

# The Long March Towards Energy Efficient Buildings In China

*A Study of Barriers for Energy Efficiency in New Buildings in China and Proposals for a New Paradigm*



Master Thesis 2008 - 2009

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Supervisors: Jesper Holm and Inger Stauning

Department of Environmental, Social and Spatial Change (ENSPAC)





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## **Abstract**

This report is the physical result of a Master Thesis study on barriers for energy efficiency in buildings in China, conducted at the Department of Environmental, Social and Spatial Change, Roskilde University, in the period between September 2008 and June 2009.

The study takes its point of origin in the present situation with building energy efficiency in China, characterized by low compliance with building codes in new constructions, leaving great potentials in energy reductions and mitigations of green house gasses, vastly unused. The report therefore seeks to identify barriers for energy efficiency in new buildings in China and subsequently propose methods of overcoming these barriers, conjuring a new paradigm for building energy efficiency in the Chinese construction industry.

In the process of identifying barriers and presenting potential solutions the report examines the economic, political and social background for the present situation in the construction industry in China. On the basis of literature surveys, interviews with stakeholders, primarily in China, and a case study of a newly constructed apartment complex in Beijing, barriers are identified and analyzed. Before solutions are proposed the general modernisation tendencies in the Chinese society, with a strong emphasis on environmental policies, will be presented and analyzed. The tendencies of ecological modernisation in the Danish construction industry are also subject to examination and related to the tendencies of ecomodernisation in China. On the basis of the identified barriers and with respect to the tendencies of ecological modernisation in China, solutions for overcoming barriers are presented. These focus strongly on reforming policies and enhancing local institutional capacities in China. The report ends with the presentation of a proposed roadmap for improving the energy efficiency of new buildings in China, and perspectives for future research.

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## Abbreviations

**AARR** - Average Accounting Rate of Return  
**BEE** - Building Energy Efficiency  
**CAS** – Chinese Academy of Sciences  
**CASBEE** - Comprehensive Assessment System for Building Environmental Efficiency  
**CCP** – Chinese Communist Party  
**CDM** – Clean Development Mechanism  
**CER** – Certified Emission Reduction  
**DCF** – Discounted Cash Flow  
**EM** – Ecological Modernisation  
**EMC** – Energy Management Contract  
**EPB** – Environmental Protection Bureau  
**EPBD** – Energy Performance of Buildings Directive  
**ESCO** – Energy Service Company  
**ESGB** – Evaluation Standard for Green Buildings  
**EU** – European Union  
**FDI** – Foreign Direct Investment  
**GDP** – Gross Domestic Product  
**GHG** – Green House Gases  
**GOBAS** – Green Olympic Building Assessment System  
**GONGO** – Government Organised Non Governmental Organisation  
**HRS** – Household Responsibility System  
**IRR** – Internal Rate of Return  
**LCA** – Life Cycle Assessment  
**LEED** – Leadership in Energy and Environmental Design  
**MEP** – Ministry of Environmental Protection  
**MOC** – Ministry Of Construction  
**MOHURD** – Ministry Of Housing and Urban-Rural Development  
**NDRC** – National Development and Reform Commission  
**NGO** – Non Governmental Organisation  
**NPV** – Net Present Value  
**PP** – Payback Period  
**SEPA** – State Environmental Protection Agency  
**SEZ** – Special Economic Zone  
**T&C** – Testing & Commissioning  
**TCO** – Total Cost of Operation  
**TVE** – Township and Village Enterprise  
**UNCED** – United Nations Conference on Environment and Development  
**UNFCCC** – United Nations Framework Convention on Climate Change  
**USA** – United States of America  
**USGBC** – U.S. Green Building Council  
**WB** – World Bank  
**WBCSD** – World Business Council on Sustainable Development  
**WTO** – World Trade Organization



# Chapter 1      China: Unused potentials in building energy efficiency

## 1.1 Introduction

If the world is a global village, then China is definitely the talk of the town these days. This East-Asian country can rightfully claim to be *Zhongguo*, or middle country, once again. The world is stunned by the economic miracle-like transformation with average annual growth rates of more than 9 percent in the past thirty years, until the present economic slow-down. The Chinese 'golden age' has brought prosperity and increased standards of life to a big part of the population, which has given rise to an epic scale of urbanisation.

The economic growth is not all bliss though. The transition from an agricultural-based economy to an economy based on industry has had huge impacts on the Chinese environment. Pan Yue, deputy director of China's State Environmental Protection Administration (SEPA)<sup>1</sup>, has stated that, "*Acid rain is falling on one third of the Chinese territory, half of the water in our seven largest rivers is completely useless, one fourth of our citizens does not have access to clean drinking water, and one third of the urban population is breathing polluted air [...]*", and has further persisted that the economic miracle will end soon if action is not taken to mitigate environmental impacts (Yue 2005).

Paradoxically, it is the very fuel of the economic growth that is also causing environmental havoc and increasing air pollution in the cities. In China coal accounts for 69 percent of the total primary energy consumption and is without doubt the main culprit for environmental and health-related problems. Coal related solid particle pollution is the source of an estimated 700.000 premature deaths in China every year (Callick 2007: p.26). According to The World Bank (WB), coal-fired heating plants are

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<sup>1</sup> SEPA was upgraded in March 2008 to Ministry of Environmental Protection (Li and Chan 2009: p.55). In this report it will be referred to as SEPA though, as most literature still refers to this abbreviation. SEPA is sometimes referred to as the National Environmental Protection Bureau or the National Bureau of Environmental Protection (See Economy 2004: p.97; Perdue 2007:172)

today the primary source of serious air pollution in cities in northern China. Since China has vast amounts of coal it is also expected to be the primary fuel for central heating systems in the future (The World Bank 2005: p.1).

As general discontent with environmental degeneration and the growing number of pollution related diseases rise, the Chinese leadership is compelled to pay more attention to the consequences of the lightning economy. Thus, the Chinese government's newest five-year plan, running through 2010, emphasises environmental protection by cutting emissions, increasing the share of renewable energy resources and conserving energy. Concerning energy conservation, building energy efficiency (BEE) is one of ten key programmes in the plan (MEP 2008, NDRC 2006).

Buildings in China today account for about 25 percent of the total energy consumption and this figure is expected to rise to some 35 percent in 2010 (Li 2008: p.1740, Liang et al. 2007: p.1098; Laurenzi 2007: p.154; Yao et al. 2005: p.1974). In the *China Medium and Long Term Energy Conservation Plan*, it is projected that new buildings in most cities will save 50 percent of energy; in Beijing and other major cities the goal is 65 percent compared to buildings constructed in the 1980s (SBCI 2008). Furthermore, in this spirit Qui Baoxing, vice-minister of construction, has stated that by 2020 all buildings in China will be energy efficient (Baoxing 2005). To substantiate these goals the government has designed specific building standards, which local governments are assigned to implement.

As far as cutting emissions and conserving energy, enhancing energy efficiency by improving urban space heating is the most economic short to medium-term option to mitigate global and local environmental impacts of burning coal (The World Bank 2005: p.1). Half of the buildings in the country are located in northern China and heating is a necessity in this part of the country, as temperatures often drop well below 0 C during winter. Each year more than 130 million tonnes of coal are burned for heating. This represents about 52 percent of the total amount of energy used in buildings in urban China. Energy consumption for heating in northern China is, due to inadequate thermal

building envelope, twice of what is used for the same purpose in for instance Denmark and Sweden (Li 2008: p.1737). Thus, the obvious conclusion is that urban space heating in northern China presents the biggest potential for energy conservation and mitigation of coal-related emissions.

The implementation of building standards has proven to be problematic though. A survey done by Chinese experts shows that, according to developers themselves, only 20.6 percent of buildings constructed after 2005 comply with the standard of a 50 percent reduction of energy consumption (Liang et al. 2007: p.1102). The World Business Council on Sustainable Development (WBCSD) paints a much gloomier picture though, as they estimate that only 10 percent of buildings in China meet the standards (WBCSD 2006). Moreover, a survey in northern China conducted by the former Ministry Of Construction<sup>2</sup> (MOC) in 2005 showed a surprising result: while 87.5 percent of buildings supposedly met the standard on paper, less than 49 percent of buildings complied with standards on actual inspection (Laurenzi 2007: p.161).

The lack of implementation of building codes constitutes a great problem for the Chinese society, as the building stock is expected to double within the next 15-20 years. If standards in new buildings are not complied with, undue energy waste will be locked in inefficient buildings, leaving the bill with the environment and the people affected by coal-related air pollution. According to a study by The World Bank, 700-800 million square metres of urban residential and commercial building floor in China is experiencing energy waste each year, due to inefficient design and construction (The World Bank 2001: p.vii). The Chinese construction industry therefore hold a great responsibility if new buildings in the future are to be energy efficient.

These contemplations dealing with inefficient building design and related problems, such as air pollution, can leave one in a rather perplexed state of mind. This, in particular in an area where the greatest potential exists for conserving energy and mitigating emissions: northern China, also often referred to as 'the heating zone'. One central

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<sup>2</sup> MOC is today called Ministry of Housing and Urban-Rural Development (MOHURD)

question arising from all of this though, concerns the lack of energy efficiency in buildings, and more precisely potentials and limitations regarding building energy efficiency of different stakeholders within the construction industry.

## **1.2 Research question**

The reflections and puzzlement above can be summed up in the following research question:

*Why is the implementation of building standards insufficient in new construction in northern China – which barriers exist within the construction industry for building energy efficiency in new buildings and what can be done to overcome these barriers in future construction projects?*

The centrepiece of the research question is the architectural structure of the construction industry. In this report I define the construction industry in its broadest sense, by establishing the framework of the industry in convergence with the approach taken by most academics working with industry; characterised by inclusion of all links in the value chain, from government to end-user, and surrounding environments, such as legal and political systems (see for example Shen et al. 2004). In order to detect and describe the existence of barriers and obstacles it will be necessary to outline the composition of the different stakeholders and the interrelationship between these. Stakeholders presented in this report are actors who each represent a link within the industry. Stakeholders in the Chinese construction industry involves: developers, design studios, contractors, material producers, engineers, subcontractors, financiers, clients and government officials at both a national and local level. An outline of the structure of the industry will be presented in chapter 4.

### **1.2.1 Limitations to this study**

The scope of this report has been limited to solely studying barriers for energy

efficiency in new buildings, thus excluding renovation of already existing buildings. In the majority of western countries the task is how to renovate already existing buildings, as the amount of new constructions is minor seen on a national scale. In the case of China an opposite picture can be painted as the amount of existing square metres is expected to double within the next 15-20 years making new constructions the focal point of building energy efficiency if a massive amount of waste energy locked in inefficient buildings is to be averted. Therefore, only new constructions is included in this report; a study on barriers and potentials for energy efficiency in existing buildings in China would require at least an equal amount of research as invested in studying new buildings, likewise it should and would result in an independent report.

As mentioned in the introduction the biggest potentials for energy conservation is found in buildings in the northern part of China, due to the amount of energy consumed for heating buildings during winter months. In this report I have therefore narrowed my research down to investigating barriers for energy efficiency in the heating zone of China. The other climatic zones of China hold great potentials for energy conservation though, as enormous amounts of coal is being burned for driving air-condition systems in summer months – a trend that is on the rise also in the heating zone. As more persons in China increase their wealth they expect increased living standards to follow. In the future it is very probable that more buildings in the north will require cooling in summer, just as buildings in central China will require heating in winter, thus heavily increasing the energy consumption of buildings if energy efficient solutions are not searched for and effectively implemented. Again, studying these future potentials would require an independent research report. In order to indicate how to find and pick the low-hanging fruits first, this report is focused on identifying barriers and potentials for building energy efficiency relating to heating in northern China.

## Chapter 2      The academic cornerstones

This Chapter contains deliberations on methodological approaches to this specific research and contemplations of philosophies of science as well. It features: a presentation of the individual chapters and their content; a presentation of the theoretical framework for the research carried out; an overview of different approaches used in the collection of data; reflections on how to carry out field-work in China; and interdisciplinary considerations. The overall purpose with this chapter is to lay out the scientific background for this research in such a way that the reader can be fully involved in the structure of the report and freely observe all methodological selections and deselections.

### 2.1 Methodology

This report is organised in eight chapters, beginning with introduction and ending with perspectives for the future. Each chapter deals with different specific aspects of building energy efficiency in China. Chapter *one and two* contains introduction and research question, and methodical considerations, respectively.

Chapter *three* gives the background information of the need for energy efficient buildings. To fully comprehend the scale of the problems and to create a strong foundation for the later analysis, it is necessary to examine the 'setting' in which this study takes place. The point of departure is the economic transformation China has been subject to during the last thirty years. Different angles on the economic transition will be discussed, with a strong focus on the implications this has had on migration from rural areas to urban areas. One important facet of urbanisation in China is the boom in construction. Furthermore, this chapter will see an investigation of trends in the increasing energy consumption, and an introduction to the climate zones of China and their significance on building energy efficiency.

Chapter *four* encompass a clarification of the structure of the Chinese construction

industry. On the basis of data collected through literature surveys, interviews and a case-study, an outline of involved stakeholders in a typical building process and their cooperative relations will be presented. This outline elucidates the barriers for building energy efficiency within the construction industry in China on three different levels: general challenges in the framework for environmental protection; general existing barriers within the construction industry; and specific barriers found in the construction industry for energy efficiency in new buildings.

Chapter *five* contains the main part of the theoretical foundation of the study. In this chapter a presentation of the concept of ecological modernisation (EM) will be given. It will be shown how ecological modernisation has had great influence on the progress towards sustainable buildings in the Danish construction industry. Subsequently the applicability of ecological modernisation outside of its breeding ground in Western Europe will be discussed. Finally the interpretation of ecological modernisation in China will be presented and the implications for improved general environmental protection will be discussed.

Chapter *six* contains deliberations on how to trigger a progressive development of energy efficient buildings in China. The chapter presents three different areas where specific initiatives and improvements would increase the level and effectiveness of building energy efficiency in new buildings in China. The three areas are: alterations in policy; potentials in technology transfers; and the necessity of institutional capacity building.

Chapter *seven* contains the conclusion on what type of barriers exist for energy efficiency in new buildings and on the basis of the discussion in chapter six present recommendations in form of a roadmap for improved building energy efficiency in future new buildings, as well as deliberations on how to trigger an ecological modernisation of the Chinese construction industry.

Chapter *eight*, epilogue containing proposals for future research within building energy

efficiency in China.

## **2.2 Theoretical framework**

In every study the researcher finds inspiration and ideas in reading and at times examining existing theories on a given subject. This process then often results in either general conclusions derived by deductive reasoning from testing the theory, or a set of new hypotheses inferred from either inductive or abductive reasoning. In this study I use the theoretical framework first and foremost as an important source of inspiration for maintaining a critical approach to the subject - by forcing me to play the devil's advocate. I have continuously sought for and examined existing and new literature on the theoretical foundation, which made me question and constantly innovate my approach to and design of this research. It can be said that the theoretical framework is used as an anchor on to which the structure and substance of my research is tied, preventing my focus from floating afar.

If one looks at the development that the Danish construction industry has gone through, and is still experiencing, it strikes the eye that new forms of cooperation between different stakeholders are continuously emerging, and at the same time the role of the state has changed from previously being the initiator of new projects to now taking the role as a mediator in new initiatives, leaving stakeholders with the obligation of driving forward the development of for example energy efficient buildings. This process, which can be found in many parts of society, not only in Denmark but in most Western European countries, is usually termed as *ecological modernisation* (EM). In this study I have studied the birth and evolution of the concept, just as I have examined the advancements in the Danish construction industry within the context of ecological modernisation. At the same time I have made the attempt of analysing the interpretation and practical use of the concept in general terms in China. Here it is important stress that I do not wish to compare the development in construction in Denmark and China, respectively, in a strict sense, but merely use the experience from the construction industry in Denmark as a focal point used to put my own overall understanding of the progresses made in environmental protection in China, into



perspective to what could be seen as a potential paradigm shift.

As the boom in construction continues, voluntary and mandatory building standards and new energy efficiency technologies are innovated in China or imported from western countries, the institutional framework which is meant to monitor and regulate, becomes anachronistic in its ability to perform as the workload and increasing complexity of tasks dwarfs the capacity within national and local institutions. As I will argue in chapter six there is an impending need for *institutional capacity building* in China. The use of capacity building as a theoretical instrument in this report is based primarily on the work of Martin Jänicke and Helmut Weidner (1997; 2002), but also on the contribution of Yu-Shi Mao (1997) on environmental capacity building in China. The objective of including theory on institutional capacity building is to draw attention to the growing schism between the intensions in development of building energy efficiency policy and the capability of institutions in China, and at the same time pinpoint specific areas where reformations are both distinctively necessary and feasible.

### **2.3 Collection of empirical data**

In the process of unearthing barriers and potentials for energy efficient buildings in China I have come across many different aspects relating to the specific field of building energy efficiency. This means that not only have I meticulously studied the construction industry in China, but I have also carefully examined the past and present situation on more general environmental issues. Although this wide-scale approach at times has been time-consuming and exhausting, I believe that it is also this holistic method which has rewarded me the most in my search for answers. During the process of studying the particular field of building energy efficiency I have found it important from the very beginning to keep close in mind the saying: *'the whole is more than the sum its parts'*. Even though many pieces of the puzzle can be found while scrutinising every detail of the structure of the Chinese construction industry, the corner-pieces can be difficult to locate until one takes a step back and contemplates it from afar. This procedure of combining a strong focus on details within each link of the construction industry, with a

broad watch on environmental issues in China in general has been the fundamental formula which I have put into use, both in studying existing literature on the subject and in carrying out interviews with Chinese and Danish stakeholders and experts.

