinese CE. Secondly, the indicator system of the CEDZs evolved along very different principles. As outlined in the respective sections, the NDRC initially gathered experiences from other state actors such as the MEP so as to increase its expertise in park management.

More interestingly is the development of target values: While in 2007 no benchmarks were set forth and thus provided much leeway for the operations of park internal companies, this gradually changed to more indicative (2015) and finally detailed, compulsory ones in 2017. Simultaneously, the NDRC gradually strengthened information feedback systems in the CEDZs. In summary, the CEDZ program has moved from an environment of relatively freewheeling experimentation to a more specified and regulated one. The particular interest preferences of the NDRC, namely economic growth and material circulation, did not experience substantial change in the course of indicator modifications. Apart from the aspect of adapting selection to state actor preferences, the high degree of change is also correlated with the overall context of EIPs and CEDZs as experimental programs. By implication, the more intensive experimentation is conducted within the programs, the more likely it is that the selection mechanism will change.

In comparison to top-down induced changes, the impact of bottom-up modifications of the selection mechanism is more difficult to ascertain. One of the major impediments in this regard is that neither secondary literature nor official documents discuss how bottom-up feedbacks are incorporated in the reshaping of selection mechanisms. Therefore it can only be assumed that bottom-up performance or a lack thereof does have an impact on the adjustment of selection mechanisms in park programs. Additionally there is reason to assume that bottom-up developments only exert a limited influence on the change of park specific selection. This is primarily due to the contextual framework that has been designed in a manner to enforce an interest alignment of the informal with the formal domain. Under these circumstances a bottom-up induced modification of selection may only occur via particular IS-arrangements among park internal corporate actors. Given that this feature constitutes one of the pivotal functions of CE-oriented parks, circumstances in which parks exhibit insufficient IS practices may be the only case of bottom-up induced changes in the selection mechanism. Here again it should be emphasised that the CE park programs are highly subjugated to the interests of the central government. In this context rent-seeking by corporate actors significantly reduces the emergence of oppositional bottom-up developments in CE related parks, which, apart from questions regarding power and authority, particularly limit the variation in outcomes. This in turn may hamper the process of and the velocity in devising effective solutions simply because the regulatory framework set forth by coordinating, central state actors is too rigid. By implication, ceding more decision-making power and latitude to park internal actors may help to generate more and in essence valuable variation. But at the

same time such a step would curtail influence and prestige of the central government as the authority in matters of CE development.

The third and final element determining changes in the selection mechanism are feedback and learning processes. By replenishing the institutional inheritance stock, these outputs constitute the most crucial feature for evolution to proceed and selection to adjust over time. Very generally, information flows are indispensible for improving the performance of experimental park programs, which can be safely assumed as principal objective of coordinating state actors. By implication, any absence of information flows would impede learning and thus hamper the improvement of park performance. In that case, changes in the selection mechanism may sometimes occur because of the need to foster information flows. This has been reflected in the indicators of the EIP program, which consistently aimed to avoid such shortcomings. In a similar fashion the CEDZ program expressed the intention to use the recent batch of parks (2017) to make up for so far lacking information. Here again it becomes clear that measurements on effectiveness require information feedbacks.

This directly leads to the inquiry of how selection changes  on the basis of feedback flows: Simply speaking the more feedback is available and computable, the higher the likeliness that the selection mechanism will change. In the context of Chinese CE-oriented IPs this means that more pilot batches generate more results and thus help to adjust the selection mechanism according to the actor interests of the respective domain. As for the question of why feedbacks change selection, the answer is that state actors aim to improve the efficiency of park performances according to their interest preferences. This can only be done on the basis of proper feedbacks. Herein, the identification of performance shortcomings is crucial. The SEPA/ MEP has from the very beginning on focussed on this aspect and therefore installed a dense information feedback system. In some respects this has led to increasingly rigid indicators and evaluations thereof. This may however also entail the negative consequence of falsified information transmitted from park-internal enterprises to the SEPA/ MEP due to rent-seeking by the former. Given this possibility, it may be not too surprising that the final indicator set for the EIP program has provided some leeway in the formal selection mechanism. Hereby, corporate actors were allowed to choose and select some indicators and discard others. One explanation based on the assumption that rent-seeking occurred would be that the MEP has learned from the ever more rigid indicator system and thus opted to allow companies to choose which indicators to adhere to. This in turn would constitute a compromise in interests between state and corporate actors involved in the EIP program.

The third analytical question that guided the query in this chapter centred on the correlation between selection characteristics and variation in park types and IS performance. In this regard the critical aspect for evolution is whether the top-down dominated selection mechanism significantly curtails the variation in park outputs. As outlined in the above the selection in Chinese CE-oriented IPs is determined by the interest preferences of the guiding state actors, which in turn leads to different institutional arrangements in EIPs and CEDZs. However despite this particular institutional context, top-down dominated selection can influence variation positively as well as negatively.

On the one hand, variation has been increased due to the explicit top-down governance approach for IPs. From the very onset, such park estates have been implemented in the form of experimental projects so as to advance economic performance. For this purpose, the central government had set up a multitude of park types under different institutional settings, which in turn led to an initial degree in variation. Once China embarked on the path towards increased economic sustainability, CE-oriented IPs emerged. Given the different groups of central state actors responsible for the development of these parks, the current industrial landscape now features three different types of CE IPs, which again induced a variation in form. By implication, the involvement of ever more central state actors has directly led to an increase in variation. This has also been the case for the EIP program, which has initially been led by the SEPA alone, but then began to include the MOST and the MOC. In further consequence the selection specifics, i.e. the indicator system, were modified and thus led to a variation in outcomes. As EIPs and CEDZs are still driven towards increasing efficiency – be it in terms of problem solving capacity as well as in achieving a consensus of interests – experimentation can be expected to continue and so will the variation in outcomes. Finally, the dominant formal domain has in both park types granted a particular degree of institutional latitude, which in turn grants the selection mechanism of the corporate domain to have bigger influence on outcomes. By means of a self-organisation of different IS linkages in parks, the variation in outcomes thus increases.

On the other hand however, there are also notable instances in which the strong impact of top-down selection has curtailed variation. In the case of the EIP program, the initially high degree of variation – exemplified in three different EIP types – was abandoned in favour of the SEPA's exclusive promotion of the sector-integrated type since 2015. By implication, the state's propensity to exclusively focus on just one type of institutional solution may entail

impediments for variation in outcomes. Another particularity reducing variation occurs if the top-down selection mechanism is too rigid in its operative requirements for corporate actors in parks. This may in turn curtail the degree of latitude when it comes to the formation of IS links between companies and subsequently generate similar outcomes in different parks. In a similar fashion, variation might be impaired if the formal selection mechanism is too narrowly focussed on one specific domain, such as economic performance. If respective requirements are too exclusively defined, corporate factors will foremost focus on fulfilling these and therefore generate similar outcomes with little variation between individual parks.

In this context of variation in park outcomes, the aspect of IS patterns obviously plays a pivotal role. Given that the reasons for the emergence of different IS networks has not been discussed in secondary literature, the following paragraphs address this aspect on the basis of the park estate case studies. The first case of REDA in fact showed that incentivising, e.g. subsidies, in combination with coercive institutional arrangements may pro-actively foster IS links among companies. An example of the latter are gradually more strict environmental regulations that exert pressure on companies and in turn force them to establish IS linkages. The emergence of variation under these circumstances then depends on the particular constellation of enterprises within the park. On the other hand, the case of SND shows that too encompassing regulatory management, or coordinative selection, may have reduced the number of IS-links in the park and in turn limited the prospects for variation in outputs. Overlapping, or poorly aligned, requirements in top-down selection may furthermore curtail the IS networks. One example for this kind of disarray are obligatory CP-audits and respective improvements in some EIPs, which reduced waste discharges and in further consequence symbiotic exchanges between participating companies. And finally there is the case of TEDA, which features a high degree of top-down coordination and at the same time the largest number of IS links. Despite the fact that all three park cases vary in terms of size, physical endowments and number of participating companies, it may be safe to contend that there is no clear positive or negative correlation between more rigid selection features and IS link emergence. Rather the latter feature seems much more dependent on park institutions that stimulate corporate actor behaviour and disseminate information. In fact, it appears that parks, which put more emphasis in information management were able to substantially increase the number of IS links: TEDA which installed two platforms features the highest number of IS links, whereas REDA with one such platform ranks second, and SND where no particular platform is installed comes last in regards to IS-linkage size. Information management via such platforms may thus serve as a means to foster cooperation between state and corporate

actors: It can be argued that through such platforms the government can more easily convey its interest specific objectives and at the same time capture the feedback from enterprises regarding their respective interest preferences. Over several cycles of such information exchanges the interests of both sides will sooner or later converge and thereby lead to a compromise.

The final analytical question addresses the type of institutions that facilitate the flow of information in park estates and to which extent information feedbacks can change selection characteristics. As for the first question, the most crucial institutional structure for the management of information flows between park-internal enterprises and central actors are the ACs, which have been implemented in EIPs. In their function as intermediaries between the formal and the informal or corporate domain, ACs could significantly reduce information imperfections in parks and seem to have vastly contributed to the success of EIPs. Notable in this regard are such institutional spinoffs as the waste minimisation club and the Low-carbon economy platform, which were established by the respective ACs in TEDA and REDA. As depicted in the above these information platforms were assessed as pivotal for the enhancement of the park respective IS networks. However, apart from such rule structures that are tailored for the purpose of disseminating information, there are also institutional mechanisms that indirectly foster information feedbacks. A notable example in this regard are financial mechanisms, which are implemented by the ACs of REDA, SND and TEDA. In many instances these financial tools not only help to ensure corporate actor compliance, but also induce companies to provide environmental records and documentation to the committees, which in turn reward the former by monetary means. In both instances of institutions, TEDA has deployed the most comprehensive set to foster information flows, which consists of several financial mechanisms and information disseminating platforms. At this point it should be again pointed out that TEDA also exhibits the highest number of IS linkages. Albeit that it is not possible to discern a fully reliable causality between these institutional features on the one hand and the size of the respective IS network, a positive correlation is highly probable.

A more challenging aspect is to answer the question regarding the extent to which information feedbacks change selection characteristics within the formal domain. Given that there are no particular records of how official actors handle park internal feedbacks, it is only possible to forward an assumption on the basis of developments in CEDZ and EIP selection mechanisms: Over the cycles of indicator adaption, the indicator set of the CEDZ program has exhibited

substantial in parts seemingly unplanned modifications, e.g. because of entire overhauls of single indicator items as well as entire indicator categories. As ascertained before, leading state actors seem to follow the efficiency oriented perspective of the new institutional economics when it comes to the management of park estates. In order to realise such improvements they are depending on obtaining a high degree of reliable information. If such is not available, as exhibited in the CEDZs which in contrast to EIPs seem to lack significant information feedback institutions, indicator sets still change. However in this case, changes appear in a less organised manner that is more akin to freewheeling trial-and-error. By implication this means that qualitatively substantial feedbacks lead to ever smaller changes over several cycles, whereas less reliable information feedbacks force the formal domain to engage in fundamental overhauls of their selection mechanism, even over several evolutionary cycles.

# 8 The CE in practice – Case 2: The formal-informal dynamic in Chinese waste management

## 8.1 Analytical method

The initiation of the CE concept in China has featured a dominant degree of formal state actor involvement: This has been clearly evident in official efforts to translate the concept to the Chinese socio-economic environment during the early 2000s as well as in the implementation of CE strategies in industrial parks. By implication, it could be argued that CE practices and relevant institutional structures are exclusively top-down implemented and predominately guided by the formal domain. The official agenda expressed in the Circular Economy Promotion Law (CPPL) would indeed suggest such an assessment as it exclusively ascribes essential institutionalising functions to central state agencies (NPC, 2008, art. 5-8). However, a closer look at the developments in waste management (WM) in the PRC actually discards this one-dimensional narrative as it shows a much more multi-facetted reality of institutional interaction.

Firstly, early CE practices have existed long before the launch of the official CE agenda. Initial trends emerged soon after the PRC's founding in the 1950s and clearly bear the mark of the modern concept's reuse and recycling principles. During this period resource shortages were ubiquitous, which in turn led to campaigns to recover secondary resources from households (HHs) and channel these back to production as feedstock (Laepple 2007, 102-7). These and similar efforts for the circulation of material soon became institutionalised during the planned economic period and thereby raised the level of sophistication in formal WM: The effective cooperation between state and non-state actors bore a WM system in the late 1970s that remains unmatched up until the very present (Fei et al., 2016, 77). Secondly, CE activities in the field of WM were to a significant degree propelled by the informal institutional domain: Since the early 1980s, socio-economic actors, who are not registered with the government nor employed by formal-private enterprises, have begun to engage in the collection, pre-processing (selection, separation, cleaning, bulking, material extraction) and treatment of discarded waste materials. Self-organised in groups and operating along up- and downstream linkages these actors have developed their own institutional systems that are centred on the management of discarded products (Li, 2002; Tong and Tao, 2016; Steuer et al., 2017a; Steuer et al., 2018). This alternative, informal system will be included in this second chapter on CE practices in China and in doing so a very different form of institutional evolution will be highlighted: The following sections show that the formal domain in the field

of WM remains far from being in control of actually generated institutional outcomes. Rather this sector of the CE evolves and produces institutional outcomes on the basis of two contesting, oppositional domains that compete for the realisation of their respective interests.

In essence, the realm of Chinese WM is split between two institutional domains with respective actor groups. In order to realise particular objectives, both sides establish institutional solutions, which at times complement and at times stand in opposition to each other. For the purpose of better understanding the respectively emerging institutional selection processes and rule system outcomes, it is first imperative to identify and pinpoint the particular value principles and interest preferences of both domains.

The first and most likely less complex domain is constituted by informal actors, who engage in collection, preprocessing and treatment (mostly recycling) of valuable waste materials and discarded devices. Attributing a lack of complexity to informal institutional solutions devised by this group is simply founded in the fact that the informal recycling sector (IRS) is primarily driven by the interest of profit generation. Historically, informal actors began to enter urban WM in the early 1980s: After the decollectivisation, rural labour migrated into China's cities in the search for employment. For some, the collection and recovery of valuable waste materials and in further consequence the sale of such discarded products offered an opportunity to generate a substantial income (Steuer et al., 2017a, 138). During a survey on the IRS in Beijing in 2016 the author and colleagues could verify two constitutive characteristics of this group: Firstly, over 77% of the interviewees stated that they had a migrant background. Secondly, as for the reason of engaging in WM, 92% would indicate the necessity to generate an income. Additionally, these actors would emphasise another value concept that keeps them in waste collection and processing, which was the concept of 'being one's own boss' (Steuer et al., 2017b). As will be discussed in more detail below, this entrepreneurial attitude paired with a tendency to adhere to principles of market-liberalism constitutes a central element of the IRS' value system: Based on the motivation to achieve high profits through exchanging and adding value to discarded products, the IRS devises institutional solutions conducive to realising these value concepts. Thereof resulting outcomes do in turn manifest in a variety of reuse and recycling practices, which sometimes correlate with and sometimes infringe the institutional solutions of the formal domain.

The institutional realm of the formal domain is slightly more complex in regard to the array of interest structures that stand behind it. Herein, two features are especially notable: Firstly, the dominant interest preferences in the formal domain have experienced several shifts over time,

which is reflected in a chronologically changing nature of implemented formal solutions: Initially, that is up until the early 1980s, recycling constituted the key principle of formal WM efforts in urban China aiming to recover valuable secondary resources for production. However after reform and opening, municipal WM agencies have shifted the objective of their operations towards landfilling and incineration. In this regard Dorn and colleagues (2012, 2178f) ascertain that the operative aim of municipalities was centred less on the recovery of municipal solid waste (MSW), but on volume reduction. Paralleled by a shift in primary executive responsibility for MSW management from the Ministry of Health to the Ministry of Construction, WM practices in major cities such as Beijing underwent respective modifications: After open dumping (sic!) in the 1980s and composting attempts up until the mid 1990s, sanitary landfilling and more recently incineration are at the main focus of formal actors (Li et al., 2009, 2598). Currently, these two practices dominate to the treatment of urban Chinese MSW: Out of the total amount entering formal treatment channels, 30% are incinerated, 60% are dumped and about 10% are either composted (organics) or left untreated safely (i.e. open dumping)[66] (Nelles et al., 2017, 10; Liu, 2015, 13). Clearly, reduce and energy recovery elements have constituted the key values behind formal institutional solutions for a substantial time period. However, in recent years yet another turn in official approaches towards WM emerged. The key legislation initiating this change was the CEPL in 2008 and subordinately integrated laws on WM: Since then, resource recovery and recycling have again gained momentum in the national agenda (Chen et al., 2010, 716), which in turn induced many municipal governments to promote the establishment of recycling systems and networks (Fei et al., 2016, 76).

Secondly, the complexity within the formal institutional structure is further intensified due to a divergence of interests pursued by different central state actors. Despite the official stance towards emphasising reduce strategies in WM, the Ministry of Commerce (MOC) and the State Council have even during the late 1980s and early 1990s continued to promote recycling concepts. In two separate documents, both actors have outlined that recycling practices should be outsourced to individually owned businesses (getihu 个体户 or geti shangye 个体商业). After registering with official bodies these were allowed to operate under relatively loose regulatory boundaries and transact recovered waste recyclables according to market principles (MOC et al., 1985; SC, 1991). By implication, these provisions show that the formal domain

[66] These proportions only apply to MSW treatment practices and do not account for processing methods applied to informally recovered waste (Steuer et al., 2017a, 137)

is by no means unified in regards to its interest structure and that private entities had been endowed with a role in WM. What could be critically interpreted as institutional inconsistencies did in fact have a significant impact on the institutional dynamic reflected in current WM practices: While the IRS received the at least tacit formal permission to engage in waste recycling for over 30 years, the new CE agenda induces the formal domain to reassert its dominance in this field. As a result, rivalry and competition for recyclable materials and discarded products characterise urban WM and manifest in a dynamic of solution responsiveness between the two domains (Steuer, 2016b, 287).

This particular constellation of two opposing systems calls for a deeper analysis on institutional evolution: Departing from the primary research question on the outcomes of institutional evolution in China's CE context, the field of WM constitutes an extremely suitable domain for applying the methodological model in regard to four aspects:

In first instance, this chapter addresses the interactive dynamic between the formal and the informal domains. Both sides are highly active in urban WM and have to different degrees of intensity and comprehensiveness established institutional solutions for the purpose of realising their respective interests. The hereof resulting, first analytical question is: *How does the formal-informal dynamic shape the generation of institutional outcomes?*

Second to that, a crucial question is how well both domains devise respective solutions to solve specific problems and challenges in WM. As outlined in the above, the actor groups of both sides pursue particular values and interests related to MSW management. In order to realise these interests and values, representatives of both domains establish institutional solutions, which most ideally tackle the challenge per se and simultaneously facilitate the realisation of actor-specific interests. Thus, the second analytical question is phrased as: *Which institutional outcomes are effective and is there a benchmark for effectiveness*?

In the outline of the methodological model it has been emphasised that learning and information feedbacks constitute pivotal elements for the progression of institutional evolution. Depending on the results of prior institutional solutions, i.e. whether these have been effective or not, actors of both domains decide on how to proceed when encountering familiar challenges. If their learning stock contains previously effective solutions to a similar problem, actors might opt to imitate these original blueprints and apply them to the challenge at hand. If however previous experiences and solutions feature no such options, actors might have to resort to new, experimental institutional approaches. In this sense the third analytical

question for this chapter is: *Which institutional solution patterns for problems in WM prevail – imitation or experimentation*?

Finally the analysis in the following sections also attempts to project future outcomes in terms of institutional solution outputs. For this purpose, the inquiry will focus on the formal-informal dynamic and based on the preceding results of this interaction some conjectures regarding the future institutional outcomes are presented. The final analytical question thus is: *Which future institutional outcomes can be expected in China's urban WM*?

With regards to the content scope of this chapter it has to be noted that the following paragraphs will not treat the entirety of WM processes in the PRC. The simple reason for this choice is based on the sheer extent of activities that WM encompasses: Not only is there a significant difference between urban and rural WM practices. Moreover, WM practices also vary depending on the respective waste categories such as industrial waste, MSW and other fields such as maritime waste. So in order to refine the analytical focus, the following chapter foremost focuses on MSW from commercial entities and private households, which generate around 80% of urban waste (Gu et al., 2015, 68). Furthermore, the discussion in the subsequent sections centres on collection and preprocessing of waste recyclables, i.e. paper, metals, plastics, glass and cardboard, as well as waste electrical and electronic equipment (WEEE). The rationale for limiting the scope of investigation to collection and preprocessing is based on two facts: Firstly, collection is considered as the most significant stage as it has the most decisive impact on overall recycling efficiency (Graedel and Reck, 2014, 22). Tightly linked to the process of collection are preprocessing activities (sorting, separation, cleaning, bulking and material extraction), which are often conducted by collecting actors themselves. Secondly, activities in both stages exhibit a high degree of institutional overlaps in the Chinese context: Institutions practiced for waste collection in many cases also include steps of preprocessing. Additionally, the rationale for confining the analytical focus on two waste categories has to be highlighted: Waste recyclables as well as WEEE are not only growing considerably in terms of their proportion in overall MSW. Moreover, actor groups of both domains have a substantial stake in handling these waste streams. The IRS on the one hand is attracted by its economic value, whereas state actors on the other hand focus on the functional value of these materials for sustaining the CE.

In conclusion of this analytical section, a few words on the findings presented in this chapter are needed. Firstly, the herein discussed facts, data and materials broadly stem from two major sources: Secondary literature on the one hand, and personal field research on the other. As for the latter, the analysis in the following paragraphs greatly draws on research projects in Chinese WM (see the acknowledgment section 11), in which the author participated during 2012 -2017 as research associate at the Institute of Waste Management of the University of Natural Resources and Life Sciences, Vienna (Austria). Over the course of these projects a multitude of interview surveys on the IRS and WEEE management have been conducted in Beijing, Shanghai, Guangzhou, Shenzhen, Wuhan and Chengdu, which involved formal as well as informal actors. Herein, a particular focus was set on assessing processed waste material quantities as well as institutional practices employed by the respective actors. In his role as one of the principal investigators the author has published several research articles on these aspects, which first presented these findings to a larger audience[67]. In adherence to the principles of scientific norms and standards, the following sections will refer to these publications as original sources of the findings. The notable novelty of the herein presented analysis is the application of the methodological model on institutional evolution to the topic of Chinese WM: In essence, the herein adopted approach thus combines earlier data and material findings of the author with the personally devised methodological model of this thesis. As a result, this chapter offers an insight on institutional evolutionary dynamics in Chinese WM, which is unique to this thesis and has not been presented in any similar form at any earlier point.

## 8.2 The history of waste management and institutional dynamics in urban China

The current institutional setting in Chinese urban WM is the result of a unique path-dependence that emerged from an interactive process between the formal and informal institutional domains. In regards to the management of recyclables, and later also WEEE, several historical shifts have first led to a change in institutional dominance and finally to a competition over the control of these resources (Steuer et al., 2017b, 14). The aim of this section is to analyse the institutional solutions practiced by both sides and explain the institutional circumstances that enabled the emergence and later dominance of the IRS.

[67] These publications include: Steuer et al., 2013; Steuer et al., 2014 ; Steuer et al., 2015a ; Steuer et al., 2015b; Steuer 2016a; Steuer, 2016b; Steuer, 2016c; Steuer et al., 2017a; Steuer et al., 2017b; Schulz and Steuer, 2017; Steuer et al., 2018;

After the founding of the PRC, the recovery of resources from waste soon received particular attention: Given consumer good and production input shortages, collection and recycling campaigns in Chinese cities were on a routine agenda so as to recover materials for the support of domestic industry (Li, 2002, 320). Clearly, the government identified reuse practices as a viable solution to foster economic growth during the 1950s and 1960s (Laepple 2007, 102-7). The thereof created learning feedbacks seemed to have entered the institutional inheritance fundament, which led to subsequent rule solutions during the late 1960s and 70s: At the administrative level, waste collection and preprocessing duties were allocated to the Ministry of Industry and the Ministry of Commerce, which respectively installed the Material and Equipment Bureau (Wuziju 物资局) and the Supply and Marketing Cooperatives (SMCs, Gongxiaoshe 供销社). While the former dealt with industrial waste, the latter focussed on household waste (HHW) and herein performed very successfully in establishing a dense urban network of recyclable take-back stations (Zhong, 2010, 44; Li, 2002, 320). These redemption depots are especially notable for two institutional functions: Firstly, such take-back points facilitated the collection and further processing of recyclables. Residents or state employed collectors first transferred recyclable fractions to the depots and therefore received some form of compensation. Thereby recovered materials were subsequently repaired or transferred downstream for further refurbishment or treatment (Zhang and Wen, 2014, 990). Secondly, this network of take back points and collection centres provided the government with an information feedback system that allowed insight into the quantitative flow of secondary material flows from generators. This in turn might have positively impacted the coordination of waste recyclable collection (Steuer, 2017, 416). In order to strengthen the system along the further downstream linkages, municipal governments in all major cities began to set up material recycling plants (Fei et al., 2016, 76).

And yet, this comparatively well-established system was bound to change in the course of reforms: After having reached an up until now unmatched apex in 1977 (Fei et al., 2016, 76), formal waste recycling capacities gradually declined with the initiation of reform and opening. In this regard, secondary literature identifies three major institutional factors that initiated the demise of formal recovery systems: Firstly, the central government had cancelled the planned management of recyclable resources from urban waste (ibidem, 76). This in turn led municipal governments to de-prioritise waste collection and recycling and resulted in a relocation of redemption depots to fringe and suburban areas (Tong and Tao 2016, 11). For residents it now became less convenient to dispose of their waste at the depots, which induced

practices of open waste dumping in the streets and only rudimentary collection and unsafe disposal by the authorities (Li, 2002, 320; FON, 2011a, 5; Salhofer et al., 2013, 51). The dismantling of the official system has to a significant part been propelled by the second factor, namely the shift in the national development agenda towards reforming the economy and fostering economic growth. The relocation and dismantling of the physical collection and preprocessing infrastructure in parts resulted from the perceived cost-intensity of the system. Instead of allocating financial means and infrastructural space on WM, municipalities would rather opt to divert budgets and room for construction to commercially more productive projects (Tong and Tao 2016, 11; Steuer et al., 2017a, 138). The demise of formal capacities has been substantial: For example in Beijing, the number of SMC affiliated take-back points decreased from 2,000 in the 1960s to a meagre 5 in the late 1990s, which were far from sufficient to absorb the quantities of generated recyclables (Shi, 2017).

The third and maybe most significant institutional change is the emergence of the IRS in urban China: In the wake of decollectivisation in agriculture, rural-urban migrant workers entered the city in the search of better income. A part of this segment began to engage in informal waste collection and preprocessing (Steuer, 2017, 416). The reason for doing so was relatively simple: In light of a waning formal system and the prevalence of waste dumping in urban areas, migrant workers quickly realised that discarded recyclables could be commercialised if sold to remanufacturing enterprises (Ensmenger et al., 2005, 3f; Zhang and Wen 2014, 997). Moreover, their doorstep collection services were by and large accepted by urban residents and officials alike: The former felt relieved of their waste and even got some money from handing it to the IRS, whereas the latter herein saw an opportunity to indirectly outsource public duties without affecting the official budget (Steuer et al., 2013, 10). Over time and under these beneficial circumstances, the IRS could gradually establish its own rule system and physical infrastructure (Ensmenger et al., 2005, 4). As a result, the informal institutional domain began to permeate the entire WM service and operation chain and gradually gained dominance over the collection and pre-processing of waste recyclables in urban Chinese WM (Steuer et al., 2017b, 60; Steuer, 2017, 416).

This expansion of the IRS has continued relatively unhampered up until the early 2000s: During this period informal WM operations were largely outside of formal supervision and in large cities like Beijing the sector only faced limited formal intervention (Zhang and Wen, 2014, 990f; Tong and Tao, 2016). Quite on the contrary the formal domain even broadened the institutional leeway for the IRS in 2002, when the central government abolished the

necessity of possessing licenses for waste recovery enterprises. This in turn facilitated the entry of unregistered collectors and pre-processors into the urban WM system (Yao et al., 2009, 836f). In parallel to that informal recycling markets, such as in Beijing, gradually began to emerge and constituted an alternative to formal recycling companies. Thus, instead of having to sell recovered materials to certified recyclers, informal collectors could also transfer materials further downstream for much higher prices (Tong and Tao, 2016, 12). However given the spread of these markets the Beijing government – and presumably other municipalities – began to curtail the informal sector. Formal efforts increasingly aimed to disperse such structures and shift them to the outskirts of the cities. And yet, the IRS was able to absorb ever growing amounts of recyclables and WEEE while it simultaneously also increased in actor size (Tong and Tao, 2016, 12f; Steuer et al., 2018, 61).

In summary, the historical developments in urban Chinese WM feature two significant elements of institutional solutions: Firstly, the interactive dynamics between the formal and informal domains have resulted in a particular form of interest synergy between both domains. While the formal WM system has over the course of the economic reform process dismantled its former effective structures, the IRS has responded by creating institutional solutions that serve as a replacement. As discussed in the above, this type of solution has worked at the benefit of formal and informal interests alike and in further consequence sustained CE based practices in secondary resource management. The formal acceptance of this approach is most notably expressed in the absence of any formal institutional rules that would explicitly prohibit informal collection and preprocessing practices. In essence, the herein manifested outcome can be interpreted as an effective solution in terms of interest inclusiveness as well as problem management[68]. Secondly, the solutions applied by the informal domain do in parts feature elements of imitation: Not only do the doorstep collection services offered by the IRS resemble formal state practices of the 1960s and 1970s. Moreover the establishment of small recycling markets and informal take back stations, which will be discussed in more detail below (section 8.4.6), resemble the operative concept and routines initially applied by the SMCs. The reasons to resort to institutional imitation may have stemmed from a simple learning process: During the period of collectivisation in the 1950s, then informal waste collectors were often integrated into formal collection and processing enterprises (Ensmenger et al., 2005, 2). Having benefitted from this ‘on the job training’, it is arguable that the older

[68] Nevertheless, municipal governments have since the early 2000s increasingly sought to push these informal activities out of city centres. These governance measures have however not been buttressed by any formal regulations to prohibit informal collection and preprocessing activities.

generation of the IRS may have imitated these formerly formal institutional practices. The rationale for doing so might be based on the perception that these institutional solutions simply performed in an effective manner.

## 8.3 Characteristics of Chinese waste management: Quantities, actor sizes and generation of economic value

### 8.3.1 Overview on the section

Before delving deeper into the institutional dynamics that define the currently practiced solution outcomes in urban Chinese WM, it is first necessary to understand the dimensions of the problem, the involved actors and the economic significance of this subject matter. The following paragraphs will thus start by depicting the dimension of actually generated waste quantities in urban China . In second instance, the involved formal and informal actors and their characteristics in terms of operation and interest preferences will be highlighted. In a final step, this section discusses the economic dimension of WM in urban China so as to underscore the motivation and reason behind actor engagement and respective institutional outcomes.

### 8.3.2 MSW: Quantities and aspects of measurement

Generated MSW quantities have experienced a rapid growth in urban China over the past decades: Starting from the earliest published records, annual amounts have quadrupled from the early 1980s to the late 1990s: While only 31.3 million tons were generated in 1980, China's cities already produced 113 million tons in 1998 (Wang and Nie, 2001, 250). In alignment with economic growth and increased socio-economic affluence, waste generation took another leap to 190 million tons in 2004 (Chen et al., 2010, 716) and surpassed the benchmark of 200 million tons of MSW in 2010 (Yang et al., 2012, 26). While these figures yet exclude the 300 million tons of waste generated and mostly left untreated in rural areas (2007) (Zeng et al., 2016, 166), the growth rate of urban MSW would assume that annual quantitative growth will continue to rise: While annual increase rates oscillated between 3-10% during the late 1990s and early 2000s (Wang and Nie, 2001, 250), the last one and a half decades have exhibited a growth rate of 6.5-10% annually. Currently, the increase in this rate has apparently halted, however annual growth in MSW generation still lingers at the extraordinary high figure of 8% (MEP et al., 2012a). In this regard, waste from residential and commercial urban households play a significant role as they account for approximately 80%

of generated MSW in China (Gu et al., 2015, 68). Therein a variety of recyclables such as wood, plastics, paper, glass and metals can be found, which constitute 10-25% of overall HHW (Gu et al., 2015; Qu et al., 2009; Linzner and Salhofer, 2014).

The above variances in data on Chinese MSW already reflect a very basic and substantial issue that affects Chinese WM: Official and even some academic estimations on generated MSW quantities are elusive (Chen et al., 2010, 718). According to the principle of 'you can't manage what you can't measure', this particular weakness significantly impedes the creation of effective formal institutional solutions – be it for collection or treatment. Some attribute this issue to flawed efforts to ascertain quantities and weak application of methodologically sound approaches (Xiao et al., 2007, 29). While this might be true, a more crucial issue is that officially documented quantities only seem to reflect the measurements of waste amounts entering the formal sector. This approach thus neglects the quantities, mostly recyclables, diverted by the IRS beforehand formal collection is conducted (Dorn et al., 2010, 1; Chen et al., 2010, 718). Indeed, a research project conducted by the author and colleagues in 2013 revealed that the formal sector triangulates MSW quantities on the basis of what arrives at waste transfer stations, landfill sites or incineration facilities (Salhofer, et al., 2013, 53ff). This implies that waste amounts are not measured at the point of generation, i.e. the household- or enterprise level. Rather official statistics, such as in Beijing, assume that 'generated amounts (chanshengliang 产生量) correspond to 'transported amounts' (yunshuliang 运输量) (FON, 2011b, 2).

The substantial dimension of divergence between real MSW quantities and official estimates can be demonstrated by a simple comparison of measurement results. Taking the city of Beijing as an example, official estimates as well as assessments by academics and NGOs on daily waste generation quantities (kg/cap/day) are available. In direct comparison the results present a relatively clear picture (see Table 27): While the figures of the government and an NGO (Friends of Nature, Ziran zhi you 自然之友) arrive at the relatively low quantity of 0.4 and 0.23 kg/cap/day (Salhofer et al., 2013, 54; FON, 2011a, 14). The results of the academic surveys indicate much higher amounts namely 0.8-1.4 kg/cap for a relatively similar timeframe (Zhang et al., 2010, 1623; Wang and Wang, 2013, 68; Li et al., 2009, 2596).

**Table 27. Differences in the measurement of household waste in Beijing (adapted from Steuer et al. 2014, 2)**

| Measurements of household waste in Beijing | | |
|---|---|---|
| **Measured by** | Beijing municipality (2007-09)*<br>FON (NGO, 2011)° | Zhang et al., 2010<br>Wang and Wang, 2013<br>Li et al., 2009 |
| **Waste generation of households (kg/cap/day)** | 0.4*; 0.23° | 0.8 - 1.4 |
| **Point of measurement** | Open bins in residential quarters | Household level |

The fundamental reason explaining this difference in results is that the survey by the NGO as well as the measurements of the government are conducted at post-household stage. The figures presented in the academic publications, on the other hand, have been gained from measurements taken at the HH level (Steuer et al., 2014, 2). The above comparison thus provides evidence that official WM authorities systematically underestimate MSW quantities and especially the herein contained recyclable fractions[69]. In the light of this finding, questions arise regarding the effectiveness of respectively deigned solutions by the formal and informal domains. The IRS on the one hand appears to have effective solutions in place when it comes to the collection of recyclable waste from households. This assessment is buttressed by findings of Qu et al. (2009, 2620), who in their survey on Beijing HHW were confronted with a sample in which 30% of HHs generated absolutely no recyclables. Obviously, the herein sampled households have transferred recyclable fractions prior to the survey measurements. If similar results have been the documented 'reality' reported to formal agencies over the last decades, it is not surprising that municipal governments have mostly resorted to reduce oriented institutional solutions such as landfilling and incineration. On the other hand, this also means that the informal sector and its institutional practices have a significant impact on the diversion of generated HHW (Ren and Hu, 2014, 341) and in fact established effective institutional solutions in this field (Steuer et al., 2017b, 37). Furthermore, the case of HHW demonstrates the far reaching impact of informal institutional practices on subsequent formal institutional outputs: Due to the fact that the IRS effectively diverts recyclables from HHs, the official measurements are prone to arrive at distorted overall

[69] For the sake of completeness it has to be added that there is one publication, which cites official statistics on HHW quantities exhibiting relatively high per capita generation such as 1.0 – 1.2 kg/cap/day for various cities (Wang and Nie, 2001, 252). Despite this being an exemption to the otherwise low HHW quantities officially recorded, it may yet indicate a more comprehensive approach to waste quantity measurements at the HH level by state actors.

amounts and compositions regarding HHW. This in turn may have affected the formal solution finding process, which, as shown above, has led to institutional outputs that focus more on final treatment instead of recycling.

### 8.3.3 WEEE: Quantities and aspects of measurement

Within the subject matter of WEEE, the nature of the challenge is relatively similar to the context of general MSW. Firstly, the PRC is confronted with particularly high WEEE growth rates, which even range above the trend exhibited in MSW (see Figure 22). This in turn renders WEEE into an even more pressing challenge.

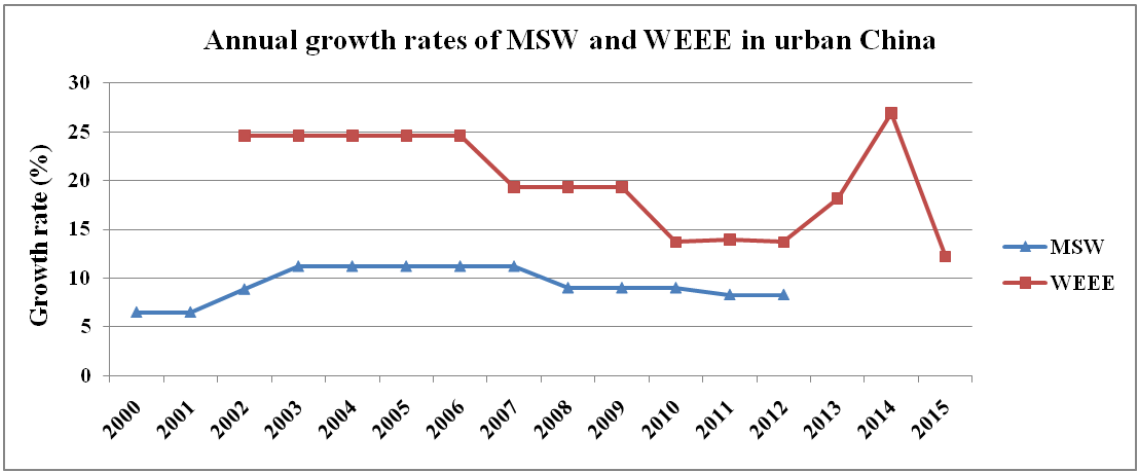


**Figure 22. Annual growth rates of MSW and WEEE in urban China (source: Steuer, 2016c, 2)**

Secondly, China is facing an enormous bulk of domestically generated WEEE quantities (see Table 28). As specific subcategory to MSW, these amounts yet seem small, but given the strong growth rate, this particular waste stream is prone to substantially increase in size in the near future.

**Table 28. Quantity of domestically generated WEEE in China (in million tonnes) (Source: Steuer, 2016b, 291)**

| Source/ Year | 2000 | 2006 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| Questionnaire survey | 0.3 | 0.9 | 1.5 | 1.7 | 1.9 | 2.2 | 3.1 | 3.3 | - |
| Estimates and projections | - | 1.7 | - | 4<br>3.3<br>1.6 | 3.7 | 1.9 | 2.6<br>2.3 | 3.1 | 5.4 |

The first row in the table shows results released by the China Household Electric Appliance Research Institute (CHEARI), which comprises stakeholders from academia, government and industry. CHEARI uses a survey and questionnaire based approach to estimate WEEE generation. The second row in the table depicts figures from previous research, in which the numbers are mostly based on extrapolations and estimated projections.

Thirdly, HHs again constitute the largest source of generated WEEE, while industry only contributes a relatively negligible proportion (Wang et al., 2011, 977f; Yang et al., 2008, 1590; Song et al., 2012, 10). Fourthly, the formal system has in a similar manner fallen victim to stylised measurement practices: For a very long period, the entire management system for consumer WEEE has been centred on five categories (TVs, PCs, washing machines, refrigerators and air conditioners), as these were considered to constitute the majority of generated devices. Despite the fact that this flaw has been tackled by the extension of the official treatment catalogue to 13 categories in 2015 (Schulz and Steuer, 2017, 317), it still begs the question whether measurements aptly reflect the actual dimension of the problem. Moreover, official measurement methods appear to have imitated the approach for the assessment of MSW quantities: Based on narrative evidence, official data on generated WEEE is in parts obtained from extrapolations regarding the expected obsolescence age of products put on the market and on quantities obtained by formal recyclers (Interview with Zheng Y., MEP, Beijing, 12 June 2016). Especially the latter element in this approach constitutes a significant problem as it ignores the generated quantities that are diverted by the IRS and channelled further downstream along informal exchange networks. Additionally, put-on-market-quantities and obsolescence rates are not entirely predictable and are prone to be influenced by socio-economic factors, e.g. storing in HHs, repair by the IRS. This in turn renders the entire calculus of the formal sector relatively inaccurate.

### 8.3.4 State and private: The formal actors in WEEE and recyclable collection

In general, two distinctive actor groups of the formal domain are engaged in recyclable and WEEE collection: Central state agencies and their subordinate bodies on the one hand and

private, registered enterprises on the other. The following paragraphs will shortly discuss their roles and respective impacts on waste collection.

In regard to the first group of state actors the most notable feature is that responsibilities in WM are divided among several central agencies. For the management of waste recyclables, various roles are allocated to four ministries (Table 29), whereas there are over seven ministries involved in the handling of WEEE (Table 30). In addition to that there are yet another five governmental agencies involved in the management of MSW (Chen et al., 2010, 717; Steuer et al., 2017b, 17).

**Table 29. Responsibilities of ministries regarding the management of waste recyclables (the author based on OECD 2007 and Liu, 2015)**

| Ministry | Tasks |
|---|---|
| Environmental Protection | Monitor the impact and control pollution caused by solid waste |
| Housing and Urban Rural Development | Cleaning, collecting, storing, transporting and disposing of municipal waste |
| Commerce | Recycling of paper and cans |
| NDRC | Policy planning and implementation<br>Increase efficiency of resource utilisation and resource recycling |

**Table 30. Responsibilities of ministries in WEEE management (the author based on Wang et al. 2013)**

| Ministry | Tasks |
|---|---|
| National Development and Reform Commission (NDRC) | Plan pilot projects<br>Define the categories of e-waste for management<br>Develop financing scheme for e-waste management<br>Define responsibilities for stakeholders |
| Environmental Protection (MEP) | Establish e-waste treatment standards<br>Manage licensing system for recyclers<br>Monitor and check environmental performance of recyclers<br>Establish list of products/ waste for import and export<br>Study best treatment technologies |
| Industry and Information Technology (MIIT) | Manage EEE manufacturing industry<br>Encourage eco-design and regulate the use of toxics in EEE<br>Define responsibilities and communicate with EEE producers and OEMs |
| Commerce (MOC) | Establish and manage e-waste collection channels and systems |
| Finance (MOF) | Define responsibilities and communicate with EEE producers<br>Define and manage subsidies for logistics, collection and recycling of WEEE |
| General Administration of Customs (GAC) | Register EEE import and export figures<br>Monitor and check illegal activity at customs checkpoints |

This constellation of state agencies generates particular challenges that affect the overall institutional scaffolding of formal WM. Firstly, this distribution of tasks among a multitude of state actors has entailed some administrative issues. Not only do some departments within the respective ministerial bodies suffer from low budgetary allocations and personal shortages, which in turn impedes proper execution of duties (Chung and Lo, 2008, 277). Moreover, individual departments collect their respective WM statistics via different approaches, which rather increases the level of complexity instead of effectively tacking the waste problem (Steuer et al., 2013, 4). Secondly, the ministry-transgressing allocation of responsibilities has also induced problems for the formal institutional solution finding process especially in collection. In general, too many formal stakeholders are involved in the selection process, which in turn requires the representation of different interest groups in regulatory outputs. As a result generated rule solutions appear relatively unspecific, probably for the purpose of avoiding interest conflicts (Steuer et al., 2017b, 17). As of now, the favoured approach in legal terms seems to be a total outsourcing of collection to private, yet licensed entities, whereas government bodies only retain supervision and monitoring duties (SWEPPL, 2016, art. 10, 39, 57). In response to this regulatory permissiveness, private and public generating entities, i.e. recyclers and property management of residential quarters, tend to informally

contract the IRS as this group is expected to effectively solve the problem of waste collection (Steuer et al., 2015b, 10f). This tendency is also reflected in the realities of actual collection performance in large Chinese municipalities. Beijing for example is host to around 22 formal private collection companies that are registered with the municipal government. Their major problem however is to obtain sufficient quantities of discarded products as the more competitive informal collectors squeeze them out of the market (Gu et al., 2016, 19). In the districts of Haidian and Chongwen, which combined host 3.7 million inhabitants, two formal entities were active in 2011 achieving a market share of a meagre around 30%, while the majority of recyclables was absorbed by the IRS (FON, 2011a, 21).

In contrast to documented inefficiencies of traditional collection services, the PRC also features several formal collection initiatives that have adopted an innovative approach to tackle the issue of WEEE and recyclable collection: Since 2009, various enterprises[70] have established collection schemes that are based on online communication techniques so as to link consumers and collecting entities. The innovation manifests in the creation of a new information feedback system that directly connects HHs with formal collection enterprises while spatial distances are bypassed. Despite initially low collection quantities, these schemes have increased in size over the years, which to some extent is based on the adoption of institutional mechanisms also used by the IRS: Such practices include monetary compensation and other reimbursement mechanisms in exchange for WEEE, the refurbishment and resale of discarded electronic devices and the establishment of collection and transfer networks including informal collectors as well as formal take-back and refurbishment structures (Steuer et al., 2015a, 12f). In sum, it is difficult to assess, whether these novel formal initiatives have consciously copied the effective institutional solutions of the informal domain. Nevertheless, they feature two innovative attributes: The management of collection via the use of online technology and the integration of informal services into a formally operating system.

[70] The most prominent enterprises engaging in this type of WEEE collection are one spinoff established by the online search engine Baidu (百度), the Beijing WEEE Recycler Huaxin Environmental (华新环保), the electronics retailer GOME (国美), the Shenzhen WEEE refurbishing company Taolü Environmental (淘绿环保) (Steuer et al., 2015a, 12f). More recent examples that collect WEEE and waste recyclables and operate in the metropolises of East China are Huishouge (回收哥), Feipin Dashu (废品大叔), Huge Huishou (虎哥回收), Meiyidian (美一点).

### 8.3.5 The informal sector in WEEE and recyclable collection

It has been outlined in the section on urban WM history (8.2) that the IRS is primarily composed of rural-to-urban labour migrants, who have entered China's cities in the 1980s in search of a better income. Among these, the central motivational value of economic profit or wealth increase seems to be predominant and may have even triggered imitative behaviour patterns among individual actors: According to one author, interviews with young rural migrants showed that participation in the IRS was to some extent incentivised by rumours (i.e. information feedback) from preceding generations, who had achieved prosperity through waste recycling in China's cities (Fan, 2014, 837). This in turn has triggered individual decisions to embark upon this path and equally engage in urban recycling activities. Narrative evidence gathered by the author in Beijing, Shanghai, Guangzhou and Shenzhen have confirmed that the prospect of wealth constitutes a strong incentive for the engagement in this sector (Personal communication with waste collectors, 2013-2016). The thereof initiated formation of the IRS over more than three decades and its continued informal nature is by no means a unique phenomenon: Goldstein (2017a, 6) has emphasised there are plenty of cases in Chinese history, in which local industries providing integral services and goods to the community were compelled to operate informally against the monopolies of the state. As a modern representation of this trend, the IRS in collection and preprocessing can be considered as an example that provides an institutional solution to a modern challenge of China's society. In doing so, practices of the IRS furthermore exhibit the dual characteristics of effectiveness: Not only are WM quantities reduced and raw materials circulated, moreover the hereby practiced institutional solutions simultaneously serve actor group specific interests as well as those of other societal actors.

The historical development of the IRS in urban China has been marked by a continuous growth in the magnitude of involved labour. Departing from the size of internal labour migrants, conservative calculations estimate that about 2-3% or 2.5-6 million migrant workers engage in urban waste recycling (Linzner and Salhofer 2014, 896). More bold calculations assert that as much as 18 million people are informally engaged in waste recovery (Gu et al., 2016, 19), or up to 20 million in WEEE management alone (Wang et al., 2013, 17). These dimensions are somewhat buttressed by a statement of the MOC, which claims that in 2014 alone the number of workers in the IRS in urban China increased by 2 million. The reason for this latter development is, according to the ministry, founded in the increasing mechanisation of recycling industries, which has forced many workers into informality (MOC, 2015, 4). As

for Beijing, several references indicate a growing, yet fluctuating trend in the size of the IRS (see Table 31).

**Table 31. Size of the IRS in Beijing 1998–2016 (Sources: Steuer et al., 2017a, 141; Steuer et al., 2018)**

| Year | 1998 | 2000 | 2009 | 2010 | 2011 | 2012 | 2013 | 2016 |
|---|---|---|---|---|---|---|---|---|
| **Number (in 1,000)** | 82 | 100 | 160 | 130 | 130-300 | 140-186 | 150 -170 | 160 |

The above presented figures should however be treated with caution: Firstly, most of these references – with the exception of 2013 – do not provide a clear methodology on how these numbers were obtained. The herein crucial problem concerns the execution of relevant surveys, proper delineation of survey areas and of course the size of the respective samples. Secondly, there are as of now no official or academic statistics available for the IRS, which in parts stems from the elusive operative nature of this segment. It is thus save to assume that most available data from academia or official sides is mainly based on 'guess-estimates' or extrapolations (Steuer et al., 2018, 61).

The figures for 2013 listed in Table 31 are the result of a survey and extrapolation process conducted by the author and colleagues from BOKU University. For this purpose 8 out of 29 sub-districts in the Haidian district of Beijing were chosen and grouped into four pairs according to similar population densities (see Figure 23).

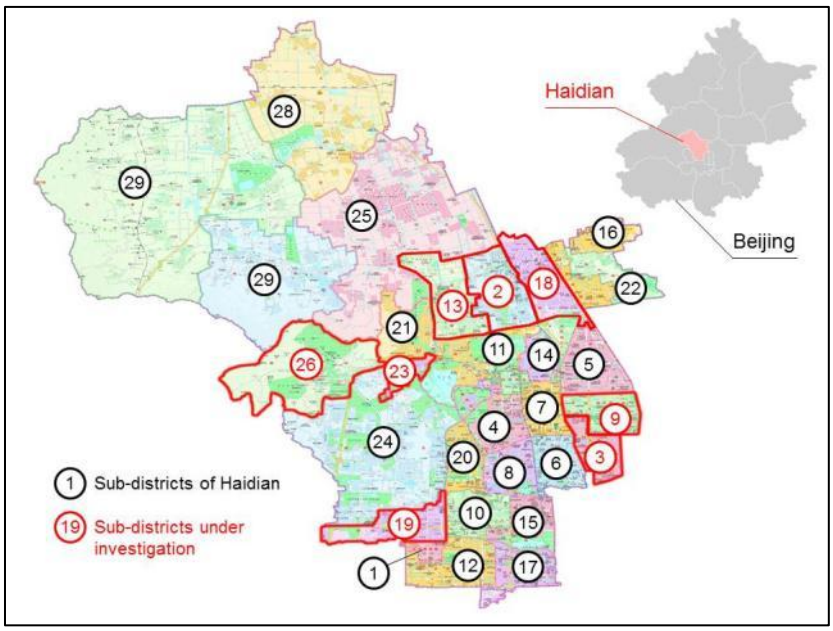


**Figure 23. Sub-districts of Haidian investigated in the 2013 survey (Source : Steuer et al., 2017a, 139)**

In a following step, the locations of all recyclable exchange markets of the IRS, so called Trading Points (TPs)[71], were ascertained in the selected sub-districts and categorised according to their size (small, medium, large). Via subsequent observations of different sized TPs over several hours the number of entering and leaving informal actors was counted and extrapolated to an eight-hour working day. On the basis of thereof gained actor sizes and the proportions of TPs in Haidian we further juxtaposed these numbers with the population densities in the respective sub-districts. Via concluding extrapolative steps, we arrived at an estimation of approximately 130,000-150,000 informal actors active in the collection and preprocessing of waste recyclables in Beijing[72]. This results in a proportion of around 1.3% of Beijing's population being active in urban WM[73].

In regard to actual operations of the IRS it can be stated that WM practices and labour-specific organisation exhibit a strong correlation. In other words, the organisation of the IRS is determined by the variety of services and activities of informal stakeholders, which centre on the creation of value from discarded materials (see Table 32).

**Table 32. Practices of value generation employed by the informal sector at the global level (source: adapted from Wilson et al., 2006; 802; previously published in Steuer et al., 2017b, 28f)**

| WM practices | Value generation processes |
|---|---|
| Collection | Identification and picking of items or collecting mixed waste allows the sector to acquire the waste and turn it into a resource. Most primary materials recovered from refuse, such as paper, plastics, rags, metal, glass, and food leftovers, constitute a commodity as they all have a market price |
| Sorting | Main process that increases the value of the waste recovered. The deeper the sorting differentiation, the higher the value of waste. For instance, if plastic is grouped into one major category, its value is lower than when it is further separated into sub-categories of hard and soft, then HDPE, PET, LDPE, etc. Sorting according to colour, size, shape and potential use or re-use of the materials so as to meet the end-users quality specifications |
| Accumulation of volume | Additional volume adds value: larger volumes command higher per-unit prices. The greater the quantity, the better bargaining power the trader has. For small quantities, transactions costs, such as checking quality, arranging transport and paying the seller, reduce the profit margin. Industrial feedstock is massive in volume. It follows that storage space is required |
| Pre-processing | E.g.: washing, changing in shape-cutting, granulating, compacting, baling |
| Small manufacturing craftsmanship | Creation of micro-enterprises that use the special skills of informal recyclers to transform recyclates into articles traded directly to the community and being affordable by the poor |
| Market intelligence | Proximity to markets where informal recyclers and traders conduct business allows for the flow of information which allows decisions to be made on accurate market prices, competitors, trading partners, etc. |
| Trading | In informal or formal markets. Links to the secondary materials network are crucial. Traders should be financially capable to add and conserve value of recyclates. Difference between buying and selling should also provide buffer against risk |

[71] The function of TPs will be discussed in section 8.4.6.4.

[72] The herein covered districts include: Chaoyang, Dongcheng, Fengtai, Haidian, Shijingshan, Xicheng and Dongcheng.

[73] This proportion is based on the Beijing 2010 census figures, which includes migrant labourers, who have settled in Beijing (see http://www.newgeography.com/content/002406-the-evolving-urban-form-beijing)

This development of a highly specified network of services offered by the IRS indicates a particular interdependency in organisation between upstream and downstream practices, which could not exist as stand-alone rule patterns. Rather, the herein emerged system structure should be seen as a result of the particular informal environment, within which the IRS operates: Informal actors conduct their activities in a context of uncertainty and hazard that results from the looming interference by formal regulatory intervention. According to findings in evolutionary economics such situations of uncertainty can force individual entrepreneurs to act cooperatively for the purpose of broadening individual chances of success (Foster and Metcalfe, 2012, 428). In order to safeguard individual operative effectiveness, cooperating informal groups make persistent and frequent use of interaction and communication so as to maintain their operations (Van den Bergh and Stagl, 2003, 303). As will be shown below, these collective mechanisms that strengthen informal organisation are far from being constrained by individualistic rule patterns, which emerge from self-serving interests and strong sentiments of entrepreneurship (Steuer et al., 2017a; Steuer et al., 2018).

During two field surveys on the sector in 2013 and 2016[74] the author together with colleagues from BOKU University identified the organisational structure that has been established by actors of the IRS (see Table 33 and **Figure 24**). Herein, the above described patterns of a hierarchically delineated set of services within a larger, cooperative network are explicitly manifested.

The most fundamental actor group are the Waste Pickers (WPs, Shihuangzhe 拾荒者), which have been active in urban WM even before the founding of the PRC[75]. Given that WPs roam through the streets by foot, they only feature a low spatial coverage and limited collection capacities. The primary sources of recyclables are open bins in the streets and within residential quarters, which further limits the potential recyclable quantities available for this group.

[74] Both surveys have been conducted in Beijing, Haidian district. However additional field investigations were conducted in other Chinese cities, which revealed that the IRS has established similar organisational structures all across urban China.

[75] There are only sparse historical records documenting the activities of this particular actor group. Based on Nele Fabian's historical research on this subject matter, WPs have been engaged in the collection of discarded materials form households and waste dump sites long before the 1950s. Despite being curtailed in their activities by municipal agencies, WPs yet managed to sell collected material to intermediaries, who in further consequence transferred these to end-users (Personal communication with Nele Fabian, 3.12.2017).

Comparatively higher collection volumes are obtained by the next group in this hierarchy – the Waste Merchants (WMs, Xiao Shangfan 小商贩). Equipped with motorised tricycles this actor group exclusively focuses on door-step collection at residential households or companies. Similar to WPs, WMs collect as much as they can, transport and then sell these materials further downstream. In direct comparison to the WP group, the emergence of WMs and their practices could be interpreted as the outcome of an evolutionary process of learning and adaption: Firstly, the acquisition of tricycles may have resulted from a learning process that was driven by the interest to increase collection quantities and thus income. Secondly, WMs operate with a much more sophisticated set of institutional routines: Doorstep collection and interaction practices with buyers and sellers of recyclables (see section 8.4.6) increase their overall effectiveness in material collection and transfer.

The third informally operating actor group are Middle Men (MM, Zhongjianshang 中间商), who serve as intermediaries between collecting parties and further processing entities. MM mainly use trucks to transfer purchased recyclables from Trading Points in the city to private yards in fringe areas. In the case of Beijing, these structures are located in suburban areas, whereas MM encountered by the author in Guangzhou and Shenzhen operated small storage depots within more central city areas. At these depots, MM engage in the preprocessing of recyclables (sorting, separating, cleaning, bailing) before transferring the materials further downstream. Comparable to WMs, MM make use of particular institutional mechanisms so as to advance their personal interests: Firstly, being at the top of the IRS hierarchy, they serve as a significant node connecting informal collection with further formal or informal processing and manufacturing. Via this position they can exercise substantial bargaining power over recyclable prices up- and downstream along the value chain. Secondly, observations and interviews have shown that MM establish relationships with collecting actors so as to ensure a steady supply of recyclable quantities. Finally, some MM indicated the practice of routines regarding their daily buying routes (Steuer et al., 2017a, 142).

**Table 33. Informal actors in recyclable and WEEE collection (source: (Steuer et al., 2018, 62)**

| **Stakeholder** | *Waste Pickers* | *Waste Merchants* | *Middle Men* |
|---|---|---|---|
| **Means of transport** | Afoot | Tricycle | Truck |
| **Source of recyclables** | Public bins, bins in residential quarters | Households (doorstep collection) | Small enterprises, households, Trading Points |
| **Waste management activity** | Collection, selling at Trading Points | Collection, selling at Trading Points | Buying at Trading Points, storage, sorting cleaning, bailing material extraction selling to industry or recycling |

* Trading points constitute informal waste markets, where recyclables are exchanged for money

**Figure 24. Waste Picker, Waste Merchant and Middle Man in Beijing (© Steuer, 2014)**

To characterise the IRS into service-specific actor groups, which resulted from the two surveys in 2013 and 2016, does by no means constitute a unique approach. In regards to the Chinese context, field surveys conducted by Chi et al. (2011) and Gu et al. (2016) have produced similar categorisations, which generally distinguish between two or more collecting and various preprocessing actor groups. Similar and yet more refined characterisations are presented by Wilson and colleagues (2006 and 2009), who analysed the IRS in various countries. From an institutional point of view, this accordance in findings may indicate that informal stakeholders around the world appear to come up with analogical, institutional-organisational solutions so as to master individual challenges, i.e. make a living out of waste. Next to this dimension of solution effectiveness for the purpose of interest realisation, it could be further argued that the IRS also contributes to solving a broader problem: In the context of the CE, informal solutions are in line with the principles of reducing (material recovery) and recycling (material circulation) discarded recyclables (Steuer et al., 2017a, 142).

What should be noted in regard to the general organisational structure of the IRS in China is its degree of compositional mutability. Far from exhibiting an ossified structure of labour relations, actor group compositions in the IRS can change substantially within a short periods of time. Such an instance of compositional mutation was observed by the author and the

research colleagues from BOKU over two surveys in 2013 and 2016. In both instances, field observations were conducted at TPs in Beijing's Haidian district so as to assess the composition of the IRS and thereof derive a proportion of respective actor groups. As shown in Table 34, WMs and MMs experienced a strong, proportional decrease in size by around 50% and 20-60% respectively between 2013 and 2016. The proportion of encountered WPs on the other hand increased from 6% to 65% (Steuer et al., 2018, 61). Apart from various explanatory factors[76] for this change, the most notable result is that the operation of the IRS did not cease. Narrative evidence instead confirmed that particular actor groups simply adapted to this challenge and shifted their operational focus (see section 8.4.6.4).

**Table 34. Proportion of informal stakeholders in WM at Beijing's Trading Points (Steuer et al., 2018, 62)**

| Survey date | Area | Number of observed TPs | Observation time per TP (hours) | Proportion of groups | | |
|---|---|---|---|---|---|---|
| | | | | WPs | WMs | MM |
| July 2013 | Sub-districts in Haidian | 1 | 0.5 hrs | 0% | 57% | 43% |
| August 2013 | Sub-districts in Haidian | 4 | 0.5 - 7 hrs | 3% | 58% | 39% |
| March 2015 | Sub-districts in Haidian | 4 | 6 hrs | 14% | 72% | 14% |
| September 2016 | Xueyuanlu sub-district | 5 | 8 -12 hrs | 71% | 26% | 3% |
| Oct - Dec 2016 | Xueyuanlu sub-district | 10 | 9 - 9.5 hrs | 59% | 12% | 29% |

### 8.3.6 Collection performance of the formal and informal sectors

Formal collection performance in urban China exhibits two diametrically opposed trends: On the on hand, overall formal collection has improved since the mid 1990s in terms of spatial coverage and collected quantities. Official statistics document a gradual increase from around 50 million tons in 1985 to approximately 150 in 2005 (Chen et al., 2010, 719). On the flipside

[76] The following factors may explain the change in actor compositions at TPs: Firstly, the second survey was only conducted in one sub-district, which could render this finding as not representative of the overall situation in Beijing. Additionally, other variables such as trans-boundary material transactions or recyclable price volatilities and thereof induced actor outflows may have skewed the results.

however, the herein collected amounts are mostly composed of either organic or non-recyclable fractions. As for the more valuable recyclable fractions in MSW, collection by the IRS has emerged as the major channel since the 1990s, which is a direct consequence of the state's retreat from waste recyclable management (ibidem, 720). The quantitative reflection of this exchange in dominance over recyclable material flows is especially well documented for the case of Beijing. After the dismantlement of the physical WM infrastructure in the early 1980s, the number of formal redemption depots and take-back stations had declined from 400 to 270 by 1989. Accordingly, the amount of formally recovered recyclables gradually decreased over the years, while informal collected quantities diametrically increased (Table 35) (Steuer et al., 2017b, 17). This trend seemed to continue directly up until the early 2000s, at which point the overall formal recycling rate of MSW had declined from 27% in 1984 to just 10% in 2003 (Wilson et al., 2009). This poor performance is also paralleled in the field of WEEE collection, wherein formal channels in China only gather about 10% of what is generated by consumers (2007) (Zhou and Xu, 2012, 4717).