In my studies of barriers for building energy efficiency in China I have used three different approaches. First of all, as mentioned, I have done extensive reading of literature on the subject. The literature on the area mostly consists of academic articles written by Chinese scholars on the subject and these gained me some insight into the structure of the construction industry and also where some of the barriers could be located from 'insiders' point of view. Secondly I have carried out a case-study of a newly constructed specific building project in Beijing, *Jiarun Garden*. The project is designed by Danish architects Schmidt/Hammer/Lassen and carried out by Chinese real estate company Supershine Co Ltd. Since the project is designed by a Danish company it gave me the opportunity to meet with architects who worked on the project before I went to China and also gave me the chance to meet with local architects in Beijing from Supershine and visit the construction site<sup>3</sup>. Thirdly I met and carried out interviews with different stakeholders from the construction industry in China. The latter two was done as a field study, *in situ*, in China from the 6<sup>th</sup> of January 2009 until the 5<sup>th</sup> of February 2009.

The three different approaches together works as a method of *triangulation* (see for example: Gomm 2008, Neuman 2006). This method is very effective in examining complex studies, such as the Chinese construction industry, since it ensures that the field of study is not just looked upon from one, but different angles. It therefore minimises the risk of producing potentially biased results and reproducing existing interpretations of a given subject, thus ensuring that results are valid.

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<sup>3</sup> At the time of my visit there was still a lot of construction activity which meant I was not able to see any of the apartments.

### **2.3.1 Literature survey**

As a non-Chinese speaker there are certain natural limitations to the accessibility of documents and articles. Many official documents such as building codes, environmental impact assessments and modernisation strategies are usually only found in Chinese, if at all available to foreigners. In this part of my study I therefore had to rely on descriptions of building codes etc., found mostly in research based articles written in English by Chinese academics. This means that it is second-hand readings that are used as part of the foundation for my analysis and conclusion. I do not find this to be of any concern though, as all articles written by various authors show uniform interpretations of this type of official documents.

### **2.3.2 Case study**

Use and especially validity of case studies have been widely discussed in academic circles for many years. Some scholars believe case studies hold a great potential of emphasising results which, although case-specific, can be generalised in to a broader context. Opponents of this stance argue that because a case-study is context-specific results are unusable in a wider scope of research (Yin 2004). Although the case used in this study is context specific, as it is a physical construction located in Beijing, it is in my view usable to identify specific characteristics of a typical construction process in China, from the drawing board to the actual construction, and in that way makes one able to pinpoint hurdles and potentials in the Chinese construction industry in general. This in particular is the situation with the Chinese construction industry, as until China's accession into the World Trade Organization (WTO) in 2001, practically all companies relating to construction were state-owned. Thus, building processes are still bound to be similar around China.

The case examined in this study is a somewhat untraditional case study. As the buildings themselves, at my time of visit, was not finished I was not able to go inside and see the interior of the buildings. The examination of the case was therefore conducted through two individual interviews with architects from Danish architect firm

Schmidt/Hammer/Lassen, who designed the building, and one interview with two local designers from the Chinese developer Supershine. These interviews differed from the other interviews conducted, as they specifically treated the design and construction of Jiarun Garden, where the other interviews treated the construction industry in general.

The information gathered from the case study is used to identify some of the barriers for enhanced energy efficiency in new buildings in China

### **2.3.3 Interviews with stakeholders**

One can retrieve a great amount of information from literature surveys and case-studies, but in order to establish an as unbiased conclusion as possible, I find it natural and obvious to gather a set of data by entering the field yourself. Reading articles and visiting construction sites, is in a way a static form of method as they rarely respond to the very questions that might arise from their contents and objective. In that manner interviews represent a more dynamic method of collecting information as one in the role of interviewer has the possibility of pursuing new ideas and data by inquiring in different ways and from various angles.

Besides the three interviews relating to the case study, I carried out seven interviews during my five weeks in China, with both stakeholders within the Chinese construction industry and experts on the area. As already mentioned these interviews treated the structure, challenges and potentials within the Chinese construction industry in general.

The interviewees each represent a link in the value chain of the construction industry and thus provided information on construction processes from their individual perspectives. Together they represented following links: designers/architects, developers, material producers, consultants and researchers/academics.

## **2.4 The art of doing fieldwork in China**

In order to present a clearer picture of my methodological approach to collecting

empirical data it is necessary to elaborate on the whole concept of doing fieldwork in China. To state the obvious, it is important to emphasise that fieldwork in China can and should not be compared with carrying out any sort of field study in Denmark. There are certain cultural barriers, such as language, which forces a researcher to take on a different approach than what might be the case in Denmark – just as a Chinese researcher would have to when conducting studies in a Danish context. In order to overcome the language barrier it would be normal to make use of an interpreter. Through my work with establishing contacts in China I had been able to correspond over e-mail with all my contacts in English, and quickly discovered that everyone interviewed was fully capable of speaking and understanding English, thus I had no need for an interpreter. Before I commenced on the fieldtrip I immersed myself in the book "*Doing fieldwork in China*" (Heimer and Thøgersen 2006), published by Nordic Institute of Asian Studies. This book was a great preparation for me as it presents almost every thinkable situation and problem one can encounter as a foreign researcher in China, as it is written by researchers who themselves have done extensive fieldwork in China.

Establishing initial contacts to stakeholders in the Chinese construction industry can be an arduous challenge, because of the nature of the Chinese society, where *guanxi* – connections – are of utmost importance. This, I discovered after all of the first e-mails sent to Chinese companies, professors, architects, etc. remained unanswered. I therefore felt a need to shift tactics and began contacting Danish companies which somehow related to the construction industry in China. This strategy paid off immediately. Not only did I get very useful information in form of first-hand experiences from my Danish contacts, but with their invaluable help I also managed to get in contact with many Chinese stakeholders.

Although knowing it would be an almost incomprehensible challenge, within the timeframe for my fieldtrip, I set out a goal of talking to stakeholders which each represented a link in the value chain of the construction industry. This would give me the opportunity of 'painting the full picture' of barriers and potentials for building

energy efficiency in China. But as I expected this proved to be difficult. As I managed to establish contacts to developers, architects/designers, material producers and consultants, it soon showed that becoming acquainted with contractors, financiers and especially government officials turned out to be beyond the realm of possibility. My inability of getting in to contact with these stakeholders was partly due to the limited amount of time I was in China and partly a result of the labyrinthian nature of the Chinese social hierarchy. With its dormant complexity it made it difficult for me in some cases to steer through to the right person. Had I been able to spend more time in China I believe it would have been possible to establish contacts with contractors and financiers as well, while I have my doubts whether officials from either local or national government would be within reach at all for a student from Denmark without any contacts within the Chinese Communist Party (CCP).

In order to include these stakeholders and their individual structures, barriers and potentials in my analysis, I therefore had to rely on existing surveys on the subject carried out by Chinese professors, who themselves have interviewed representatives from these links in the value chain. As I was told by one of my interviewees it would be extremely difficult for me to get in contact with government officials, and if I should succeed I would probably not be able to get any noticeable information from them. He therefore advised me to talk to professors from universities as they are often involved in the legislation processes and often compose first drafts for new laws (Interview 6). As I talked to professors from Tsinghua University in Beijing, I have been in contact with a link within the construction industry which draws out the legislative framework for all the stakeholders.

Talking to Chinese individuals who works with or in the construction industry often brings up topics of a more delicate character, such as social inequalities of temporary migrant workers (the floating population) on construction sites (Li 2006), and the sometimes violent displacement of reluctant inhabitants by gangs of so-called 'black hands', allegedly orchestrated by restive developers and contractors in areas selected as sites for new high-rise buildings (Gøttcke 2009). In every interview I have treated such

topics with great circumspection as I was not interested in offending any of my interviewees or make them feel uncomfortable. Therefore I only brought up such sensitive subjects in cases where the interviewees themselves indicated a willingness to discuss such topics.

In general, one is obliged to consider some basic precautionary measures when doing research in a country where political and religious persecution of specific groups in society is not uncommon. It was at all times essential for me that especially my Chinese contacts felt they could speak freely and not had to consider whether their statements could somehow boomerang, putting them in a potentially pernicious situation. On the basis of my research in China I do not suspect that this would be the case with any of my interviewees, but since the intention with this report is to circulate it among academics and professionals in China, I have decided to anonymise all interviewees to prevent that any such situation - although against my better judgment - could arise.

## **2.5 Interdisciplinary research**

In the process of researching the Chinese construction industry, and in the subsequent writing of this report, I have drawn on experiences from different academic schools of thought and worked on combining them in a cross-disciplinary approach in the study of barriers for building energy efficiency in China. The idea of merging disciplines is in no way unfamiliar to me, as it has been one of the key concepts in my five years of academic education. Although being a full-time student in the field of environmental management I have a background with a bachelor's degree in geography and am therefore a living example of interdisciplinary education and research. The area of environmental management is in itself cross-disciplinary as it draws on lessons and approaches from social studies, natural science and the humanities.

Naturally, having been born into and educated in the school of interdisciplinary research I tend to carry a biased opinion towards having a predominantly positive view on

amalgamating disciplines in academic research. Although it can be argued that merging, sometimes disparate, schools of thought in a research project can be inexpedient, as empirical and analytical methods differ from one academic school to another, the results are on the contrary often more thorough since a broad set of ideas and theories are tested, thus widening the perspective and comprehension of a given field of study. In my perspective one of the integrated boons of an interdisciplinary research method is undoubtedly the way different approaches in this way supplement, rather than oppose each other.

In the process of studying barriers for building energy efficiency in China, a combination of methods from different academic schools have been paramount in order for me to be able to paint the full picture, as barriers are multangular in shape and content, and in many aspects criss-cross traditional academic demarcations. Even though the emphasis in this research has been on methods from social studies, I have directly and indirectly drawn important lessons from both more natural scientific studies and the humanities. Especially in my understanding of the build environment's impact on the perceptible degradation of the ecosystem, and the Chinese comprehension of sustainability in a cultural context, have I drawn on experiences from natural science and humanities, respectively.



## Chapter 3      What is the background?

This chapter encompasses the historical and economic background for the present situation with rapid industrialisation, urbanisation and heavily increasing energy consumption by buildings, hence the need for energy efficient housing. The chapter presents the characteristics of the economic transformation; facts on the boom in urbanisation and construction; details on the rising consumption of energy in China including a presentation of climatic variations and thereof different needs for energy efficiency in buildings; and a presentation of present building energy efficiency policy in China. The objective of the chapter is to examine the background for the present situation and lay out a broad foundation, partly for further investigation of which barriers exist for energy efficiency in new buildings in China, and partly for an analysis of how to overcome those barriers.

### 3.1 China's economic transformation

Following Mao Zedong's death in 1976 and the subsequent resurrection of Deng Xiaoping as the leader of the Chinese communist party in 1978, China's economic transformation initiated. During the next 27 years China accomplished a remarkable economic growth at an average annual rate of over 9 percent (Garnaut 2005: p.509; Keng 2006: p.183). Although China, as the rest of the world, has been affected by the global economic downturn, the country is still experiencing economic growth at a time when most of the world is in actual recession. Former Danish Minister of Taxation; Finance and Foreign Affairs, Mogens Lykketoft, recently stated with reference to the industrialisation of China, that: "*It is evident that what took the western countries 250 years – China has accomplished in 30*" (Lykketoft 2008). The economic transformation is generally seen as connected with Deng Xiaoping's pragmatic approach to economic reforms (Mackerras et al. 1998: pp.82-83). The famous quotation: "*I don't care if it's a white cat or a black cat. It's a good cat so long as it catches mice*", can be seen as a strong pragmatic statement which places economy on an equal footing with ideology (Holm and Lykketoft 2008: p.160). Deng Xiaoping's pragmatic views were undoubtedly of

significant importance which proves to be true when one looks at the particulars of the economic transformation.

One of the reasons for the success of the transformation of the Chinese economy was the approach to the actual process of the reformations. The Chinese reforms were, in contradistinction to the reforms in the former Soviet Union, characterised by a *gradual* approach (popularly known as 'crossing the river by feeling for stones'). The lack of a master-plan meant that the reforms consisted of gradual changes to the Chinese system. More specifically the gradual approach meant that reforms within one sector prompted reforms in a related sector (Østergaard 2008: pp.94-95). One example of this was the structural alterations of the *communes* and *collectives* which under the *Household Responsibility System* (HRS)<sup>4</sup> in the end gave the individual farmers more control over the land (Leith 2006: p.56). With the reforms in the agricultural sector the farmers had a larger income. This meant more and better possibilities in financing the already existing *Township and Village Enterprises* (TVEs) – all rural non-agricultural enterprises (Mackerras et al. 1998: pp.218-219). The combination of better financing and the appearance of an 'invisible' workforce, due to the efficiency improvements under the HRS, resulted in an explosion in numbers of successful TVEs in rural China. The TVEs led to reforms in the industrial sector which again decreased the monopoly of the state. (Østergaard 2008: pp.95-98)

Thus, the economic transformation is very much a result of the process and succession in reforms. The process alone though, is not the sole reason for the economic growth. Other reasons of importance are often discussed with great passion by economists. Some of the aspects discussed are: *increased competition; gradual price-reform; privatisation; decentralisation; deregulation; the market; property rights; the role of ideology; the process of institutionalising; role of the state; rates of saving and investment; and demographic structure.* (Garnaut 2006: pp.511-514; Østergaard 2008: pp.95-96) In this thesis I will not commence a discussion of the importance or impact of the above

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4 Household Responsibility System (HRS) – This system imply that the agricultural collective own the land but lease it to the individual farmers for a period of 20 years (today 30 years). The farmers pay the collective with a certain percentage of the output (Østergaard 2008: 97)

mentioned aspects of the economic reforms, since they are of little relevance to the objective of the research question, but merely note their existence.

Year	Total amount (100 million US\$)	FDI <sup>5</sup> (100 million US\$)	FDI of total amount* (%)
1985	47,60	19,56	41,09
1986	76,28	22,44	29,42
1987	84,52	23,14	27,38
1988	102,26	31,94	31,23
1989	100,60	33,93	33,73
1990	102,89	34,87	33,89
1991	115,54	43,66	37,79
1992	192,03	110,08	57,32
1993	389,60	275,15	70,62
1994	432,13	337,67	78,14
1995	481,33	375,21	77,95
1996	548,05	417,26	76,14
1997	644,08	452,57	70,27
1998	585,57	454,63	77,64
1999	526,59	403,19	76,57
2000	593,56	407,15	68,59
2001	496,72	468,78	94,38
2002	550,11	527,43	95,88
2003	561,40	535,05	95,31
2004	640,72	606,30	94,63
2005	638,05	603,25	94,55
2006	670,76	630,21	93,95
2007	783,39	747,68	95,44

Table 1: Amount of utilised foreign capital in China, 1985-2006. Source: NBS 2008: p.729, \*own calculation.

<sup>5</sup> The exact amount of actual 'Foreign' Direct Investment into China has been widely discussed, due to the use of 'round-tripping' ("domestic Chinese capital that is relocated to Hong Kong in order to take advantage of various tax and regulatory advantages, as well as involving the laundering of the proceeds of corruption"). The discussion of how much of the FDI from Hong Kong that are 'recycled' remains unfinished, but is probably somewhere between 20-50% (Smart and Hsu 2004: p.549). The numbers used in this report is the official statistical figures from the Chinese National Bureau of Statistics.

One very important aspect that I will look at is the role of *Special Economic Zones* (SEZ) and the closely related aspect of *Foreign Direct Investment* (FDI). The concept of FDI was introduced in China parallel to the other reforms in the late 1970s as an *Open Door* policy. The same gradual approach was also applied on the FDI as the rest of the reforms, so the actual effects of foreign capital invested in China remained relatively low until the 1990s (Chang et al. 1995: pp.692-693). As table 1 show, the amount of FDI rose through the 1990's and well into the new millennium, accounting for almost 95 percent of the total amount of utilised foreign capital in 2006.

But, where does all the money come from? According to journalist and author of the book *China Inc.*, Ted C. Fishman, the bulk of the investments are made by overseas Chinese primarily based in Hong Kong, Taiwan and Macau (Fishman 2005: pp.26-27) This statement is substantiated by anthropologist Alan Smart and Geographer Jinn-Yuh Hsu. They state that out of the amount of utilised FDI between 1979 and 1999 (\$307.6 billion), investments from Hong Kong and Taiwan accounted for nearly 60% of the total (Hsu and Smart 2004: p.547).

So, where does all that money end up? This is where the role of Chinese SEZs emerges. Economist Wei Ge gives the following description of the characteristics of Special Economic Zones:

*"From the broadest perspective, a special economic zone may be characterized, in general terms, as a geographic area within the territory of a country where economic activities of certain kinds are promoted by a set of policy instruments that are not generally applicable to the rest of the country. Institutionally, the existence of a SEZ reflects the fact that the host government conducts its economic policy in such a discriminate manner that certain geographical regions, economic activities, and interest groups are strongly favoured over others."*

(Ge 1999: p.1268)

In the wake of the decision on allowing foreign businessmen to invest in China, the Chinese leadership decided to establish four SEZs; Shenzhen, Zhuhai and Shantou of

Guangdong Province and Xiamen of Fujian Province. All four of them were chosen for their close proximity to Hong Kong and Taiwan respectively (Chang et al. 1995: p.1268; Mackerras et al. 1998: p.203, Smart and Hsu 2004: p.545). The main purpose of the SEZs was, and still is, to attract FDI. In the following years, zones similar to the SEZs emerged and today the so-called Open Economic Zones involve 40 cities under provincial governments and 215 counties, and a number of other various forms of economic development zones (MOFCOM 2004). The vast majority of the FDI has been to cities. In 1996 the utilised amount of FDI in cities accounted for 76.1 percent of the national total (Lin and Song 2002: p.2253).