**Table 35 Formal and informal recyclable collection in Beijing (adapted from Wang and Nie, 2001, 258)**

| Year | Total material recovery | | Collection by formal enterprises | | Collection by informal collectors | |
|---|---|---|---|---|---|---|
| | in 1,000 tons | in % | in 1,000 tons | in % | in 1,000 tons | in % |
| 1987 | 233.9 | 7.6 | 165.9 | 71 | 68 | 29 |
| 1988 | 251 | 8.6 | 135.5 | 54 | 115.6 | 46 |
| 1989 | 281.3 | 9.1 | 127.7 | 45 | 153.6 | 55 |
| 1990 | 293.1 | 8.5 | 109.6 | 37 | 183.3 | 63 |
| 1991 | 295.2 | 8.1 | 102.2 | 35 | 193.1 | 65 |

In contrast to formal efforts, the IRS exhibits a very strong performance in the recovery of waste recyclables and WEEE: For the former waste stream estimations and extrapolated results state recovery quantities of between 5-20% (Ren and Hu, 2014, 341; Mian et al., 2016, 1129) and 17-38% (Linzner and Salhofer, 2014, 896) of overall generated MSW[77]. In order to ascertain the actual absorption of waste recyclables form urban HHs by the IRS, the 2016 research project by BOKU University tentatively juxtaposed generated and collected quantities: Within Haidian's Xueyuanlu sub-district, recyclable quantities generated at the HH level were documented via 'waste diaries' and compared to the overall, informally collected quantities of surveyed, locally active collectors. Via these two parallel surveys and subsequent extrapolations it was found that the IRS recovered approximately 92% of recyclables generated by the sub-district's households. Based on the assumption that urban households

[77] By definition, MSW contains various fractions other than waste recyclables or products with an inherent monetary value. However given the strong profit oriented interest focus of the IRS, the above given proportions of informally collected materials can be assumed to be exclusively composed of waste recyclables and WEEE.

generate up to 80% of MSW in China, this finding if extrapolated to the entirety of Beijing would indicate that the IRS collects 74% of the city's overall generated waste recyclables (Steuer et al., 2018, 62). A similar assessment is applicable for the informal recovery performance regarding WEEE. According to surveys by the Chinese WEEE research institution CHEARI, the IRS dominates the recovery of recyclables as it constitutes the major source (90%) of channels delivering such discarded devices to formal recycling companies (CHEARI, 2017, 4). In regard to generating sources, the interviews with informal actors showed that households were most significant for WMs (59%), whereas WMs were most important suppliers of MM (42%). Second to that were commercial entities, which constituted 28% and 34% of the recyclable and WEEE sources of WMs and MM respectively (Steuer et al., 2017b, 52).

This gradual achievement of IRS dominance in collection and recovery over time is also reflected in the growth of individually collected quantities per day: For the city of Wuhan, Li (2002, 330) finds that informal collectors gather around 40-50 (kg/cap/day) on average days and 100-150 (kg/cap/day) on ideal days. More recent data gained through field research in Guangzhou and Shenzhen shows that these rates have nearly doubled in over 10 years: During 2013-2015, amounts collected by WMs ranged at minimum levels of 50-100 kg/cap/day but can go up to 200-350 kg/cap/day under ideal conditions (Steuer et al. 2015b, 9). However, also in this regard changes in secondary raw material prices can exert severe impacts on informal collection performance. Between 2013 and 2016 waste recyclable prices have plummeted significantly due to contracting macro-economic demand. During one year (2015-2016) the values of secondary copper, aluminium and iron have decreased by 16%, 26% and 44% respectively. Subsequent interviews with actors of the IRS have shown that these changes might force informal collectors to exclusively focus on recyclables, for which demand is still strong, such as cardboard and paper, whereas other recyclables were simply left behind (Steuer et al., 2018, 62).

For the purpose of directly contrasting collection performance by both domains, the field of WEEE offers some interesting insights. As the two tables below (Table 36 and Table 37) highlight, informal collection channels obtain a much larger share of discarded devices than what is achieved by formal collectors.

**Table 36. Informal collection of WEEE from Chinese urban households (source: Steuer, 2016b, 292)**

| Informally collected WEEE (%) | Area | Year |
|---|---|---|
| 60 | China | 2006 |
| 60 | China | 2011 |
| 88 | China | 2011 |
| 30 | Peking | 2008 |
| 60 | Peking | 2010 |
| 60 | Peking | 2011 |
| 30 | Peking | 2012 |
| 76 | Shanghai | 2013 |
| 55 | Xi'an | 2010 |
| 51 | Baoding | 2012 |
| 50 | Hangzhou | 2013 |

**Table 37. Formal collection of WEEE from Chinese urban households (source: Steuer, 2016b, 292)**

| Formally collected WEEE (%) | Area | Year | WEEE received by |
|---|---|---|---|
| 10 | Peking | 2010 | Recovery stations |
| 10 | Peking | 2011 | |
| 24 | Shanghai | 2013 | |
| 13 | Baoding | 2012 | |
| 7.8 | Xi'an | 2010 | |
| 20 | Peking | 2009-2011 | Return to retailers during the OfN (2009-11) |
| 20 | Peking | 2009-2011 | |

In this regard, the relatively recent Old-for-New (OfN) WEEE pilot scheme (2009-2011) should be mentioned. During this period, formal collection rates shortly doubled in 2010 (Beijing), due to a reimbursement mechanism that was offered to consumers: For every returned device, consumers would get a 10% discount voucher for purchasing a novel device of the same category (Steuer, 2016b, 292). The reason that formal recovery quantities still remained far behind their informal counterpart appears to stem from the more attractive monetary reimbursement offered by informal collectors to households.

After collection, recyclables and WEEE are transferred downstream for further processing. From an institutional perspective, these steps by themselves constitute an institutional solution for the management of these material flows. Here again the formal and the informal domain

pursue different interests, hence the respectively chosen solutions are different. In this instance, the different choices for managing WEEE are especially noteworthy: Whereas formal collection directly channels discarded electronics to formal recycling facilities for material extraction, which constitutes the formal domain's key interest (Schulz and Steuer, 2017, 322ff), informal handling is slightly more selective. Depending on the functional condition of the collected device, informal collectors would rather favour selling these to refurbishment and remanufacturing instead to recycling. The simple reason for this preference is that the former channel offers a much higher product value than what could be gained from the mere material value. In Beijing this interest preferences have led to constellations in 2011, in which only 12% of collected WEEE arrives at formal recycling, while the remainder is either stored in HHs or sold to refurbishment and repair for extended use (Wang et al., 2011, 978). Especially this second option appears to account for a large volume of WEEE transfers. Second-hand markets for WEEE, which are centred on product repair and refurbishment, receive a significant share of discarded devices. Unsurprisingly their major supply source is the IRS, which provides around 60-80% of inputs to these markets (Steuer, 2016b, 293). At the same time informal collectors are also the dominant force in the provision of WEEE to formal recycling yards. In an attempt to verify the actual quantitative dimensions, a survey by the author and colleagues at BOKU University was conducted among major, formally registered electronics recyclers. The thereof gained responses clearly show that formal recycling enterprises depend somewhere between 80-100% on informal collection (Table 38).

**Table 38. Sources of WEEE arriving at formal recycling yards (Source: Survey among formal WEEE recyclers in China conducted during the Rewin research project, 2016)**

| Recycler | Large generators | Informal collectors | E-producers | Retailers | Own collection | Total collected (1,000 units) | Collection Period |
|---|---|---|---|---|---|---|---|
| Shanxi Jiuzhou | 0.1% | 99.9% | 0% | 0% | 0% | 258 | 1.10. - 31.12.2014 |
| Shanghai Weixiang | 0% | 92.7% | 7.3% | 0% | 0% | 123 | 1.10. - 31.12.2014 |
| Hebei Wangzhong | 14.5% | 78.7% | 6.8% | 0% | 0% | 139 | 1.1. - 31.3.2015 |
| Hunan Tongli | 0% | 100% | 0% | 0% | 0% | 148 | 1.1. - 1.12.2014 |
| Beijing Huaxin | 4% | 96% | 0% | 0% | 0% | 324 | 1.7. - 1.9.2014 |
| Jilin Shanhe | 1% | 99% | 0% | 0% | 0% | 242 | 1.7. - 1.9.2014 |
| Henan Nanyan | 0.1% | 99.9% | 0% | 0% | 0% | 257 | 1.10. - 31.12.2014 |
| Tianjin Taiding | 0% | 0% | 100% | 0% | 0% | 80 | 1.10. - 31.12.2014 |
| Zhejiang Qingmao | 0% | 100% | 0% | 0% | 0% | 327 | 1.4. - 30.6.2014 |
| Shan'xi Daye | 0% | 100% | 0% | 0% | 0% | 240 | 1.10. - 31.12.2014 |
| Zhejiang Shengtang | 0% | 100% | 0% | 0% | 0% | 364 | 1.4. - 30.6.2014 |
| Jilin Jing | 0% | 92.7% | 7.3% | 0% | 0% | 117 | n.a. |

### 8.3.7 The economic dimension of Waste Management in China: The recyclable industry, turnovers of the IRS and its contribution to the formal system

The WM industry constitutes a relatively young sector and is categorised as a sub-segment of the environmental protection industry. When it comes to its economic dimension, literature provides various estimates based on differing calculation methods and branch-specific coverage. A Goldman Sachs report from 2015 for example cites an MEP report from 2011, which presents the number of 18.2 billion RMB of market value for this segment. In regard to this figure the authors contend that '… as the vast majority of China's solid waste goes untreated, we believe China's solid waste treatment industry is significantly underestimated' (Zhu et al., 2015, 42). There are two noteworthy points in this passage that need further analysis. Firstly, what is possibly misrepresented in the report is the economic size of the segment. While the particular factors considered by the MEP for its assessment are not clearly presented, the figure itself appears to be too low. As a point of comparison, the MOC has since 2012 issued annual reports on the recycling industry alone, which covers the recycled quantities and thereof generated added value from mineral resources, paper, WEEE, waste tires, glass, accumulators, textiles, EOL ships, discarded tires and discarded cars (MOC, 2017,

2). The herein documented sizes of overall generated value by far exceed the figures provided by Goldman Sachs, and by extension, the MEP (see Table 39). Furthermore it should be noted that these figures do not include the entirety of the solid waste industry, which by implication also encompasses final treatment and processing sectors such as incineration and landfilling. What however also becomes clear is that the generated value and sizes (in processed quantities) of these business branches is subject to substantial fluctuations (Figure 25), which renders any assessment particularly difficult.

**Table 39. Generated value and recovered quantities of the Chinese recycling industry (the author, adapted from MOC 2013b, 2014, 2015, 2016, 2017)**

| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| **Generated value (billion RMB)** | 576.3 | 541.3 | 642.1 | 644.6 | 514.5 | 590.2 |
| **Recovered quantities (10,000 tons)** | 16,461 | 16,067 | 23,307 | 24,470 | 24,550 | 25,642 |

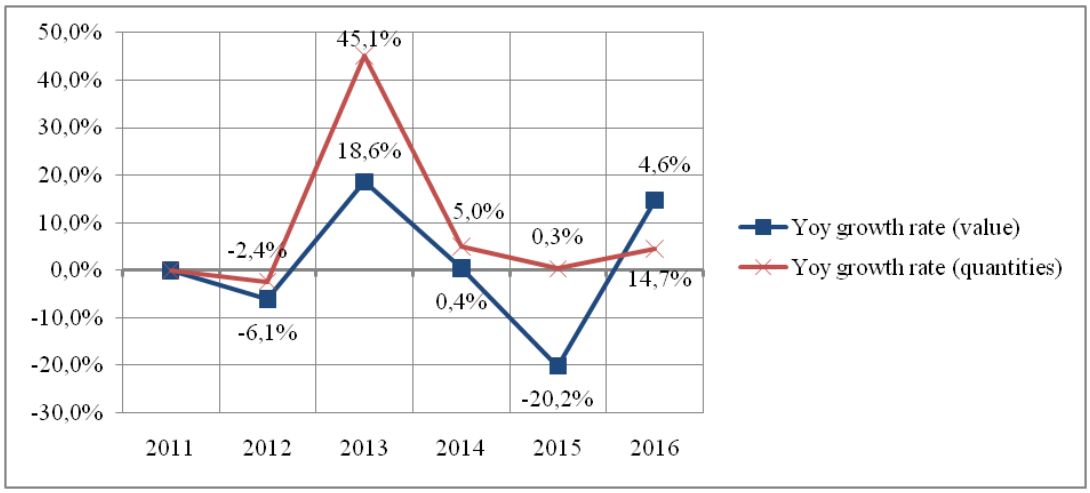


**Figure 25. Year-on-year (yoy) growth rate of generated value and treated quantities of China's recycling industry (the author, adapted from MOC 2013b, 2014, 2015, 2016, 2017)**

On the other hand, the Goldman Sachs report is possibly correct in its statement that the segment may be underestimated due to a strong impact from IRS activities and thereby informally generated economic value. To the best of the author's knowledge there is as of now no systemic assessment of the economic dimension created by the IRS in China. In an attempt to reduce the hitherto existing knowledge gap, the author and colleagues from BOKU University assessed IRS incomes via the interview survey in 2013. For this purpose a mutually multi-sequential and data contrastive approach was chosen: Via a pre-survey, informal actors of the IRS were interviewed in regards to their daily routines, working hours and income levels. Based on these results a semi-structured questionnaire was designed in

which two particular items addressed the topics of net income and turnover: In first instance, WMs and MM were asked to state their approximate monthly income. Additionally, the interviewees were asked to provide the quantities of each collected recyclable during the day of the survey as well as the respective buying and selling prices. Based on these figures a simple mathematical calculation was used to determine the approximate gross income:

$$\sum_{\text{gross income}} = [(\text{buying price}_{\text{recyclable (x)}} - \text{selling price}_{\text{recyclable (x)}}) * \text{quantity}_{\text{recyclable (x)}}] + \ldots + [(\text{buying price}_{\text{recyclable (n)}} - \text{selling price}_{\text{recyclable (n)}}) * \text{quantity}_{\text{recyclable (n)}}] * 30.5 \text{ days}$$

Via multiplying recyclable profits with respectively recovered recyclable amounts, it was possible to arrive at the approximate monthly gross income. In a concluding step both income levels were juxtaposed, which showed a conformity degree of 92% and 56% for WMs and MM respectively (see Figure 26 and Figure 27). The most likely explanation for the rather large deviation of the latter figure might be that MM have higher expenditures for maintaining storage facilities, servicing transportation vehicles and paying employed labourers. This in turn widens the gap between real net income and turnover of this actor group (Steuer et al., 2017a, 148f).

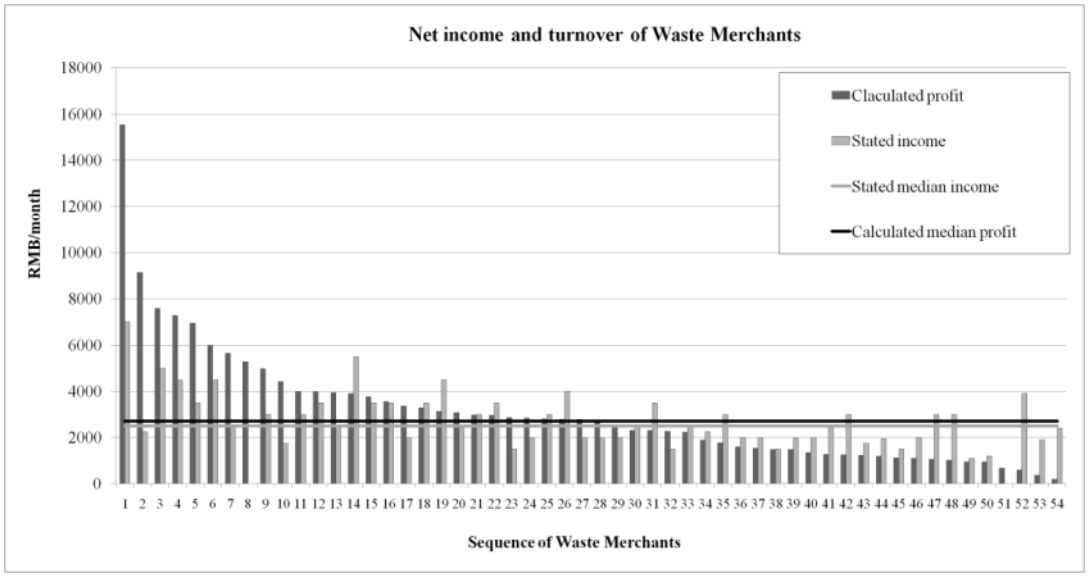


**Figure 26. Net income and turnover of WMs surveyed in Beijing in 2013 (source: Steuer et al., 2017a, 148)**

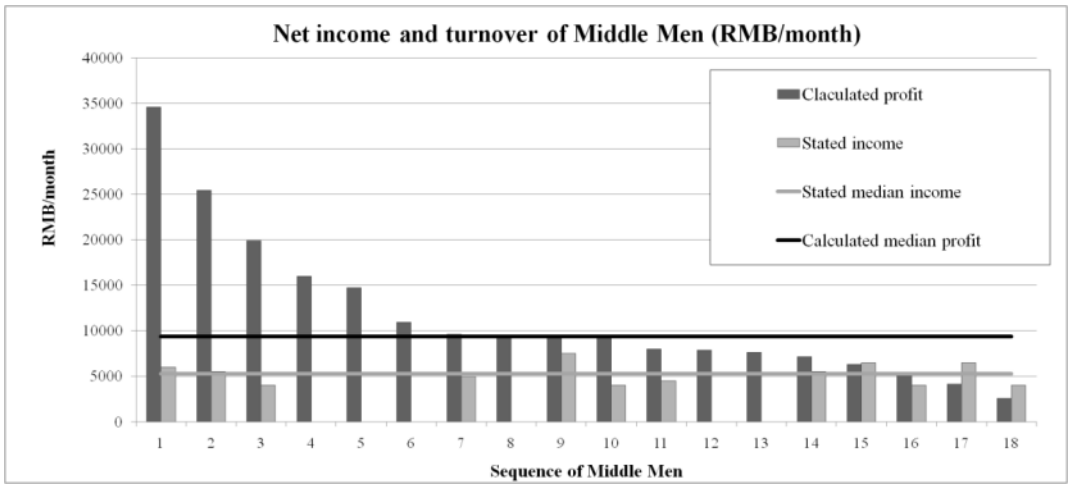


**Figure 27. Net income and turnover of MM surveyed in Beijing in 2013 (source: Steuer et al., 2017a, 148)**

The generation of profits by the IRS results from instances of interaction along a chain of different actor groups, which stretch from households over collectors and intermediaries to recycling and manufacturing companies. Herein, the basic mechanism is that every recyclable collected and sold generates a marginal profit, which emerges as the difference between the selling price and the buying price. In Beijing, and presumably in other cities, the marginal profit between selling and buying price decreases the higher the recyclable moves along the informal exchange hierarchy. By implication, WMs achieve a higher marginal revenue when buying a recyclable in a particular quantity from households and selling it to MM, than what MM obtain when purchasing the same recyclable from WMs and then vending it further downstream (see Table 40). In direct contrast, WMs on average obtain median revenues that are around 50% higher than the median revenues of MM (Steuer et al., 2017a, 147). This finding is in fact similar to the value generation process in the global IRS, analysed by Linzner and Lange (2013, 79). According to this study, marginal prices of informally exchanged recyclables increase the further they are transacted along the informal waste trading network. At the same time the marginal revenues for each fraction decrease with every exchange stage. This price raising, but profit margin reducing procedure continues further along the value chain up to the point when MM transfer the materials further to recycling companies[78] (Interviews with Mr Qiao in Dongxiaokou Beijing, April 2013 and Mr Cui in Tiancun, Beijing, March 2015).

Despite the apparent feasibility to mathematically model income and turnover specifics of the IRS, caution needs to be taken when assessing the reliability of such figures: Firstly, actors of

[78] A necessary amendment in this regard is that decreasing profit margins do not correspond to decreasing net turnovers: While profit margins decrease with every exchange instance, profits per se are still made, which renders the entire business concept effective.

the IRS evince particular prudence in regards to the interaction with outsiders. This is partly owed to the informal nature of the sector and the inherent precaution against attracting too much attention of the government to the IRS' operations. Therefore in order to get into contact with representatives of the sector, the author generally resorted to open interview techniques so as to foster a basis of trust and mutual interest. In a subsequent step, the approach shifted towards inquiring about the operative specifics, such as collection/ exchange routines, managed waste recyclable quantities and generated incomes. Yet despite these efforts there is only very little guarantee that hereof derived numbers fully reflect the individual performances of the interviewees.

**Table 40. Comparison of marginal profits of WMs and MM per transacted recyclable category (Source: Steuer et al., 2017a, 147)**

| **Recyclable category** | | **Marginal profit of WMs (RMB)** | **Marginal profit of MM (RMB)** | **Marginal difference in profits (RMB)** |
|---|---|---|---|---|
| Metals | Aluminium (kg) | 1.00 | 0.75 | 25% |
| | Aluminium tins (unit) | 0.02 | 0.01 | 50% |
| | Copper (kg) | 3.00 | 1.50 | 50% |
| | Iron (kg) | 0.30 | 0.35 | 14% |
| | Iron tins (unit) | 0.02 | 0.01 | 50% |
| | Steel (kg) | 0.99 | 0.75 | 24% |
| Paper | Books (paper) (kg) | 0.20 | 0.15 | 25% |
| | Cardboard (kg) | 0.20 | 0.10 | 50% |
| | Paper and newspapers (kg) | 0.20 | 0.10 | 50% |
| Plastics | Plastic bottles (unit) | 0.02 | 0.01 | 50% |
| | Plastics (other) (kg) | 0.30 | 0.30 | 0% |
| Miscellaneous | Clothes (kg) | 0.10 | 0.30 | 67% |
| | Glass (kg) | 0.18 | 0.14 | 22% |

When shifting the focus of analysis from IRS-internal processes to their larger impact on municipal WM, then it is again the case of Beijing that exhibits the degree of the IRS' solution effectiveness. This is particularly reflected in the significant alleviation of official expenditures. Starting in 1998, the IRS already generated an annual profit of 1.1. billion RMB from the recovery of waste recyclables in the city (Ensmenger et al., 2005, 8). A decade later, a Chinese expert assumed that the operations of the IRS helped to save 400 million RMB per year in official expenditures on WM (Xie, 2010). This particular contribution to the local WM sector can be explained via two factors: Firstly, the items entailing the highest cost burden in WM are staff and personal costs, which in some areas can amount to as much as 55-74% of total WM expenditures (Ren and Hu, 2014, 343). By implication, as long as the IRS continues

its engagement in collection and preprocessing, expenditures on WM can be effectively economised by local administrators. Secondly, MSW collection and treatment costs constitute a considerable issue. In Beijing, the collection and transport of one ton of MSW generates an approximate cost of 150 RMB (Sina Finance, 2014). The overall costs covering final treatment as well as environmental and social externalities may even be as high as 1,500 RMB/ton (Sina Finance, 2015). So if formal costs and informal services are put into direct comparison, the informal institutional effectiveness in Beijing's WM becomes visible: While overall formal annual MSW treatment costs amounted to 2 billion RMB in 2014, the services of the IRS helped to alleviate the budget of the formal WM system by around. 1.8 billion RMB (Crrainfo, 2014). By implication, replacing the informal system of the IRS would in turn force the Beijing government to implement substitutive formal institutional solutions that may double official expenditures on WM (Steuer et al., 2018, 65).

Despite the apparent effectiveness of the institutional solutions created by the IRS, there are also several external factors that threaten its further existence in China: Firstly, as mentioned in the above, secondary raw material prices have been plummeting substantially during 2013-2016 and have only recovered in 2017. This has directly affected the income levels of actors in the IRS, which in Beijing has amounted to a median decrease of 44% among those WMs and MM interviewed by the author and colleagues in 2016 (Steuer et al., 2018, 62). In further consequence several articles have surfaced indicating an increase in actors leaving the segment (ibidem, 62). While some have decided to adopt a wait-and-see strategy so as to sit out the macro-economic downturn, the general exit opportunity may be reinforced by another factor, namely the gradual raise of minimum wages (Steuer et al., 2017a, 149). Minimum wage levels have been continuously increased by municipal governments over recent years, but are not always stringently enforced in those sectors that absorb a bulk of migrant labour. Nevertheless, the figures of Beijing in 2016 (1890 RMB/month) already exceed the average income of WPs and may thus constitute a convincing argument to leave the sector (ibidem, 149). The third and final factor that influences the future of the IRS relates to the institutional responses of central and municipal governments: Will they rather integrate or expel the activities of informal actors in WM? Given the obvious benefits generated for urban WM by the IRS, the crucial question is to which extent these institutional outputs can be aligned with the interests of the formal domain. As will be shown in the next section, the degree of interest congruence does by and large determine the solution outputs of the formal domain.

## 8.4 The institutional dynamic between the formal and informal sector in Chinese waste collection and preprocessing

### 8.4.1 Overview on the sections on institutional dynamics in WM

In contrast to the general overview on Chinese WM presented in the above, the discussions in the following sections constitute the analytical core of this chapter. As starting point for the analysis of the institutional dynamics between the both domains the first paragraphs focus on the formal institutional framework, which has been established from scratch in the mid-1990s. At this stage, the presence of informal institutional structures in urban WM had already reached a certain level of maturity. Therefore, the discussion will focus on how the formal rule system, especially in regards to collection, has responded to the IRS and whether thereof resulting formal solutions prove to be effective (sections 8.4.2 – 8.4.5). In a similar approach the subsequent sections will deal with the institutional structures of the IRS aiming to discern the reasons for the effective performance, which is reflected in the comparatively high collection rates of the IRS (section 8.4.6). In a final step, the institutional dynamic of responsiveness that has emerged between the two domains will be outlined (section 8.4.7).

### 8.4.2 Legislation on MSW collection

The first thing to note regarding the legislative framework around WM is that there were hardly any formal regulations issued at the central level before the 1995 Solid Waste Environmental Pollution Prevention Law (SWEPPL). After this initial key law, it took another five years before a comprehensive regulatory body was established for purpose of governing waste related matters. The overall development trend of the legal development in this field is depicted in Figure 28.

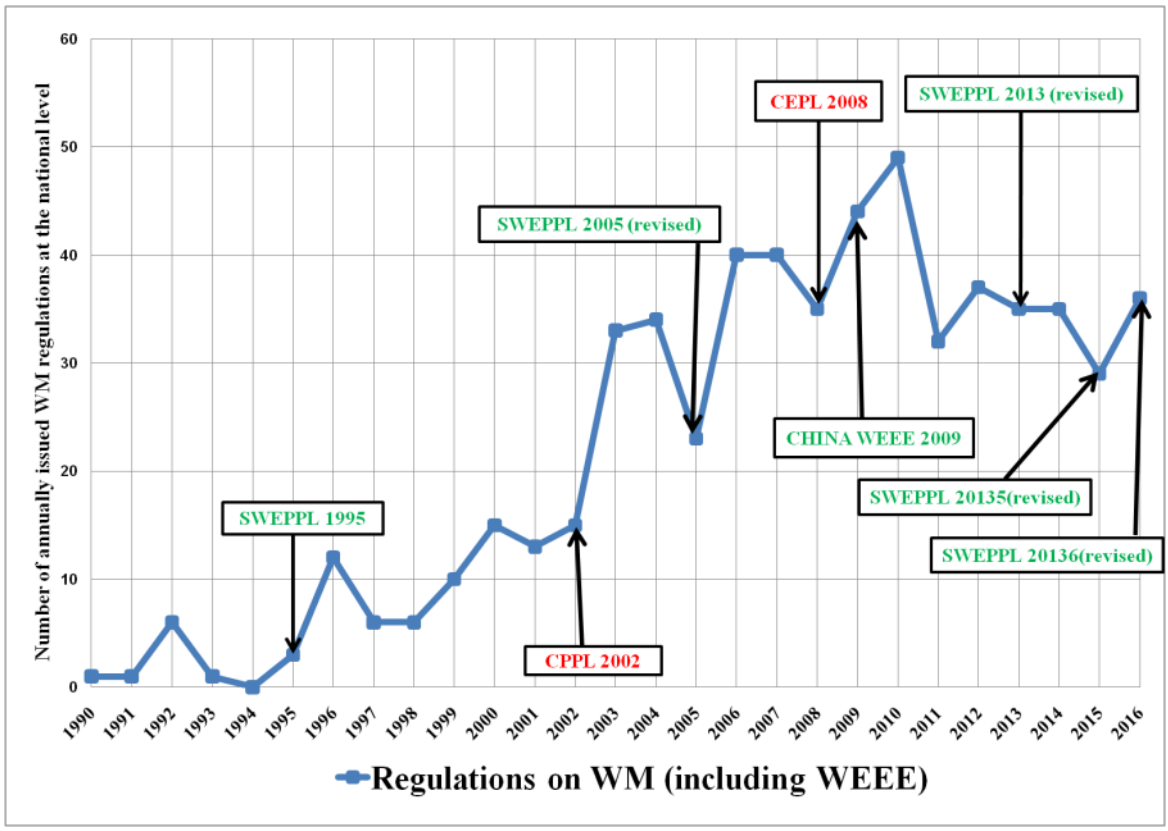


**Figure 28. Regulations issued on WM including WEEE at the central government level**[79]

Herein, four particular institutional features are remarkable: Firstly, the process of formal institutionalisation began relatively late around the mid-1990s. This is in parts offset by the second characteristic, namely that this process has from its very beginning been intensively promoted at the central government level: Measured in issued regulations per year, the PRC exhibits a very lively institutionalisation development up until the very present. The question is however if these quantitative efforts also translate into actual performance effectiveness. Thirdly, it should be emphasised that this process is significantly propelled by certain key laws, which are indicated by black boxes in the above figure. The significant effect is that after every single issuance of a key law, the number of follow up regulations in subsequent years surges for a limited period. The fourth particularity of this legal development is that some key laws like the SWEPPL are subject to repeated revisions and amendments. This can be taken as a proxy for the heuristic, solution finding process of the formal domain. Based on the conceptualisation of the methodological model the following assumption for the analysis of this particular pattern can be offered: The more often a certain law is subject to

[79] The abbreviations for the key laws in the figure are as follows: Solid Waste Environmental Pollution Prevention Law (SWEPPL), the Cleaner Production Promotion Law (CPPL), the Circular Economy Promotion Law (CEPL), the Environmental Protection Law (EPL)

modifications that led to an amendment of the rule itself, the less effective it has been in creating a solution for the respectively designated challenge.

In regard to the IRS, which has been benefiting from formal regulatory laxity and loopholes, the more recent vigour in strengthening the legislative framework could also imply a substantial impact on this segment (Steuer, 2017, 418). Therefore it is useful to investigate the key laws in WM and verify to which extent the formal domain has addressed waste collection, which constitutes the field with the highest degree of IRS prevalence[80].

Despite addressing WM only in a marginal sense, the first key law to be discussed is the Cleaner Production Promotion Law (CPPL). In its initial version, only a small number of articles (9 out of 42) mention the aspect of waste (CPPL, 2002, Art. 10, 13, 16, 19, 20, 22, 26, 27, 33). The law however remains silent on the topics of recovery and collection. A remarkable difference becomes evident in the more recent version of 2012: Albeit the fact that the number of articles on waste is not increased, the significance of secondary material recovery from consumer good waste has at least been highlighted (CPPL, 2013, 10, 20, 33).

Being closely related to WM, the CEPL puts a comparatively stronger emphasis on WM. Herein, 20 out of 58 articles revolve around the topic of waste and the entire chapters 3 and 4 underscore this emphasis (CEPL, 2008, Art. 2, 4, 9, 10, 15, 17, 19, 22, 23, 26, 29-31, 33-38, 46). Especially in regards to urban WM, this legislative piece has been considered as a path breaking outcome due to the fact that it accelerated the turn-out of formal regulations in this field (Mo et al., 2009, 410f). The CEPL is particularly remarkable as it directly addresses waste collection. In two of its article articles, the law allocates the task of collection to municipal governments who have to

> '...*support* waste recovery enterprises and other organizations to conduct waste collection, warehousing, transport' and '…make a comprehensive plan on building facilities for the classified collection and recycling use of urban and rural household garbage, establish and improve the system for classified collection and recycling use, and raise the recycling rate of household garbage' (CEPL, 2008, art. 37, 41).

In essence this approach equals a legal suggestion to outsource tasks formally allocated to state actors to private and public enterprises. In doing so, the law not only marks a significant deviation from pre-reform governance concepts, but also opens the first step for the

[80] The following paragraphs draw strongly from an earlier papers of the author: Steuer et al., 2014; Steuer et al., 2015; Steuer, 2016a and 2016b; Steuer, 2018.

generation of institutional loopholes: In this regard, the critical aspect relates to the fact that waste recovery enterprises, which in regard to their legal nature are not clearly delineated in the law, could thus be either formal or informal[81].

The most detailed accounts regarding waste collection are stipulated in the SWEPPLs (1995, 2004, 2013, 2015 and 2016). Already the first version of 1995 addresses the topic intensively (14 of 77 articles) and allocates the task of collection directly to sanitary bureaus of municipal governments. Any collecting entity – including private ones – have to take preventive measures so as to avoid secondary pollution and need to apply for permissions from municipal governments when handling hazardous waste, e.g. WEEE (SWEPPL, 1995, Art. 10, 16, 39, 49, 54). The subsequent issued versions of 2004 and 2013 further increase the emphasis on matters of collection as they dedicate the identical 19 of overall 91 articles to the topic. Both pieces however seem to follow the pivotal idea of outsourcing collection to public and private entities. Herein, the key thought is that municipal governments can either organise and execute collection by themselves or outsource these tasks via tender and according to individually determined conditions. A more explicit approach to outsource waste collection and thus fully strip this duty from municipal governments is applied for managing entities of residential and public properties: According to the 2005 and 2013 versions, they are directly responsible for managing the collection of waste generated within their vicinity. Here again, any company employed for the collection of waste needs to register with the government and apply for respective permits (SWEPPL, 2005 and 2013, Art. 38, 39, 48, 57, 77). Judging by these latter two versions, it is quite clear that the formal domain has gradually eased the institutional rigidity regarding the collection of MSW, i.e. by outsourcing collection. Yet, in order to avoid the abuse of emerging loopholes, both versions also prescribe the requirements of official certification and registration. However this new institutional element may also be subject to subversion by the IRS: Instead of originally one actor group (the state) handling the entirety of waste collection, outsourcing via tender allows second and third parties to engage in this segment. While this per se does not constitute a problem, it yet leaves open the possibility that second parties like residential estate managements could arbitrarily contract informal collectors without ascertaining their official certification.

[81] This approach to outsourcing formally official tasks to non-state actors is also adopted in the new Environmental Protection Law, issued in 2014. Therein, municipal governments are only marginally tasked with waste collection duties as they have to engage in 'comprehensive planning', but not with actual execution. Nevertheless, those official entities, which are seen as neglecting their WM duties, can be punished by pecuniary means or via demotion and dismissal from office (EPL, 2014, 51 and 64).

Despite the frequent amendments and the fact that informal collection has played an ever increasing role since the issuance of the first SWEPPL, modifications in the field of waste collection are still absent in the most recent version of 2016. Therein, municipal and local governments are only tasked with the supervision and management of waste collection. Actual execution should still be outsourced via tender to eligible companies, who possess respectively required licenses (SWEPPL, 2016, art. 10, 39, 57).

In sum, the formal regulatory system on MSW collections features several weaknesses, which cast doubt on its overall effectiveness. Firstly, the centrally issued key laws on WM do not contain any mentioning of recyclable waste, let alone specifications for collection. This in turn subordinates this particular stream to the overall management of MSW and by implication renders it into a non-explicitly institutionalised category. As a result of this negligence, waste recyclables do not receive any particular attention by the formal domain, which subsequently enables the IRS to gain a monopoly in its collection: Zhang and Wen (2014) for example state that the IRS dominates 90% of PET-bottle collection because of formal institutional deficiencies (Zhang and Wen, 2014, 988 and 995). Secondly, the attempts to outsource collection duties to non-state actors have in essence created a loophole for the benefit of the IRS. This is especially evident for the case of entities managing residential estates, where the majority of urban MSW is generated. While property management companies are theoretically obliged to hire formally registered collectors, field interviews by the author have revealed that collectors active in residential quarters do in most cases not possess required permits. Furthermore the interviewees stated that they hardly if ever face obstructions by authorities or security personal when collecting recyclables from households within residential quarters (Steuer, 2017, 419). And yet, there is also an alternative interpretation to this leeway and negligence exhibited by the formal institutional domain: As will be more precisely outlined in the subsequent paragraphs (sections 8.4.3 – 8.4.5), the laxness of the formal domain might per se prove to be effective. By adopting an approach of non-interference, the formal domain opts for a relatively liberal interpretation, which in essence provides sufficient leeway for the IRS to engage in collection. In doing so, the state thus effectively, yet indirectly solves the problem of reducing overall MSW quantities[82].

[82] As paradox as it might seem, this approach resembles the Daoist concept of Wuwei (无为), which might be loosely translated as 'action without action'. This practice does not call for a total abstinence of action, but rather promotes a concept of action that is in accordance with the dynamics of the environment. Translated into a governance approach of modern China, it would imply that state actors simply choose to not interfere with external processes that also serve the interests of the formal domain. A similar observation is presented by Jean Louis Rocca: He however asserts that the Chinese state conceded limited autonomy to bottom-up emerging

### 8.4.3 Legislation on WEEE collection

The legislation on WEEE collection equally suffers from substantial inconsistencies in regards to regulating collection. As it has been indicated in the sections above the majority of WEEE is generated at the household level (Song et al., 2012, 10). The current regulatory scaffolding however focuses on the recycling stage of discarded electronics in formal recycling facilities. Therefore, from a pragmatic point of view, the most crucial challenge for the formal domain thus consists of how to channel WEEE generated at the HH level into formal recycling. Without forestalling too much from the following paragraphs it has yet to be pointed out that there is plenty of unfavourable critique in secondary research regarding the formal regulatory system for WEEE management in China (Yu et al., 2010; Chi et al., 2011; Chung and Zhang, 2011; Qu et al., 2013; Chi et al., 2014; Schulz, 2015; Schulz and Steuer, 2017). Considered as particular shortcomings of the formal domain are 'poor law making skills, a low level of technical knowledge regarding WEEE and e-products in general, a lack of all-inclusive consideration and consultation, a lack of inter-ministerial communication, coordination and support' (Chung and Zhang, 2011, 2643). In addition to that, it is especially the field of WEEE collection, which has as of now not been adequately solved by formal institutional means.

When delving into the subject matter of formal legislation, the first notable aspect is the recentness of the institutional framework. Initially established in the early 2000s, this legal codification process features elements of institutional imitation as well as experimentation. Starting with a formal import ban on obsolete electronic devices, the national legislation for WEEE has evolved along two lines: On the one hand, Chinese WEEE legislation emerged as a result of intensive pilot experimentation at the provincial and city level (Yu et al., 2010, 993ff; Streicher-Porte and Yang, 2007, 43; Hicks et al., 2005, 466). Thereof generated results have been gradually rechanneled as a learning feedback into the national regulatory framework with the aim to increase overall WEEE management effectiveness[83] (Steuer, 2016b, 294; Steuer, 2017, 420). On the other hand, the central government has put considerable efforts in the translation of foreign, effective regulations to China. Herein the most notable ones are the EU Regulation on Hazardous Substances and the EU WEEE directive (both issued in 2002), which were emulated in the PRC (Steuer, 2016b, 294).

societal dynamics, because it lost its grip on society. So according to Rocca's interpretation, the practice of non-interference is imposed on the state simply because it lacks the capacity to organise such dynamics in an effective manner (Rocca, 2003, 20).

[83] As this aspect deserves more attention, the subsequent section (8.4.4) will go into a more detailed analysis.

Especially in regard to the latter, it is interesting to note that the Chinese version goes into much more detail concerning the prescriptions for dismantling and recycling of electronic components than the European counterpart[84]. This difference in contents is however turned around when it comes to collection: While the Chinese directive only marginally touches upon this topic, the EU version tends to treat it rather extensively[85]. Albeit the fact that the China WEEE directive stipulates the general take-back of designated WEEE categories, it omits the practical procedures for collection. In essence, the directive fails to 'allocate responsibilities to…stakeholders for e-waste collection [and there are, the author] no requirements about collection channels and measures… provided' (Qu et al., 2013, 177). As Qu and colleagues (2013) point out, the three key legislative pieces that address WEEE, namely the 2008 CEPL, the 2002 CPPL and the SWEPPLs do not even touch upon the issue of WEEE collection (ibid., 177). Having left this aspect of WEEE management unregulated to such an extent practically opens the doors to an informal and unregulated market coordination of WEEE collection. The only tentative approach to somehow codify collection within the formal institutional framework is provided in the 2009 China WEEE directive: Herein it is stated that WEEE collection should be conducted along a multi-channel (duo qudao 多渠道) system, which obliges recycling companies to merely document amounts and sources of received WEEE (SC, 2009, art. 5 and 11). It is difficult to interpret, whether such leeway was deliberately admitted by the central government so as to indirectly integrate informal collection services as a viable way for transferring WEEE to formal recyclers. This again would hint to formal effectiveness, by pro-active non-curtailment of an informal solution that also benefits the interests of the formal domain. The thereof created result simply is that overall quantities otherwise left idly in homes or on the street are 'somehow', i.e. by informal means, transferred to formal recycling.

Apart from collection, the other relatively significant topic neglected by the formal WEEE legislation is the refurbishment and remanufacturing of discarded devices. While the IRS has exhibited a clear interest preference for refurbishment and repair over recycling (Steuer, 2016b, 294), the formalisation of WEEE management in the formal domain has primarily emphasised recycling and material extraction. Although a shift towards a greater institutional integration of the former processing stage is manifested in recent legislation, the actual

[84] Compare for example the differing prescriptions of cathode ray tubes, photoconductor drums and components containing Cadmium or hydrocarbons in both WEEE directives.

[85] Compare the China WEEE directive (2009) with the EU WEEE directives (2002 and 2012), with the latter respectively dedicating 12 and 29 articles to the issue of collection. It is especially this shift to increase emphasis on collection, which renders this initial, yet crucial process highly important.

dimension of such regulations remains small within the overall legislative output. Within this subject matter one of the key objectives of the state was to integrate this so far mainly informally practiced treatment form into the formal framework by setting forth various normative provisions for all involved actor groups (Figure 29) (Steuer, 2016b, 295).

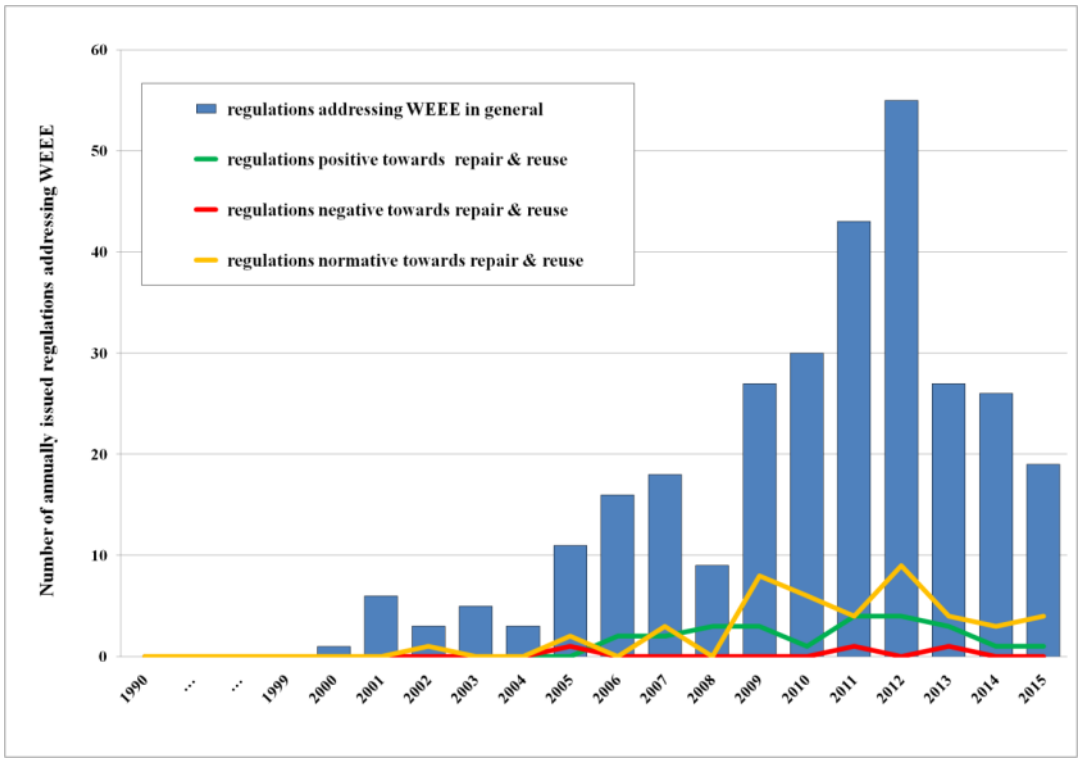


**Figure 29. National legislation on WEEE refurbishment and reuse (source: Steuer, 2016b, 296)**

The first step of formalising refurbishment and reuse of WEEE has initially been taken by the CEPL. Here, it is only trivially stipulated that discarded electronics destined for resale have to be labelled as 'reuse products' meeting corresponding recyclable product standards (CEPL, 2008, art. 39). This initial recognition of reuse and refurbishment has been further extended, yet only marginally, in national legislation with the issuance of the WEEE directive in 2009: The respective provision stipulates that refurbished WEEE destined for reuse has to be properly labelled as 'old good' (jiu huo 旧货) upon resale and must meet user safety standards (SC, 2009, art. 12). The so far most recent and most substantial step towards institutionalising WEEE repair and reuse was the Management Measure for the 2013 Circulation of Worn-out Electronic Devices, which stipulates encompassing provisions for managing refurbished WEEE (Steuer, 2016b, 296).

Overall, the formal institutional framework on WEEE management displays similar institutional deficiencies and loopholes as featured by the superordinated regulatory body for

MSW management. Firstly, collection is hardly regulated and the collection from urban households as largest generators is entirely absent. This in turn enables the IRS to maintain its monopoly on this WM process. Secondly, WEEE refurbishment, repair and reuse has been substantially marginalised in the formal institutional scaffolding for a long period (Schulz, 2015, 45; Schulz and Steuer, 2017, 323), while only recent years have exhibited some regulatory trends within the formal domain to institutionalise this segment. Given that WEEE refurbishment has enjoyed a history of over two decades in China, the formal institutional negligence of this topic stands in stark contrast to actual practices: Recent field investigations by the author in Beijing, Chengdu and Guangzhou have shown that urban areas feature extensive refurbishment and reuse networks for WEEE. These comprise informal collectors, small unregistered repair shops and grey-area structures like second-hand electronic markets with wholesale traders and buyers (Steuer, 2016b, 287), which originally emerged in response to the 'challenge' of consumer demands. Clearly, the absence of formal institutional structures addressing this issue has greatly benefitted the extension of the informal institutional domain (Steuer, 2016c, 5). Here again this constellation may suggest that the formal domain makes use of pre-existing informal institutional solutions, so as to advance its own interest-specific goals: Via informal collection and reuse practices overall WEEE quantities are effectively reduced and those proportions, which are not refurbished, enter formal recycling via informal channels. From the perspective of state actors, there herein generated overall outcome is however less than ideal as there is yet a large volume of WEEE that enters informal recycling. When combining these factors that are relevant for the interests of the formal domain, it becomes clear why formal regulation tends to prohibit informal recycling practices, while adopting a lenient approach towards informal collection and preprocessing. The institutional solutions currently in place constitute the outcome of top-down selection by the formal domain. Herein, selection merely aimed to permit informal systems that are in line with formal interests, while other elements such as informal recycling remain prohibited (Schulz and Steuer, 2017, 320).

### 8.4.4 Formal pilots and the issue of collection

As indicated in preceding chapters and the methodological model of this thesis, pilot projects serve as a significant mechanism for testing institutional solutions within a spatially and temporally delineated context. Faced with the emergence of new challenges, the formal domain can broadly resort to two options: It either opts to redesign preceding solutions that are captured within the institutional inheritance stock or, if the challenge exhibits substantially

novel elements, decide to engage in experimental solution finding, i.e. via pilot projects. Given the particular background of Chinese WM, i.e. the shifts and changes in the institutional dynamic and the emergence of new waste streams, pilots constitute a highly important mechanism for the management of these complex challenges.

For the subject matter of MSW, pilot activities started as early as 2000 and yet existing documentation is rather sparse. In fact, among the 30 pilots issued between 2000 and 2017 at the central level, the majority centres on hazardous waste (6 projects), waste imports (5), medical waste (3), industrial waste (2) and various other streams such as maritime waste and construction waste or final processing techniques (5) (www.pkulaw.cn, individual search by the author in December 2017). After the exclusion of these, only two pilot related regulations (2000 and 2014) have been issued for the topic of waste recyclables in MSW dealing with the sorting and separation of household waste. Whereas the first one sets its focus on recovery strategies for residual waste and recyclables from households (MOCN, 2000), the second one merely stipulates the extension of the pilot to other municipalities interested in participation (MOHURD et al., 2014). A closer look at pilot performance and thereof achieved results, exhibits elements of learning and imitation from previous experiences and informal structures, as well as conceptual failures.

One of the more successful outcomes was that over the first twelve years of the 21st century the central government managed to implement a pilot for recyclable waste within residential quarters in 12 major cities (Liu et al., 2009, 268). Taking Beijing as an example the pilot initially covered 200 residential quarters in 2002, 600 in 2010 and expanded to 2,400 in 2012. This allegedly corresponds to a coverage rate of 50% in Beijing's central districts (FON, 2013, 2ff). Different sources further claim that the pilot managed to establish 4,400 small community-based, waste recyclable take-back depots, however without providing explanations regarding the proportion of depots to residential quarters (Zhang and Wen, 2014, 991). On the flipside however, the pilot seemed to have achieved only marginal impacts after 9 to 11 years since its initiation: In 2009, the scheme in Beijing only managed to sort and separate about 10% of the overall generated quantities, due to the perceived discomfort expressed by residents. 70-90% of respectively interviewed households considered sorting and separation as a time consuming and unpleasant burden (Liu et al., 2009, 268). In parts, this may have come as a result of the poorly conceived pilot strategy, which merely consisted of setting up waste bins for different recyclables and disseminating leaflets to households. Actual implementation was simply transferred to the households themselves (FON, 2013, 2ff).

In response to these outcomes and in order to boost the performance in pilot municipalities, the MOC issued a work plan for waste recyclable collection in 2006. Herein, the ministry stipulated the establishment of previously absent waste recyclable buying depots within residential quarters, which were designated to provide collection services to respective households. The overarching idea expressed in this document was to use these depots as initial nodes of a larger material exchange network: By design, this system should establish an exchange chain between households, waste buying depots in residential quarters and terminal markets for the trade of recovered recyclables (Zhong 2010, 53f). In this regard it is interesting to note that the state has adopted an imitative approach in two respects: Firstly, the institutional solution of waste buying depots appears to be an imitation of the formal SMC system, which was practiced up until the 1990s. Secondly, the particular exchange network encompassing consumers, collectors and trading markets appears to strongly draw on the structures of the informal system that centre on the mechanism of Trading Points (see section 8.4.6.4).

Additionally, the MSW sorting and separation pilot also incorporated previously learned lessons: In light of informal dominance in waste recyclable collection, the pilot aimed to integrate over 90% of informal recyclers (sic!) into the scheme thereby hoping to re-channel 90% of overall recovered recyclables back into formal structures. The predominant approach for the integration of informal actors was to compel collectors to use uniform working attire, logos, prices and means of transport, which should be centrally coordinated by the municipal government (Zhong, 2010, 53f). In order to buttress this approach, the MOC and other ministries issued the 2007 Management Regulation on Renewable Resource Recovery. Herein it is stipulated that all recovering and collecting enterprises have to register with the municipality and obtain respective permissions (MOC et al., 2007, art. 6-8, 10). The conceptual flaw however was that this regulation did not explicitly include informal collectors and traders, which led some municipalities to simply enforce registration of informal actors and include these in the pilot (Zhong 2010, 54).

What hereof resulted is one type of effective exploitation of formal loopholes by the IRS[86]: In response to the enforced integration by the formal domain, informal actors applied for the position of collectors and managers in formal waste recyclable take-back depots that were established in residential quarters. However instead of selling the recovered waste recyclables

[86] A more detailed discussion of the institutional solutions adopted by the IRS in response to formal institutional measures is presented in section 8.4.8.

at fixed prices to formal channels, the now formally engaged informal actors would transfer these recyclables to informal channels for a comparatively higher profit (Tong and Tao, 2016, 14). So despite successfully integrating learned experiences from preceding institutional outcomes in recyclable collection, the formal domain did in its most recent pilot underestimate the adaptive capacity of the IRS: Due to being subject to one-dimensional, top-down pressures and because of obvious loopholes, informal actors have simply devised a countervailing institutional solution that would benefit their own interests.

The dynamic between the two institutional realms has been even more intense in pilots related to WEEE management. As shown in the figure below, local pilots and central legislation have formed a particular responsiveness cycle (Figure 30): While local experimentation has been propelled by the institutionalisation process conducted at the central level, the results from pilots have vice versa provided a feedback loop of information and learning to the centre. This in turn induced the issuance of significant national regulations such as the WEEE directive issued in 2009 and the WEEE recycling fund established in 2012 (Schulz and Steuer, 2017, 318ff).

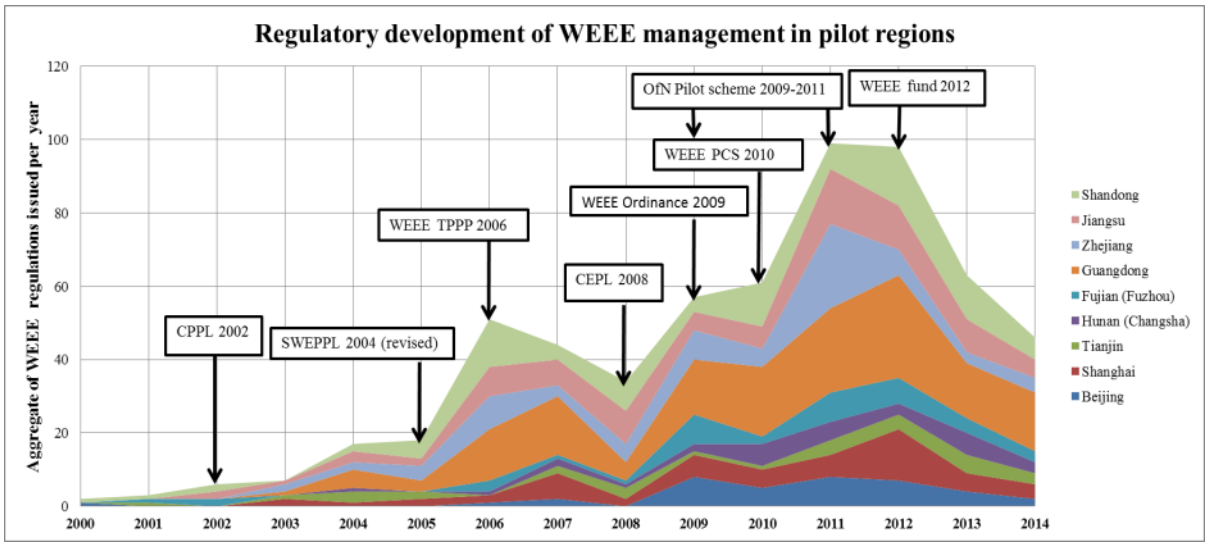


**Figure 30. WEEE regulations in pilot regions during 2000-2014 (source: Schulz and Steuer, 2017, 319)**[87]

The initial aim of WEEE pilots issued by the central government was to gain a better understanding on recycling practices and the necessary institutional requirements for conducting this process in a CE-oriented manner. So in essence, the formal domain initially

[87] The abbreviations used in the figure are: Solid Waste Environmental Pollution Prevention Law (SWEPPL), Cleaner Production Promotion Law (CPPL), Circular Economy Promotion Law (CEPL), WEEE Technical Pollution Prevention Policy (WEEE TPPP) and WEEE Pollution Control Standard (WEEE PCS).

lacked information on environmental standards as well as on how to arrange collection and recycling technologies (Yang et al., 2008, 1593). Another notable feature concerns the balancing of costs and benefits: In this regard the initial question was how much financial assistance would be required from the government to sustain recycling practices of individual companies (Zhou and Xu, 2012, 4717). In terms of pilot batches, broadly two stages can be differentiated: The first pilot covered five areas, in which these programs were implemented without particular coordinative linkages in-between. The second pilot initiative was the highly influential Old-for-New (OfN) trial scheme that has decisively shaped national legislation.

The initial pilot set was implemented during 2003-2006, with Qingdao and Zhejiang taking the lead, while pilots in Beijing, Tianjin and Suzhou followed in second instance. In all cases, pilot companies were set-up and developed with financial aid from the NDRC, which hints to the central government's concern for solutions being found at the local level. However the major problems that permeated all of these trials occurred at the stage of collection: In Hangzhou, for example, 47 collection sites were established all over the city in places, where a high density of obsolete household electronics was expected. However, only small amounts could be reaped from these sources, because the IRS had practically monopolised collection. Responsive attempts to include informal collection networks were not successful, which in sum led to a failure in achieving designated collection amounts: Out of the annually expected 800,000 devices, only 200,000 entered actual treatment in two years. The Qingdao pilot faced similar problems: Despite the local government's issuance of the 'Administrative Rules for E-waste Collection and Treatment in the Qingdao Pilot Region', the target of 600,000 units was not achieved during the pilot period. In this project, collection mainly centred on stationary take-back points, which requires individual residents to dispose of their waste on site, while pre-existing, informal collection networks were ignored. Exemplarily, Hai'er, the main corporate driver involved in the Qingdao pilot intended to set-up a collection and treatment centre in the city, but backed away from its plans, once having realised that expected WEEE volumes designated to enter recycling were simply too small. (Hicks et al., 2005, 466f); Qu et al., 2013, 177f; Yu et al., 2010, 994; ZTN, 2005). As for the national pilots in Beijing and Tianjin, launched in 2003, existing documentation is relatively sparse. However from what is known companies in both cities faced similar problems: The major issue curtailing formal recycling operations was the difficulty to obtain sufficient WEEE quantities. In both cases, collection was dominated by the IRS and here again standardisation and reorganisation of the IRS under the formal domain did not reap any results (Social Resources Institute, 2010). The final pilot of this initial batch was conducted in Suzhou with financial and technical aid

provided by the United Nations Development Program. Despite the variation in project set-up, it could not be avoided that corporate recyclers soon faced the issue of lacking sufficient feedstock for recycling: Albeit having established a formal collection system, the herein allocated financial means to buy WEEE from households were far below the level of what the IRS offered (Yu et al., 2010, 994). In summary, the first batch of WEEE pilots may have failed due to conceptional inconsistencies at the planning stage: Too much focus was set on the process and design of recycling operations, whereas concepts for collection were either missing or poorly conceived (Zhong 2010, 49).

The feedback information from the first batch had most likely influenced the institutional design of the second pilot group termed the Old-for-New scheme (OfN, yi jiu huan xin 以旧换新). Herein, three significant institutional flaws of the preceding pilots were corrected: Firstly, the focus was set on the primary generators of devices, i.e. consumers. Secondly, financial fiscal support was extended to recyclers and thirdly the pilot was conducted in a coordinated and simultaneous manner in designated project areas under a uniform regulatory framework. In detail, the OfN featured the following institutional particularities: Implemented during 2009-2011 in nine pilot regions, the conceptual set up was centred on the level of generators: By means of a reimbursement mechanism, consumers should be incentivised to return their obsolete electronic products to retailers, when buying a new device. Therefore they would be rewarded with a maximum 10% discount on the new appliance (Wang et al., 2013, 34). Via this approach it was hoped to channel a sufficiently large volume of WEEE into formal recycling facilities. In terms of financing, the government – 80% out of central and 20% out of local budgets (Zhong, 2010, 51f) – subsidised all included formal parties, i.e. recyclers directly and retailers as well as collectors indirectly. The intention behind it was to render formal recycling companies capable of competing with the high prices paid by the informal sector to households upon doorstep collection (Salhofer et al., 2016, 29; Wang et al., 2013, 36). This seems to indicate a learning result from information feedbacks gained through preceding pilots: Instead of formalisation, informal collection and transfer to recyclers has not been forbidden by any of the regulations issued in the OfN pilot regions. This in turn enabled formal recyclers to use the received subsidies for the purchase of WEEE from informal collectors: According to interviews conducted with recyclers in Chengdu, Zhejiang, Wuhan, Beijing and Shanghai, amounts obtained from informal channels range somewhere between 80-95% (Rewin research project, 2016). This dominant exchange practice has since then been

maintained by the formal recycling sector, also because no regulations prohibiting such arrangements were issued (Zhong, 2010, 45; Wang et al., 2013, 34ff).

On the flipside, this pattern can only be afforded by using a significant proportion of state subsidies and this indirectly alludes to the major flaw inherent in the OfN scheme: Only cost-intensive support by central and local governments could ensure the supply of WEEE to formal recyclers. And yet, as depicted in Table 37 earlier above, OfN collection rates only managed to obtain 20% of the estimated overall generated amounts. Furthermore, there are indications that recyclers considered the subsidies as being yet too low to cover the entire costs accruing from collection (Zhong 2010, 51ff; Personal communication with formal WEEE recyclers in May, August and September, 2013). Experiences gathered from the pilot were also decisive in generating the subsequent national institutional solutions: After 2011, the Chinese central government established the national WEEE fund in 2012 and further amended it in 2015. In the first instance subsidy levels were increased, while in the revised standard these thresholds were further adapted based on official investigations of formal recycling enterprise performances[88] (see Table 41).

**Table 41. State subsidies to formal WEEE recyclers (Sources: MOF et al., 2015b; Wang et al., 2013)**

| State subsidies (RMB) per recycled device type | TV (colour) | Refrigerator | Air conditioner | Washing Machine | PC |
|---|---|---|---|---|---|
| OFN (2009-2011) | 50 | 55 | 35 | 40 | 50 |
| WEEE fund (2011-2015) | 85 | 80 | 35 | 35 | 85 |
| WEEE fund (since 2016) | 60-70 | 80 | 130 | 35-45 | 70 |

While yet another learning element is reflected in the extension of subsidised devices in 2016 (MOF et al., 2015b), the substantial dependency of formal recyclers on state subsidies has by no means been reduced up until the very present (Schulz and Steuer, 2017, 320). This very deficiency of the system is rooted in the fact that informal collection channels could never be effectively integrated into the formal framework (Chi et al., 2011, 736). Quite on the contrary, formal fiscal allocations rather indirectly subsidize the informal system. This in turn evokes the question of whether this solution is effective: In the strict sense of being able to (1) satisfy a wide array of actor interests and (2) solving a particular challenge it indeed is: While idly dumped WEEE quantities are reduced and partially recycled by the formal domain, actors of

[88] According to the presentation of Mr Song X. at the MEP in Beijing, supervision and monitoring of formal recyclers is based on corporate volume documentation and video feeds of around 90-120 cameras per recyclers that record the entirety (sic!) of recycling operations per work day. These recordings are subsequently counterchecked at local EPBs (Song, 2014).

the informal domain achieve a particular gain in wealth. This may be interpreted as a formal solution with built-in latitudes for informal institutional practices. What further supports the impression that this system is designed to remain in the near future, is that overall trend of pilot intensity has been decreasing since the issuance of the WEEE fund in 2012 (see Figure 30). By implication, the reduction in efforts to launch pilots would mean that the currently practiced solution suffices to serve the interests of the formal domain.

### 8.4.5 Institutionalising the integration of the IRS: An emerging trend in formal institutional solution finding?

At least since the experiences gained from pilots on MSW and WEEE, it can be assumed that the formal domain has realised the particular challenge created by informal collection structures. Given the prevalence of informal practices and thereof generated repercussions for the formal domain, institutional theory suggests that the formal domain is in some or the other way bound to respond. In this regard, developments within the formal regulatory framework at the formal level are especially interesting, since there seems to be a trend towards formal integration of the IRS in collection.

The earliest steps in this direction can be traced back to the beginnings of institutionalisation of formal WM practices: Already in 1985, the MOC acknowledged individually owned businesses (geti shanghu 个体商户) as significant players of the waste recycling system and made these subject to formal provisions (MOC et al., 1985). While a further formalisation process was interrupted during the years 1985-2009[89] and may in parts explain the negligence of the IRS in pilot projects, more recent regulations seemed to have rediscovered this particular subject matter: In 2010, the MOC tentatively proposed to register and integrate these individual actors and formalise recovery networks under the formal institutional umbrella (MOC, 2010, art.3, sect. 3). One year later the State Council (SC) further suggested to formalise the management of waste pickers (shihuang renyuan 拾荒人员) (SC, 2011, art. 9). This approach was developed further by the MOC in 2016: In a document on the transformation and upgrading of the resource recovery industry, the ministry not only suggested to integrate individually owned businesses, but also to make full use of waste pickers (chongfen liyong shihuang renyuan 充分利用拾荒人员) (MOC et al., 2016, art.6). This increasingly non-rigid approach is also reflected in the domain of WEEE refurbishment.

[89] The legal search engine pkulaw.cn lists 19 regulations for this period that revolve around the topic of recyclable recovery, however without addressing the IRS.

The Management Measure for the Circulation of discarded WEEE issued by the MOC in 2013 equally attempts to formalise the refurbishment and reuse segment via the standardisation of work processes (MOC, 2013a, art. 2, 3, 7, 8, 13, 15, 17). Yet, no attempts were made to prohibit and ban informal practices or replace them via formal collection systems (Steuer, 2016b, 296f). All this may hint to a substantial shift in formal institutional approaches toward the sector, but yet it seems too early to affirm a sustained alteration in the overall trend.