The significance of FDIs into the open economic zones, led by the SEZs, remains substantial. The economic zones, especially the SEZ and the later invented Open Coastal Cities<sup>6</sup>, have all recorded extensive changes in industrial development, population and standards of living (Ge 1999: pp.1269-1270).

### **3.2 Urbanisation in China**

The investments in Chinese cities triggered one of the largest domestic migrations of people in history. Between 1980 and 2000, 268 million Chinese migrated from rural areas to the cities, where the former peasants came to seek for their slice of the cake: better-paid jobs and improved standards of living. In that same period of time the percentage of the population being urban dwellers increased from 19 to 36 percent and getting close to 45 percent in 2006. It is expected that urbanisation will continue to rise, possibly reaching 60 percent in 2020 (Yusuf and Nabeshima 2008: p.1).

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6 Open Coastal Cities: Shanghai, Tianjin, Dalian, Qinhuangdao, Qingdao, Yantai, Weihai, Lianyungang, Nantong, Ningbo, Wenzhou, Fuzhou, Guangzhou, Zhanjiang, Behai (NBS 2007: 389).

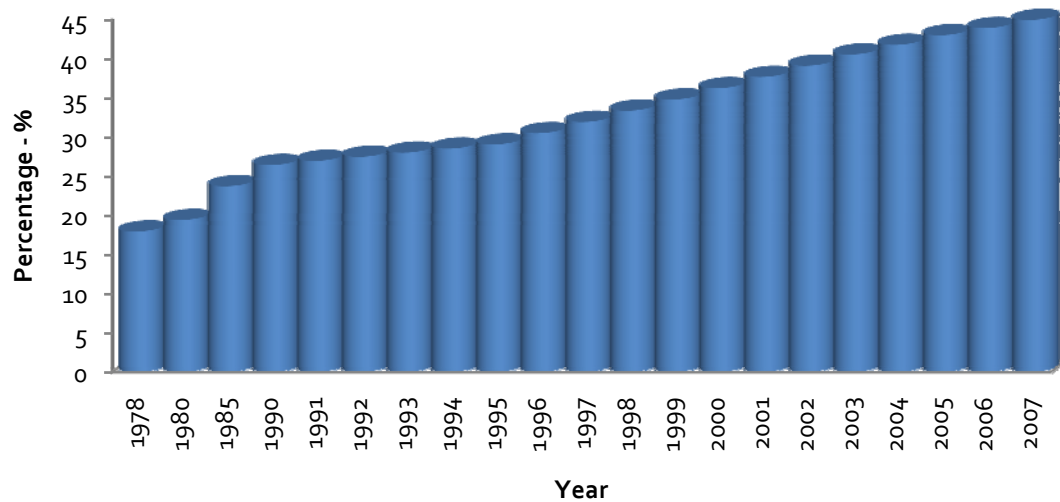


Figure 1: Percentage of population living in urban areas in China, 1978-2007. Source: NBS 2008: p.87

One city, *Shenzhen Special Economic Zone*, illustrates the changes in urban development in China. At the time Shenzhen was appointed as a SEZ, it was nothing more than a small town situated at the frontier with Hong Kong. In 1979, 80 percent of the inhabitants made their living from either agricultural or fishing activities, there was practically no infrastructure, no skilled labourers and a constant shortage of electricity (Ge 1999: p.1269). Few people, probably including Deng Xiaoping himself, would have anticipated the total transformation of Shenzhen that took place during the following 25 years. It went from being a relatively small town holding seventy thousand people to a booming metropolis with more than seven million inhabitants, this in only a quarter of a century, and is today the fourth-largest city economy in China (Fishman 2005: pp.86-89).

Shenzhen is an example of extremes though, as most Chinese cities are experiencing changes either to a lesser degree or at a slower pace, but the progress of Shenzhen is a striking symbol of the process of urbanisation in modern day China.

### 3.2.1 The boom in construction

The progress in urbanisation trends has put an apparent pressure on the Chinese

construction industry to build housing corresponding to the amount of new inhabitants in the cities. The inflow of FDI combined with encouragement from national and local governments to create economic growth, laid the foundation of expansion in the building sector. Thus, there has been an enormous boom in construction in the Chinese cities. The amount of floor space under construction for real estate development has quadrupled in the last ten years (see figure 2), and it is predicted that more than half of the completed urban residential and commercial buildings in 2015 is to be constructed after the year 2000 ( Zhu and Lin 2004: p.1288).

This means that nearly half of the world's construction is taking place in China and the expenditures on construction each year, about \$375 billion, accounts for approximately 16 percent of the Gross Domestic Product (GDP). At the same time the construction boom induced a rise in the industry's consumption of building materials. In 2004 the Chinese construction industry used 54,7 percent of the world's production of concrete, 36,1 percent of all the steel produced in the world, and 30,4 percent of the world's coal (Pearson 2004: p.71). Nevertheless, China has for many years kept up the building pace. In 2005, Shanghai alone, was expected to complete more square metres for working and living than there is in all office buildings in New York (Barboza 2005).

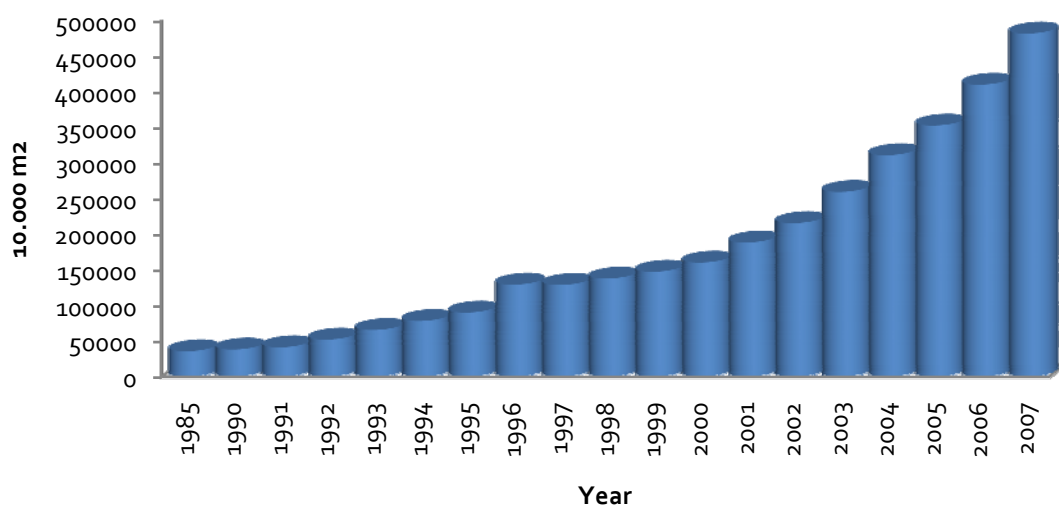


Figure 2: Floor space under construction, 1985-2007. Source: NBS 2008: p.590

It is obvious to state that the scale and the pace of the Chinese construction boom is unprecedented (Burdett 2005). On the one hand, the positive one, the construction industry is creating homes and jobs for millions of Chinese. On the other hand there is a huge downside of the boom in form of rapid environmental deterioration, including generation of waste, overexploitation of ground water and destruction of the ecosystem (Zeng et al. 2003: p.107). Estimates suggest that solid wastes from construction make out 30 to 40 percent of total urban solid wastes (Zhang and Yang 2001). The jumble of people and industry in Chinese cities has also merited six cities<sup>7</sup> a place on *Blacksmith Institutes* list 'the dirty-thirty' – the thirty worst polluted cities in the world (Blacksmith Institute 2007).

The standard of the houses being build are unfortunately not as efficient as they could be and Chinese experts estimate that 95 percent of buildings in China are "*highly inefficient, with envelope thermal conditions that are two to three times less efficient than those in developed countries*" (Laurenzi 2007: p.155). Undoubtedly, given the scale of construction and the quality of the energy efficiency of buildings in both new and old homes, China will see the building stock making a huge dent in the country's energy consumption and a massive increase in mitigation of Green House Gases (GHG), such as CO<sub>2</sub>, in the future if initiatives are not undertaken.

### **3.3 Increasing energy consumption**

The environmental problems are not the only aspect of urbanisation and construction, causing the Chinese leaders worries. The rise in energy consumption in China is considered to be a major headache to the leadership and increasing awareness is now being addressed at supply and conservation (ICG 2008: p.3).

China has gone from being an exporter of energy until 1993, to being the world's third-largest net importer of oil in 2006. This has left a gap between energy production and consumption, which is projected to grow as China is expected to experience an annual

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<sup>7</sup> Huaxi, Lanzhou, Linfen, Ürümqi, Tianying, and Wanshan.



rise in natural gas and oil consumption at 6,8 and 3,8 percent, respectively, through 2030. As stated in the Asia Business Council book; *Building Energy Efficiency – Why Green Buildings are Key to Asia's Future*, the energy demand in China is expected to 'more than double in two decades from the current level' (Laurenzi 2007: pp.153-154).

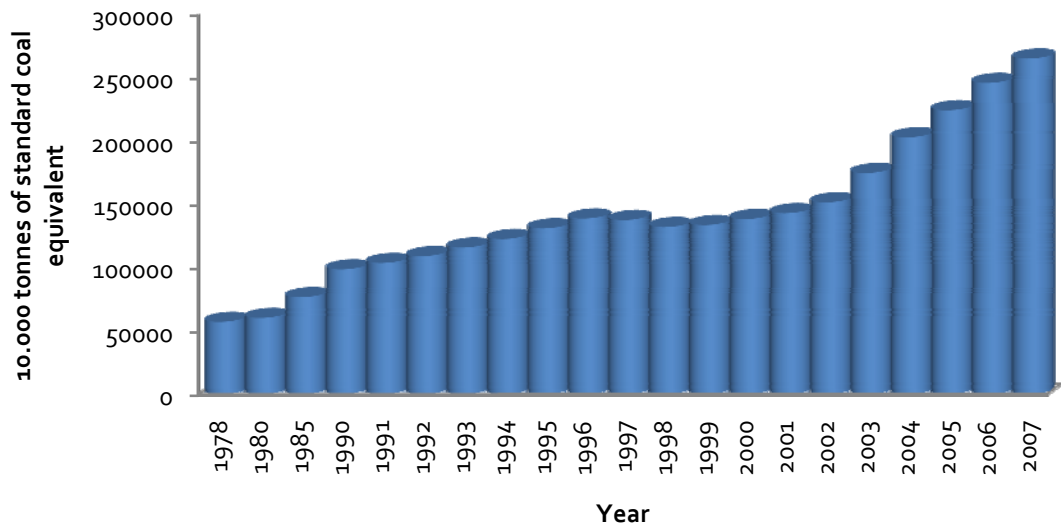
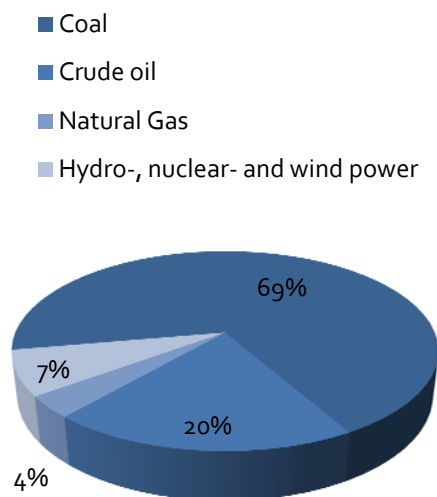


Figure 3: Total consumption of energy in China, 1978-2007 Source: NBS 2007: p.260; 2008: p.244

China has the third-largest reserves of coal in the world and is using vast amounts of



coal to power the economic growth, including the construction of buildings, and for heating, cooling and providing electricity to new and existing buildings. Coal accounts for 69 percent of the total primary energy consumption with serious impacts for health and environment. China has enough

Figure 4: Composition of energy consumption in 2007 in China; in percent. Source: NBS 2008: p.243

coal reserves to continue heating houses and power electrical appliances for at least one more generation (ICG 2007: p.2).

The amount of coal, oil and natural gas used could without doubt be lowered if the energy efficiency of buildings was higher. In the late 1970s buildings consumed about 10 percent of the total, in recent years that number has risen to about 25 percent, and is expected to rise to somewhere around 35 percent early in the next decade (Liang et al. 2007: p.1098; Laurenzi 2007: p.154; Yao et al. 2005: p.1974).

Today the floor area of all buildings in China amount to around 40 billion square metres, and it is anticipated that this number will double by 2020. With these number's in the back of your mind, and concurrently realising that 95 percent of the existing building stock, according to experts, is 'highly inefficient', the potential for saving energy and lowering GHG emissions from buildings is without exaggeration, prodigious.

### **3.3.1 The variations in climate**

China is a huge country and covers around 9.6 million square kilometres. It is evident that a land mass that big experiences variation in climatic conditions. As figure 6 shows, China is roughly divided into five different climate zones: very cold, cold, hot summer/cold winter, hot summer/warm winter and a general warm zone. Requirements for energy efficiency in buildings vary according to the different climate zones. In the very cold and cold regions heating is required and has traditionally been provided by the state as it is seen as a necessity for survival. In the hot summer/ cold winter region both heating and air-conditioning is needed to stay comfortable, but not required in national building standards, as heating in this area is not seen as a necessity for survival. In the hot summer/warm winter only air-conditioning is needed. In the warm region neither heating nor air-conditioning is required (Lang 2003: pp.1191-1192, The World Bank 2001: pp.12-13).

In the very cold and cold regions in northern china, also referred to as 'the heating zone',

temperatures during winter are well below 0 degrees C, and with winters between 3-6 months, heating in buildings is most certainly a necessity. Air-conditioning in northern China is only provided in up-scale hotels and shopping centres in the very cold region, but is becoming more common, especially in new buildings, in the cold zone. Air-condition systems are widespread in Beijing. Building mass in the heating zone in China accounts for nearly half of the national total, which means this part of China accounts for the largest amount of energy used for heating and cooling (The World Bank 2001: p.12).

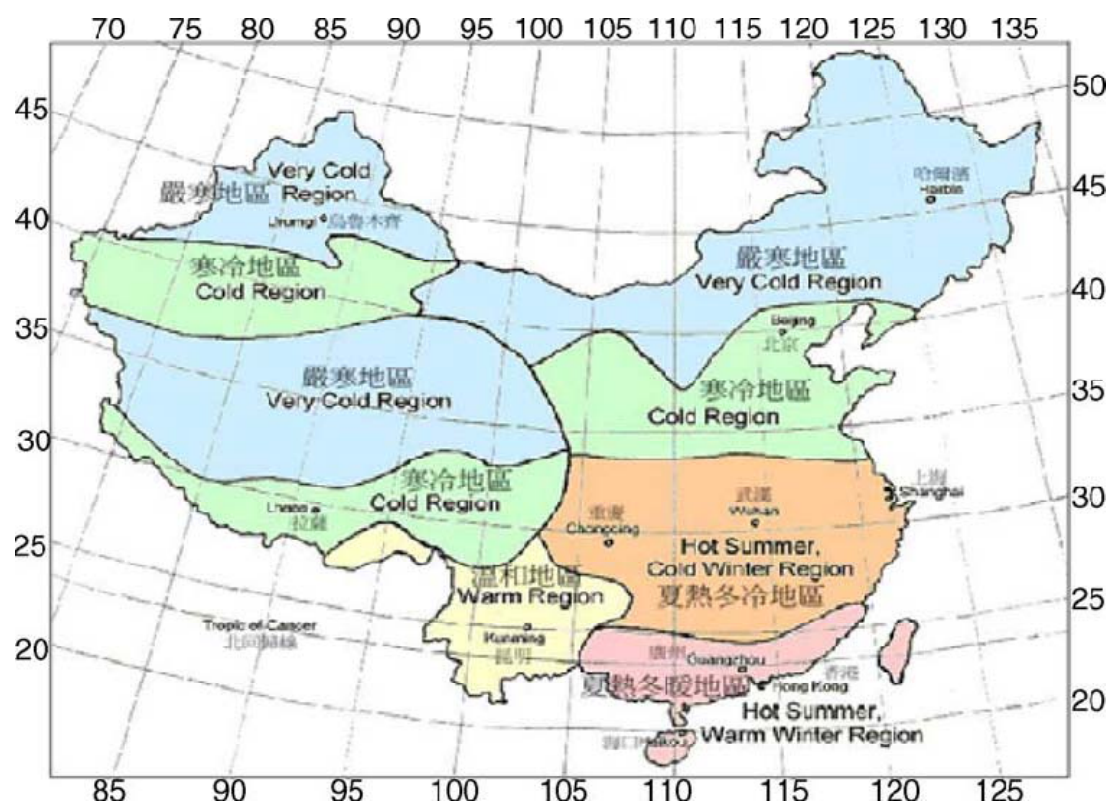


Figure 5: Climate zones in China .Source: Lang 2003: p.1192

In northern China space heating in urban areas has since the 1950s been considered a welfare funded by the government. During the years the system has evolved, and today employers are expected to pay employees heating bills originating from central heating (The World Bank 2001: p.4). Two types of heating systems are being used in the northern part of China: small coal stoves used for heating separate rooms, and central heating with hot water radiator systems, primarily fuelled by coal. Centralised heating is

gradually replacing coal stoves throughout the heating zone and all new buildings are supposed to be connected to central heating. The central heating system is based on a single vertical pipe system, where hot water is pumped from a boiler to the top of the buildings and then dropped floor by floor through the piping system into stand alone radiators. The radiators in apartments are not connected to each other, but are connected to radiators in neighbouring apartments above and below. This system is very similar to the ones found in countries in Eastern Europe and the former Soviet Union, the only difference being that in China the system is only used for heating living space, not for hot water, as it is in the above mentioned countries. The single pipe heating system is simple, but does not allow end-users to regulate the heat supply, with big variations in room temperatures between the first apartments in the system to the last, as a consequence. There is no metering system in existence, which means that heat billing is calculated on the basis of heated floor area and not on actual heat consumption (The World Bank 2001: p.14). The inefficiency of the heating system combined with the poor thermal quality of the building envelope, makes it obvious why heating and hot water consumption, on a national scale, represents two-thirds of energy demands in buildings (Li 2008: p.1737).