### 8.4.6 Informal institutional systems in collection and preprocessing

#### 8.4.6.1 Institutional inheritance and value concepts as pillars of the IRS

The operations of the IRS in the PRC are based on a framework of non-codified, private rules of behaviour, which has evolved over time. In contrast to the formal, codified institutional system, in which rules are enforced and safeguarded by an authority with legislative, judicative and executive powers (Groenewegen et al., 2010, 26f), institutions in the IRS are built upon fundamentally different principles. These private rules of behaviour are maintained either through sanctions by involved actor groups (self-regulating) or because it is in the self-interest of individual actors to adhere to these rules (self-enforcing) (ibidem, 25). This essentially bottom-up devised system yet also features similarities to its formal counterpart when it comes to modifications in its structures: Just as it is the case for the formal institutional structure, changes are either induced through the emergence of new challenges and problems, or due to the impact from the opposing institutional domain. While the institutional dynamic between both domains will be the subject of the next section (8.4.7), the present section (8.4.6) will focus on the particular institutional solutions created by the IRS in collection and preprocessing. However, before going into more detail, the following paragraphs will first outline the very fundamental institutional value components and mechanisms upon which the comparatively sophisticated institutional system of the IRS is built. In this regard, three particular features need to be discussed.

The first notable aspect revolves around what may be loosely termed as the fundamental value set of the IRS. During various field interviews with informal collectors and processors, the author encountered several occasions in which the interviewees explicitly stated their pivotal rationale for engaging in this business: The value concept of ‘being one’s own boss’ and thus being able to enjoy a status as independent entrepreneurs constituted a crucial motivation for remaining in this line of work (Steuer et al., 2017a, 148). This significant core concept might

be directly connected to the value ideal of generating wealth. Indeed, preceding research on this sector has shown that young rural migrants were incentivised to enter the IRS, because they heard rumours about or even met their older informal collectors, who had become successful businessmen (Fan, 2014, 837). This particular belief system might be founded in the particular socio-economic environment of rural-urban working migrants: Having been brought up in the countryside, this group seems to have experienced a particular and shaping impact from events of the younger past of the PRC. In his analysis of how socio-historical events have impacted the economic growth dynamic in China, Rawski (2008) asserts that past developments in the countryside has given rise to a cultivation of particular norms among rural society. According to this perspective, the particular hardships experienced before reform and opening have led to the emergence of skills among rural actors that would prove essential for the survival in the competitive realities of China's market economy: First of all, the author asserts a failure of top-down enforced attempts to eradicate 'historically-rooted organisational skills'. Quite on the contrary, Rawski claims that the rural commune experience that involved two decades of nutrition shortages and unprecedented pressures would induce rural actors to closely monitor and respond to external challenges. In further consequence, this kind of struggle for survival actually led to the emergence of a very strong entrepreneurial spirit among a collective setting. This in turn had equipped commune members with an 'unusually rich and flexible portfolio of organizational skills…to pursue economic advantage', which further manifests in a particular set of entrepreneurial verve and managerial talent (Rawski, 2008, 11ff).

The above analysis hints at an informal institutional outcome and later inheritance that resulted from top-down implemented formal solutions, entailing particular challenges for societal actors. The hereof achieved institutional innovations in the informal domain find their representation in the organisation of the IRS in urban China. As depicted in the outline of the sector above (section 8.3.5) informal actors in this field have generated an organisational system, which allocates different duties and tasks to actor-specific groups. All of these stakeholder groups can in their own right be considered as entrepreneurs in WM, in which every individual is clearly adhering to the strategy of making money under uncertain circumstances (informality) and the constraint of scarce resources (competition for discarded waste recyclables). What however drove this form of self-organisation? According to the analysis of the sector in the international context, Wilson and colleagues assert that isolation due to social exclusion has led informal actors to develop their own habits, customs and values of beliefs (Wilson et al., 2006, 803). The context of uncertainty and the frequent

absence of formal regulatory systems has most likely created an environment that induced actors to gradually develop organisational structures for the purpose of realising group specific interests. These institutional solutions may have emerged in response to market needs and to avoid exploitations from the formal sector: Acting as a sufficiently large group with respective upstream and downstream linkages, the IRS has more leverage to bargain prices with representatives of the formal domain (ibidem, 798ff). Instead of selling materials to formal recyclers and manufacturers, informal actors can alternatively opt to exchange waste recyclables along informal lines.

However in order to compete with the formal system, a degree of internal specialisation and division of labour is imperative. Based on findings by the author and secondary literature, it can be confirmed that the IRS in China features a high degree of specialisation (Chung and Poon, 1998; Chi et al., 2011; Tong and Tao, 2016). In parts this institutional solution is the result of contextual circumstances, such as in Guiyu: Initially, local families themselves engaged in WEEE processing (Hicks et al., 2005, 461f), but soon after began to hire external labour to provide for the increasing need of transport and dismantling. In parts, specialisation also resulted from evolutionary processes such as capital accumulation and learning: It has been documented that after having been in business for several years, some actors simply decided to focus on the more profitable practices in the IRS. So instead of trying to cover all stages – from collection over preprocessing to material exchange with corporate actors – some stakeholders began to operate as intermediaries between industry on the one side and less potential collectors on the other. In essence, this self-organisation process simply constitutes the result of the IRS' evolving business structure (Tong and Tao, 2016, 13). Along this process of specialisation and due to the growth in size, the establishment of coordinating internal rules became increasingly important. Documentation on Bejing's Dongxiaokou waste village for example shows that so called 'bosses' of therein located informal recycling markets have set forth non-codified rule systems. The primary motivation to do so is founded in the aim to preserve economic interests and avoid conflicts with the formal system (ibidem, 13). By implication, these self-organisation patterns also reflect an inherent desire to avoid regulation or formalisation by the formal domain. While a top-down governance approach to regulate the IRS had been attempted in the past, the sector resisted and continues to show a high degree of evasive responsiveness to avoid being formally incorporated by the state[90]. The hereby promoted argument of informal actors is that their particular solutions are effective in

[90] This particular dynamic will be discussed in section 8.4.7 in more detail.

terms of providing job security and waste reduction. According to their line of thought, any attempts to modify this system would merely result in more problems for the formal domain (Orlins and Guan, 2015, 77)

The final fundamental institutional technique of the IRS is the setting of prices for discarded recyclables and devices, as well as the thereof impacted generation of added value via product transaction. In this regard, it is firstly important to point out that this mechanism stands apart of what is usually understood under the generation of added value in the IRS: Indeed the profits in this sector largely depend on how well collected materials are pre-processed (sorting, separating, cleaning, bulking, material extraction), simply because these operations improve the recycling and reuse value of these discarded products (Wilson et al., 2006, 801-804). While these service solutions for the generation of added value are undoubtedly important, actors of the IRS have moreover developed institutions in regard to the *pricing* of collected recyclables: In mainstream micro-economics, the *procedure* to tag a price on an exchangeable good merely constitutes a profit oriented cost-benefit assessment. However, from an institutional perspective, the pricing procedure adopted by informal actors can be seen as an institutional outcome from preceding learning processes: The practice per se emerges on the basis of interactions with other individuals and the computation of information on supply and demand. Over a certain period of time, individual actors in this segment will increase their knowledge on the subject matter. This in turn will lead the actor to develop particular habits and routines to assess and price gathered waste materials and products (Steuer, 2015, 16). Given that this process is an ever continuing one, individual routines are prone to change over time, which in some cases has led to the formation of particular recyclable and device foci among collectors and traders in China. In this regard, the market mechanism, or rather the secondary material demand expressed by the Chinese market, has an increasingly strong impact on the shaping of the IRS' institutional practices. Via interviews and surveys on this stakeholder group it has been ascertained that patterns and preferences in collection and trading shift according to the prices formed by domestic market demand (Steuer et al., 2017a, 144). This as well as the above outlined institutional features of the IRS can be considered as most fundamental components that have given rise to more complex and observable institutional structures described in the following sections.

#### 8.4.6.2 Spatial-temporal collection systems of the IRS

The first important institutional practice employed by informal actors for the collection of waste recyclables and devices is to spatially and temporally align daily operation routes.

Based on preceding research and via observational evidence two particular features of this institution have been discerned: Firstly, a temporal planning of daily collection routines to increase collection quantities. This practice implies that collectors based on their experience choose particular time intervals during the day to engage in collection of waste recyclables. Secondly, some actor groups have been found to focus on a pre-delineated territory for conducting collection. Initially, emphasis has been put on the spatial limitation of collection routes, while more recent findings have shown that this preference has shifted towards enlarging collection territory and establishing a customer-based network among households (Li, 2002; Steuer et al., 2013, 5).

A comprehensive account on the first aspect has been documented by Li (2002) for the case of Wuhan. According to his observations, made in 2002, waste collectors roam through individually designated areas in late morning, during lunchtime and later afternoon. This arrangement of collection routes is made in accordance with the presence of residents and shopkeepers as they both constitute important generators of waste products. As Li points out this practice considers the preferences of waste generators, for which reason collectors seem to avoid periods, during which waste generators are not accessible due to occupational circumstances (Li, 2002, 331). This institutional solution of the IRS is particularly notable as it indicates a form of institutional symbiosis between the sector and its larger socio-economic context. Given the high collection rates achieved within the informal domain, it can be argued that rules aiming to achieve institutional effectiveness in waste collection need to account for the socio-economic environment and therein practiced institutional systems. This rule-based practice appears to be strongly correlated with another institution, namely that waste collectors appear to have limited their collection territory: In Li's 2002 survey of Wuhan, it was found that around 70% of all interviewees would focus on a collection distance of around 5 km based on their transport capacities.

Yet, the author contends that this system is prone to change, if the means of transportation were to improve (Li, 2002, 333). In fact, a change in this direction was asserted in the 2013 field survey conducted by the author and colleagues in Beijing. In this project, it was witnessed that most collectors were WM, who use motorised tricycles and thus substantially increased their spatial coverage. This implies that technological innovations, however trivial they may seem on first sight, can have a significant impact on institutional practices. Another side effect observed in 2013 was that the means of transportation also affect the composition of recyclables recovered by WMs. Via a project survey it was found that some motorised

WMs prefer to collect recyclable fractions that are particularly easy to transport over larger distances (Steuer et al., 2017a, 144). There are, however, also other factors that influence the choice for collected material compositions: Secondary resource market prices as well as individual specialisations exert an influence on what informal actors ultimately collect. Another feature that defines individual collection practices relates to establishing good relations with households and commercial entities. As is further discussed in the following section, communication and service arrangements via telephones have not only helped collectors to establish relationships with residents. Moreover, informal actors have indicated that such connections to households facilitated the timely arrangement of collection routes and thus benefited overall institutional effectiveness (ibidem, 142).

#### 8.4.6.3 The IRS' connection to households and the significance of information management

Given that recyclable and WEEE collection practiced by the IRS is in essence a service intensive segment, it does not come as a surprise that informal actors have put much emphasis on refining service related institutional solutions. In contrast to earlier findings from 2002 stating that the IRS does lack relations with the sources of recyclable waste (Li, 2002, 328), more recent studies on the segment have shown that there has been a volte-face in this matter. In essence, households as most significant generators of waste recyclables and WEEE have shown a strong preference for transferring these materials to the IRS (Wang et al, 2010; Chung and Zhang, 2011; Li et al., 2006; Wang et al., 2013; Yang et al., 2008; Ma et al., 2012; Chung and Poon, 2001). Although this does not automatically induce the establishment of business relationships between these two sides, it yet constitutes a significant institutional basis for such.

In order to understand the exchange patterns that exist between households and the IRS in waste recyclable collection, it is imperative to investigate the interest preferences and value ideals of both actor groups. In this regard, there is one specific value element that explains the congruence in interests: Just as it is the case for the IRS, urban households perceive waste recyclables and WEEE as a valuable resource and thus as a potential source of additional income. This value concept is very prevalent among urban Chinese households and has evolved to a degree inducing residents to store waste recyclables and WEEE at home – just as they would do with any other valuable commodity (Zhang and Wen, 2014, 993-997; Yang et al., 2008, 1592; Ma et al., 2012, 241; Wang et al., 2011, 977). What can be contended is that the IRS and households share a congruence in interests regarding the valorisation of waste

recyclables and WEEE and the hereof expected gains from material exchanges. This has in further consequence institutionalised a preference among households to favour informal over formal collection channels (see Table 42) (Steuer et al., 2018, 63).

**Table 42. Preferences of urban households for formal and informal MSW (collection) systems (Source: (Steuer et al., 2018, 64)**

| | | Economic factor | Cultural Factor | Environmental Factor |
|---|---|---|---|---|
| **Formal institutional structures** | **Formal collection** | (-) No/ little economic benefit | (-) Distance to redemption depots | n.a. |
| | **Waste management fees** | (-) Economic loss | (-) Purpose not accepted/ recognised | (+) Rising environmental awareness |
| **Informal institutional structures** | **Informal collection** | (+) Significant economic benefit<br>(+) Welfare considerations: Contribute to income generation of IRS<br>(+) Doorstep collection<br>(+) Quick transaction and quick cash<br>(+) Convenience of services | (+) Custom since 1990s<br>(-) Security concerns regarding criminality of the IRS | (-) Environmental hygiene and city appearance<br>(+) Perceived conservation of resources |
| | **Storage of waste in households** | (+) Selling to collectors for profit | n.a. | n.a. |

As the above table indicates, the primary motivation for households to choose formal over informal collection appears to be primarily rooted in the economic domain. The manifestation of this institutional pattern is reflected in the quantitative material flows accruing to the IRS: Exemplarily, 95% of Wuhan's households sold their household waste to informal door-to-door collectors rather than to formal redemption depots in 2002 (Li 2002, 323). Similarly, 65-70% of households in Beijing (2005-2010) preferred to sell their WEEE to the IRS (Streicher-Porte and Geering 2009, 3; Wang et al. 2011, 982). What has so far however not yet been determined is whether this preference is solely bound to the economic factor. In a similar fashion, logistical conveniences such as doorstep collection may play an equally important role for households to prefer the IRS over formal channels.

The pivotal challenge in that context is centred on the question of how to establish a connection, and more ideally a stable relationship between households and informal collectors.

According to interviews conducted by the author, the decisive factor in this context is to foster a basis of trust among both sides: Once a collector has been able to achieve a certain level of trust between him or her and the residents in a particular area, she or he faces only little competition from other collectors among his customer base (Personal communication with Waste Merchants, Beijing, Haidian, Xueyuanlu subdistrict, April 2015). In order to achieve that, pro-active communication to connect with households is crucial. For WMs, two basic approaches can be discerned: On the one hand these collectors tend to roam through residential quarters and offer their services through loud puffery (yaohe 吆喝). The second and even more frequently observed technique is to disseminate business cards and set up cardboard signs on the street in front of residential quarters. In a similar fashion to commercial advertising, these signs aim to provide residents with information on what products the collector recovers and a 'service number', which can be called for the collection of recyclables from their homes (see Figure 31 and Figure 32) (Steuer et al., 2018, 63).

**Figure 31. A cardboard sign of a WM set-up in Shenzhen, Futian district (© Steuer, 2015)**

**Figure 32. Cardboard signs of a Waste Merchant in Beijing, Haidian district (© Steuer, 2016)**

In regard to this institutionalised practice, it is important to note that variations in patterns have emerged: While the basic idea of using signs remained the same, some collectors – maybe for the purpose of flexibility – chose to attach these signs to their cars (Figure 33) or tricycles (Figure 34). It can be assumed that this choice may benefit actual collection operations of individual actors in the IRS.

**Figure 33. A cardboard sign attached to a collection van (source: Song et al., 2016, appendix 1, 2)**

**Figure 34. Cardboard sign attached to the tricycle of a Waste Merchant in Beijing, Haidian district (© Steuer, 2016)**

In essence, interviews with waste collectors have revealed that good communication, i.e. ensuring a steady flow of information, has proven decisive for the improvement of informal collection performance: Not only does this mechanism provide more flexibility to the IRS for aligning collection time and routes according to the demand expressed by households. Proper communication furthermore enables informal actors to avoid a typical fallacy of the formal system: Via this technique a more reliable information feedback on recyclable waste

quantities is obtained, which in turn facilitates planning and decision making by informal actors (Steuer et al., 2018, 63). In sum this buttresses the assertion that the IRS employs effective institutional solutions to collect waste recyclables and WEEE from households. Households on the other hand, seem to have responded positively to the services offered by the informal domain: Exemplary cases like in Shanghai indicate that residents have developed the habit to call informal actors, once they are in need of someone to collect recyclable waste materials from their households (Yang et al., 2013, 16f). In sum, this in parts institutionalised business relationship features advantages for both sides: Residents can derive a monetary compensation from this exchange and benefit from a time-saving doorstep collection service. Informal collectors on the other hand are directly connected to the source of waste recyclables and can via effective bargaining at the stage of collection broaden their profit margin before conducting further exchanges down-stream[91] (Steuer et al., 2018, 63).

#### 8.4.6.4 The informal exchange of waste recyclables at Trading Points

At the post-collection stage, the most crucial institutional system established by the IRS in waste recyclable preprocessing is the Trading Point (TP, jiaoyidian 交易点) system. These exclusively informal institutional structures take the shape of small market places that are scattered all over the city and function as a platform for waste recyclable exchanges between collectors (sellers) and pre-processors (buyers). First discovered by the author and colleagues from BOKU University during the 2013 field survey on Beijing's IRS, it was ascertained that TPs occur in all sub-districts of the capital with varying degrees of spatial density. Variations are also notable in terms of structural appearance: While some of these markets are only composed of a single buyer and several sellers, others feature several booths of buyers along an entire stretch of a road (Steuer et al., 2017a, 143). These differences are best explained by different socio-economic circumstances, such as population density, accessible space and municipal control[92]. With regards to the identification of these structures, the 2013 field survey first conducted preliminary interviews with informal collectors (WMs). When asked about their waste exchange modalities, the interviewees indicated that they would go to these market points for the exchange of collected recyclables to informal buyers, i.e. MM. Via

[91] For the sake of completeness it should be noted that formal-private collection initiatives also engage in doorstep collection at the household level, but tend to compensate residents with vouchers for presents. It seems that this approach has so far proven less attractive then forms of pecuniary compensation.

[92] Similar systemic structures to the TPs have also been observed in other Chinese cities and will be discussed below.

subsequent field verifications in 8 sub-districts of Beijing's Haidian district an average proportion of 0.87 TPs per 10,000 inhabitants was extrapolated (ibidem, 143).

The pivotal institutional function of TPs is twofold: Firstly, as indicated above, the system facilitates the exchange of recyclables between collecting and preprocessing actor groups. Secondly, it serves as a platform that effectively reduces the spatial distance in between these transactions. These two characteristics increase the performance of the IRS as it represents an effective node for the connection of services between these two actor groups (Figure 35). In this regard, the feature of bridging the spatial distance between the two operative segments is especially significant: On the one hand, collecting actors face less difficulties when it comes to transporting waste recyclables from generating sources to pre-processors. In Beijing the locations of TPs have proven to be relative stable and are perceived to be within walking distances. This not only facilitates the work of WPs who need to make their routes by foot. In some cases also residents themselves have been found to go to TPs so as to dispose of recyclable materials stored at home. For waste recyclable buyers this system equally offers some advantages. Based in fringe areas such as Dongxiaokou in Changping district, MM shuttle between TPs to buy materials and their private storage yards (Figure 36), where they pre-process and further resell their materials to recycling and manufacturing companies (Steuer et al., 2017a, 143f). In terms of operative characteristics over time, field research by the author and colleagues has revealed that the TP system can undergo actor constellation related changes without reductions in terms of solution effectiveness. Via observations in 2016, it was found that less WMs were present at surveyed TPs, while at the same time the number of residents and WPs has increased (see Table 34). This change in the operational structure thus suggests that the task formerly fulfilled by WMs was at this point handled by two other actor groups. Further observations then showed that MM, in a seemingly reciprocal manner, began to establish TPs in direct vicinity to residential quarters and thereby reduce the distance between waste sources and transaction nodes (Steuer et al., 2018, 63f). This in turn indicates another feature of institutional solution effectiveness of TPs: Via inherent flexibility and adaptability mechanisms, the system manages to fulfil its designated purpose despite internal changes regarding actor and exchange linkage constellations.

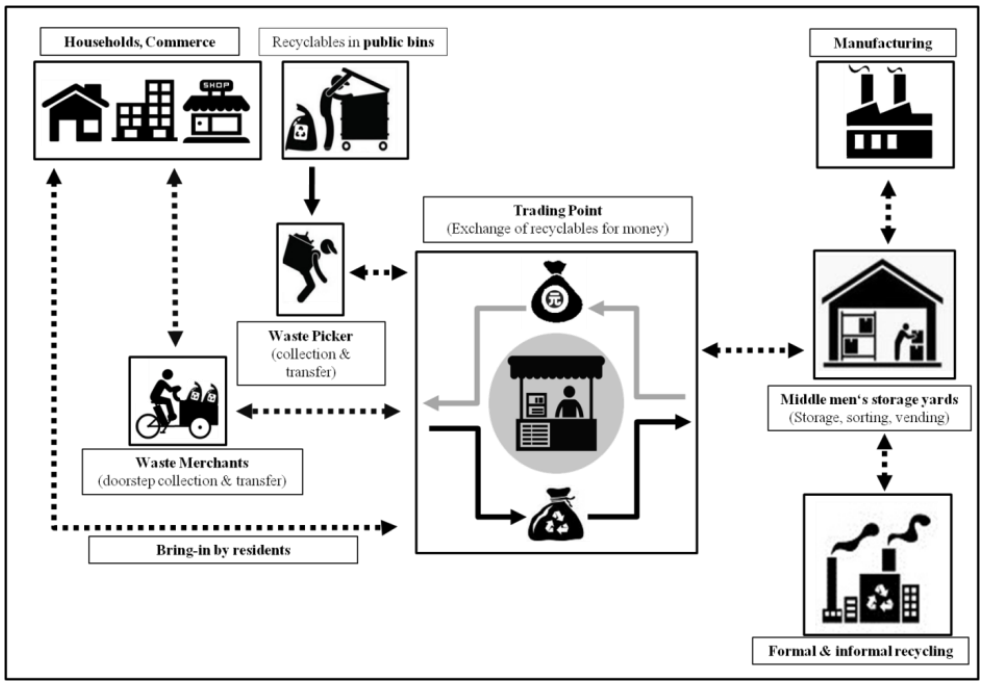


**Figure 35. The connective function of Trading Points (Grey arrows indicate monetary flows, black arrows refer to recyclable flows and two-directional arrows indicate diametrical flows of money and recyclables) (Steuer et al. 2017a, 140)**

**Figure 36. Storage yard of a Middle Man in Dongxiaokou, Changping district, Beijing (Steuer et al., 2017, 143)**

As holds true for any institutional structure, the TP system has to fulfil certain prerequisites of effectiveness for actors to employ this institutional solution in the long run. In this regard, the following characteristics can be discerned: Firstly, TPs simply offer an opportunity for sellers and buyers to generate turnovers, which can be considered as the pivotal interest element that induces actors to engage in this line of work. The profit margin achieved in this transaction in first instance depends on the individual bargaining abilities of collectors at the household

level as well as during subsequent interactions with MM (Steuer et al., 2017a, 143). Secondly, the TP system has developed its own coordination mechanism on the basis of information feedbacks. Based on field interviews with the IRS, it was found that locations and particularities of TPs are disseminated via the communication between selling and buying actors. As will be discussed further below, different TPs trade recyclables at different prices. Specifics in this regard are known by informal actors via group internal information exchanges. In further consequence, the TP system thus reduces search and information costs for selling and buying actors, as they do not have to look for individual business exchanges, but can select between different selling and buying offers. In essence, this system manifests the highly price competitive nature of the IRS in urban China (ibidem, 143). A third feature is the combination of spatial flexibility and infrastructural provision. TPs are flexible as they in their simplest form consist of booths, ground scales and a vehicle for further transport. This makes it very easy for operators to setup and remove TPs in cases of sudden controls by the formal sector[93]. And yet despite being equipped rather sparsely, TPs provide the necessary infrastructure and service structure for the exchange of waste recyclables. In fact observations at such points have shown that MM stand in front of their booths, constantly operate their ground scales and order their subordinates to store acquired materials in large transport vehicles (Steuer, 2016a,, 32; Steuer et al., 2017a, 143f). The final two significant systemic features of TPs are the overall network density in terms of spatial coverage and the relative continuity of individual points. In regard to the former it was found that the TP-system exhibits a much higher spatial density than for example achieved by formal waste transfer points. Thereby the system exerts a beneficial effect on transport distance and transfer costs for the IRS. As for the latter characteristic, interviews revealed that especially large TPs have been operating at fixed locations over a long period of time for the same business hours[94] (Steuer, 2016a, 31).

Via the 2013 and 2016 research projects in Beijing, two institutional follow-up outcomes have been identified. Firstly, the interview surveys showed that all three actor groups exhibit preferences and elements of habituation when it comes to selecting particular TPs for recyclable exchanges. First of all, all three actor groups nearly exclusively use TPs for their transaction of waste recyclables. What appears to be however even more important is that 68%, 80% and 87% of WPs, WMs and MM respectively chose to always frequent the same

[93] Albeit not deemed illegal by the formal domain, TPs induce crowd-building and are therefore often seen by city inspectors as disruptive. In order to avoid conflict and looming penalisation, some MM have confirmed to the author that they would rather abort transactions than getting fined.
[94] Business hours of large TPs in Beijing's sub-districts generally last from 11:00 to 19:00 seven days a week.

TP (see Table 43) (Steuer et al., 2017b, 52f). These behavioural patterns hint at a habituation or working routine of informal actors, and the prevalence of this routine seems to be stronger among those groups that feature higher income levels and transaction volumes. The explanation for this institutional solution preference, i.e. choosing to focus on one instead of several TPs, might be linked to the aspect of familiarity. Fei and colleagues have observed that informal collectors and formal recycling facilities in Suzhou have developed bonds of familiarity over periods of time which in turn facilitated the transaction of waste recyclables (Fei et al., 2016, 80). The same phenomenon was observed by Li (2002, 325), who states that this bonding principle was founded on the interest to strengthen mutual trust and thereby improve business relations.

**Table 43. Informal actors' perceived relevance of TPs for selling or buying recyclable materials (Source: Steuer et al., 2017b, 53)**

| Actor group | Does not use TP as selling/ buying point | Number of TPs habitually frequented > 1 | Always frequents the same TP | Median distance to TP in min | Median distance to TP in km |
|---|---|---|---|---|---|
| WPs | 0% | 32% | 68% | 15 | n.a. |
| WMs | 10% | 10% | 80% | 40 | n.a. |
| MMs | 0% | 13% | 87% | 38 | 13.5 |

The second institutional outcome of TP operations is the emergence of variation in buying and selling prices. Via the 2013 survey in eight sub-districts of Beijing's Haidian district, it was found that TPs differ in terms of selling and buying prices and have thus produced a specific price hierarchy (Table 44). From an institutional perspective, this outcome might constitute an institutional solution of buyers to secure the most profitable suppliers by offering more competitive prices. Alternatively, differently evolved price levels could also be the result of information asymmetries and specific, localised price formation processes (Steuer et al., 2017a, 147). In essence this institutional feature shows that even within a uniform solution outcome, as manifested in the TP system, elements of variation may occur due to competitive dynamics in-between informal actor groups.

**Table 44. Buying and selling prices indicated by WM and MM interviewed at different TPs (Steuer et al., 2017a, 146)**[95]

| Fraction | TP-location (in Haidian sub-districts) | WM | | MM | |
|---|---|---|---|---|---|
| | | Buying | Selling | Buying | Selling |
| Copper | Shucun | 43.5 | 46.0 | 46.00 | 47.50 |
| | Zhengbaiqi | 43.0 | 46.0 | 46.00 | 47.50 |
| | Tiancun | 40.0 | 44.0 | 46.00 | 47.50 |
| Books (paper) | Shucun | 0.60 | 0.80 | 0.80 | 0.90 |
| | Zhengbaiqi | 0.60 | 0.80 | 0.80 | 0.90 |
| | Tiancun | 0.57 | 0.79 | 0.80 | 0.90 |
| Cardboard | Shucun | 0.40 | 0.60 | 0.58 | 0.73 |
| | Zhengbaiqi | 0.40 | 0.60 | 0.58 | 0.73 |
| | Tiancun | 0.40 | 0.50 | 0.58 | 0.73 |
| Plastic bottles | Shucun | 0.08 | 0.10 | 0.11 | 0.12 |
| | Zhengbaiqi | 0.08 | 0.10 | 0.10 | 0.11 |
| | Tiancun | 0.08 | 0.09 | 0.10 | 0.11 |
| Aluminium | Tiancun | 10.00 | 11.00 | 11.00 | 14.00 |
| | Shucun | 9.00 | 10.00 | 11.00 | 11.75 |
| | Zhengbaiqi | 9.00 | 10.00 | 11.00 | 11.75 |
| Newspaper | Tiancun | 0.60 | 0.95 | 0.90 | 0.87 |
| | Shucun | 0.60 | 0.80 | 0.88 | 0.95 |
| | Zhengbaiqi | 0.60 | 0.80 | 0.88 | 0.95 |

Buying and selling prices marked grey indicate values that were not directly derived from the respective TPs. Instead these values represent the median values of recyclable prices provided by interviews with WMs and MM at all surveyed TPs

Variations in the TP system however also occur over larger spatial distance. Alterations to the Beijing system have been identified by the author during individual field surveys in Guangzhou (Yuexiu district, November 2014) and Shenzhen (Futian district, March 2015). During the first observation in Guanzhou city, the author encountered several WMs nearby residential areas over a walking distance of approximately 2.9 km (indicated in Figure 37). These actors stated that they would either sell their recyclables to a formal transfer station or to a nearby TP, depending on respective price offers. The first remarkable aspect in this constellation was that the TP took the form of a small outlet within a building, which could be freely entered by collecting actors. Secondly, this TP was directly competing with a formal system and was yet allowed to continue its operation. In an interview with the MM heading the TP, it was explained to the author that this arrangement resulted from good contacts to the

[95] In some instances the table exhibits transfer price discrepancies, i.e. deviations between the selling price of WMs and the buying prices offered by MM for one recyclable category at specific TPs. Various assumptions may help to explain this phenomenon: Firstly, actors may have over- or underestimated the prices of recyclables and may therefore have indicated individually expected selling or buying prices. Another possibility is that actors may have ignored the impact of bargaining on price formation (Steuer et al., 2017a, 147).

local municipality. Based on the premise that he would sell collected materials to formal channels only, the TP manager was awarded with an official permission to acquire recyclables from the IRS (Personal communication, Guangzhou, Yuexiu district, 11 November 2014). This approach exemplifies the result of a response dynamic between the formal and informal domains out of which emerged an effective solution outcome based on formal-informal interest congruence.

**Figure 37. Occurrence of WMs (collectors) and TPs in Guangzhou, Yuexiu district (the author, adapted from www.baidu.maps.com)**

A similar constellation has been identified in Shenzhen city, where a field reconnaissance of a 3.6 km large area revealed several positions of WMs (marked as blue stars in Figure 38) and one TP (marked as encircled star in the figure below). Here again, WMs stated that they would transfer waste recyclables to the large TP in this area, which was again located in the first floor of an office building resembling a small business outlet. The head manager of the TP confirmed to the author that authorities would 'turn a blind eye' on his operations, provided that he would prevent environmental pollution and proper appearance of the TP's surroundings (Personal communication, Shenzhen, Futian district, 12 March 2015). Here again it appears as if the formal domain has adopted a comparatively lenient approach so as to achieve the pivotal objective of waste quantity reduction and material recycling.

**Figure 38. Occurrence of WMs (collectors) and TPs in Shenzhen, Futian district (the author, adapted from www.baidu.maps.com)**

In conclusion to this section, it should be pointed out that the TP system combines imitative as well as innovative institutional characteristics. With regards to their functional nature, TP networks very much resemble the preceding formal recycling depots in urban China, which equally offered collection services and exhibited a large spatial coverage. On the other hand this bottom-up concept also features innovative attributes as TP systems encountered in Beijing are setup in way so that they are easily movable in response to external impacts, e.g. controls by the formal domain (Steuer et al., 2017a, 143f). In general, it can be asserted that institutional systems of the IRS derive much of their effectiveness from the capacity of informal actors to trigger information feedbacks and learn from practices. This particularity not only concerns the aspect of TPs, but extends to all institutional structures established by the IRS. The simple reason for learning to occur to a relatively strong extent is that actors of the IRS are constantly interacting with buying and selling parties during their work days. Given that every exchange generates new information that is crucial for business success, informal actors exploit thereof derived options to the fullest possible extent. This in further consequence gives rise to the formation of new institutions, which if proven effective will be imitated by other actors. In that sense, it can be further argued that informal systems might have also served as a model for the formal domain: In WEEE management, for example,

private-formal initiatives have made increasing use of reimbursement mechanisms, which are also practiced by the IRS, so as to compensate residents for obsolete devices. Successes have however been limited as formal actors often resort to reimbursement point schemes and little presents, which generate comparatively low incentives for households to engage in these transactions (Steuer, 2016a, 17). In contrast to such formal efforts, the next sub-section shows that the IRS has also used monetary incentive mechanisms to buttress its very own WEEE exchange structures.