The Chinese government has put forward initiatives to overcome the above mentioned problems with the heating system. Thus, in 2000 the government issued regulations stipulating adoption of two-pipe technology, indoor temperature control, apartment-level heat metering, and implementation of heat consumption based billing in new residential buildings (The World Bank 2001: p.17). According to Chinese experts the regulation has not proved to be implemented by the building constructors or the energy suppliers, as they remain reluctant to install individual thermostatic valves and heat meters (Li 2008: p.1739). One of my interviewees pointed at a recent example from the city of Tianjin where consumers simply stopped heating their houses to save money as a consequence to individual metering, leaving the heating company with massive economic losses, as no basic amount was to be paid by consumers (Interview 3). This could very well be a likely explanation to why individual metering is still not effectively implemented.

### 3.4 Building energy efficiency policy

The overall instrument for controlling energy consumption in buildings in China is the five-year plans, developed by the National Development and Reform Commission (NDRC). Among other aspects, these plans set out general goals for energy reductions and improvements in energy efficiency. The eleventh five year plan running through 2010, calls for reductions of up to 65 percent in new buildings, compared to buildings constructed in the 1980s. The five-year plans only work as a general guideline though, so in order to realise such projections the government, in form of the MOHURD and before that MOC, issues more specific building standards aimed at specific building types in specific climatic regions. These building codes set out minimum standards for buildings energy consumption for, for example heating of living space and water. Specific preparation and implementation of standards is assigned to local governments, where implementation and enforcement is usually managed by local construction bureaus. As figure 6 below shows, the majority of standards issued by the ministries are aimed at residential buildings in the northern part of China.

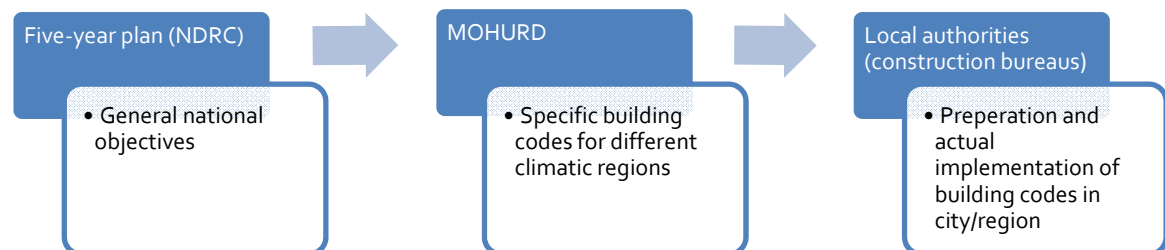


Figure 6: Implementation process of building codes in China. Source: Own production.

According to a study by the McKinsey Global Institute building energy efficiency standards in northern China, in limitations for heat leakage in walls, windows and roofs are well below benchmarks in more developed countries with comparable climate (Bressand et al. 2007: p.78). However, this is questioned by Joe Huang, a scientist associated with The China Energy Group at Lawrence Berkeley National Laboratory. He argues that the current Chinese standards are appropriate to China, when considering

the specific technological and economic context (Huang 2007).

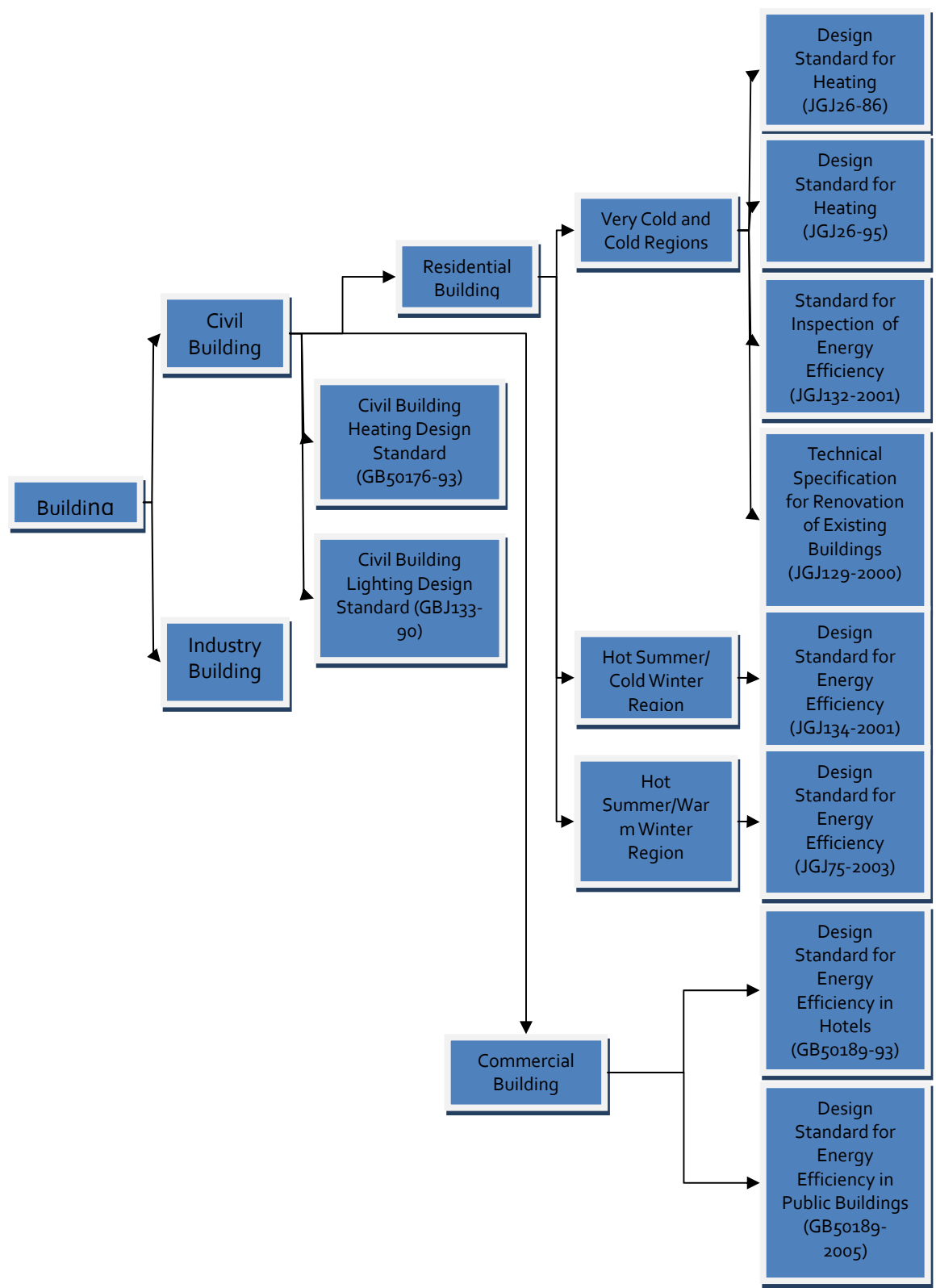


Figure 7: Building standards applying to new and existing buildings. Adapted from: Yao et al. 2005: p.1980; additional source: Liang et al. 2007: p.1099

Nonetheless, the study from McKinsey indicates that there is a potential for further improvements and tightening up of the mandatory buildings standards; this emphasised by the tendency of low compliance with mandatory standards in most Chinese cities.

Besides the mandatory standards, voluntary green building standards have in recent years seen the light of day. Two different voluntary standards have been designed, where the first one, *Evaluation Standard for Green Building* (ESGB), is very similar to the US developed LEED<sup>8</sup> standard, also widely used in China. The second voluntary standard was developed to support the idea of a green Olympics, held in Beijing 2008, and was labelled *Green Olympic Building Assessment System*, also known as GOBAS. The development of this standard was led by Tsinghua University in Beijing and is modelled on the Japanese CASBEE<sup>9</sup> system (Laurenzi 2007: p.81). Even though LEED at the moment seem to be spearheading the voluntary green building systems in China only 18 projects as of April 2009 were certified by LEED standards, 12 of these located in either Beijing or Shanghai, with 100 more nationwide still awaiting approval (USGBC 2009). The low number of certified LEED buildings along with their clotting together around office buildings of multinational corporations and exclusive apartments in only major cities, indicates that voluntary standards altogether are still without any real significant leverage on the overall standard of energy efficient buildings in China.

### 3.5 Conclusion

The almost legendary economic progress that China has seen in the last thirty years transformed parts of the Chinese society. Walking hand in hand with the economic advances the country has experienced an, in scale and pace, unprecedented growth in urbanisation. The upturn has lured hundreds of millions of Chinese to the cities looking for fortune and prosperity, and even though some suggest that around 14 million have

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8 Leadership in Energy and Environmental Design. Four-level certification system for various types of buildings. Certifications issued by a third party. See <http://www.usgbc.org/>.

9 Comprehensive Assessment System for Building Environmental Efficiency. Voluntary evaluation tool for assessing environmental design and performance of buildings. See <http://www.ibec.or.jp/CASBEE/english/index.htm>.

returned to their home-provinces in the last year of economic slowdown, Chinese cities are still home to hundreds of millions of migrant workers (China Labour Bulletin 2009). The urbanisation has brought with it improved standards of living and a massive boom in construction; approximately half of the world's construction is taking place in China. Increasing standards of living require more comfortable indoor temperatures and this has contributed to an augmenting consumption of energy in China, especially in the northern part of the country where heating is seen as a basic necessity of life during winter months, and air-conditioning for cooling in summer is becoming more common. The loss of energy used for heating is enormous due to insufficient thermal envelopes of housing and an inefficient heating system. The government has launched heat reforms and issued new building codes, but these still remain to be effectively implemented by local governments, building developers and heating companies. Along with mandatory standards, a set of voluntary green building standards have been developed or imported, but buildings applying for voluntary standards are still low in number and green building standards are only adapted by upscale building projects.



## **Chapter 4      An outline of barriers for building energy efficiency in China**

The objective with this chapter is to illuminate the structure of the Chinese construction industry; to draw out the configuration of stakeholders within the industry and their interrelationship. The aim with this exercise is to illustrate what type of barriers exist and where they are located in the different layers of the construction industry. Drawing out the structure of the industry will make it easier to pinpoint exact barriers and challenges for building energy efficiency in China. Painting the full picture of the structure and barriers is based on the inclusion of data collected from already existing literature on the subject, as well as information collected from the conducted interviews and exploration of the case-study, during my fieldtrip to China. In order to be able to embrace the complexity of barriers the presentation will be distinguished into three different aspects, which relate to the breakdown of the industry's structure into different spheres used by Shen et al. (2004: p.387), presented in figure 8 below, and which to me illustrate a logical structure: general challenges for environmental progress in China; general problems within the construction industry; and specific barriers within the industry for energy efficiency in new buildings. These three aspects and the barriers located in them are very much interconnected and should thus not be seen as if they are strictly separated in reality.

### **4.1      Structure of the Chinese construction industry**

The high growth rates in the GDP in China in recent years have created extensive growth opportunities in the Chinese construction industry. The construction industry in China was regarded as the third-largest of the world in 2002, with a total construction value of US\$404 billion (Shen et al. 2006: p.966). The expansion of the construction industry is expected to grow in the future as the effect of China's entry in to the WTO gradually gain acceptance.

According to professor at the department of Building and Real Estate at Hong Kong Polytechnic University, L.Y. Shen (2004), the Chinese construction industry generally

involves three aspects: the business relationship, the regulation frame and the general environment. As seen in figure 8, these three aspects make up the contents of the construction industry. The inner layer contains the business relationship – in other words, the relationship between the different stakeholders involved in a building project. The intermediate layer contains various aspects of the regulation frame such as the quality monitoring system, the project supervision system and the professional qualification management system. The outer layer contains the general environments constituting the general framework of the construction industry.

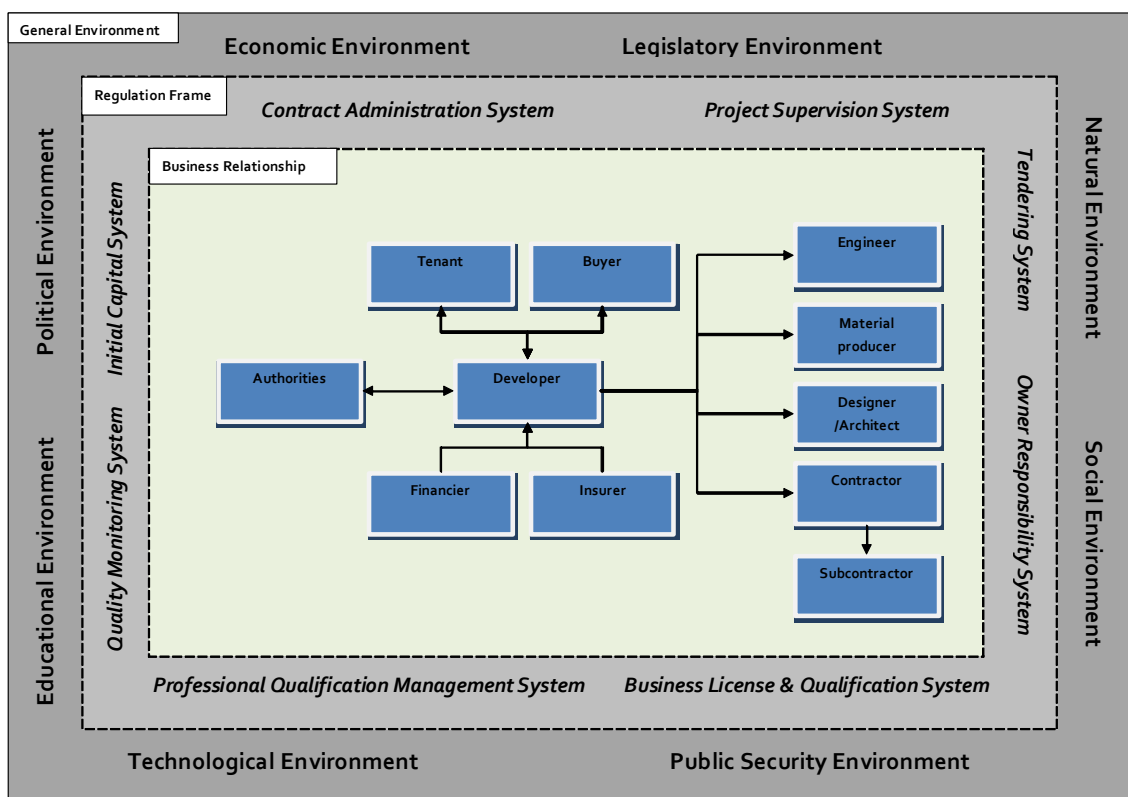


Figure 8: Structure of the Chinese construction industry. Source: Partly adapted from: Shen et al. 2004: p.387 and partly own production.

The structure within the inner layer is centred on the developers. The developers typically initiate the building process by acquiring land, obtaining building permits and engaging design studios and contractors. In this perspective, developers are the key component among the stakeholders since they control the building objective, design expertise and budget (Laurenzi 2007: p.31). Thus, developers have a major influence on

the quality, e.g. the energy efficiency, of a building. In the intermediate layer, in the perspective of building energy efficiency, the quality monitoring system, the project supervision system and the professional qualification management system, play a major role. These three interrelated systems are responsible for the quality of the building and their purposes are defined in various regulations by the government. The overall role of the quality monitoring system is to supervise on the quality of the building, e.g. make sure that building standards are complied with. The project supervision system has the role of appointing supervision engineers to report on the quality of the building in the interest of the developer and the public. The professional qualification management system is established to secure the professional level of for example supervision engineers. These three systems are therefore the main aspects to look at in the intermediate layer when studying the implementation of building energy efficiency policy in China. In the outer layer all the environments have more or less influence on the energy efficiency of buildings. As we shall see, many of the barriers for energy efficiency in buildings in China are related to social, technological, educational, legal and economical conditions in China.

#### **4.1.1 General challenges for environmental progress in China**

Although many of the barriers for building energy efficiency in the Chinese construction industry can be found within the industry itself, it is necessary to relate these to the actual framework of the industry, understood as the distinctive aspects of the perception and execution of environmental protection within the Chinese state and society.

One of the fundamental characteristics of the Chinese society and the self-image of the majority of the population is found in the social and cultural traditions of Confucianism, Taoism, Buddhism and Legalism. The view on humans and their relations to the environment differ among these philosophies, from the egalitarian view in Taoism that humans and nature are equal, much like the thoughts of deep ecology of today, to the more structural and guiding view in Confucianism, hinged in the belief that humans have the ability and right to explore and take advantage of the resources of earth

(Economy 2004: pp.30-36). Despite the fact that nature and the environment is an integral part of all these philosophical schools of thought, the environment in China has historically suffered due to the progress of economy, warfare and population growth. This has happened in continual cycles through history where detrimental changes in environment such as deforestation, flooding, desertification and soil-erosion, has always been the result of various emperors efforts to meet an ever growing population's sustenance and at the same time retain political and military power (Economy 2004: pp.36-57). Historian Mark Elvin goes as far as contending that ideas of a balance between humans and nature found in some Chinese historical writings are nothing but an illusion, *"The restraint preached by the environmental archaic wisdom found in certain Chinese classical texts is both familiar and in all likelihood commonly misunderstood: it was probably not a symptom of any ancient harmony but, rather, of a rational reaction to an incipient but already visible ecological crisis."* (Elvin 1998: pp.738-739) The stance here taken by Elvin suggest that the environmental crisis is nothing new in China, nor is its provenance: humans' constant aspiration for increased material prosperity.

It can be argued that the pinnacle of the Chinese quest for economic development on the expense of the environment was reached during the exhaustive growth schemes during the Mao era, but as historian Peter C. Perdue shows, the process of modernisation of the Chinese society dates as far back as the Qing dynasty (1644-1911 AD) (Perdue 2007: p.176). Perdue states that although reform leaders, who took over from Mao, worked for a more efficient use of resources, the search for rapid industrialisation and technological modernisation still remained the pivotal goal, without regards of consequences for environment. As he rightly claims, this rise the question of what sustainable development means for the Chinese leaders of today,

*"Sustainable development really means for China the ability to continue a long-standing developmental goal indefinitely: making China into a powerful economy and state equivalent to the leading industrial nations of the world."*

(Perdue 2007: p.176)

One of my interviewees backed this claim by criticising western societies for trying to transfer the western perception of sustainability to a Chinese context, which – according to the interviewee - often fails due to general misunderstandings of what sustainability actually implies (Interview 7).

This does not rule out a switch-over to a circular green economy in China, apparently sought after by political leaders in Beijing<sup>10</sup>. Rapid technological modernisation can in theory trigger and uphold a powerful economy, and lift China from being a developing to a highly developed country, but it certainly is a difficult task. So far no society has been able to leapfrog over the environmental degradation, which historically has been an invariable part of industrialisation. Such an effort would require extensive political, social, economical, technological and cultural changes at all levels of society. Chinese history of continual cycles of economic progress, followed by environmental deterioration, is not placing odds on the side of opportunists. Nevertheless, such historical and cultural aspects of the relationship between humans and the environment in China sheds light on some barriers for sustainability in general. It shows us that prioritising environmental protection at the same scale as economic progress is not an accustomed and integral part of the Chinese mindset, where hierarchal order is ubiquitous. As I will argue in the following, the Chinese perception of humans vs. nature fosters certain barriers for steps towards ameliorating the current situation with depletion of natural resources and concomitant environmental degradation, and often obstructs implementation of initiatives on more efficient use of resources, like for example improved energy efficiency in buildings.

#### **4.1.1.1      *The history of environmental protection in China***

In contrast to the long history of damaging environmental effects from industrialisation, history of environmental protection on a national level is fairly recent

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<sup>10</sup> On the 29 of August 2008, the 11<sup>th</sup> National People's Congress adopted the *Circular Economy Law of the People's Republic of China*, which promotes general environmental protection in the form of increased conservation and recycling etc. See for example: <http://www.chinaenvironmentallaw.com/wp-content/uploads/2008/09/circular-economy-law-cn-en-final.pdf>. (2009-06-12)

in China. First real initiatives came in 1984 with the establishment of SEPA, although there had been many more or less futile run-ups towards creating various commissions on environmental governance during the 1970s (Economy 2004: pp.93-96). In the following decade China saw the emergence of many provincial Environmental Protection Bureaus (EPBs), as well as the country in a response to the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992 formulated an Agenda 21 paper on future sustainable development. Within the same period and until today, numerous laws and projects on environmental protection have been promulgated with varying degrees of success (Economy 2004: pp.91-100; Perdue 2007: pp.173-174).

In the nature of the hierarchical structure of the Chinese society all local and provincial EPBs respond to SEPA, which again responds to several ministries, for example the Ministry of Finance, Ministry of Housing and Urban-Rural Development, the Ministry of Water Resources and of course the all-powerful NDRC. On top of that they also rely heavily on support from their respective local governments for help with budgets, career advancements, number of personnel and basic resources as office buildings, cars and employee housing (Economy 2004: pp.105-108). This leaves the already underfunded and ill-equipped EPBs<sup>11</sup> with little room for maneuvering without prior authorisation from higher ranking levels of authority and consent from local politicians, and leaves them prone to subject to political pressure. This severely hampers efforts from EPBs to monitor and manage potential breaches of laws and regulations on environmental protection, as especially local governments absolute top-priorities are economic growth and avoiding social unrest (Economy 2007). Economy gives in her book – *The River Runs Black* – some examples of cases where local EPBs simply do not hold sufficient power to enforce laws, as well an example where the administrative rank within the CCP of a local EPB officer was lower than that of the company director of a paper manufacturing company, thus prohibiting the EPB to monitor wastewater from the company (Economy 2004: pp.108-110). In this manner polluters can avoid

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<sup>11</sup> SEPA itself has some 500-700 full-time employees on national level, half of these based in Beijing. In comparison, the U.S. Environmental Protection Agency has 9.000 full-time employees in the capital, Washington D.C., alone (Economy 2007).

inspection, as long as they hold a high enough position within the CCP. Problems with enforcement is accentuated by statements from one of the top environmental lawyers in China, Wan Canfa, estimating that not even ten percent of environmental laws and regulations are actually enforced (Economy 2007).

The situation with lack of enforcement and implementation of laws and regulations in the construction industry is unfortunately no different. As shown in the introduction of this report, less than half of all buildings constructed after 2005 comply with new regulations requiring a 50 percent reduction of energy consumption for heating, air-conditioning and lighting in new buildings, compared to buildings constructed in the 1980s. In the interviews I conducted in China, this problem was often a key element. According to the interviewees, the lack of enforcement of regulations appear mostly in provincial capitals as local governments in many provinces lack resources to monitor and enforce these regulations, just as inspection teams are generally underfunded and lack the capacity to monitor implementation on both national and local scales. As one of the interviewees put it, when asked the question why the situation in provincial capitals differs from the situation in Beijing, Shanghai and Guangzhou, "*Sometimes the local developer is simply a stronger guy than the local politician*" (Interview 4). This statement, which in a good way sums up the position most interviewees had on this question, indicates that political pressure and/or corruption play an important role outside of the key cities in China when it comes to enforcement of building codes. As with environmental protection in general, implementation of energy efficiency in buildings is often given a lower priority than rapid economic development, for example in the form of construction of new buildings.

#### **4.1.2 Overall existing problems in the construction industry**

Even though the construction industry is the third-largest in the world and the fact that nearly half of all square metres in the world are being constructed in China, the construction industry is considered as a weak sector by international standards (Xu et al. 2005: p.845). This is due to problems inside the construction industry itself. According

to, among others, the vice president of Jurong International (a Singaporean construction enterprise) Tianji Xu, the problems are located within the legal framework, the industry structure, the technological standards and the international market share held by Chinese enterprises (Xu et al. 2005: p.845)

The problems within the *legal framework* are especially linked to the lack of clearly defined roles of government, contractors and design studios. According to Xu, "*The government is not regulating the construction enterprises in a macro way that empowers the construction enterprises, but instead government authorities are directly involved in the construction enterprises' business most of the time*" (Xu et al. 2005: p.845). The government is often protecting state-owned, and often mismanaged, enterprises, which makes it difficult for non-state owned enterprises to secure a share of the market. At the same time government agencies responsible for interpreting building standards are also involved in contract management of contractors and are responsible for the examinations of engineering professionals and technicians (Xu et al. 2005: pp.845-846). The complexities of tasks performed by such an agency bring about the risk of detrimental interference in stakeholders business.

The *structure* of the industry causes the productivity of the industry to be low compared with production of construction industries in more developed countries. The construction output per employee is much lower in China (US\$5.493) than in for example Japan (US\$100.030) (Xu et al. 2005: p. 486). In other words, the amount of square metres constructed in China requires far more employees than if the same amount of square metres were to be constructed in Japan. Perhaps more important is the general connection between different links in the value chain. As seen in the construction industries in other countries, the linking between stakeholders in the building value chain is often very complex and fragmented, obstructing a more holistic approach to the design and actual construction of a building (WBCSD 2007: pp.14-15). This is especially true in China where developers control the process and manage contacts to different stakeholders. In interviews with designers working in China the fragmentation and complexity of the value chain was evident, as designers usually have no or little contact with contractors, subcontractors etc. (Interview 1; 4).



The output of the construction industry is linked to the *technology* available. Many of the Chinese contractors are equipped with old machinery and outdated building technology. Most of these firms simply do not prioritise bringing in new machinery and adapting new technology, due to the scale and the pace of the construction in China. Often, projects are hurried through due to pressure from developers and this leaves little or no time for contractors to introduce new building techniques etc. Most employees in the construction industry in the Chinese cities consist of former farmers, also referred to as 'the floating population', often with no training and experience with construction. One of the persons I interviewed also noted this, and stated that it had been an issue of consideration for his company on several projects, as it often complicated efforts on integrating more advanced energy efficient technologies into buildings (Interview 1). Looking at the key elements from the regulatory layer in the figure above, it is discouraging that less than two percent of employees within the construction industry holds a diploma, one percent holds a bachelor degree and a trifling 0.03 percent holds a master degree or above (He 2000). According to Xu, this problem also applies to several authorities, where key personnel do not have adequate knowledge about construction laws, blueprints and building standards (Xu et al. 2005: p.487). The effectiveness of regulatory mechanisms such as the quality monitoring system depends on the education and qualification of the people monitoring and approving new constructions. In this context there are simply not enough people within the construction industry which holds the educational level required to implement and monitor relatively advanced energy efficient building technology. In most provincial cities implementation and enforcement of building codes is overseen by local bureaus of construction, but as most other agencies and bureaus in China they lack sufficient financial and human resources in order to be able to act on problems within selected areas, such as inspecting the energy efficiency of new buildings. To put it clearly, the capacities of employees and institutions relating to the construction industry are simply underdeveloped.

The Chinese construction industry is also weakened by the lack of *international market shares*. Chinese contractors and design studios are not specialised enough as they tend

to solely focus on traditional projects such as industrial buildings. Since they generally speaking, do not master advanced building technologies they are bound to export contract labour to other Asian construction projects and to Africa, rather than more attractive markets in western countries (Xu et al 2005: p.487). Since Chinese contractors and design studios are not capable of achieving contracts in the EU and the USA they, Xu argues, are missing out on important knowledge sharing, technology transfers and market shares. I would expect though, that this shortcoming of the industry is to some extent counterbalanced by the increasing number of foreign architects, consultants and material producers now operating in China. As they normally cooperate with Chinese designers and firms, they indirectly bring with them important knowledge to the Chinese construction industry. Hence, I disagree with Xu and do not see the lack of international market shares by Chinese firms as a barrier for energy efficiency in new buildings, as the industry in other ways is penetrated by foreign knowledge on design, and production and use of materials.

#### **4.1.3 Barriers in the construction industry for energy efficiency in new buildings**

The problems relating to energy efficiency in buildings in China are closely related to the above mentioned general problems, but the distinctive character of barriers for energy efficiency in new buildings must be specified.

As mentioned earlier developers play an important role when identifying the barriers for energy efficiency in new buildings. The key mantra of developers in China seem to be that time equals money, and therefore the building process is often hurried on the expense of thorough incorporation of energy efficient design and materials. A direct and obvious barrier would therefore lie in the extra cost when incorporating energy efficient design and technologies in a building. According to Chinese experts the extra cost for energy efficient buildings is approximately 100 RMB per square metre which equals a 2-5 percent initial extra cost (Li 2007; Liang et al. 2007: p.1102), and for money fixated developers this presents a clear barrier as long as subsidises by government only cover around 10 percent of expenses in form of tax-refunds, and subsidies are only attached to some energy efficient technologies. This leaves inefficient buildings as the

cheapest, and therefore most attractive, option for developers (Interviews 6; 9; REEEP 2009: pp.19-22). This is not made any better by the split incentives involved in building energy efficient; economic benefits from for example lowered heating costs, financed by developers, allots mainly to residents. On top of this a survey from 2007 shows that among Chinese developers, architects, engineers, contractors and the like, there seem to a general misperception of how much a certified sustainable building would cost to build compared to normal buildings. This group of stakeholders in the construction industry estimated that it would cost 28 percent more to build sustainable (WBCSD 2007: p.18). This is a sharp contrast to the 2-5 percent actual extra cost.

Two of my interviewees pointed at the Chinese approach to the concept of payback periods in relation to implementation of energy efficient design in buildings. As they put it, developers and government officials alike do not operate with payback time as they solely calculate with 'here and now' profits (Interviews 5; 6). At the same time developers lack the pressure from the demand-side as an estimated 70 percent of potential buyers are not concerned with a building's energy efficiency, but tend to prioritise location, apartment layout, neighbourhood, and access to public parks in the local community (People's Daily 2006).

This especially became clear to me when I visited the construction in Beijing used as a case-study in my research. The case consists of 93.000 square metres of residential apartments and is placed in a newly developed area, named Upper East Side, of Chaoyang district in Beijing. The whole Upper East Side area consists of 200.000 square metres with different parcels where architects from abroad have been invited to design residential building blocks in a western layout. The area is being marketed for the more wealthy part the population, mainly Chinese who have lived abroad for a period and want to retain many aspects of a western lifestyle upon their return to China. The buildings designed by Schmidt/Hammer/Lassen comply with national and local building codes. The building does not go beyond the standards though, as the developer was not interested in spending the extra money on making it more energy efficient as long as they would not receive subsidies for the full amount spent. As local designers, who have

been involved in the project told me, they did not expect to be able to sell the energy efficient apartments at a higher price, since consumers are simply not interested or aware of the benefits of energy efficient houses (Interviews 1; 2; 4). In this area it was very clear that all marketing was aimed at selling apartments as exclusive housing in an exclusive area of Beijing, close to the city centre and the international airport.



Picture 1: Jiarun Garden and aerial view of Upper East Side, Beijing. Source: Schmidt/Hammer/Lassen Architects; Google Earth

In addition, this case showed the complexity and fragmentation of the value chain in the construction industry. The process worked like this: (1) Schmidt/Hammer/Lassen was invited to draw the design of the buildings; (2) they dispatched the drawings to the developer where local designers continued the work on specific details of the building, making sure that it would comply with building codes; (3) further dialogue between Danish architects and local designers; (4) developer applied for approval from local authorities and made final decisions on what type of building materials were to be used (Interview 1; 2; 4). This means that the original architects, Schmidt/Hammer/Lassen, were 'cut out' from important dialogue with for example local authorities and contractors, creating non-constructive gaps in the value chain. One of the Danish architects who worked on the project described it as "*a process where one needs to be very flexible and constantly prepared for unexpected changes in design and material use*" (Interview 1). At the same time the architect pointed at the fragmentation between actors as a key challenge for all Danish firms working in the Chinese construction industry, as the many unexpected changes make it difficult to yield an actual profit (Interview 1).

At the same time designers are under a massive pressure by developers to deliver

designs within a short time frame. Inevitably, this results in 'off-the-shelf' design with only a few alterations in the aesthetic design (Laurenzi 2007: p.43). John Burnett, chair professor of Building Services Engineering at the Hong Kong Polytechnic University, describes a typical building process in China as characterised by a, "*tremendous pressure to build quickly; often construction and design are happening at the same time. The result is 'quick and nasty' design based on rules-of-thumb. There is little time for analysis and some of the details get missed*" (Burnett 2007). Developers tend to rely on outmoded, but well-known designs which are inefficient when it comes to energy conservation. This gives little incentive to designers, contractors and material producers to adopt energy efficient principles in design and materials. Often, developers excuse themselves by saying that they cannot build energy efficient buildings as the required materials are not available. At the same time material producers say they cannot produce and supply these materials since there is no demand from developers and contractors (The World Bank 2001: pp.29-30). Clearly, this obvious contradiction freezes any development in supply and demand of energy efficient building materials and upholds a state of inertia within the building energy efficiency scheme.

The materials needed for constructing energy efficient buildings is a substantial barrier. One aspect of this is, as mentioned, availability of applicable products, such as insulation, windows, doors, bricks etc. Another aspect is the quality of products actually available. According to a study by Chinese experts, the quality of products presents a big problem. They state that 43 percent of energy efficient materials produced independently by Chinese material producers are causing problems in buildings. Materials jointly developed by Chinese materials producers and research institutions are of an even worse quality as 65 percent of these materials is the cause of problems. Some developers and contractors actually trying to comply with building standards try to solve this problem by importing materials from overseas producers. This has not proven to be a very good solution though since 30 percent of these materials are not being installed properly, and yet another 30 percent simply do not match with the building design (Liang et al. 2007: p.1103). Problems with building materials are mostly due to lack of knowledge of energy efficient concepts and building methods among

developers, designers, contractors and workers. Developers in China are highly dependent on advice from engineering consultants when it comes to energy efficiency in buildings (Laurenzi 2007: p.46). If developers are to push the emergence of building energy efficiency, more in-depth knowledge about energy efficiency is required among developers. At the same time, as mentioned earlier, training and education of designers and workmen is vital.

The process of testing and commissioning (T&C) also presents certain problems and barriers. This relates to the before mentioned aspects from the regulation frame in figure 8; the quality monitoring system, the project supervision system and the professional qualification management system. These three systems are meant to function as a precautionary measure for the quality of the buildings. According to John Burnett, "*commissioning is meant to be a quality control process, yet most of it happens at the end of the build rather than during the process*" (Burnett 2007). Thus, T&C is more of an automatic clearance than an actual quality control process. Often, T&C reports are signed after only a perfunctory review, or at worst not verified at all. Use of independent T&C consultants is uncommon (Laurenzi 2007: p.45).