#### 8.4.6.5 Second-hand markets for WEEE refurbishment

In analogy to the TP system, the informal domain has also devised an institutional exchange structure that centres on the waste category of WEEE. At its core are second-hand markets (SHMs) for discarded electronic devices that still possess a reuse value. The principle idea of this concept is to take back discarded devices and after refurbishing and repair resell the products back to consumers. Historically, these markets flourished during the 1990s and early 2000s because of strong consumer demand and due to the then very costly primary electronic products (Steuer, 2016b, 297). Given the ever continuing, downward price spiral for electronics due to an increasingly competitive domestic market, SHMs tend to attract only less affluent consumers in recent years. And yet, field visits in Beijing and Guangzhou in 2015, still exhibited a high demand for second-hand electronics, if measured in numbers of visitors present at these markets (see Figure 39 Figure 40).

**Figure 39. Guangzhou's Dashatou SHM with (a) a trading area and (b) integrated repair service structures (© Yvan Schulz)**

**Figure 40. Guang'an zhonghai dianzi shichang SHM in Beijing, Haidian (© Steuer)**

In terms of institutional embedding SHMs are slightly more integrated within the formal institutional framework than it is the case for the TPs. On closer look however, these markets operate in a legal grey area. On the one hand most of the sellers interviewed by the author in Guangzhou and Beijing have obtained licenses for their operations. On the other hand, however, legally prescribed warranty claims as well as proper labelling of devices as refurbished products are often missing (Steuer, 2016b, 298). Within this subject matter, it seems that SHMs have vastly benefitted from a weak and incomplete formal framework. Comparatively early research by Chi et al (2011, 736) indicates that such markets have long operated in the absence of significant regulations. For example the above mentioned aspect of labelling appears to be outside of formal controls despite a respective regulation issued in 2006 (Zhong, 2010, 52). In fact, it seems as if informal refurbishment and reuse of WEEE, suffered from little governmental curtailment and intervention in the past (Steuer, 2016b, 287). This in turn led local vendors to ignore or bend formal provisions such as labelling, guarantees and safety standards and explore other loopholes such the modification of unclearly specified land-use rights so as to establish SHMs (Tech.sina.com. 2001; Steuer, 2016b, 297; Li, 2007).

The operative system encapsulating SHMs very much resembles the dynamics of the TP concept (see Figure 41): Private households and businesses are the generators of WEEE, which they either transfer to SHMs directly or sell them to WMs, who in further consequence resell discarded, yet repairable devices to the markets. Another transfer channel are shops offering repair service for obsolete devices. In some cases these shops might refurbish devices rejected by households and then transfer these to SHMs. In regard to this linkage, particular forms of symbiotic interactions can occur: For example the Weixun Digital City SHM in

Guangzhou has incorporated several repair shops that are located in the back alley of the trading hall. Based on the principle of division of labour, three small outlets focus on the refurbishment of LCD screens, which upon completion are transferred back to store owners in the SHM. Based on interviews with the owners, it was stated that the refurbishment outlets stand in a contractual relationship with the sellers in Weixun SHM (Steuer, 2016b, 298). Once devices are properly repaired the final step of this exchange flow consists of vending products back to households.

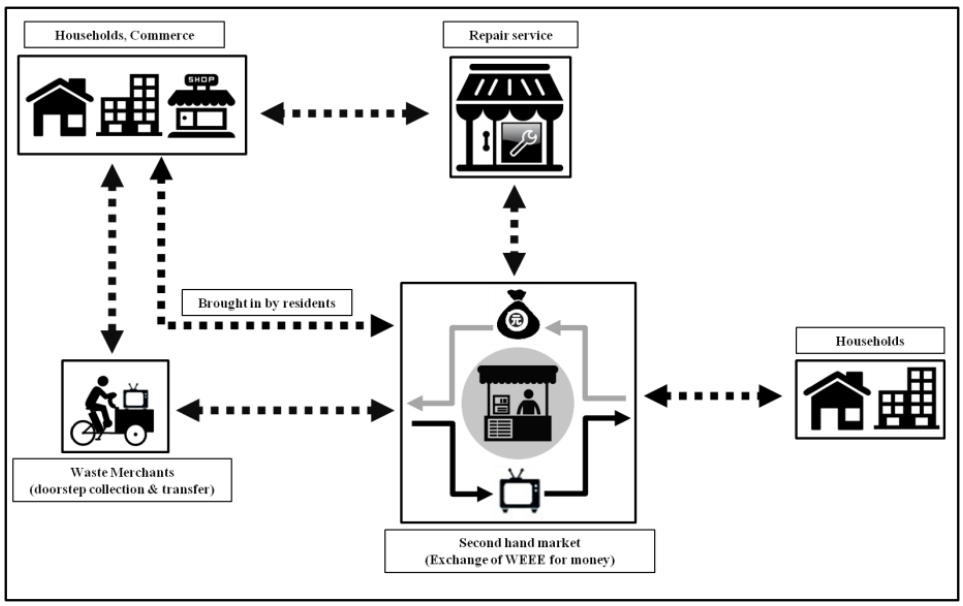


**Figure 41. WEEE transfers for reuse via second-hand markets (Grey arrows indicate monetary flows, black ones represent WEEE flows and two-directional arrows indicate diametrical flows of money and WEEE) (Steuer, 2016b, 299)**

The operation and effectiveness of this system is based on the premise that a sufficiently large quantity of generated WEEE remains in circulation instead of being transferred to recycling channels. In this regard, collecting actors in the IRS play a pivotal role: Upon obtaining a discarded device they first verify its operative condition. Should they deem the product to be repairable, the preferred choice is to sell the device to SHMs instead of handing it over to recycling for component salvaging. The simple principle behind this institutional selection is founded in the higher monetary value that functioning electronic devices can reap, compared to what is offered by recycling (Orlins and Guan, 2016, 75; Schulz, 2015, 47). Despite the constraint that there are no figures available on which proportions of informally collected WEEE go to refurbishment instead of recycling, secondary research data on the provision of devices to SHMs indicates that the IRS is the dominant supplier (see Table 45). This again underscores the significant role of such markets for consolidating the informal institutional system in WEEE management.

**Table 45. WEEE entering SHMs in different regions (Steuer, 2016b, 294)**

| Area | Source | Proportion by source (%) |
|---|---|---|
| Baoding | Informal collectors | 60-70 |
| | Residents | 10 |
| | Formal retail and formal appliance repair service | 10-20 |
| Xi'an | Informal collectors | 70 |
| | Residents | 15 |
| | unknown | 15 |
| Peking | Informal collectors | 80-85 |
| | Residents | 5-6 |
| | Formal retail and formal appliance repair service | 10-15 |

While the absolute dimension in WEEE volumes handled by SHMs still remains difficult to verify, the mechanism for profit generation through these market system has been highlighted relatively well. As outlined above, the basic principle of this system is to first acquire discarded devices, add value to the products via repair and refurbishment and subsequently resell these to consumers. In regard to the thereof generated profit margin two variables appear to play a crucial role: Firstly, the location of SHMs constitutes an important factor. While profit margins for electronic product refurbishment in fringe areas were in some cases only around 50%, more centrally located markets could reap profits of up to 200-300% (Süddeutsche.de; Personal communication with Mr. Xu, informal refurbisher in Panyu district, Guangzhou, 17 May 2015). Secondly, the prices for repaired EEE also depends on product age, generation and product brand. For the case of mobile phones, reports have shown that older devices and less highly valued product brands only create small profits (30-150 RMB/unit) for informal collectors. More modern products on the other hand could on the other hand generate a net turnover of up to 1,500 RMB per unit in 2014/15 (Crgta.org.cn. 2014; Crrainfo.org.cn, 2015). In regards to the effectiveness of this informal system, earlier research by the author has shown that flexible profit margins, a steady supply by the IRS and the continuing demand for refurbished products sustain the operations of the SHM system (Crrainfo.org.cn, 2013; Steuer, 2016b, 297ff).

When interpreting SHMs as an institutional solution outcome in the context of China's CE, it is easy to identify the two instances of institutional effectiveness: Firstly, markets effectively increase the profits of informal actors and thereby further the actor group inherent interest preference of wealth generation. Secondly, refurbishment and reuse practices are in line with the official CE value concepts of reduce and reuse. This in turn may explain why the formal

domain has so far been rather cautious or lenient in regards to regulating or even inhibiting these grey area systems. Another indication for the effectiveness of the SHMs is that formal-private actors have imitated some features of this institutional system. One example of a company engaging in this domain is Taolü Huanbao, which was visited by the author in the course of a research project on Chinese WEEE management. Established in 2009, the company focuses on recovering discarded mobile phones and selling them back to customers after refurbishment (Figure 42).

**Figure 42. Recovered mobile phones and refurbishment practices at Taolü Huanbao (© Steuer, 2015)**

The significant imitative element is however not the operational focus on repair and refurbishment activities. Rather, characteristics of imitation occur in the institutional set-up of the company: Apart from directly receiving old phones through the company's website, it imitates the practice of SHMs and employs individual mobile phone collectors in 80 cities all over China, who engage in doorstep collection (Crra.org.cn, 2014). Via an interview with the CEO, it was confirmed to the author that this collector network does not discriminate between formal and informal supply channels. At the same time, Taolü Huanbao also applied institutional innovations to its exchange system for second-hand devices: Firstly, the company emphasises transparency in its services. Via its own online information platform Taolü Huanbao provides all available data for each product including details on the applied repairs to potential customers. This is done for the purpose of fostering trust and reliability between consumers and the company. Secondly, refurbishment practices adhere to national safety standards, follow company-internal assessment rules for quality and make intensive use of technology to verify device functionality. In essence, this business model is built upon the same interest preferences as the IRS: Reuse and refurbishment are considered to be significantly more profitable than engaging in recycling for material value recovery (Personal communication with Manson Loo, CEO of 1101 Taolü Huanbao in Shenzhen, 9 March 2015; Steuer, 2016b, 300f).

### 8.4.7 Informal institutional responses to formalisation

#### 8.4.7.1 Formal negligence as root cause behind the emerging formal-informal dynamic

In reiteration of the preceding discussion in this chapter, the demise of municipal WM systems and the lasting negligence or leniency towards the informal activities constituted important factors that facilitated the IRS' rise in dominance over collection and preprocessing. However as depicted in the preceding sections, there are several aspects indicating that present institutional outcomes could rather be the result of a conscious if not deliberate selection process of the formal domain: Firstly, no regulations have been issued at the central level that would prohibit IRS activities in preprocessing and collection. Rather central government actors have resorted to merely adopt integrative measures to govern informal practices. Moreover, recent legislative pieces issued by the MOC and NDRC tended to affirm the beneficial role of the IRS in these aspects of WM. Secondly, the institutional solutions of the IRS have in parts been in alignment with central state actors' interests, as these practices have contributed to realising the reduce, reuse and material cycling value concepts promoted by the formal CE agenda. A similar picture is presented by Schulz (2015), who in his interviews with Chinese state officials could show that the IRS is at least tacitly endorsed by formal actors: In conversations with the author, official decision makers exhibited a rather tolerant view on the IRS and in the case of Guangzhou even supported recyclable transactions by households to the IRS. Due to an absence of further specifications, this latter statement can imply a support for both, formal and informal, channels (Schulz, 2015, 46). This stance also extends to the domain of WEEE, wherein corresponding official documents have supported 'multi-channel collection' schemes (SC, 2009, art. 5 and 11). However as Schulz also points out, this approach might change over the long term, as government and academic experts opt for a formalisation of informal activities in collection (Schulz, 2015, 46) and thus most likely also preprocessing.

In light of this particular constellation and the probable outlook towards integration two questions arise: Firstly, how has the dynamic between the formal and informal domains evolved so far and secondly, what presumptions can be forwarded in regard to future institutional outcomes? In order to answer these questions the following sections first present some, yet relatively few, cases of formal-informal dynamics at the regional level. In a subsequent step, the three general patterns of interactive response cycles between the two domains will be analysed. In third instance, the concluding sub-section will present an outlook

on which institutional outcomes can be expected on the basis of preceding institutional interactions.

#### 8.4.7.2 The formal-informal responsiveness dynamic in Beijing

In Beijing, one of the first documented, major informal exchange hub for waste recyclables and WEEE was Bajia village (Bajiacun 八家村), which is situated in Haidian district in-between the fourth and fifth ring road. In 1992, this area emerged as an important trading hub for waste recyclables and WEEE, where buyers would rent land from the district government and establish trading stalls. Up until the mid 1990s this trading node included 174 outlets with over 5,000 involved actors. The decision by the IRS to spatially concentrate in this area primarily came in response to a formally generated, spatial leeway following the demolition of old buildings for the purpose of urban expansion. However due to an apparent disapproval by officials, this hub soon fell subject to formal expulsion and thus only a few waste buying outlets remained until today along nearby Shuangqing Street (Tao et al., 2014, 9; Tong and Tao, 2016, 12). This very rudimentary overview on chronological events already indicates the basic outline of the formal-informal institutional dynamic: Once a particular (spatial or institutional) latitude is opened up by the formal domain, informal actors quickly occupy the hereby generated free space so as to create their own institutional environment. Sooner or later, as further documentation shows, the formal domain will respond by retrieving the formerly lost control, which in turn forces the IRS to search for alternative options to realise its interests.

A similar development in Beijing is the case of Wali junk market (wali 瓦梨). This structure has since the 1980s served as an informal waste recycling exchange spot before being demolished due to construction works in course of preparations for the Beijing Olympics in 2008. In response to this top-down measure, informal traders relocated to Dongxiaokou, rented local land and began to lay the cornerstones of what would become the Dongxiaokou ‘waste village’. While this area had already given home to informal pre-processors since the 1990s, its rise in influence only began with the influx of traders from Wali and Bajia village in the 2000s (Tong and Tao, 2016, 13).

At the other side of the institutional array, formal actors began to devise their plans for waste recycling and continuously attempted to intervene with the informal system around Dongxiaokou during 2000 and 2003: Via plans and pilots to setup a formal recycling

hierarchy encompassing collection, separation & sorting as well as trading structures, the municipal government attempted to standardise formal collectors and integrate them into the official system (ibidem, 10-14). Similar efforts were also directed at other informal waste preprocessing and trading hubs in the fringe areas of Chaoyang, Fengtai and Shijingshan districts. In order to compete with the IRS, official decision makers intended to establish parallel structures equipped with state-of-the-art technology that would substitute the labour-intensive informal system (Tao et al., 2014, 12). This official approach however fell victim to inherent flaws: Firstly, informal collectors largely evaded formalisation and instead of working under formal conditions they still continued to operate informally. One of the reasons explaining this decision was that formal recycling companies could not offer a sufficiently competitive income to dissuade informal collectors from continuing to work individually. This in turn made formal recyclers highly dependent on the well developed and persisting informal collection networks (Tao et al., 2014, 12). Secondly, the formalisation of doorstep collection systems within residential quarters via a pilot project proved to be ineffective: Up until 2008 the municipal government had covered over 70% of Beijing's population under the pilot scheme via the establishment of collection booths in residential quarters. However, when it comes to the management of these structures, the pilot only could attract informal collectors, who did not mind to engage in this line of work. The herein inherent problem was that the now contracted informal actors still had business contacts with traders in Beijing's waste villages. By implication, they thus tended to default on the contract and sell recyclables collected via the scheme to informal markets for a higher price than to formal recyclers at a lower, fixed price-ratio. This practice not only curtailed the effectiveness of the pilot, it moreover furthered the commercial development of major waste villages like Dongxiaokou (ibidem, 14).

The formal failure paired with informal solution effectiveness might have constituted the pivotal trigger for the formal domain to engage in a more rigid confrontation of the IRS as documented for the case of Dongxiaokou. The first pushback occurred in 2009, centring on the curtailment of uncontrolled flows of recyclable and inappropriate processing of hazardous materials. As these measures fell short of desired effects, the municipal government began to demolish the waste village in 2011 on the grounds that the occupation of agricultural land by commercial activities was in essence illegal. Some of the traders accepted and shifted to other areas, while some refused to leave and via support from civil society could endure to stay for another four years. Around 2015 the entire structure was demolished, which in turn led local traders to resettle in nearby areas or return to small scale trading hubs in the city centre (Tao

et al., 2014, 11; Tong and Tao, 2016, 13f). By implication, the formal solution to banish this structure merely resulted in another cycle of evasion and resettlement as informal counter-solution. This response by the informal domain resulted in the formation of a new 'waste village' near Nanqijia village (nan qijia zhuangcun 南七家庄村). Interestingly, local traders or MM chose to imitate features of Dongxiaokou: Organisational elements (division of labour, specialisation on recyclable categories, information networks and capital investment strategies) of the old structure were translated to the new 'waste village' – probably because these means had proven effective (Tao et al., 2014, 11).

#### 8.4.7.3 The formal-informal responsiveness dynamic in Lin-an, Zhejiang

Another case of formalisation occurred in Lin'an city, Zhejiang in 2004. Instead of opting for an approach of expulsion, the municipal government decided to incorporate the IRS within the formal system (Chen et al., 2010, 720). This process was initiated via the issuance of an official notice on the standardisation of WPs in city districts. Herein, the primary aim was to modify the IRS' 'unorganised management system' (guanli wuxu 管理无序) and its impact on social safety via the standardisation of actors and their integration into a corporate structure. Informal collectors would furthermore have to apply for officially issued licenses and pay fees to the state-run company so as to ensure funding for collection equipment. This scheme was essentially intended to function on the basis of self-financing by the employees, while the government made no efforts to invest in this enterprise. Yet, four months after the initiation of this strategy, only a small fraction of locally active informal actors had participated and among those some even opted to leave the scheme. The primary reason was that the formal set-up deprived a significant proportion of the individuals' income (Zhou, 2010, 29) and would leave them with profits as little as 5% of what they had earned when working on their own (Chen et al., 2010, 720). Apart from the fact that this formal solution constituted an evident infringement of IRS core interests, informal actors also felt alienated by being consolidated within one, large enterprise under similar payment conditions. In doing so, the formal domain effectively disincentivized collectors to focus on increasing collection quantity as this was not reflected in improved incomes (Zhou, 2010, 29).

#### 8.4.7.4 The formal-informal responsiveness dynamic in Guangzhou

A similar approach to Lin'an has been adopted by the municipal government in Guangzhou, where figures for 2007 assume the size for informal collectors to be as much as several ten-

thousands. These in turn were estimated to provide recyclables and WEEE to over 4,000 collection booths operated by MM. During 2005 to 2007, local authorities initiated a pilot scheme to integrate informal collectors via the issuance of standardised vehicles, working attire and licenses, which also requested the payment of fees by the collecting actors. While this formalisation process reaped initially positive results reflected in about 1,000 persons working under the scheme, some among the IRS voiced their discontent to this approach (Lai and Wu, 2007). According to statements recorded by local journalists, it was less the act of formalisation per se that led to refusal among collectors. Rather the disapproval voiced by informal actors related to the high registration fees, which amounted to approximately one month of collectors' incomes. Additionally, any delay in regular organisation fees to the government, would incur financial penalties (China.com, 2007). Here again it appears as if formal actors explicitly fail to realise that the nature of formally issued solutions substantially infringes the very fundamental interests of the IRS. While this may prove to be effective for the expulsion of informal activities, it is certainly not useful for the purpose of integrating the segment into the formal system.

### 8.4.8 Patterns of formal-informal responsiveness dynamics due to institutional competition

As the above examples have indicated the dynamic between formal and informal domains is most likely a ubiquitous phenomenon permeating the PRC's urban areas. In some cases, formal and informal solution outputs exist in parallel due to a balance of interests: As discussed in the above the informal domain has in some cases created institutional solutions that also further the interests of the formal domain. However, Chinese urban WM is also a highly contested sector as waste recyclables and WEEE constitute secondary resources with a high economic value. As outlined in the above, informal collection and preprocessing has in some cases achieved a level of dominance, which appears to be untenable for the formal sector. This in turn triggered institutional responses or counter-solutions by the state to curb and curtail informal activities in this field. Via individual research by the author and documentation in secondary research three major patterns of this institutional responsiveness dynamic can be discerned[96].

[96] This analysis has in similar form been published previously by the author (Steuer, 2016b, 301-306).

(1) Expulsion without effective substitution

The first pattern constitutes a relatively frequent choice among state actors aiming to disperse informal activities. As exemplified in the dynamics around the Dongxiaokou 'waste village' in Beijing, municipal actors have repeatedly tried to simply get rid of informal practices by expelling these from particular areas. In response to that the IRS has mostly resorted to a relocation of their activities and gradually shifted away from city centres to fringe areas (Tao et al., 2014; Tong and Tao, 2016). This procedural pattern of official expulsion and responsive resettlement is in essence an effective solution of the informal domain, made feasible due to the absence of effective formal institutional replacements.

A similar dynamic has been observed in Wen'an county, Hebei. In this case, state officials have during 2000-2011 repeatedly launched initiatives to crack down on informal plastic processors. The calculation was that 'repeated harassment would raise costs and disrupt business enough to chase the enterprises to some other location'. However, the outcomes were only moderately effective: Once campaigns relaxed, previously prohibited shops simply reopened and continued their business operation (Goldstein, 2017a, 15)[97].

Another example of expulsion aiming to suspend informal collection channels without substitution has occurred in the OfN scheme on WEEE management. Due to the quasi-monopoly of the IRS over WEEE collection from households, central decision makers opted to test a reimbursement system for consumers: Upon returning obsolete devices to formal channels, they would be rewarded with 10% vouchers for the purchase of a new electronic product of equal category (Wang et al., 2013, 34). However while the scheme was operative, business at informal SHMs yet continued to thrive and profits from trading refurbished devices even increased by 100-200% (Cheasa.org, 2012). This development did in part result from consumers' increasing awareness regarding the economic value of WEEE. While the OfN pilot's reimbursement concept might have triggered a behavioural pattern desired by the formal domain, consumers did not transfer their obsolete devices to formal channels. Rather, they would opt to exchange their appliances at SHMs so as to reap a much higher profit (Qianlong.com, 2015). By implication, the OfN scheme's reimbursement-upon-purchase concept failed to create an effective institutional substitute for the profit creation mechanism created by SHMs..

[97] The further development in Wen'an will be picked up in the next pattern, as it features an alteration in formal institutional outcomes.

(2) Integration of informal activities via licensing and infrastructure provision

The second pattern of formalisation constitutes an alternative to or a learning result from the preceding expulsion approach. One example for this institutional solution is the MSW pilot scheme in Beijing, which entailed an overhaul of the waste collection and exchange infrastructure since 2000. As outlined before, community-based recovery depots were established all over the cities and plans for recycling markets with automatic sorting and dismantling appliances were forwarded (Tao et al., 2014, 12; Tong and Tao, 2016, 10-14). However, when it came to proactively integrate the IRS, informal collectors largely rejected the concept. Those willing to participate in collection booths within residential quarters simply opted to sell recovered recyclables for a relatively higher profit to their colleagues in the IRS, instead of transferring the materials to formal recyclers at fixed prices (Tong and Tao, 2016, 13). In a similar manner, integrative approaches to the IRS in Guangzhou and Lin'an had failed, because they deprived actors in the IRS of their expected profits (China.com, 2007; Zhou, 2010, 29). The common institutional flaw in all three cases simply was that formalisation of the IRS was conducted on formal interest terms: Instead of devising an institutional solution that would benefit the interests of actors from both domains, the formal outputs were mainly centred on formal interest realisation.

The pattern of formalisation via integration has also been applied in the field of SHMs for refurbished electronic devices. Given various concerns regarding user safety and device functionality, local governments have set forth regulations to align this system with formal standards. One example is Zhongguancun China Sea Electronics Market in Haidain, which was visited by the author in 2013 and 2015. By gradually issuing regulations, the market became increasingly formalised, e.g. via the establishment of guarantee and product standards as well as officially acknowledged billing systems to which local traders had to adhere. Nevertheless some traders refused to follow these regulatory provisions: Many shops were not labelling their products correctly – indeed some were not labelling them at all – and refused to provide discounts so as to compensate consumers for absent product guarantees. Despite these informal counter-solutions, the overall purport of local traders was that increasing formalisation has had an adverse effect on their profits. This had in some cases caused some shop owners to leave the market for other alternatives (Steuer, 2016b, 302f; COGA, 2013). Here again, official formalisation efforts substantially violated the key interests of informal actors.

Another example of integrative formalisation was noted by the author upon a field research visit in Guiyu town (May 2015), Guangdong. While this township is known as one of the two major informal recycling hubs in China (Chi et al., 2011), the local IRS has also engaged in the trade of electronic components extracted from WEEE. In response to these pervasive informal activities, the local government had setup an EIP, which foremost aimed to integrate informal recyclers, but also featured a market hall for the trade of extracted components. Here again, the infrastructural provisions failed to effectively integrate previously informal practices: Upon arrival of the author during early afternoon it was found that several buildings and storeys stood idle and that hardly any sellers or buyers were present (see Figure 43) (Steuer, 2016b, 303). In interviews with traders, the author was told that businesses had not gone well ever since the establishment of the EIP trade hall. The primary reason for this stagnation was that various fees and taxes would require a rise in component prices, which in turn disincentivized buyers to conduct purchases at the EIP. In response to the question as to why traders would join the EIP, the traders explained that local authorities confronted them with the choice to either participate within the formal framework or entirely cease operations (Personal communication with traders at the second-hand electronic component market within the Guiyu Eco-Industrial Park, Guiyu, 26 May 2015). The failure of this approach is that it not only impairs operations of traders in the market, but most likely facilitates the activities of those, who yet managed to conduct business outside of the EIP.

**Figure 43. Idle trading stalls within the halls of Guiyu's second-hand electronic component market (© Yvan Schulz)**

**Figure 44. Salvaged processors sold in Guiyu's electronics component market (© Yvan Schulz)**

In a similar fashion, government officials in Wen'an modified their strategy to cope with informal plastic processors and shifted towards a more integrative approach during 2005 to 2011. Based on feedback learning from the previous, ineffective expulsion of the IRS, the local government set up an EIP in nearby Dongdu and enforced the relocation of the sector. Yet, this campaign turned out to be ineffective as well: Informal processors perceived the rents in this area as too high and additional taxes and fees would further impair their business profitability. In response to this institutional premises, local processors simply left Wen'an and resettled in other areas such as nearby Baoding (Goldstein, 2017a, 7-26).

(3) Circumventing formalisation via (pre-emptive) evasion

The third and final pattern is in essence a bottom-up initiated measure. This institutional solution can be seen as a learning result that the IRS achieved from the preceding two patterns of formal institutional intervention. In this regard, the most recent developments in Dongxiaokou resemble such a pre-emptive evasion strategy adopted by informal actors: While the government has over the last 9 years exerted increasing pressures on the waste village, ever more MM took the initiative and left the area in advance to its total shutdown and thereby evaded formalisation. After having resettled in the nearby location of Nanqijiazhuang, the former operational structures were re-established and thus resemble a copy of Dongxiaokou's operative model (Steuer et al., 2017; Tong and Tao, 2016, 12ff). Another manifestation of this pattern is reflected in organisational changes initiated by the leadership of SHMs and waste villages. These modifications aim to generate endogenous improvements of the sector so as to obtain tacit approval of the local government for informal operations (Personal observations in Guang'an Zhonghai Electronics Markets in Beijing, China, 10 June 2015; Tong and Tao, 2016, 13). In essence, this practice constitutes a pro-

active alignment of informal interests with formal institutional requirements. Nevertheless, the institutional nature of these organisational structures still remains informal, which in turn renders these changes into a process of formalisation on informal terms. Another variation of pre-emptive evasion has been demonstrated in Beijing's Zhongguancun China Sea Electronics Market, where many actors decided to leave before the completion of the formalisation process. However instead of abandoning the business itself, traders simply relocated to other, still less formalised markets (Beijing Mingyu Huishou, 2010; Personal communication with several traders at Guang'an Zhonghai Electronics Markets, Beijing, April 2013 and June 2015). Such practices have also been adopted by traders in Guiyu's EIP. Once faced with the formalisation efforts of the local government, some traders simply opted to relocate their operations to nearby areas instead of entering the park. Given that pre-established business networks of capital-competitive traders were not bound to a specific location, simply resettling their operation proved to be a relatively cost-effective solution (Steuer, 2016b, 304f). In summary, this final pattern constitutes a cultivated routine of the IRS that may have emerged on the basis of acquired inheritance: Given that attempts of formalisation have by and large turned out to be detrimental to informal interests, it can be assumed that this formal institutional approach has been communicated along informal networks. This in turn may have induced some among the IRS to adopt evasive, precautionary measures as soon as being confronted with looming formalisation efforts by the formal domain.

### 8.4.9 A retrospection of the formal-informal dynamic and conjectures about the future

In light of the particular historical dynamic of the formal and informal institutional systems in collection and preprocessing, one quickly arrives at the question of how this interaction might play out in the future. For the purpose of finding a tentative answer to this conundrum, the present section in first instance reviews the dynamic from an aggregate perspective. In second instance, the remaining paragraphs will juxtapose current challenges and trends and thereof derive a conclusion regarding the future interplay of both domains.

In regard to the first aspect of how the institutional dynamic has evolved over time, the above analysis has produced one pivotal finding: Most formal attempts to expel or integrate the IRS have merely resulted in evasive or undermining institutional solutions generated by the informal domain. Especially in WEEE management, Chi et al. (2011, 737) find that integration only produces marginal results at best, while major crack-down and removal operations feature only temporal effectiveness: Once shops or markets are closed, informal actors respond by relocating the centre of their operations, simply because this line of work is

in terms of skills or facilities independent of any specific spatial environments (Chi et al., 2011, 737). The overall reason for the IRS not being willing to join the formal system appears to originate in the formal domain's failure to acknowledge and permit the realisation of informal actors' interests. In interviews with the IRS in WEEE management, Orlins and Guan (2015, 77) discern that income generation and employment opportunities constitute the most pivotal value ideals of this segment. In the view of the interviewees, formalisation is perceived as adverse to this value setting, as it would reduce incomes, job opportunities and organisational effectiveness. In other words, actors in the IRS consider their institutional solution outcomes to be much more effective for realising their personal interests than the alternatives offered by the formal domain.

So when it comes to the chronology of this interactive process between both domains, the central characteristic can be somewhat described as a constitutive interdependency: As discussed in the introductory section, the emergence of the IRS in urban China was to a significant extent facilitated by the retreat of the formal sector. The hereby left open leeway could moreover be exploited by the informal domain as formal institutional systems only regained form during the mid- and late 1990s. Yet, what the regulations on MSW persistently ignored was to institutionalise the aspect of MSW collection and preprocessing. Based on this constellation – an incoherent formal framework on the one hand, and a highly organised informal system on the other hand – the dynamic between the two domains has ever since manifested in the interplay of formalisation efforts vis-à-vis evasive countermeasures.

This pattern can be observed for the collection and preprocessing of both waste streams, in which the IRS is involved. In waste recyclable management in Beijing, the chronology of interdependency features, what appears to be, a process of endlessly repeating cycles of reciprocal solution finding (**Figure 45**). Once the IRS had emerged in the 1980s, the formal system has repeatedly devised solutions to deal with the IRS. These solutions per se include learning inputs from the institutional outputs that precede them: For example, once the 2000 pilot had failed to perform effectively, the formal domain had apparently received this information feedback and therefore shifted the aim of it subsequent institutional solution to the expulsion of the IRS. The informal system, on the other hand, constantly looked for loopholes in the formal system so as to exploit them and advance its own interests. This responsiveness is reflected in the emergence of the IRS itself, the employment of informal actors under less-than-ideal conditions in the pilot scheme and finally the continuous relocation of informal structures in response to official expulsions.