A recent survey on 1079 design studios, consultancy services and contractors showed that while 90 percent of designs and 77 percent of construction methods complied with building energy efficiency standards on paper, only 43 percent of buildings were actually capable of passing standards for energy efficiency in buildings on inspection (Liang et al. 2007: p.1103). The high compliance percentage for buildings on paper and the low actual compliance indicates that T&C have been carried out as a formality and actual T&C have scarcely been carried out. This could also indicate that operation and maintenance manuals and training of building operators is not good enough.

In one of my interviews I was surprised to hear that the interviewees, representatives of a major Chinese developer, could not answer my questions on specific targets for an eco-city this developer was planning. I was quite perplexed that they did not have an exact target for how much energy would be consumed by buildings for heating and hot water and what type of energy efficient technologies they were planning on

implementing although construction work had already begun in the area. It seemed as if they were planning to take such important decisions along the way (Interview 8). It is hard to imagine how buildings in this area will become energy efficient when no fixed target or strategy exists and decisions on this are made in a desultory way. Lack of predetermined targets for energy consumption incites the risk that erroneous decisions are made at the wrong time, thus spoiling opportunities for creating sound energy efficient buildings.

The lack of actual implementation of low-energy technologies in the above mentioned example could also be a symptom of problems with sustainable housing in China in general. An often mentioned potential solution for environmental problems caused by urbanisation is the development of eco-cities. The most well-known of these eco-cities is probably Dongtan, originally planned to be located at Chongming island, north-east of Shanghai. This, on paper eco-friendly, city designed by engineering firm Arup was planned to accommodate 500.000 people in the year of 2040, with the first 50.000 inhabitants already moving in for the World Expo 2010 to be held in Shanghai (Arup). The idea with Dongtan was to work it as model city for other cities, not only for China, but for the whole world – a city which emitted no pollution. In 2006, the former chief of CCP in Shanghai, Chen Liangyu, who originally assigned the land area to the Shanghai Industrial Investment Corporation (SIIC), a state-owned developer, was accused of property related corruption and later convicted to 18 years in prison (Barboza 2008). This incident clearly changed the original premises of the project. In October 2008, British newspaper *The Sunday Telegraph* paid a visit to the area and found nothing but a local farmer grazing his buffaloes, and scattered around the Dongtan site, high-rise apartment blocks without any traces of 'eco' in them. The paper concludes that Dongtan is nothing more but a 'pipe-dream' (Moore 2008). *Ethical Corporation* is also skeptical towards the project calling it an 'eco-Potemkin village' and awarded Arup with the less than flattering award of being 'greenwasher of the year' in 2007 (French 2007). Dongtan is an example of a project, presumably well-intentioned, gone wrong because the basic foundation for the project from the beginning was defective and apparently disconnected from the possibilities within the local context.

Another example of an eco-city gone wrong in China is Huangbaiyu in north-eastern China, co-designed by one of the authors of the highly acclaimed book *Cradle to Cradle*, and co-chair of the China – U.S. Center for Sustainable Development, architect William McDonough, as the first example of exemplary rural eco-dwellings in China. Surprisingly enough, according to reports and articles from journalists and researchers who have visited the area, it seems as if the houses have been planned without taking the local context into consideration. Out of the originally intended 400 houses only 42 have been constructed and the original plans of providing houses with biogas and solar power have been shelved (May 2008a: p.243). As a curiosity all houses have an attached garage even though none of the locals own a car (Streeter 2006). One of the local farmers describes the whole situation in this way, *"No one consulted us about what we wanted in a new house or if we wanted to move there. The new houses are only suitable for factory workers, not farmers. If they want us to move they have to establish a factory there first."* (Toy 2006). As a result, by December 2007, all but two of the 42 dwellings stood empty as most of the local farmers had decided not to move in since the cost for houses largely exceeds economic capacities of the farmers<sup>12</sup>, and because the needs of a traditional family of farmers, e.g. space for growing vegetables in the garden, are not fulfilled (May 2008a: p.242), Toy 2006). According to anthropologist Shannon May, who lived in the district of Huangbaiyu for a total period of 18 months between May 2005 and March 2007, the project lacks a true sustainable approach as it merely upholds the traditional unequal distribution of resources; *"the criteria for sustainability are defined for one population by another population"*, as May puts it (May 2008a: p.243, May 2008b).

The above specific examples do not account for all new construction projects in China, as fine examples of sustainable housing, such as Steven Holl's *Linked Hybrid* in Beijing<sup>13</sup>, do exist. But they do show that ambitions of sustainability in new construction projects, although well-intentioned, sometimes exceed capabilities of planners and designers. The large-scale 'revolutionary' projects seem to be subject to failure because they are

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<sup>12</sup> Each family would have to pay \$8341 to move into one of the houses. The median household in Huangbaiyu would have to work 6.58 years to earn that sum (May 2008a: p.242)

<sup>13</sup> See: <http://www.stevenholl.com/project-detail.php?id=58>



planned and carried out in too much of a hurry and disconnected from the local context, and thereby reproduce the systems and models of unsustainable and inefficient buildings. Instead of constructing houses on the basis of a thorough research and analysis of the foundation and adaptability of a project within a local context, projects seem to be pushed through in a vacuum of ephemeral momentum; the fear of not striking while the iron is hot overshadows genuine long-term investments in low-energy housing, thus resulting in the reuse of cheap and fast, but inefficient design.

## **4.2 Conclusion**

From studying existing literature on the structure of the Chinese construction industry and through interviewing different stakeholders from the industry on location in China, I have found that barriers for energy efficiency in new buildings exist on various levels of society and problems can generally be seen as being many-sided and complex. Roughly speaking barriers can be classified to be within three different spheres; cultural, institutional and technological. Below is a presentation of barriers found, placed in separate spheres.

The division of barriers into these three spheres should not be seen as if there is a Chinese wall between them. Many of the barriers are connected to each other meaning that even though a barrier is primarily relating to one sphere it can also relate to one of the other.

As figure 9 shows, the majority of barriers are to be found in the institutional sphere. This can be ascribed to the lack of reformations within most government institutions at both national and local levels. It is fair to say that most, if not all, developing countries experience challenges with insufficient capabilities of institutions. Taking into account the pace and scale of developments in China it would be reasonable to assume that institutional reforms are having a hard time keeping up with economic and social changes. Thorough institutional reforms are hence paramount in order to remove barriers for building energy efficiency in China.

Barriers located in the technological sphere are fewer but just as significant as the ones found in the institutional sphere. Constant time pressure and the continuously growing amount of construction projects hampers contractors in their efforts of acquiring and taking into use newer technology.

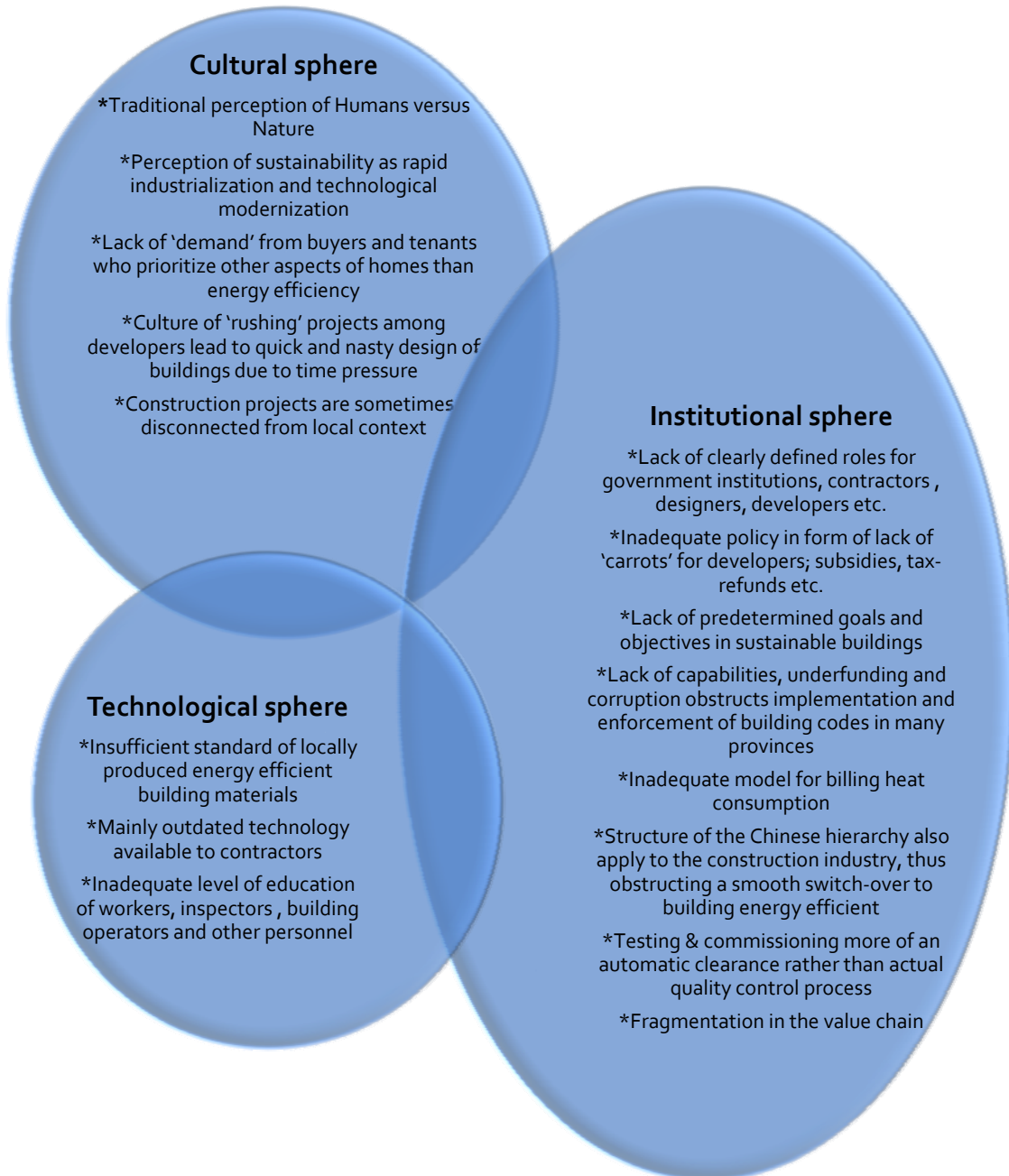


Figure 9: Barriers for energy efficiency in new buildings within cultural, institutional and technological spheres. Source: Own production.

The same challenges apply to material producers who are subject to lack of demand from developers for high-quality energy efficient building materials. At the same time the low numbers of professionals employed in the construction industry constitute a huge barrier, as an educated workforce is a prerequisite for the construction of 'green' buildings, as new and relatively advanced building techniques is applied to most energy efficient buildings.

When looking at barriers in the cultural sphere some are unique for China while others are found in most construction industries around the world. The perception of seeing humans as disconnected from nature instead of as a part of nature, is the foundation for all present and previous economic development in practically all societies. Likewise, demand from tenants and buyers for energy efficient buildings is globally seen a rarity, but is in some countries on the rise due to increasing prices for heating – a similar trend is likely to occur in China if and when reforms of the heat pricing system are implemented. Fragmentation and complexity in the value chain is also a barrier which is found globally in construction industries.

The different barriers identified in this report together obstruct sound and effective integration of energy efficient initiatives in the built environment in China. Bundled together these barriers result in a state of inertia in the Chinese construction industry, where motion in the industry moves unhindered; construction of inefficient buildings continue as sufficient direction-changing external force is not applied, resulting in little real progress. In that context, it is noteworthy that the only progress made is use of voluntary standards as LEED, used as branding by multinational corporations, a progress completely unaffiliated with national and local authorities. In this present state of inertia the initiative to change is left with the industry itself, which cannot be relied on to push forward for a shift in paradigm. As long as the industry is making more money on constructing inefficient buildings than efficient, as long as authorities lack the capacity to enforce building codes and educate employees, and as long as contractors and material producers lack the sufficient technologies, no real progress can be expected. These barriers have to be diminished or overcome before new construction in

earnest will become energy efficient.

Generally speaking barriers for increased building energy efficiency embrace many and multi-faceted aspects. Overcoming these barriers thus require extensive and concurrent efforts on different levels of society.

## **Chapter 5 Ecological modernisation of the Danish construction industry: Perspectives for the industry in China**

This chapter presents the concept of ecological modernisation seen as a shift in developing and using policies on environmental management. The presentation of the concept consists firstly of an introduction to the roots of ecological modernisation. Then the progress in the Danish construction industry will undergo a thorough review with a strong focus on how changes towards sustainable buildings in the industry can be understood within the realm of understanding of ecomodernisation. Afterwards follows a short discussion of the applicability of the concept outside of its breeding ground in Western Europe, which subsequently leads to a discussion of the characteristics of ecological modernisation in China – also seen in the light of perspectives of ecological modernisation of the Danish construction industry. The objective is *not* to compare the development in low energy housing in Denmark and China, but rather to provide a basis for a discussion of the present and future development of building energy efficiency in China. The link to Denmark works as an inspiration model for two approaches: understanding the development in ecomodernisation in China and conceiving recommendations for potential changes in policy towards building energy efficiency in China. This chapter thus provides a theoretical background for the discussions in chapter six on how to push forward the evolution of energy efficient buildings in China.

### **5.1 The characteristics of ecological modernisation**

The changes in the Danish building industry towards seeing sustainable buildings as generally feasible can be described through the concept of 'ecological modernisation' (Jensen and Gram-Hanssen 2008: p.1). Therefore, a presentation of this concept – its roots and implications for modern environmentalism – will precede any description of the process of ecological modernisation in the Danish and Chinese building industry.

The concept of EM emerged in the early 1980s and was quickly adopted by social scientists all related to the 'Berlin school' of environmental policy research (Jänicke 2007: p.557). The concept was not presented in English until the early 1990s, from where the discussion gained momentum within a broader segment of social scientists (Fisher

and Freudenburg 2001: p.702). The motive force for the concept was the need for an ex ante approach to the environmental challenges in form of innovation in environmental technologies. In this way ecological modernisation presents a rupture with former ways of addressing environmental issues through policy-making. Ecological modernisation emphasises advancement of industrialisation and technological innovation hand in hand with development of capitalism. The concept differs in this way from former (and present) approaches which argues that capitalism and/or the process of industrialisation needs to be slowed down in order to address environmental degradation caused by growth and industrialisation (Ibid., Jänicke 2008: p.557). Professor of Political Science and Public Policy, Maarten Hajer, gives the following definition of EM,

*"Ecological modernization [...] uses the language of business and conceptualizes environmental pollution as a matter of inefficiency, while operating within the boundaries of cost-effectiveness and administrative efficiency. Ecological modernization is the positive approach to environmental policy: environmental improvement does not have to be secured within constraints of capitalist market logic, [...], ecological modernization suggests that recognition of the ecological crisis actually constitutes a challenge for business. Not only does it open up new markets and create new demands; if executed well, it would stimulate innovation in methods of production and transport, industrial organization, consumer goods, in short, all those elements that Schumpeter once identified as the forces that produce the 'fundamental impulse that sets and keeps the capitalist engine in motion' (Schumpeter 1961: 83)."*

(Hajer 1995: pp.31-32)

In other words, the linchpin of ecological modernisation is continued industrial development with a strong focus on technological innovation. The approach with solving problems related to environmental pollution by an 'anticipatory' policy-making differs from the more reactionary or 'remedial' approach used by many industrialised countries (Hajer 1995: pp.34-35). Thus, it can be stated that environmental regulation, contrary to what may be the perception of many industries and politicians, does not necessarily hamper innovation and economic growth. It can, according to the theory of ecological modernisation, be the engine of future innovation and economic growth and

in that way foster win-win situations. The ultimate outcome of a process of ecological modernisation is thus an actual *decoupling* of economic growth and environmental degradation; technological innovation and institutional reformation can in theory lead to societies with sustained growth in the GDP but without additional pressure on the environment.

The development of ecological modernisation has gone through three phases. Where the first phase focused on market actors and technological innovation within the industry, the second phase went further and looked closer at institutional and cultural dynamics. The third phase is centred on consumers and how they are affected by the dynamics of ecological modernisation and processes of globalisation (Jensen and Gram-Hanssen 2008: p.3, Mol and Sonnenfeld 2000: pp.4-5).

The theory is by no means stringent in its configuration of relations between state, market and civil society. On the contrary, differing views on especially the roles of the state and the market is a point in the theory where conflicting views clash. The most common view on ecomodernisation is that a voluntary approach will eventually be taken on by both the actors of the market and the political institutions (Hajer 1996: pp.251-253, Holm and Stauning 2002: p.2). The belief is that the economic actors, such as producers, will be able to adjust their production to being more environmentally desirable in accordance to consumer preferences, and that political institutions can rethink the discursive approach to environmental issues and thereby alter the instruments used for environmental policy-making in continuation of views on environmental issues in the public. One can argue that in this view on ecological modernisation, which Hajer describes as 'institutional learning' (Hajer 1996: p.251), the state takes on a sort of *laissez faire* approach toward the market as it trusts the market to self-adjust through technological innovation and competition.

As opposed to this, another view is that in order to facilitate a prudent and rational readjustment towards ecological modernisation, the state needs to act in a more regulatory way. Hajer describes this approach to ecomodernisation as being 'technocratic' because it relies on already existing institutional processes and instruments to solve environmental problems (Hajer 1996: pp.253-256). It can be said

that society in this belief put their trust in the existing structures of institutions – institutions need not to learn or change as they already provide channels and instruments for change. Critics have stated that this will only provide 'false solutions' to 'real problems' as no change is really taking place (Ibid.). Nevertheless it can also be argued that no change will take place if the elite of institutions and policy-makers are not involved as liaisons between economic and environmental interests. In other words the state should act as a sort of enabler in form of using policy instruments that make environmentally preferable production attractive (Holm and Stauning 2002: pp.2-3).

The third approach to ecological modernisation, defined by Hajer as 'cultural politics' (Hajer 1996: pp.256-260) takes the two first approaches; institutional learning and technocracy, a step further. The thesis is that the narrative of environmental interpretation works as a conceptualisation of an environmental discourse adapted consciously or unconsciously by the political system, the market and the civil society. In this mindset all approaches to ecological modernisation act as story lines made up by varying views on environment as a whole, which to some degree uniform different actors' understandings of environmental challenges within certain groups in society; groups made up of different types of actors make up differing story lines as they hold disparate views on environment. As Hajer states: this 'excludes some aspects of reality while manipulating others' (Ibid.: pp.256-257), subsequently confining any environmental discourse to being a product of a certain dominating periods views on nature, society and technology. EM can therefore be seen as an emblem of the belief among dominating actors that an integration of economic growth and environmental advances is needed in order to avoid an environmental crisis. For the analytic mind, the cultural politics approach presents an opportunity to study how the process of ecological modernisation manifests in different political, cultural and social environments within and across borders.

### **5.1.1 The Western European approach to ecological modernisation**

When looking at what characterises the form of ecological modernisation that European scholars usually study, three key elements of the concept can be identified: *political modernisation; economic and market dynamics and economic agents; and civil*



*society* (Mol 2006: pp.34-35). Firstly, increased governance and decentralisation is an integrated part of modernisation in the political system. Today, Mol argues, regulation and legislation is no longer characterised by a command-and-control approach, but is the result of a more flexible process, characterised by a changing relationship between state, market and civil society, and in which non-state actors play a more influential role. At the same time supra-national institutions as the European Union are gaining more direct control with legislation and to some extent undermine national environmental policies (Ibid.). Secondly, readjustments in order to enhance environmental protection is no longer pushed forward only by the state, but to a greater extent by a wickerwork of consumers, producers, customers, financial institutions, insurance companies, business associations etc. (Ibid.). Thirdly, the disintegration of traditional roles and frames for environmental policies has given rise to actors within the civil society who traditionally was placed in the periphery of environmental regulation. They find themselves today very close to the core of decision-making (Ibid.). The traditional European approach to ecomodernisation is closely linked to institutional changes on the basis of alterations in behaviour of the general public and is therefore an approach which can be classified as a moderation of Hajer's institutional learning.

### **5.1.2 Limitations to ecological modernisation**

Ecological Modernisation has and should not go free of critique. One of the limitations of ecological modernisation is its lack of providing genuine, long-term solutions for the environmental crisis. Every time technological innovation has led to improvements it is hit by a 'rebound-effect' (Jänicke 2007: p.557). This effect is to some degree the result of side-effects from the very modernisation process itself; economic growth leads to increased consumption, which neutralises environmental gains. An example is found in the car industry, where efforts have been made to make develop efficient cars that reduce emissions. The effect has been absent though, since the effect of more efficient cars have been neutralised by increased road traffic (Ibid.: p.562). The rebound-effect is also to some degree the result of 'modernisation losers'; actors within the industrial sphere, who loose market shares when the use of a certain product is phased out. They

often find new uses for products which neutralises the initial effect of modernisation. Martin Jänicke describes both situations as an 'N-curve' (Ibid.).

Although there are unanswered questions as far as the actual effect on environmental improvements of ecological modernisation, and whether it will lead to genuine and sound environmental advances, it is without doubt that the concept has and is gaining influence in readjusting and reformulating environmental policies around the world.

## **5.2 Ecological modernisation of the Danish construction industry**

The co-evolutionary way of addressing environmental challenges has had great influence of readjusting the Danish building sector toward an integration of sustainable buildings. Although not a commonly known concept in Danish politics, ecological modernisation is widely used in Danish policy-making<sup>14</sup>. Denmark is one the countries where the concept of ecological modernisation is used the most and the country is in that way only second to The Netherlands and Sweden (Weidner 2002). The use of environmental indicators and measurements of consumption has been used in housing and construction for a long time, and it was the first country to introduce energy labelling of houses (Jensen and Gram-Hanssen 2008: p.4).

In Denmark the overall tool used for formulating certain standards which a building must comply with, is the Building Regulations. This set of regulations features different conditions that need to be complied with whenever buildings are being erected. The regulations contains requirements for administrative processes relating to construction, the built-up area, lay-out of buildings, structure of buildings, fire safety, indoor environment, installations and energy consumption (Danish Enterprise and Construction Authority 2008). The building regulations contain requirements for most aspects of a building process and have been an important part of the regulations since 1982 (Jensen and Gram-Hanssen 2008: p.4). During recent years houses that go beyond

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14 This might seem contradictory but is due to the simple fact that the theory describes and explains recent developments in environmental policy and is in that way not an applicable instrument. Therefore, many politicians and leaders of industry are not familiar with the concept, even though they may work within the discursive believe model of the theory.

minimum requirements within the building regulations in terms of energy efficiency are becoming more common. This progress in the building sector can be ascribed to the process of EM. If one looks more closely at this, three central aspects of the modernisation process in Denmark stand out: *governance*, *standardisation* and *visibility* (Ibid.).

The first aspect, *governance*, is closely related to ecological modernisation. The state is no longer, according to Jesper Ole Jensen and Kirsten Gram-Hanssen from the Danish Building Research Institute, the most important player on the field and this is giving rise to other players in civil-society. Governance features increasingly important roles to NGOs and leaves the state in a situation where it is no longer adequate in regulating in a strict top-down way with methods of only legislation and enforcement. Other methods of regulating, such as voluntary agreements and partnering is therefore emerging within the construction industry (Jensen and Gram-Hanssen 2008: p.5, Thomassen 2004: p.21-23). One example of a new approach to regulating construction of buildings in terms of energy conservation is seen in the new regulations. Today the Building Regulations simply outlines a target in an allowed amount of kWh/m<sup>2</sup> for heating, which all new buildings must comply with, and it is then up to architects, engineers etc. how they reach the target. This differs from the earlier regulations which for example specifically prescribed the thickness of insulation to be used and the area of windows allowed (Jensen and Gram-Hanssen 2008: p.6). In this way the state is regulating in a more invisible macro manner.

In practical terms the shift toward governance in the Danish building industry can be seen in the increasing co-operation or partnering between stakeholders in the building sector on the one side, and NGO's or grassroots on the other. NGO's are playing a more central role in recommending specific materials from a viewpoint of sustainability and in some projects as consultants, co-ordinators and mediators (Jensen and Gram-Hanssen 2008: pp.10-11). It can also be seen in the increased use of cross-disciplinary approaches to building projects. An example of this can be found at Danish architect firm, Henning Larsen Architects, who have just recently employed two civil engineers, specialised in energy conservation. The objective of this manoeuvre is to unify practitioners who

usually works separated from one another, in order to produce the best solutions for integrated energy design in new buildings (Kongebro and Strømman 2008).

The second aspect, *standardisation*, is closely related to governance. As the state loosens the direct top-down regulation, new and voluntary standards arise. This has very much been the situation in Denmark, where an abundance of new standards and tools have been introduced in recent years. Often voluntary standards are used in buildings where sustainability has been on the drawing table from the very beginning of the project, where it is also common that several standards and/or tools are used for one single building project. The voluntary standards and tools are thus not about achieving one specific goal, but more about the process of integrating sustainability into buildings. As Jensen and Gram-Hanssen puts it: it is about branding a building by having used a certain standard or tool in a new building (Jensen and Gram-Hanssen 2008: p.7). According to Hajer the use of multiple standards and tools can be seen as way to provide a 'story line'; a uniform perception of sustainability among different stakeholders (Hajer 1998). Arguments have been put forward that modernisation is closely linked with standardisation, as the many standards and tools compete on setting the norm on for example energy efficiency in buildings (Moore and Engstrom 2005).

Two of the more famous new examples of using voluntary standards in houses in Denmark is, 'The Future Single-family Houses in Køge', located south of Copenhagen and 'Stenløse Syd' north of Copenhagen. Both of these housing projects have gone beyond the standard regulations in terms of energy efficiency and environmental assessments of building materials, and implemented voluntary standards into the houses. In Køge the houses have been labelled by local criteria based on the Nordic eco-label, The Swan, which sets up requirements for building materials and energy consumption. The single-family-houses in Køge are constructed in accordance with the voluntary standards, which in the Building Regulations are called 'low-energy-house class 1 or 2' (Fremtidens Parcelhuse 2008, Danish Enterprise and Construction Authority 2008). Single-family-house and apartment houses constructed in the first phases are allowed to use up to 35 kWh/m<sup>2</sup> and 30 kWh/m<sup>2</sup> respectively for heating and cooling,

meaning that energy consumption in houses in Stenløse Syd constructed in the first phases is approx 35 percent lower than requirements in Building Regulations. Houses constructed in present phases are to comply with requirements in 'low-energy-housing class 1' which encompass a 50 percent reduction in energy used for heating and cooling compared to mandatory requirements. In Stenløse Syd requirements to the new houses was developed in accordance with the local Agenda 21 strategy, which resulted in stricter requirements, meaning that all houses are free of PVC and impregnated wood and all make use of collected rainwater for flushing toilets and in some cases laundering as well (Egedal Municipality 2008, KIBS 2008).

An interesting aspect of the above mentioned examples, which applies for most sustainable construction in Denmark, is the structure of the driving forces behind the building projects. The core of the driving force is actors from, and within the civil society. In both projects mentioned above it were the local municipalities who in co-operation with local NGOs drove the development forward and pushed for the use of voluntary standards. Economic actors and the market has not been able to or seen any reason for why they should take the lead on constructing buildings which go beyond minimum standards in terms of energy efficiency, indoor environment and building materials. Although it is not a traditional top-down way of regulating, it shows that some sort of involvement from the public sector is necessary, at least in Denmark, if an ecological modernisation of the construction industry is to be successful.



Picture 2: Low-energy housing in Stenløse Syd. Sources: Panoramio;KAB

Thirdly there is the aspect of *visibility* in relation to an ecological modernisation of the Danish building sector. This aspect could just as well be named measurement, as monitoring of substance flows, such as heat and electricity consumption, is a key

component of an ecological modernisation. In Denmark there is tradition for using individual metering on heat, electricity, gas and water and studies have shown that individual metering, combined with individual payment for consumption, has an impact on consumption. In existing buildings an average of 15-20 percent reduction in consumption has been registered in connection with installation of individual meters (Jensen and Gram-Hanssen 2008: pp.8-9). Another aspect of visibility is the actual integration of, for example energy efficiency technologies such as photovoltaic cells into the aesthetic design of a building. The development in the Danish sustainable houses is moving towards what could be called an invisible application of eco-technologies. Today there is a strong emphasis on designing and constructing sustainable houses, which architecturally look like conventional houses. The idea is that if the technology can be integrated into a building in such a way that the beholder is not able to see it, then it will make an expansion of the market for sustainable houses easier (Ibid.: pp.15-16). This notion is also the case with the before mentioned examples in Køge and Stenløse Syd

An example of such an approach to invisible 'technological fixes' is the use of passive energy in form of integrated energy design. Consumption of heat and electricity for cooling and lighting can be reduced down to one-fifth of the normal by using geometry optimisation, meaning designing location, angles and facades of a house in such a way that the light from the sun can be used as a passive source of energy (Kongebro and Strømmand 2008).

The progress made in the Danish construction industry shows that when it comes to environmental efforts it is possible to build houses that not only comply with existing legislation, but also go beyond it in terms of energy efficiency and use of environmentally desirable building materials. Essential elements necessary in order to succeed with such projects though, are a progress driven by actors within the civil society, increased co-operation and knowledge exchange between all stakeholders involved in a building process, development and use of well-defined voluntary tools and standards based on environmentally sound principles, usage of measurement of substance flows in buildings and invisible eco-technologies, which can be integrated

with architecturally conventional houses, and as shown in the examples above some sort of involvement from the public sector can be required. These initiatives are all centred on innovation within the existing institutional framework and can be characterised as a paradigm shift from traditional industrial modernisation towards ecological modernisation. Even though there have been some progress in the Danish building sector, it has also seen the limitations of ecological modernisation. In the Danish housing sector energy conservation has been a central issue since the 1980s, but gains in conserving energy for heating has been counterbalanced by consumers' desires for larger houses. As a result, net energy consumption for heating has not changed in the past fifteen years, even though houses have become more energy efficient (Jensen and Gram-Hanssen 2008: p.14). This is a clear example of a rebound effect, or what Jänicke describes as an 'N-curve'.

The form of advances in the Danish building industry tells a story about the dimension of the ecomodernisational approach which dominates the development in Denmark. Although it is not transferable in its 'pure' form, Hajer's ideal-typical array of ecological modernisation as institutional learning, has many similarities with the process of readjustments in the Danish construction sector. First and foremost there is a heavy focus on governance and an implicit confidence in the ability of existing institutions and market actors to rethink their embedded practices and this trust is displayed in the development of voluntary standards. Moreover the focus on building sustainable houses in such a way that they aesthetically look like conventional houses does indicate an ability to adjust products to the preferences of consumers.

### **5.3 Applicability of the concept outside of Europe**

One of the main critique points of ecological modernisation through the years has been the applicability of the theory to other countries and cultures, than the European countries, in which the theory was developed (Fisher and Freudenburg 2000: p.705). Nonetheless, the concept of ecological modernisation is widely discussed and used in many countries around the world – also in China. Professor Arthur Mol, one of the European theorists working with ecological modernisation, has carried out studies on

the process of integrating the concept into environmental policies in China. Mol agrees on the point that ecological modernisation indeed to a large extent is a Western European concept, but argues that the idea of modernising institutions and frameworks on the basis of environmental improvements, has for some time now, been 'exported' to developing countries through different globalisation processes (Mol 2006: pp.29-31). Mol states that,

*"If we apply the (Western) idea of ecological modernization outside Western Europe, we might expect to find environmental reform models that resemble some of its core features, but they will also be coloured by specific local conditions and positions in the world-system"*

(Mol 2006: p.31)

The ideas of ecological modernisation can therefore be found in many of the developing countries, but they will not necessarily be similar to the ideas in Europe, as specific national and local characteristics will transform the concept to some extent. One cannot expect to find a progress in China identical to the paradigm shift, which to some degree has taken place in the Danish construction industry. Similarities in the process of transforming institutions, civil society and discursive approaches to environmentalism are likely to appear, although national and local differences between Denmark and China complicate comparison. In the mindset of Hajer's view on cultural politics the story line on environmental issues in China will differ from the story lines found in Denmark, as environmental discourses, due to cultural, social and political distinctions between the two, vary significantly. The understanding and use of ecological modernisation in a Chinese context is hence bound to dissociate from the European and Danish interpretation. It is here important to emphasise that this does not make the Chinese approach or vice versa inferior in any way, as the basic principle of the concept is its openness for interpretation within different cultural, social and political frameworks.

#### **5.4 Ecological modernisation with Chinese characteristics**

The emergence of environmental institutionalisation in China is strongly linked to the



economic transition which started in the late 1970s. Initially, steps were taken to reduce impacts from pollution on the environment, but these steps were vague and characterised by a strict top-down approach (Mol 2006: pp.38-39). In recent years though there have been greater progress in transforming the institutions in society relating to environmental advances, and signs of modernisation can be seen in changes in the political system, the market, and the civil society, which I believe have had some effect on the approach to environmental improvements, such as energy efficiency, in buildings and the construction industry.

#### **5.4.1 The relationship between state, market and civil society**

Mol describes in his article *Environment and Modernity in Transitional China: Frontiers of Ecological Modernization* (2006), that although the political system in China is clearly dominated by the CCP, which holds hierarchical power over the administrative system, there have been some progress in reforming the political institutions towards greater levels of decentralisation and flexibility (Mol 2006: pp.39-40). Local EPBs are for instance given greater level of liberty in designing strategies for environmental protection in local provinces. The problem in this case being that other local authorities have been giving the same amount of freedom to develop policies, and they tend to prioritise economic growth and social stability over environmental improvements, and since the local EPBs are subordinate to local governments, EPBs are left without any real opportunity of developing and implementing sound environmental strategies (Ibid.).

Although the economic transition has transformed the shape and role of the Chinese state, and it has given greater influence and power in decision-making to local authorities, there is no doubt that the state and the CCP is still of great importance in its influence on decisions taken on all political levels (Schwartz 2004: pp.28-29). In other words decentralisation has not weakened the central government as the 'decline in micro-control' has been compensated by the 'strengthening of macro-controls' (Ibid.). As an example it is clear that even though environmental concerns are being raised by local EPBs, and that they have gained more influence, many analysts, Chinese and

foreign alike, have criticised that EPBs lack the capacity to carry out actual environmental improvements. This due to the hierarchical structure of the system (Mol 2006: p.39). In China the state is, unlike in Denmark, therefore still the most important player on the field and it is difficult to readjust any sector, including the construction industry, without the acceptance and endorsement of the state.