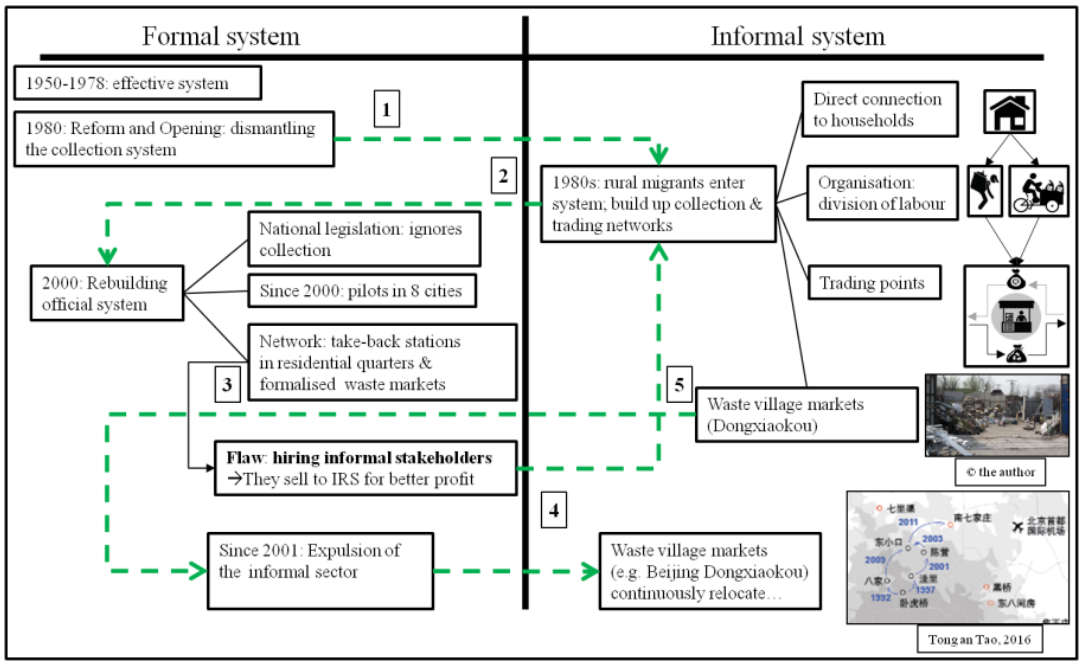


**Figure 45. The interactive dynamic between the both domains in Beijing waste recyclable management (Steuer et al., 2018, 66)**

A similar dynamic can be discerned in the institutional interaction in national WEEE management (Figure 46). While the IRS from early on began to dominate the control over handling imported WEEE since the 1990s, the formal institutionalisation process only started in the early 2000s. Here again the aspects of collection and preprocessing were consistently neglected in formal legislation. However, as soon as formal recycling structures lacked WEEE inputs, the formal domain initiated several sets of pilot projects (2004-2011) so as to address this challenge in a tentative, experimental manner. During these experiments, also the aspect of collection was considered and the OfN's reimbursement system actually targeted the pivot of the problem, i.e. urban households constituting the major generators of WEEE. While financial subsidies by the formal domain for formal recyclers continued in a modified form beyond the piloting process in 2012, the question is whether the hereof created institutional outputs really are effective. Here again, the answer depends on how the objectives, i.e. interests, of the formal domain are defined: If the objective was to dominate and control the management and flow of WEEE the answer must simply be a no. In essence, the IRS has in all instances either devised counter institutional solutions or modified its existing institutional practices, which kept them in control over collection and preprocessing of discarded devices. If, on the other hand, the formal domain's aim merely was to reduce untreated WEEE quantities and increase the circulation of materials, the formal institutional structure could be assessed as effective. Simply by implementing institutional as well as fostering formal recycling operations, the formal domain improved sustainability in WEEE management and in

parts curtailed the free market dynamics and thereby entailed environmental burdens (e.g. pollution from informal dismantling).

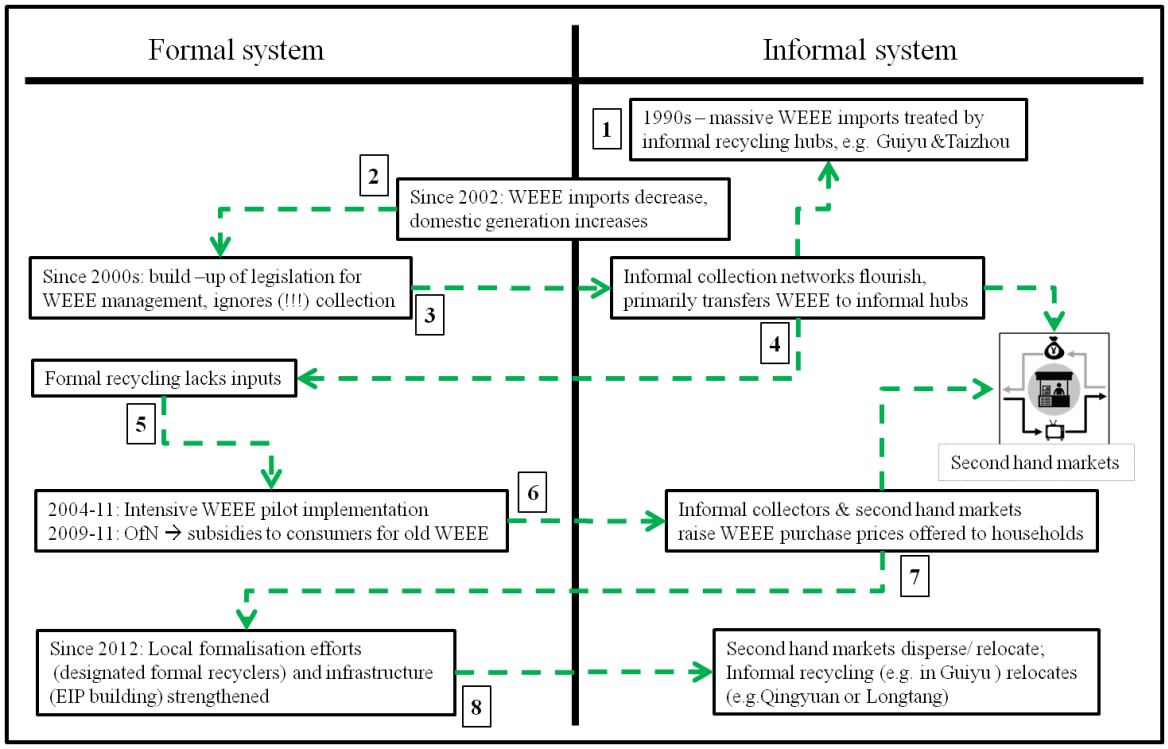


**Figure 46. The interactive dynamic between the both domains in national WEEE management (the author)**

The above analysis touches upon the fundamental question of whether or to which extend both domains in fact operate in opposition to each other. Indications that the formal domain might have adopted a gradually more positive attitude towards the IRS can be discerned from local regulations addressing the IRS in all over the PRC's municipalities. A review of locally issued legislative pieces shows that the sector has not gone unnoticed: Municipal legislators have to a comparatively predominant extent rather tended to prohibiting instead of integrating the IRS (**Figure 47**) (Steuer et al., 2018, 65).

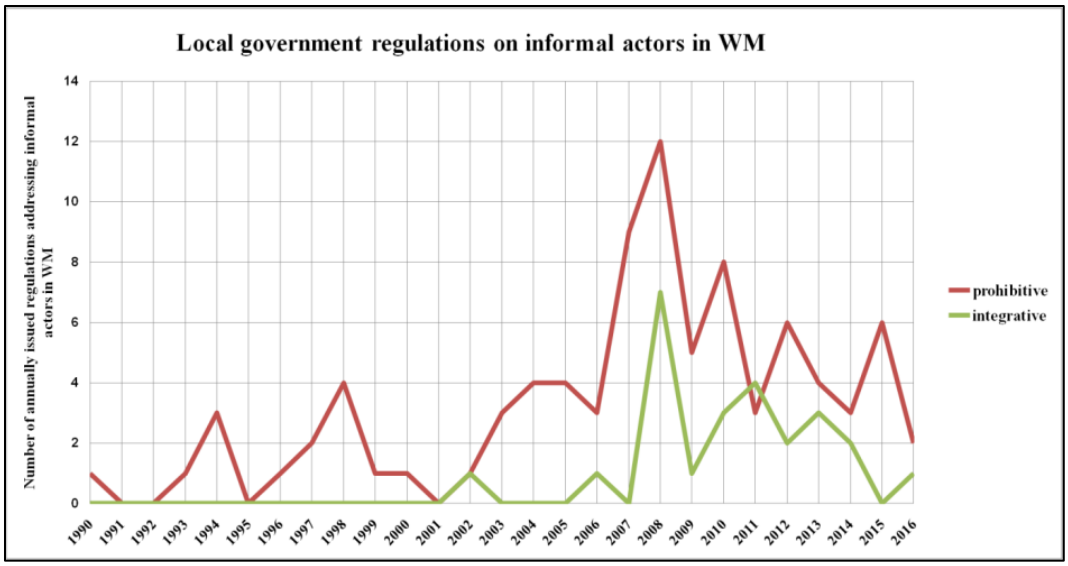


**Figure 47. Local government regulations at the municipal level addressing the IRS (Steuer et al., 2018, 66)**

This stance however stands in stark contrast to two significant perspectives: Firstly, a prohibitive approach runs counter to the recommendations of many academics inside and outside of China. Several studies have indeed provided arguments for an acceptance or balanced integration of the IRS due to its contributing function in collection and preprocessing of WEEE and waste recyclables (Chi et al., 2011, 739; Fei et al., 2016, 74; Goldstein, 2017a, 27; Davis and Garb, 2015, 73). Indeed it is difficult to assess, whether these opinions or information feedbacks from actual implementation were effectively rechanneled to decision-makers in the formal domain. However, the figure above may indicate that at least a partial learning process in this direction has taken hold among official actors: Firstly, recent years have featured a relative decrease in prohibiting regulations. Secondly, and maybe more importantly, the figure shows that there is an absolute decrease in institutional measures directed at the IRS (**Figure 47**). In the sense of the methodological model, the mechanism of non-responsiveness – herein embodied in a gradual decline in regulations – implies that the non-responding domain perceives its interests realised with the 'as-is' institutional constellation. So by implication, the apparent trend towards more laissez-faire in collection and preprocessing would mean that the contribution of the IRS to quantity reduction and material circulation could correspond to the interests of the formal domain. This in turn might explain why the number of regulations on the IRS at the local government level is gradually decreasing.

The above analysis documents that the formal domain has disseminated at least tacit signals in support of the IRS in collection and preprocessing. However there are also highly practical

aspects that strengthen the conjecture regarding the future existence of the IRS in urban China. Firstly, waste quantities are high and yet will continue to grow over the next decades: While the country still exhibits a relatively low per capita generation rates, these figures are prone to increase with rising income levels, which. Given that incomes in the PRC are expected to rise, so will waste quantities generated in urban households. Secondly, the IRS in collection and preprocessing has helped municipalities such as Beijing to economise on their budgets allocated for WM: On the one hand, informal actors divert around 20-30% of waste that would otherwise go to final treatment (Goldstein, 2017b, 181). On the other hand, a replacement of the IRS' organisational and physical structures would require corresponding formal structures, which are very cost intensive and would have to be built up from scratch. In third instance, the prices for secondary raw materials have again recovered in 2017 after several years of decline due to the contraction of macro-economic demand[98]. This is particularly significant because informal actors decide over their engagement in WM upon the profits expected to gain from these activities (Steuer et al., 2018, 64-67). A final factor suggesting that the nature of the formal-informal dynamic is prone to change manifests in the recent institutional outputs of some central state actors: Recent legislative documents by the MOC and the NDRC have begun to break the traditionally predominant stance of the government towards the IRS: Instead of ignoring this segment these two state actors have taken a comparatively supportive stance on informal actors engaging in the collection and preprocessing of waste recyclables and WEEE (see section 8.4.5). What yet remains to be seen is the form which thereof derived practical approaches will take: Will formal actors again resort to forcing the IRS to align with state interests, or will the formal domain open its framework so as to enable the realisation of informal core values? Whatever the ultimate outcome will be, it may in any case take several cycles of institutional solution finding from both sides to clearly assess the result.

## 8.5 Conclusion

Undeniably, WM is the realm of the Chinese CE that is most affected by the dynamics between the formal and the informal domain. The herein encountered institutional setting is quite different to what has been depicted for the Eco-Industrial and CE park programs: Instead of being the outcome of the PRC's shift to the CE, Chinese urban WM features its very own history that has emerged prior to the official CE development agenda. Rather, the

[98] This is especially visible for such items as secondary steel, aluminium and copper as well as to a lesser degree for waste paper http://www.crrainfo.org.

institutional patterns in present Chinese WM came as the result of China's particular socio-economic environment and the various challenges entailed by the country's development path: On the one hand, economic growth and the increasing affluence of urban residents contributed to an ever growing amount of generated MSW in China's cities. On the other hand, the linear type of economic development was always, yet to different degrees over time, subject to acquiring a sufficiently large feedstock for production. Especially after reform and opening, this dual challenge gave rise to those informal entrepreneurs in Chinese society who identified the inherent value of MSW, which could be easily realised and turned into actual economic benefits. The formal domain on the other hand did in several instances shift its attitude and perception towards MSW management. Only in recent years, especially with the rise in prominence of the CE agenda, the formal domain has embarked on the same path and attempted to regain its former dominance in this field.

The hereof emerging institutional context is one of, at least moderate, competition between the formal and the informal domains for control over the circulation of valuable secondary materials and devices. Before going into more detail by addressing the chapter specific research questions, I shall first address the reasons that perpetuate this fundamental dynamic. In first instance, the competition for control over secondary materials and WEEE is clearly driven by the attempts of both domains to realise respective interests. When analysed in isolation both sides have devised institutional solutions that address the associated challenge and realise the domain specific interests. At this point the crucial question relates to the degree of interest inclusiveness of these domain specific institutional solutions. Within this subject matter, the above analysis has shown that informal rule-based outputs more effectively advance the interests of the formal domain than vice-versa: Institutional solutions of the IRS not only contribute to the realisation of the official 3R value principles, their existence moreover helps to absorb otherwise unemployed labour in urban areas and further alleviated municipal WM budgets. Given this mutually beneficial outcome, the question arises why the formal domain has at the local level attempted to subvert this otherwise effective constellation? Local official regulations on informal collection and preprocessing tend to highlight particular issues such as 'disruption of social order and city appearance', but these points may only conceal a more fundamental interest of local state actors: The economic dimension of the IRS' performance is substantial and in this regard the case studies (8.4.7.2 – 8.4.7.4) have shown that formalisation and integration of informal practices have at least to some degree served economic interests of the state. Drawing on the field of formal WEEE management, it can be shown that the state has a substantial interest to establish an economically effective sector

(Schulz, 2015). Not only should formal recyclers contribute to the circulation of secondary raw materials, but also generate economic profit and in further consequence provide revenues for local budgets. This approach is also clearly aligned with the official CE agenda, according to which economic performance takes priority over ecological sustainability. Such attempts to formalise the IRS in collection and preprocessing however failed, due to the perceived infringement of informal actors' interests: Documented cases of formal integration have shown that informal actors have taken a strong issue with such formal endeavours that would curtail the former's profit. What hereof results is a repeating, cyclic pattern of informal activities, formal countermeasures, correspondingly evasive responses by the IRS and finally a gradual re-emergence of IRS practices that reinitiate the process. Within this dynamic, it is actually the IRS, which determines initiation and speed of this cyclic sequence: As long as informal operations remain spatially confined and run below the radar of the formal domain, informal actors can perform effectively, also in a manner that does not affect formal interests.

As emphasised in the above paragraph particular interests and the endeavour to realise these are at the centre of this competitive dynamic: The profit orientation of the IRS on the one hand and the 3R principles paired with economic considerations of the state on the other handled to the generation of different rule-based solutions. The first question of this chapter centres on this aspect and asked for the institutional outcomes that resulted from the formal-informal dynamic. In this regard, the concept of reciprocal responsiveness is pivotal to understanding the institutional output of both sides: The initial triggers that put the institutional interaction into motion were the retreat of the formal domain from WM and the influx of migrant labour into China's municipalities after opening and reform. After this initial shift both sides devised rule solutions, which not only served respective interest groups, but simultaneously also emerged in response to the institutional modifications of the opposing domain. Up until the very present this dynamic has ad interim produced two concurrent rule systems, which enables both sides to realise respective interest and value ideals to a certain degree. However, as discussed before, this balance of interests can be easily disrupted, once one domain attempts to pursue its interests beyond what can be accepted by the opposing domain. The IRS has for example demonstrated such efforts by expanding its operational scope in Beijing's Dongxiaokou, whereas local governments overstepped this 'border' by integrating or expelling informal operations.

Hereof one crucial question arises, namely to which extent is the formal domain willing to accept the existence of informal rule structures in collection and preprocessing? This query again touches upon the aspect of interest congruence, which in turn decides over the nature of (formal) solution outcomes. Within this subject matter, two yet slightly conflicting findings have been produced: Firstly, it is highly probable that the formal domain – especially at the central level – accepts the performance of the IRS, which in turn explains the various loopholes and latitudes that permeate the formal regulatory framework. Examples in this regard are featured in the legislation on MSW and WEEE management, which up until now neglect the aspect of collection as well as respective pilots in both domains. Therein, collection has been addressed only marginally, and in parts even created entry points for the cooperation with the IRS, such as the multi-channel recovery provision so as to facilitate the flow of WEEE to formal recyclers. Secondly, however, the formal domain – especially at the local level – has also exerted pressure on the IRS, most notably reflected in two of the three patterns of responsiveness dynamics between the two domains: Be it enforced expulsion or integration, state actors attempted to replace or respectively incorporate the IRS, however, to a limited effect at best. The crucial factor explaining these results is most likely related to the infringement of IRS's interests, which these two formal solution outcomes entailed.

In summarising the current results of this dynamic, it can be argued that the formal domain has gained substantially in terms of learning from previously failed formal outcomes: Instead of increasing pressure on the IRS, no regulations curtailing the IRS in collection and preprocessing have so far been issued at the central level. Quite on the contrary, central state actors such as the MOC and the NDRC have even produced institutional outputs that mark a new, much more liberal approach in terms of engaging with the IRS. Equally, local legislation which has initially adopted a comparatively prohibitive stance towards the IRS has in recent years been reversed. The reason for this shift in formal institutional outputs, which is yet difficult to prove, might be the sufficiently broad congruence of interests perceived by the formal domain: The IRS in collection and preprocessing has to a significant degree contributed to the reduction, reuse and circulation of waste recyclables and discarded devices, which in essence corresponds to the official 3R principles. By implication, the absence of more rigorous formal regulations on the IRS follows the calculus of realising formal interests via informal means.

In second instance, the chapter dealt with the question on the effectiveness of institutional outcomes and whether there is a benchmark to evaluate effectiveness. In regard to the latter, it was found that the effectiveness of respective institutional systems can be measured in terms of managed waste quantities and the direction of waste streams. In both instances, the IRS has been clearly dominant – be it in the field of collection from generators, the transfer to formal recycling or to SHMs, which operate in a legal grey area. The formal domain on the other side appears to fail in generating proper institutional solutions. In parts, this is also caused by the weak formal capacity to properly assess the dimension of waste at the point of generation.

The IRS appears to have devised solutions, which in terms of design are very much oriented towards generating entities on the one hand and transacting partners on the other. Similar to the operative structure at the international level, China's IRS has evolved towards a well organised system: Via a highly specified division of labour it managed to establish an integrative service network-chain: At the one end of this system is the connection to urban households, which constitute the largest waste generating group. In order to strengthen the relationship with this group, actors in the IRS have adapted collection routines that account for spatial and temporal factors. Another key factor for the IRS' effectiveness in this regard is manifested in the practiced communication techniques, which are designed to serve the convenience of waste generating households. In final instance, this crucial relationship is buttressed by the congruence in interests: Both sides perceive waste recyclables and WEEE as valuable commodities, which can be exchanged for monetary profit. This in turn has formed a strong, institutionalised preference among households to conduct waste material exchanges with the IRS. On the other end of this network are TPs and SHMs. Both systems are deeply embedded in the informal recycling chain, as they serve as nodes for material, monetary and informational exchanges, which in turn facilitates coordination within the entire system. Additionally, both informal structures create solutions for exchange distance reduction and wealth generation, which in turn has attracted large volumes of WEEE and waste recyclables being transferred to these nodes. This may also have led to the imitation of parts of these structures by the formal domain, exemplified in Taolü Huanbao's second-hand phone exchange platform or the waste collection booths created in the course of the MSW pilot. By implication, informal TPs and SHMs appear to be effective institutional outcomes since imitation only occurs on the basis of successful institutional solutions.

However the attribute of effectiveness also relates to the capacity to devise solutions that include as many interest groups as possible, even beyond the boundaries of the institution

creating domain. In this regard formal solutions to integrate or expel the IRS have proved ineffective, simply because informal actors have in an effective manner devised counter-solutions to evade these measures. What appears to be even more stunning is that the IRS has gained a learning feedback from preceding formal expulsion and in some cases devised solutions to pre-emptively avoid being expelled. Herein, the simple, but effective solution consisted of abandoning operations in certain areas once formal pressures start to gain momentum. In a second step, informal actors would simply relocate to another area and re-establish (emulate) its operative structure, had it proven effective before. However here again the question must be asked whether the entirety of the formal institutional approach towards the IRS really is ineffective. This query traces back to the conundrum of loopholes in the formal institutional framework: Be it in regard to the exemption of collection in the legal frameworks for MSW or WEEE, the formal domain indirectly achieved some of its core interests such as quantity reduction and material circulation. In addition to that, the operations of the IRS in collection and preprocessing also help municipalities to economise on their budgets, which again corresponds to the interests of the formal domain. So in this respect, it can be argued that formal institutional effectiveness has to some extent been achieved: Simply by not creating any institutional output that would impede informal operations, the formal domain indirectly manages to further its own interests.

The third question in this chapter addressed the prevalence of the institutional characteristics of imitation and experimentation. In regard to this question, problems in assessment arise due to difficulties of discerning these phenomena from a macro-perspective on institutional changes over several cycles. Nevertheless it could be shown that both domains exhibit imitative as well as experimental characteristics in their institutional solution outcomes. Broadly speaking, the above discussions seem to indicate that imitation is slightly more prevalent in the informal domain, whereas the formal domain more often features elements of experimentation.

Nevertheless three decisive elements in regard to imitation and experimentation practices can be noted: Firstly, imitation occurs in cases where previous solutions have proven successful, which in turn induces actors, who are confronted with a similar challenge, to resort to this option. In the informal domain this is exemplified in the learning of younger generations from older ones, who have succeeded in the IRS and in turn induced the former group to embark on

the same path. In the formal domain, the initial legislation for WEEE management strongly drew on the positive results of EU legislation on this subject matter.

Secondly, the dynamics in WM have generated a cycle of imitation that transcends the boundaries of the domains: After the demise of formal structures during reform and opening, the IRS began to establish its alternative system for collection and preprocessing. However, some features like doorstep collection practices and the TP-system strongly resemble the previously existing SMCs of the formal domain. Apart from the fact that informal actors might have been involved in and learned from SMCs before its extensive disbandment, the reason for imitating this system might have been founded in its success. After a relatively large time lag, the formal domain attempted to regain its influence and began to re-establish formal structures. Here again, collection booths within residential quarters suspiciously feature the same effective elements previously practiced by the SMCs and the TPs. Trans-boundary imitation may however also occur in the opposite direction: In formal WEEE pilots, the government has employed a reimbursement system that addresses households, which in essence is very similar to what the IRS does: Compensating consumers for their obsolete devices has been one of the pivotal success factors practiced by informal collectors.

Thirdly, once challenges emerge that feature too many novel elements for institutional imitation to be applied, actors in both domains resort to experimentation so as to devise new solutions. In the formal domain this has been most notable in the field of WEEE pilots, in which many mechanisms, such as funding schemes, were first applied on a trial basis and later translated into national legislation. The informal domain on the other hand has shown experimental approaches when it comes to the spatial flexibility of TPs or in regard to devising (pre-emptive) evasion strategies to counter formal integration or expulsion. Despite not being explicitly designated as experimental in nature, these solution outcomes constitute a novelty per se, as they have not been practiced before and thus emerged from a heuristic approach to the given challenges.

Finally, the chapter has set forth the question on the nature of future institutional outcomes in China's urban WM. Answering this complex question is relatively difficult as it has to account for the many unpredictable elements of human nature, which in turn result in institutional outcomes that are even more difficult to assess in advance. However, what can be done is to look back on the past chronology of the institutional dynamic and thereof predict a

possible trend for the near future. Given that the essential analysis in this regard has been outlined in the beginning of this section, it would be redundant to re-phrase the entirety of these findings again. In short, it appears as if the formal domain might rather tend to restrain from curtailing, expelling or enforcedly integrate the IRS in the near future. The strongest indications buttressing this argument are manifested in corresponding developments within the central and legal regulatory system. At the same time however, it is quite likely that the formal system will proceed in an even more rigorous manner than before when it comes to informal activities outside of collection and preprocessing. WEEE treatment (Wang et al., 2013) and raw material processing (Goldstein, 2017a) are telling examples in this regard. In doing so, the formal domain can pursue its own interests regarding reduction, reuse and circulation of secondary materials and devices via the operations of the informal domain. Simultaneously, it can forestall the further spread of the IRS into processing stages, which are exclusively reserved for formally sanctioned enterprises and initiatives.

# 9 Conclusion

## 9.1 Introduction

The following paragraphs of this concluding chapter present the central findings on the institutional evolution of the Circular Economy in the PRC. Herein, the discussion centres on the primary and secondary research questions (Table 46), which were treated in the respective sections. Each section will proceed in a chapter-specific chronological order and highlight the pivotal findings for the respective research questions.

**Table 46. The primary and secondary research questions**

| | |
|---|---|
| **Primary research question** | Which institutional outcomes have been generated by the evolution of the CE in China? |
| **Secondary research questions** | How does the formal-informal institutional dynamic shape institutional selection and in further consequence the Chinese CE? |
| | What institutional variation emerges from the selection process? |
| | Which types of institutional outcomes are effective and how can effectiveness be measured? |
| | Which institutional patterns for solving CE related problems prevail – imitation or experimentation? |
| | Assessment of the future trajectory of the Chinese CE? |

The primary idea behind this approach is to demonstrate the occurrence of particular key operative mechanisms of institutional evolution in the CE, which are captured by the methodological model. Given the comprehensiveness of the model and the analytical delineation determined by the research questions, some aspects of institutional evolution will fall short in following discussions. This for example concerns the aspects of institutional inheritance and information and learning feedback flows that nurture the inheritance stock. While both elements constitute significant elements of institutional evolution, it is especially the latter component that deserves a deeper examination as is offered by any of the specific research questions. The reason for not subjecting information feedbacks to an explicit analysis in form of a research question is that feedback flows permeate the entire sequential process of evolution. By implication, all evolutionary mechanisms investigated in this analysis and addressed by the research questions shape and are shaped by information flows. Therefore the aspect of information and learning feedbacks will be included in the discussions below at the appropriate instances.

## 9.2 Key findings for the primary research question on outcomes

In regards to the institutional outcomes of the evolution of the CE in China the first important insight is that the initiation of this process originated from the reciprocal dynamic of two factors: The emergence of a problem vis-à-vis the search and implementation of a corresponding solution. Chapter 5 has outlined the ecological challenge China faces as consequence of its resource-intensive growth model. The CE concept as corresponding solution to impede a continued ecological deterioration and safeguard economic growth does in itself constitute the outcome of an evolutionary process. This theoretical tenet represents the most recent institutional outcome that follows a sequence of preceding concepts such as Industrial Ecology or Ecological Economics. Via its application within the Chinese context, the CE as evolutionary product has in further consequence triggered a new sequence of institutional evolution in the country. Since the concept's emergence up to the very present, three particular outcomes are notable within the formal domain: Firstly, there is a high degree of revising old solutions and adapt them to novel challenges; secondly, an intensified issuance of new institutional solutions has occurred; and thirdly the CE has received ever more emphasis in political-economic development planning, e.g. in five-year plans and policy action initiatives.

Despite the fact that these outcomes result from the interactions between bottom-up and top-down directed efforts, the government adheres to a course of top-down coordination and implementation. This is most notably manifested in the various indicator systems, which are used to shift the economy towards a CE trajectory. This predominant idea within the formal domain to realise the CE via top-down means constitutes one of the central outcomes of the concept's evolution. However this strategy is not without flaws: Firstly, indicator based target achievement is per se a highly mechanistic approach, which implies the adherence of actors on all levels to the central government's creed. If bottom-up trends are not captured by central state actors, such an approach is prone to fall short in effectiveness. Secondly, politically emphasising particular 3R values over others may not fully account for the complexity of socio-economic activities in real life. Instead of being inclusive of all CE practices, the issuance of unilateral key directives may fall short of tapping unrealised potentials. Thirdly, China's central government exclusively directs its efforts for realising the CE at the corporate sector due to its contribution to economic growth. This again ignores the potential within the society at large, where consumers and individual actors offer much to facilitate the realisation of the CE.

Chapter 6 has delved deeper into the formal institutional domain so as to understand the specific interest and value dynamics that generate the institutional outcomes of the formal realm. The emergence of the CE has herein induced a significant change regarding the constellation of state actor interests: Not only has the preceding, unilateral dominance of fostering economic growth yielded to a more nuanced approach, in which economic interests predominate, but need to account for ecological soundness. Moreover, the advent of the CE as a national industrial policy has also induced a shift in interest group constellations among central state actors: While the SEPA/ MEP was initially in charge of CE implementation, this task has been transferred to the NDRC in 2005. Important in this regard is the fact that both actors continue to create institutional solutions for the CE. Due to the actor specific divergence in interests this constellation results in a certain variation in outputs generated by the formal domain.

Two more significant outcomes have been generated by the evolution of the CE in the formal domain: Firstly, in order to render the concept applicable pilot experimentation plays a central role for advancing national institutionalisation. The intensity of experimentation is particularly evident if compared to the developments in the field of Cleaner Production. In the case of the CE, policy experimentation and national legislation occur alongside and thereby propel the institutionalisation of the concept in China. This in turn results in an intensive regulatory increase at the national level, which at its centre features pivotal CE key laws. These institutional backbones not only indicate substantial achievements of the official CE agenda, they moreover provide a structural and organisational function for the entire regulatory framework. The evolutionary dynamic however also affects these institutional pivots as they are subject to frequent revisions and amendments. The reason for these changes is based on the evolutionary element of information feedbacks, which result from the constantly continuing emergence of challenges to which these key solutions need to be re-adapted.

Chapter 7 discusses the most significant outcome of formal efforts to realise the CE in China – the CE industrial parks. These industrial estates were set up for coping with the dual challenge of realising economic growth while simultaneously mitigating the negative ecological impact. Since their initiation the number of IS parks has vastly increased and the entities feature a certain degree of variation. Albeit being a product of the formal domain, evolution occurs in CE IPs due to two factors: Firstly, the involvement of several central state actors has induced a competition for the realisation of different interest preferences, which in

turn led to a variation in outcomes in park types and indicators for selection. Secondly, CE park estates have emerged as a result of the interplay between coordinating central state actors and park-internal companies, which respectively pursue different interest preferences. Despite the constraint that these parks are rigidly implemented according to top-down devised benchmarks, the necessary premise for evolution to occur, i.e. the interaction between two opposing institutional domains, is in place.

The analysis of two park types further showed that learning from information feedback channels is highly significant. In this regard the EIPs have put relatively more emphasis on implementing respective systems than the CEDZs, albeit neither park system can fully guarantee that bottom-up provided information aptly reflects actual performance and effectiveness. Nevertheless, learning and thereof generated novel institutional outcomes are clearly discernible as both park categories have continuously modified and updated their respective indicator systems. This repeated and in the case of the EIPs frequent adaption of the formal domain's selection mechanism is another noteworthy outcome: It implies that CE related IPs have not yet entirely fulfilled the desired results of state actors. Despite these shortcomings the number of CE industrial parks continues to grow, which appears to be influenced by nationally issued key laws as well as national development planning. This trend may to some extent also be explained by the successes within these parks: As presented in the case studies, IS linkages among park-internal enterprises have been established and in some cases even reached internationally advanced levels. It appears that this outcome resulted from a combination of leeway provision to enterprises and top-down coordination via institutional means.

The most notable outcome in chapter 8 is the emergence and establishment of two institutional domains that engage and compete for the recovery and treatment of waste recyclables and discarded products. Both domains have created a multitude of highly complex institutional structures, which in terms of sheer quantity is unique within the field of the CE. A further interesting outcome of institutional evolution is the context of reciprocal responsiveness, along which both domains interact: Institutional outcomes from both sides thus not only emerge in response to a WM related challenge, but also as a reaction to the institutional solutions of the other side. This continued existence of both domains constitutes an evolutionary outcome that is owed to the inclusion of domain-external interest and value preferences: The IRS on the one hand could emerge in the 1980s and sustain their operations until now, because informal institutional solutions have served the interests of the formal

domain. Not only do informal operations in WM help to reduce municipal budget expenditures, they moreover realise the CE value concepts to reduce and reuse waste quantities. The formal domain on the other hand has responded by not legally prohibiting informal waste collection and preprocessing and in some cases even left open loopholes in legislation that appear to be tailor-made for the IRS.

## 9.3 Key findings for the secondary research question on selection

With regards to the question on how formal-informal dynamics shape selection and thereby influence the institutional evolution of the CE chapter 2 provides the first valuable insight: Within the formal domain interest group related competition such as between the NDRC and the SEPA/ MEP and respective interest realisation determine the operation of selection and in turn the respective institutional outcomes. A notable development in that regard is the cooperation between several actors for example in the CE IP programs, which in turn leads to a manifestation of a plurality of actor-specific interests in selection principles, e.g. park standards or pilot program objectives. The selection mechanism in the formal domain may therefore be either shaped by a single actor or multiple actors. The latter constellation however entails complexities and thus protraction for formal institutional selection: If too many interest preferences need to be harmonised for the output of a particular institutional solution, then it will take more time to generate respective outputs. Decentralised experimentation and thereof generated interim institutional solutions have been deemed helpful by the central government for overcoming those stalemates caused by competing formal interest groups.

The influence of formal-informal dynamics on selection has been the central topic for the analysis of China's CE IPs in chapter 3. Generally, these park estates are substantially shaped by the formal domain, which dominates selection via indicators and benchmarks. Here again, multi-actor engagement in park-specific selection influences the institutional outcomes: In both EIPs and CEDZs, more than one single central state actor determines the selection principles. This inclusion of other ministerial actors, who pursue different interest and value preferences, in turn entails in a respectively broad scope of indictor items in both park programs. The MEP guided EIPs for example also feature economic indicators, whereas indicators in the NDRC led CEDZs equally include non-economic items. However, also park-internal corporate activities shape selection: Firstly, the formation of IS links is dependent on the institutional framework. By implication, if the latter is insufficient, IS-linkage building will fail to materialise and corporate actors will via an implicit bottom-up effort force state

actors to modify selection. Both dynamics – competing interests between central state actors and bottom-up signals from park-internal companies – seem to have influenced the frequent adaption of indicator systems in the EIPs and the CEDZs: On the one hand, changes in this sequence of selection may have been caused by shifts in central state actor interest groups. On the other hand, indicator modifications may have also resulted from insufficient IS performances of corporate actors and thereof emerging signals inducting central state actors to adapt the selection mechanism.

The most explicit manifestation of how the institutional dynamic between the formal and the informal domain shape selection is demonstrated in the field of urban waste management. The formal domain on the one hand is permeated by different interest agendas of ministerial players, i.e. the MEP's focus on environmental soundness vis-à-vis the MOC's and NDRC's endeavour to channel waste resources into production. The informal domain on the other hand strives for economic profit from waste material exchanges. These positions theoretically allow for a compromise in interests within the institutional selection process. And yet, both sides in one way or another tend to impede the achievement of institutional dominance and control of the respectively opposite side. In essence there is a delicate balance of compromise in interests, a give-and-take, which have in numerous instances determined the selection mechanism on both sides: The informal domain has in many cases devised institutional solutions that occupy those institutional loopholes, which the formal domain has most likely intentionally left open for the operations of the informal domain. In fact, recent policy documents issued by the NDRC and the MOC even indicate a willingness to integrate the IRS, yet on formal terms. Direct opposition only occurs in cases when the IRS substantially infringes the interests of the formal domain, such as in WEEE recycling. Informal collection and preprocessing, which seem to be in line with state actors' interests, on the other hand remain permitted. However, once integration or formalisation of the informal domain is conducted in a manner that neglects the IRS' economic profit orientation, formal institutional outcomes are prone to fail: In these cases the informal domain tends to respond by counter-solutions so as to evade formal efforts. This reciprocal dynamic indicates that the selection mechanism on both sides is not only influenced by the waste specific challenges, but also or even more substantially by the institutional practices of the opposing domain.

## 9.4 Key findings for the secondary research question on variation

The question of which institutional variation is generated from the selection process has to be answered in correspondence to the particular field of CE practices. In chapter 1, the analysis indicated that variation in institutional outcomes of the formal domain is somewhat curtailed by the official CE implementation strategy: Herein, the state clearly takes the lead in matters of the CE and pursues a realisation of the concept via top-down means. Respective key legal documents, such as the CE promotion law, not only underscore this approach, but moreover neglect and thus exclude bottom-up developments as alternative, complementary patterns of CE institutionalisation. Theoretically, this stance expressed in the formal CE agenda could imply a limitation of institutional variation.

However as shown in chapter 2, institutional outcomes in the formal domain feature several instances of variation. Firstly, variation occurs in and is indispensable for decentralised CE policy experimentation so as to generate a substantial information feedback for the formulation of national policy making. Secondly, variation is evident in economic policy coordination of the CE. Depending on which state actor dominates in matters of implementation, instances of statist coordination as well as market-based coordination is practiced. By implication, the emergence of variation in formal institutional outcomes depends on shifting interest preferences in the formal selection process. This has to some extent been exemplified in the change of leadership over CE implementation, which took place between the SEPA/ MEP and the NDRC. In a similar sense, variation in formal outcomes also occurs due to the inclusion of more state actors in the selection process over time. The recent past of institutional solution finding within the formal domain has featured an increase in included stakeholder groups, which in turn suggests that variation in institutional outputs of the formal domain will most likely increase in the near future.

A vivid example of variation in formal institutional solutions is presented in chapter 3, which revolves around the CE industrial parks. Within this subject matter the first notable instance of variation is reflected in the three types of CE related industrial estates. These emerged out of different interest group coalitions within the central government. In a second instance, the EIP program has further diversified during 2006-2009 which lead to the emergence of three types of concurring EIPs. Another notable institutional variation has occurred between the two major CE IP types, i.e. the EIPs and the CEDZs: Behind both park programs are different state actor constellations, which pursue their respective interests. This in turn has resulted in a variation of indicator items and categories stipulated for both parks. In a final instance,

variation also emerges at the level of IS linkages among enterprises in the park estates. These are the direct consequences of two evolutionary processes: Firstly the number of parks has been constantly growing, which in turn leads to ever more companies from different industries to enter the parks and establish ever different IS links. Secondly, the changing institutional environments of these parks will induce companies to alternate their IS networks. Given that both processes are of an ongoing, open-ended nature, the variation within China's CE parks is prone to increase over future cycles of institutional evolution.

A variation in institutional outputs is also present in the domain of urban WM: As discussed in chapter 4, a multitude of formal and informal actor groups is involved in the collection of waste recyclables and discarded products. Given this diversity, a variation in practiced rule system can be observed within the formal and informal sector: Private registered collection companies for example exhibit variation in their use of online tools to arrange recyclable and WEEE collection from households. In a similar fashion, informal operators differ in their means of connecting to households, be it via cardboard signs or business cards. At a more complex level, informal institutional structures, such as Trading Points, feature elements of variation: Firstly, differences not only manifest in size but also in form, e.g. open market-like structures vis-à-vis shop-like outlets. In this regard, variation emerges as a result of the specific context of locally differing environments. Secondly, variation in TPs also occurs at the level of exchange prices: For this subject matter it appears as if TPs – at least within Beijing's Haidian district – have established a kind of price hierarchy for waste recyclables, which resulted from respective material specialisations by sellers and buyers.

## 9.5 Key findings for the secondary research question on effectiveness

The evaluation of institutional effectiveness has to consider two particular characteristics of institutional solutions: Institutional effectiveness relates to the degree of CE problem resolution as well as to the scope of interest group inclusiveness. The particular difficulty for any rule system is to equally account for both factors to the largest possible extent. Chapter 2 has shown that the official concept of the CE can per se be classified as an effective institutional outcome if compared to preceding legal outputs in the environmental domain: Despite its pro-environmental agenda, the CE has been formulated as an economic strategy, in which economic development takes precedence over ecological aspects. This not only facilitates compromises between dominating economic and marginalised environmental interest groups in the selection process, the approach moreover shifted the so far dominating economic growth agenda towards more sustainability. Especially after the transfer of

leadership over CE development to the NDRC, the influence on other state actor groups has been increased. This step of balancing state actor interest preferences can be seen as the crucial fundament for achieving effective formal institutional solutions. As the discussion in the chapter has shown, the subsequent step to foster institutional effectiveness has been initiated via decentralised pilot experimentation: In doing so central state actors tested how novel solutions to CE specific challenges are handled by different interest groups at the local level and how well these actor groups align with central interests.

The most prominent example of experimentation in the CE manifests in China's CE IPs, which have been discussed in chapter 3. Herein, several aspects indicate elements of effectiveness in institutional solution finding: Firstly, since their initiation the EIP and the CEDZ programs have experienced a vast growth in numbers up until now. Despite the absence of clear benchmarks for comparison, this growth trend could indicate that CE parks constitute an effective solution in terms of coping with the environmental challenges in industrial estates. Secondly, the growing emergence of new parks may also imply that the surrounding institutional framework enables interest compromises between coordinating state actors and participating corporate actors. A third evidence of effectiveness is that now new pilot batches have been launched in any of the two programs. Should this state prevail, the absence of new efforts for experimentation may imply that by and large state actors see their objectives and interests sufficiently realised. Continued refinement of the selection mechanism (e.g. indicator systems) may yet occur so as to further increase overall institutional effectiveness in park performance.

The park systems also highlight the significance of learning for the realisation of institutional effectiveness. The improvement of selection via indicator systems is for example depending on learning processes from information feedbacks. While this information exchange flow is potentially affected by incorrect reporting or the provision of biased data from the corporate domain, effective institutional outcomes depend on these feedbacks. The more information is provided the less sequences of institutional solution finding are required for the improvement of park performance. In this regard, the EIPs exhibit particularly noteworthy mechanisms such as the Administrative Committees, which not only strengthen monitoring and corporate reporting within the parks, but also engage in information dissemination and feedback collection. As a consequence of well organised information exchange cycles, some Chinese EIPs have exhibited a high number of IS-linkages between participating companies. This type of outcome is in essence considered as effective since it not only constitutes a solution to

resource constraints, but also realises economic benefits (cost savings, resource supply security) for operating companies. Yet, specific assessments regarding the effectiveness at the corporate level need to distinguish between each case and have to account for other, possibly opaque external factors. Corporate rent-seeking for example would not constitute a case of CE relevant effectiveness, as the specific company would hereby pursue political-economic instead of economical-ecological interests. Overall the investigated EIP cases indicated that effectiveness in terms of IS network strength is positively correlated with and moreover dependent on the quality of information exchanges within the parks.

A plethora of instances regarding institutional effectiveness have been highlighted in the chapter on WM. At the side of the formal domain, it appears that the institutional structure after reform and opening mostly features incomplete and in parts ineffective institutional solutions. At the very fundament, the effectiveness of solutions in the formal domain is impaired by a deficient assessment of waste quantities. As depicted in the chapter, the formal sector only measures waste quantities obtained by formal collection, while it neglects the waste recyclables diverted by the IRS. Furthermore, formal regulatory structures are subject to frequent overhauls, which albeit indicating an attempt to improve effectiveness nevertheless shows that devised solutions fail to achieve desired outcomes. Formal pilots to improve MSW management have equally performed insufficiently as these ignored the exchange patterns between included, former informal actors and the IRS. On the other hand the analysis of the formal institutional structure also permits an alternative interpretation: The many loopholes in legislation on waste collection and preprocessing appear to some extent tailor-made for the IRS. The reason for the formal sector to allow this leeway to the IRS may stem from a perceived congruence in interests regarding collection and preprocessing: Not only do informal collectors indirectly economise municipal budgets for WM, informal collection and preprocessing also contributes to achieving the CE principles of reduce and reuse. If seen from this angle, formal institutional structures have under different circumstances and to varying degrees performed effectively in regard to interest inclusion and problem solving.

In contrast to the formal domain, informal waste collection and preprocessing practices feature a relatively high degree of institutional solution effectiveness: On the one hand the IRS substituted the dismantled formal system and thereby achieved a high degree of congruence in interests (i.e. approval of services) with state and non-state actor groups. On the other hand the informal domain performs very effectively in the sense of problem solution,

which is reflected in high recovery quantities. The reasons behind this operational effectiveness are manifested in such elements as division of labour and organisational flexibility, networks of exchange structures and personal relationships as well as the capacity to aptly assess the value of recyclables. These institutional structures also safeguard the survival of the sector, which has in several instances of the recent past been under pressure of the state. Forceful attempts to bring the IRS under institutional control of the formal sector have not proved effective: Such measures have been met with evasion by the IRS and thus failed, which can be primarily attributed to state actors' negligence of informal interest preferences. Overall, the institutional constellation and interplay between both systems has so far generated an institutional outcome that broadly satisfies both criteria of effectiveness: Waste recyclables and WEEE are recovered, preprocessed and reused by the IRS or recycled by the formal domain, which in turn contributes to solving the waste problem per se. Except for particular cases of direct conflict like in Beijing's waste villages, the interest and value preferences of both sides are in many instances at least partly realised.

## 9.6 Key findings for the secondary research question on imitation and experimentation

The question of whether experimentation or rather imitation prevails cannot be answered in general terms. Rather it is useful to conduct relevant assessments for each development stage and context specific institutional practices separately. For example in chapter 1 the discussions on the emergence of the CE as a theory and its application to the Chinese context highlight notable elements of imitation: The CE as a theory for example emerged on the basis of and thus imitates elements of preceding theoretical schools. Furthermore the concept imitates key principles of nature at large, such as the feature of circularity. As a consequence, discarded materials are not categorised as waste but as feedstock for production. Imitation also occurs at the stage of translating the concept to the PRC: Central state actors initially adopted an imitative approach when transferring the concept to China. This was done on the basis of the positive experiences of CE models developed in Japan and Germany.

After the accomplishment of this initial stage, experimentation clearly played a more prominent role in the formal domain: Chapter 2 has shown the extent to which decentralised pilot projects influenced national legislation and arrangements regarding the leadership over the CE development within the political centre. Pilots were not only conducive for identifying workable institutional solutions that were subsequently translated into national key laws so as

to strengthen the effectiveness of the CE framework. Moreover, experimentation also serves the purpose to understand and overcome conflicts of interest within the centre as well as between central and local state actors. Therefore repeated cycles of pilot experimentation help to foster a learning feedback and increase the respective inheritance stock so as to gradually increase effectiveness in solution output. In essence, China's reliance on experimentation-based solution finding is indispensable as the country is at the international forefront of realising the CE. By implication there is relatively little opportunity to imitate foreign CE solutions apart from a few exceptions such as in China's WEEE legislation, which in terms of content is strongly oriented towards the institutional precursors of the EU. A look at the numbers seems to confirm that the central government has realised the necessity to rely on domestic experimentation so as to further CE development: During 2002-2012 around 190 CE pilots have been launched and judging by the NDRC's very recent CE action plan of 2017, future CE development is inevitably linked to pilot experimentation.

For answering the question regarding the prevalence of imitation or experimentation in the field of China's CE IPs two sequential stages must be distinguished. Initially, imitative practices were clearly visible in two instances: Firstly, the CE IP parks are a direct imitation of the traditional IPs. The endeavour to transfer this feasible model to the CE is again based on two reasons: Not only did Industrial park estates prove successful for fostering economic growth, moreover their form as isolated applications helped to promote the economic growth oriented political ideology within larger circles of the formal domain after reform and opening. The modern CE IPs can thus be seen as imitation of the previously effective IP solution so as to sway ever more state actors for the CE concept. The continuing growth of CE park estates may be seen as an effort of pro-CE oriented groups to buttress this effect. Secondly, there is also a trans-boundary element of imitation, which occurred with the transfer of the EIP concept from Germany and Japan to China. However, after these fundamental steps, the development of China's CE IPs mostly exhibits characteristics of experimentation. In first instance, the transformation of traditional IPs into sustainable park forms was and is still based on experimental approaches. Secondly, all CE IP programs feature a varying numbers of pilot batches so as to determine basic operational principles. Thirdly, each program is subject to continuing experimentation, which is most aptly reflected in the constant modification and re-adaption of the respective indicator systems. Here again the experimental approach is used so as to verify which selected institutional framework conditions are most conducive to generate effective park performances. In a forth, somewhat associated instance, experimentation is also used to solve particular problems related to concurring value concepts.

Resolving operational conflicts between CP and IS or environmental and economic value preferences is highly dependent on experimental approaches. In summary, imitation as well as experimentation are strongly interlinked with learning from information feedbacks. In other words, learning prevails if a sufficiently large pool of preceding, effective experiences is available to decision makers. Experimentation is on the other hand practiced, if information on how to solve a challenge is absent and can only be generated via a heuristic, trial-and-error based solution finding process.

In the chapter on WM, imitative as well as experimental practices permeate both domains, and yet the respective analysis has shown that imitation is slightly more prevalent. Overall, the findings in the chapter also buttress a general trend: Imitation occurs if effective, previously practiced solutions are available to decision makers, even if these solutions originate in the opposite institutional domain. Experimentation is on the other hand chosen if emerging challenges feature a substantial degree of novel elements. In regards to the informal domain imitation constitutes the predominating practice. Doorstep collection as well as the establishment of TPs very much resembles the operative principles applied by formal SMCs during the pre-reform era. However, the IRS has further innovated these institutions, which is reflected in improvements regarding spatial flexibility and recyclable fraction specific price hierarchies. On the other hand, state actors of the formal domain have intensively resorted to pilot experimentation for the establishment of the legal WM framework. Within the subject matter of actual practice formal solutions exhibit strong elements of imitation: For example the analysis of the MSW pilot in Beijing has shown that the establishment of formal waste buying depots and the pilot-encompassing system of material exchange is strongly modelled on the operational principles of the earlier SMC system and the informal TP mechanism. Imitative practices are also evident among formal-private collection and preprocessing companies: Doorstep collection and fostering direct relationships with urban households feature a strong resemblance to informal practices, albeit the herein used means of modern telecommunication constitute a notable innovation. In a similar fashion the formal company Taolü Huanbao has imitated the elements of informal second-hand markets, e.g. via integrating informal collection channels and by offering repair and refurbishment services for customers of second-hand electronic devices.

## 9.7 Key findings for the secondary research question on the CE's future

Assessments regarding the future evolutionary trajectory of the Chinese CE may easily fall victim to the fallacy that evolution occurs along a predetermined path of development. Rather, institutional evolution is subject to a multitude of factors that are related to human agency, such as interest and value preferences and thereof derived institutional outcomes. However what can be done is to pinpoint and identify recent strategic shifts within one institutional domain or repeatedly occurring interaction patterns between both domains. What can be derived from these instances is a tentative prediction about possible institutional outcomes in the future.

One of these trends has been highlighted in chapter 1 regarding the shift in 3R value emphasis in formal pilots. Herein the notable development is the increased emphasis on reuse practices vis-à-vis the other values. This could imply that future formal legislation will focus more on reuse and refurbishment activities. Similar indications can be discerned from the analysis in chapter 2: Several recent policy documents for example emphasise the functionality and mandatory provision of pilot experimentation for advancing the CE. Among the lead authors of these policy documents are the influential State Council and the NDRC, which in 2013 and 2017 respectively state that pilots serve as a means to inform future policy making and help overcoming implementation gaps. This in turn leads to the assumption that CE related pilot experimentation will continue to be intensively applied in the PRC. Another interesting indicator for pre-anticipating future institutional outcomes relates to the reciprocal dynamic between decentralised pilot programs and national key laws: Judging by patterns observed in WM relevant legislation it can be assessed that once a pivotal law has been issued a subsequent decrease in pilot intensity indicates that the institutional solution in place is deemed as sufficiently effective. By implication, it is unlikely that substantial changes in the national framework will occur in the near future. However, once pilot activity begins to surge, revisions or innovations within national legislation are imminent. In broader perspective, the CE constitutes one of the prominent recent concepts in a larger sequence of political-economic strategies set forth by the formal domain to achieve social, ecological and economic sustainability. By implication it can be assumed that the CE is not a steady-state political tenet, but rather a mutable institutional strategy, which is subject to continuous extension and modification: Over the course of time, interest groups of the CE will presumably expand and forge new alliances, which in turn implies the incorporation of new values. This in turn entails

modifications, which may lead to substantially new institutional characteristics of the CE or to an absorption of the concept into an overall novel political tenet.

Interpretations for future development trajectories can also be derived from the analysis in the chapters that deal with CE practices in the PRC. Relatively little can be ascertained for the future of CE IPs: The most meaningful finding in this field is that changes in indicator systems are highly correlated with the emergence of new challenges. The thereof derivable causal implication is that indicators change once a new challenge has emerged and is identified as such by central state actors. Secondly, the patterns of frequent and substantial modification in indicator sets, such as in the CEDZ program, most likely imply that the system is not yet deemed to be sufficiently effective. If these changes begin to occur in larger intervals and to a less substantial degree, it can be assumed that the indicators as solution output are deemed more effective. By implication, an interim consolidation of the indicator set can be expected to emerge within the next few cycles.

In WM, recent trends in legal outputs of the formal domain seem to indicate that central state actors acknowledge and intend to substantially integrate the IRS into the formal system. However, should these institutional approaches ignore the profit oriented interests of the IRS, they will be prone to fail as was the case with previous integrative measures. In a similar fashion, local stakeholders have failed to expel the IRS and any continuation in this direction is doomed to suffer the same fate. On the other hand, recent local regulatory developments on the IRS indicated a quantitative decrease, which could indicate the adoption of a wait and see approach by local government. Given the trend of declining in institutional activity, it can be assumed that local state actors have adopted a wait-and-see approach: As long as no specific direction is set forth by the central government, local state actors are most likely to abstain from implementing any new measures in favour or against the IRS.

Overall the Chinese CE constitutes a remarkable example of institutional evolution: Despite the fact that the concept represents an official development strategy and is therefore subject to top-down coordination and implementation, interactions between the formal and informal domain and bottom-up induced practices render the process evolutionary. Over an infinite sequence of problem occurrence and institutional solution finding, involved actors of the formal and the informal domain aim to realise their interests and values. It has been shown that this reciprocal dynamic constantly moulds and remoulds the selection process and in

further consequence leads to a variation in institutional outcomes. In general terms, selection as solution finding process and thereof derived institutional outputs feature elements of imitation and experimentation, which depends on the available knowledge captured by the institutional inheritance stock. For replenishing and amending this institutional heritage learning from failure and successes is indispensible. In other words, as long as feedback flows and thereby induced learning outputs are rechanneled into the institutional-evolutionary process, each subsequent sequence will arrive at gradually more effective outcomes than what has been generated before. While this causal particularity can be taken as a proof for the effectiveness of China's CE evolution, the more important question is to which extent actor groups of both domains are capable to draw the best possible lessons from preceding institutional solutions: The more responsive and candid involved actor groups integrate the existing institutional heritage, the more effective outcomes will be generated by their respective CE practices. This in turn will propel the pace of CE evolution in China.

# 10 Epilogue

In a final instance I will address the question propounded in the introduction to this thesis: Why is it indispensible to engage with the Chinese CE for anticipating future trends in the domain of global environmental-economic institutionalisation? The relatively short answer to this query consisted of depicting the PRC as being particularly affected by ecological deterioration, which in turn has induced various efforts to grapple this issue. The thereof generated results may thus provide valuable lessons for other countries that likewise aim to align their economic operations with CE principles.

Based on the findings presented in this thesis and given the institutional particularity of the PRC, two aspects nevertheless remain to be clarified: In which respects can the country be regarded as a frontrunner in matters of the CE and which valuable lessons does this model bear for other socio-economic systems? The most compelling argument to these queries is related to the efforts of institutionalisation of the concept in China. Not only did the government implement a CE promotion law and increasingly aligned the national development agenda with the principles of the concept. Moreover, the institutionalisation of CE relevant domains, measured in annually issued regulations, has been rigorously promoted by local and central state actors. While these efforts do per se not guarantee effective implementation, particular institutional outputs nevertheless offer follow-up economies an additional value for comparison to other CE systems.

Within the subject matter of CE institutionalisation, the aspect of interest dynamics within the formal domain is particularly noteworthy. Not unlike any other country, different state actor groups adhere to respectively different value and interest principles. By implication, the emerging support for the CE in China implied a challenge to those groups adhering to a purely economic growth oriented model. The competition between these actors and in further consequence the realisation of the CE against adverse interests may serve as role model for managing conflicts within the realm of political ideology and development agendas. Particularly noteworthy in this regard is the Chinese conceptualisation of the CE, in which economic matters take precedence over environmental ones. While being a relatively unpopular stance in current discussions on sustainability in the West, the Chinese model may hereby offer an appealing alternative for lower income countries: Those systems facing the dual challenge to achieve high growth rates and sustainable production simultaneously may see the Chinese CE as more instructive than versions of the concept promulgated in the West.

For both aspects, institutionalisation and actor group dynamics, the method of policy experimentation has proven to be a crucial mechanism for resolving interest as well as topic specific problems. Setting aside legal specifications that might impede the application of such trials at a large scale in some countries, CE related pilot projects may indeed be seen as a generally useful method to verify which institutional solutions work within particular country environments. The lesson to be learned from China is however not only confined to the mechanism per se: Moreover, attention should be paid to integrating the thereof learned feedback properly. For the case of the Chinese CE, the analysis in this thesis has indicated several instances in which learning from pilots was less effective, especially in the domain of WM where mistakes were repeated over a series of trials. On the other hand, this assessment appears to be particularly rigid in light of China's position as frontrunner of the international CE development: For a plethora of problems internationally available experience is still absent, which in turn forces those spearheading systems such as China to heuristically approach such challenges.

Are policy experiments in China's CE indeed effective? Presumably, there is a fair share of failures and successes, out of which the former are less well documented by preceding research. What is however hailed by many researchers as outstanding achievement are China's experimental programs for the CEDZs and the EIPs. Not only do these experimental parks constitute an effective strategy to implement the CE concept on a broad scale over various industrial sectors and thereby bypass resistance of opposing state actor groups. Furthermore these CE related park models are increasingly translated to traditional IPs, who as of 2015 produced approximately 60% of the gross industrial output value and 50% of the GDP in the PRC (Liu et al., 2015a, 1071). Based on the fact that some EIPs have performed extremely well in IS-linkages compared to international standards, the Chinese CE park programs may serve as attractive blueprint for other CE systems, which wish to rearrange their industrial structure accordingly.

Finally, the dynamic between formal and informal institutional domains in WM is highly relevant for the international context. Not only does the field of WM feature a considerable economic dimension, the Chinese case moreover involves a substantially sized labour force. In this regard the treatment of the IRS by the state holds particular lessons for other countries: For the past decades formal efforts to more or less enforce the integration of informal collectors and pre-processors has yielded ambiguous results. In parts the currently displayed laissez-faire approach implies that the state simply lacks the capacity to effectively subject the

informal sector to a formal regulatory framework. This in turn begs the question if more cooperative approaches such as adopted by the formal domain in India, Brazil and the Philippines to deal with their respectively large informal segment may even generate more effective outcomes (Steuer, 2016, 307).In essence, observing the evolution of the CE in China especially in regards to the selection mechanisms and its inherent interest dynamics that propel the evolutionary process are useful for grasping the future in international CE developments: Hereof emerging effective institutional outcomes are most likely to attract attention and imitation by other countries that intend to align their socio-economic system with the operative principles of the CE. By implication, solutions that work in China are among those that we can expect to see practiced in the wider international context in the future.

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Sustainable Ship Recycling by Adopting Integrated Waste Management Approaches in China (ship rec). Contract number: DCI-ASIE/2013/322-333. Duration: 2013-2016.

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## 13 German abstract of the thesis

Die vorliegende Dissertation behandelt die Evolution der Kreislaufwirtschaft (KW) in der Volksrepublik China und untersucht in erster Instanz die institutionellen, i.e. regelbasierten, Lösungsergebnisse dieses Prozesses. Für diesen Zweck wurde ein analytisches Modell der institutionellen Evolution entwickelt, in dessen Zentrum die prozedurale Abfolge zwischen institutionellem Erbgut, dem Selektionsprozess und der Variation institutioneller Lösungsstrukturen steht. Diese drei operativen Elemente sind durch eine wiederholt generierte Informationsrückkopplung verbunden, die als Folge der Anwendung institutioneller Lösungen entsteht und ergebnisseitig das institutionelle Erbgut erweitert. Diese Einspeisung neuer Informationen in den Evolutionsprozess generiert einen Lerneffekt für Entscheidungsträger, wodurch sich wiederum deren Fähigkeiten zur Entscheidungsfindung im Selektionsprozess erweitern.

Basierend auf der zentralen analytischen Rolle, die Akteuren und Institutionen in dieser Arbeit zukommt, wurde die inhaltliche Analyse in vier Kapiteln durchgeführt: Zu Anfangs steht die formelle institutionelle Entwicklung der KW in drei Länderstudien – inklusive Chinas. Das zweite Kapitel geht diesbezüglich einen Schritt tiefer und diskutiert im Kontext der KW die Interessensdynamiken staatlicher Akteure, den formellen institutionellen Selektionsprozess sowie daraus resultierenden institutionellen Ergebnisse in der Volksrepublik Chinas. Das erste Fall-bezogene Kapitel widmet sich den KW-spezifischen Industrie Parks und der sich darin abspielenden institutionellen Reaktionsdynamik zwischen staatlichen und unternehmensspezifischen Akteuren. Hierbei zeigt sich eine starke, von oben nach unten gerichtete Lenkung der institutionellen Entwicklung, wobei jedoch die evolutionäre Variation aufgrund divergierender Unternehmenskonstellationen und entsprechender Interessensdivergenzen generiert wird. Die zweite Fallstudie beschäftigt sich mit der Abfallwirtschaft im urbanen China, insbesondere mit den Prozessen Sammlung, Transport und Vorbehandlung von rezyklierbaren Materialien und obsoleten elektronischen Produkten. In diesem Zusammenhang wird die institutionelle Evolution stark durch den harten Wettbewerb zwischen dem informellen Sektor – nicht-registrierte, gut organisierte Abfallsammler und -händler – und den staatlichen Akteuren vorangetrieben.

Zusammenfassend zeigt die Untersuchung, dass die Kreislaufwirtschaft seit ihrer Einführung in China den institutionellen Schaffensprozess stark vorantreibt und resultierende institutionelle Ergebnisse oft überholt werden. Dies verweist nicht nur auf Probleme bei der Entwicklung von nachhaltig effektiven, Regel-spezifischen Lösungen. Es zeigt sich darüber

hinaus, dass es noch schwierig ist Akteur-spezifische Interessen innerhalb der chinesischen Kreislaufwirtschaft in institutioneller Form miteinander in Einklang zu bringen.

## 14 English abstract of the thesis

The present thesis deals with the evolution of the Circular Economy (CE) in the People's Republic of China and in primary instance investigates the institutional, i.e. rule-based, solution outcomes of this process. For this purpose, an analytical model of institutional evolution was devised, which covers the procedural sequence between institutional inheritance, the operation of selection and thereof derived variation in institutional outputs. These three operative elements are connected via constantly occurring information feedbacks, which emerge from the practice of institutional outputs (i.e. solutions) and nurture the institutional inheritance stock. This knowledge that is channelled into the institutional inheritance stock accrues to actors in the form of learning and in turn increases their decision making capacities in the institutional selection process.

Given that actors and their institutional solutions are at the centre of the analysis, the thesis engages with the Chinese CE along four content-specific chapters: Firstly, the CE concept per se is highlighted and its formal institutional development is discussed in three country case studies including China. The second chapter offers a closer insight into the domain of state actor specific interest dynamics, formal institutional selection and outcomes of the CE implementation in China. The last two chapters constitute case studies on CE applications in the PRC. Herein, the first one centres on CE relevant industry parks, which depicts the evolutionary institutional process propelled by the institutional responsiveness dynamics between state (administrative) and corporate actors. The outcomes in this field are strongly influenced by the state’s top-down guidance, while evolutionary variation emerges due to divergences in corporate actor constellations and respective efforts of interest realisation. The second case study revolves around the institutional dynamics in urban waste management, particularly the collection, transport and pre-processing of waste recyclables and discarded electronic devices. In this context, the institutional dynamic is significantly propelled by the informal domain, consisting of highly-organised, unregistered informal waste collectors and traders, who pose a substantial challenge for state actors.

In summary, the results of the main query show that the initiation of the CE has induced a substantial and ongoing creation and subsequent revision of CE relevant, institutional outputs. This result not only indicates the difficulties of finding durable and effective solutions for tackling CE specific problems. It moreover indicates that the competing, actor-specific interests are yet difficult to reconcile within the Chinese CE.