Even though the market and economic actors are experiencing a greater level of freedom and autonomy, not many of these have taken an active part in innovating new environmental strategies or formulating environmental objectives. According to Mol, this is to a great extent because consumers on the domestic market still not do not insist on having the option of purchasing environmentally preferable products, and because eco-labelling systems are only poorly developed (Mol 2006: p.45). As a result, neither insurance companies, banks, business associations, general corporations or building developers, push forward for environmental reforms. Taking on the view of institutional learning, an argument challenging this analysis is that the growing middle-class in China is more conscious about what they spend their money on and more aware about quality in products (Laurenzi 2007 p.27). One survey backing this show that, *"68 percent of Beijing residents said after visiting the site of an energy-saving pilot program in Tangshan, Hebei province, that they would pay more for BEE spaces. Before visiting, just 30 percent said they would pay extra."* (Jia 2008) Consumers would therefore in future be expected to demand more energy efficient buildings and in that way pressure the market actors towards environmental modernisation.

Civil society, which in Denmark has played a role in the reforming of the construction industry as sparring partners, is of a different nature in China. Environmental NGOs are new, few and with minuscule influence on the political arena in which decisions are taken. Western-style civil environmental NGOs are hence not common phenomena in the political landscape of China, but they do exist and are reportedly growing in numbers (Tang and Zhan 2008: pp.426-427). Civil society is thus not precluded from influence. Recent years have also seen a rise of Government Organised NGOs (GONGOs) in China and they have, according to Mol, proven to be able to include environmental concerns among the population and at the same time assert great

leverage on decision-makers (Mol 2006: p.47). GONGOs are often presented as a symbol of democratic problems in repressive rogue states, utilised to put forward governmental concerns at non-governmental or supra-national levels – which to a large extent is presumably true – but, according to an expert on Chinese NGOs, Fengshi Wu, they also hold the capability of enhancing democratic processes and evolve civil society actors within national borders. Because GONGOs in China are not subject to the same restrictions on registration as civil NGOs, due to their close links to state agencies, they are able to bring in environmental concerns in decision-making processes among market and state actors, and in that respect act as mediators between state and market on the one side and civil society on the other (Wu 2002: p.48).

As much as this probably is true for many aspects of environmental work in China, it is important to keep in mind that the nature and role of the civil society itself differs radically from western civil societies. As professor of political science, Jonathan Schwartz, argues, Chinese civil society is not confrontational towards government as it may be in many western countries,

*“As conceived by the Chinese central government, the role of civil society is to link citizens to the state, thereby ensuring the more effective flow of public policy while avoiding disorder. Civil society is not democratic, nor is it considered a precursor to democratization. Civil society is state-led, and cooperates with, rather than opposes, the state.”*

(Schwartz 2004: p.45)

In this context civil society, including civil NGOs and GONGOs, is not representative for a form of bottom-up movement, as seen in the west, but merely exist on the benevolence of the state, which in top-down manner confer and control the political latitude of all civil society actors.

Additionally there exist three aspects of civil society which have influence on environmental reforms in China: respect for authority and status; social connections, in Chinese, *guanxi*; and moral authority and social capital, closely related to the concept of losing, gaining and maintaining *face*. In attempts of reforming environmental policy and

protection, these aspects play a great role. In China it is customary to respect people of higher status, even if it means conflict with government administration or regulation, and *guanxi* and *face* play an important role, as environmental protection is much about exerting influence on informal networks (Mol 2006: p.48).

Civil society actors play an equally important role in formulating existing and new environmental discourses in China as they do in Denmark. In China the available channels used for raising environmental concerns are very different than in Denmark, but they do the job. Of course, it can be discussed to what degree civil society pushes development forward, and in that manner, democratic deficiencies of the Chinese political system, but a counterargument to this can also be put forward: is ecological modernisation driven forward by civil society, necessarily a warrantor for successful environmental reforms? The point being, that market and/or civil society driven ecomodernisation is not necessarily the optimal strategy for China. The historic role and present influence of the state and the embedded respect for authority contains a different opportunity of combining economic growth and environmental advances through technological innovation, and to a slighter degree institutional adjustment, thus resembling what Hajer refers to as *technocratic* ecological modernisation.

#### **5.4.2 Chinese modernisation strategies**

On the 27 of January 2007, the Chinese Academy of Sciences (CAS) released the report, *China Modernization Report 2007: Study on Ecological Modernization*<sup>15</sup>. The report is part of a larger project, by CAS named 'second-time modernisation', which according to Zhang, Mol and Sonnenfeld (2007) is analogous to Beck's concept of second or reflexive modernisation (Zhang et al. 2007: p.662). In short, the report outlines the theoretical and historical background of ecological modernisation and propounds a road map for an ecomodernisation model for China to the year 2050. According to the report, China is ranked 100<sup>th</sup> among 118 countries, based on 121 indicators relating to the ecological modernisation level (TONE 2006). The ambition of the report is that if appropriate strategies, policies and practices are adopted and implemented, then China can be

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15 The full report (450 pages) is in Chinese and has not been available to me; therefore I have used second-hand descriptions and analyses of the report.

among the top 40 countries in terms of ecological modernisation by 2050 (Zhang et al. 2007: p.664). In order to achieve this objective the report states that the Chinese society face several challenges, and based on this presents ten overall suggestions for China's ecological modernisation, all relating to regulation and implementation of strategies for mitigating negative impacts on the environment from the industrial development (CAS 2007). In this manner the report introduces an interesting view on the process of ecological modernisation. It argues that different countries can have different pathways towards ecomodernisation, all depending on the modernisation stage a country is in, and that different modernisation models exist for highly developed countries. Three different pathways are introduced in the report, where *pathway one* relates to the development process of highly developed countries from being primitive civilisations going over agricultural and industrial stages in their development, and ending as knowledge based ecological civilisations.

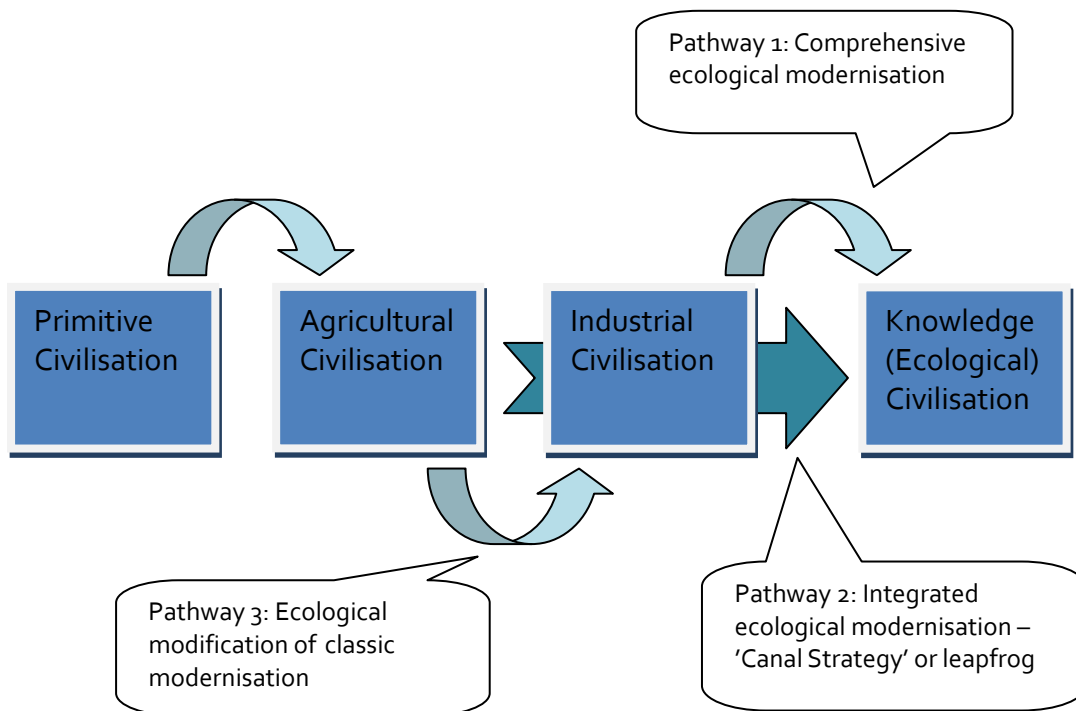


Figure 10: Pathways towards ecological modernisation. Source: Adapted from Zhang et al. 2007: p.663

In addition, the report makes a distinction between different models of modernisation for highly developed countries, by introducing 'the idealist European model', 'the

pragmatic North American model', and a 'realistic model' used by newly industrialised countries, such as China. *Pathway two* applies to developmental countries that take a short-cut by 'leap-frogging' over most of the extent of industrialisation.

This can, according to the report, be done by focusing on accelerated greening industrialisation and circular approach to economic modernisation. This pathway, also called 'the canal strategy' the report states, is the course that China has been on since 1998 where the country publicised a plan for environmental protection (The Ecological Environmental Construction Plan). *Pathway three* concerns developing countries which follow the process of traditional industrialisation but with ecological modifications (Zhang et al. 2007: pp.662-663).

Basically the report is, according to Zhang, Mol and Sonnenfeld, focused on generating ecomodernisation in China by technological innovation and institutional changes, but not by involving the civil society as it has been seen in 'western' societies. In that way they conclude that the strategy for ecological modernisation in China can be related to the first or second phase of ecomodernisation, as it focuses on institutional dynamics and technological innovation rather than the role of consumers and processes of globalisation (Zhang et al. 2007: p.665). According the principle author on the report, He Chuanqi, "*NGOs are less relevant in ecological modernization processes [in China] compared to Western societies*" (Zhang et al. 2007: p.665), due to the role of government. This statement underlines that the theory of ecomodernisation is permeated by the contextual influence of time and place, and when seen as a global phenomena, it is very much a case of *cultural politics*.

Chinese construction firms and design studios have traditionally been owned and controlled by government as they were used for supporting the centrally planned economy. Even though some of these firms and studios today are non-state owned there are still many links and connections between authorities and companies (Mayo and Liu 1995, Xu et al. 2005: p.846), which makes modernisation of the industry virtually impossible without the support of the government. At the same time the lack of market driven environmental reforms, and almost orthodox character of the Chinese civil

society's acceptance of authority, indicates that a sturdy level of state-driven modernisation of the construction industry is in the pipeline. In that way the strategy is similar to what Hajer describes as a technocratic approach to ecological modernisation.

A few similarities between the development of the Danish and Chinese building industry can be found though. As described in chapter three voluntary green building standards have been developed and applied to some buildings within recent years. According to the Worldwatch Institute, in 2007 140 'green' buildings were under construction in China, but few of them meet international standards on energy efficiency and use of materials etc. (Li 2007). Buildings that do show impressive savings and show that sustainable buildings are possible in China have been constructed though. One of them is the Agenda 21 demonstration building in Beijing. This building was completed in 2004 and was the first building in China to become certified by LEED standards. So far the building has shown savings on 74 percent on energy and 60 percent on water, and energy monitoring has shown reductions of 1700 tonnes of emission of CO<sub>2</sub> per year (Jin and Rui 2008: p.113). As LEED is largely driven by market forces, the success of LEED, although moderate, indicates that the market could play an important role in assisting the state in pushing forward a process of ecological modernisation of the Chinese construction industry.

Even though voluntary standards have been developed the approach to ecological modernisation in China differs from the ones found in Europe, and as shown above in Denmark where the diminishing role of the state have been one of the key characteristics of the modernisation process. In China the civil society still play an insignificant role in pushing ecomodernisation forward. This is emphasised by the fact that civil society is not mentioned in the earlier mentioned *China Modernization Report 2007*. This does not mean though that the Chinese structure makes an ecological modernisation of the construction industry infeasible or prospects of a successful implementation of ecomodernisation bleaker. The order of the system and the influence of the state could be a sensible solution for China in creating opportunities for an ecological modernisation of the construction industry which integrates economic

growth and environmental advances. This notion might come across as absurd for advocates of a civil-led progress of modernisation in China, but it is not a case of whether 'power to the people' in form of increased governance and greater margin for civil-NGOs, as shaped after a western recipe, will prove as a voucher for improved environmental management in the case of China – although it would undoubtedly suit the CCP to loosen its grip on the more state-critical part of civil society – or whether the interventionist state in the form of CCP will perform better as a provider of improved environmental management. It is simply a question of political evolution rather than revolution, which means that political leaders in China cannot relinquish the reins completely, nor can they tighten the reins any further as both scenarios would lead to undesirable disintegration of the Chinese society. Again it is a question of commencing on a path of social, political, economic and environmental modernisation with Chinese characteristics.

For the sceptical researcher it can be questioned whether the strategy followed in China is actual leapfrogging or if the country is more on a path of traditional industrialisation, as seen in the west, only more intense in time and scale. It is incontestable that China is making a lot of progress in many areas of technological innovation, such as solar water heaters, where China not only is the largest producer but can also boast about accounting for approximately 60 percent of all installed solar water heaters in the world (Xinhua 2006), and is expected to increase its coverage of solar water heaters by 50 percent by 2010 (Xinhua 2007). At the same time though, it is more than conclusive that China suffers from major environmental degradation and serious setbacks in public health as a result of rapid industrialisation and massive urbanisation (Economy 2004; 2007), and is in that way experiencing all the same 'teething troubles' as western countries has gone through. So the million dollar question, without an attending answer, sums up to: is the process of ecomodernisation in China at present on the pathway of accomplishing the first-ever full-scale technological *and* institutional leapfrog or is the country on the pathway of a more classic industrialisation with hints of ecological and technological advances?



## 5.5 Conclusion

Shifts in policy on sustainable buildings can generally be seen as processes of ecological modernisation. One of the central researchers of ecomodernisation, Maarten Hajer, works with three different types of this form of modernisation: *institutional learning*, *technocratic regulation*, and *cultural politics*. All three types of ecological modernisation are hinged on changes in the relation between the state, economic actors and civil society. What separate the types are the varying degrees in which the relations are changing. The concept is characterised by its flexibility and openness as there is no set definition of how, where and why ecological modernisation will work best; different types of society will experience different modes and forms of ecological modernisation. Although the concept originates from a small group of Western European countries, implications of its characteristics can be found in environmental policy in many countries around the globe.

In recent years the approach towards sustainable buildings in Denmark has seen changes in relations between actors in the building industry. The role of the state has changed from being a regulator of the industry to being more of a mediator between stakeholders, and at the same time new forms of collaboration among stakeholders has emerged. Examples of newly constructed low-energy housing in Denmark show that the process was somewhat initiated by NGOs and local municipalities, and that they complemented existing building regulations in pushing forward the development of sustainable housing by creating a so far unseen demand for low-energy housing, putting pressure on the industry to innovate new products and building techniques. As a consequence, low-energy housing is now aesthetically constructed as conventional houses. The process of ecomodernisation in Denmark has been characterised by what Hajer calls institutional learning, where existing structures and institutions manage to adapt to changing market demands. It is a distinctive feature in the Danish version of ecological modernisation though, that the actors on the market did not adjust and innovate by 'pure' competition, as hinted by Hajer, but needed some sort of starting aid by part of the public sector and civil society, in order to adapt to new modes of constructing buildings.

Ecological modernisation in China differs from the type found in Denmark, but it exists and the idea of connecting economic growth and environmental protection in form of technological innovation is steadily gaining ground. Examples of an increased focus on ecological modernisation are found in the official modernisation strategy for 2007, which focused solely on how China can augment its level of ecomodernisation and in the development of voluntary green building standards. Predictors of an incipient process of ecomodernisation are present, but as Mol and Hajer predicted, they differ in key areas from the typical characteristics of EM found in for example Denmark. The modernisation trend in China is state-driven and thus resembles what Hajer refers to as technocratic modernisation, this underlined by the role of civil society, which plays a minor role in the Chinese variant compared to western forms of modernisation. This inevitably raises questions of whether the future will see, as predicted by Chinese themselves, leapfrogging in the standard of environmental protection and sustained economic growth substantiated by technological innovation and institutional reformation, or whether the country is on a more traditional path of industrialisation with an enhanced focus on environmental challenges, which implies sustained growth in GDP but not necessarily includes noticeable improvements in environment. So far ecological modernisation tendencies in China have not, apart from the small amount of buildings constructed according to LEED principles, had great implications for the sustainability of buildings, including the energy efficiency of new buildings, but the future of the construction industry can be expected to see a modernisation, driven forward by the state and maybe to some degree the market.

## **Chapter 6      The Way Forward**

This chapter will focus on different ways of overcoming existing barriers for building energy efficiency in new buildings in China. The solutions here will be presented separately although they are intertwined and interdependent. The proposed solutions given here are derived from the shortcomings within the identified barriers and based on experiences from countries and regions, which are, or have been, confronted with identical or similar barriers for energy efficiency in new buildings. In order to address the identified barriers and challenges, efforts will ideally have to focus on the following areas: reformations in policy and institutional capacity building.

It is important to emphasise that this report will not be able to provide the optimal solutions and answers to all barriers. The report will point at areas where potential solutions may be found, and to some degree how these solutions can be carried out, but some barriers require such complex solutions that they inevitably will reach across the scope of this report, leaving it empty-handed for answers. In these cases further research is strongly proposed.

### **6.1 Time for change in policy: stick, carrot – and tambourines**

Many of the barriers for improved energy efficiency in new buildings are a result of inadequate policies. The problems are found in policies used to either encourage certain behaviour or enforce existing rules. Such instruments are used globally in many industries and are traditionally centred on market- and financial based instruments. Below follows an introduction of policy-instruments used internationally to improve the quality of the built environment and a discussion of potentials of implementing these tools in China.

#### **6.1.1 International experiences with building energy efficiency policy: potentials in China**

In most developed countries different instruments and schemes are used for lowering

energy consumption in buildings. Although the instruments applied vary among different countries, they all rely on a set of general tools for enhancing energy efficiency in buildings; *standards and codes; Taxes; and Subsidies and soft loans etc.* In addition other, and in some cases more unproven, instruments are in use; *ESCOs; White certificates; CDM projects; Life cycle assessments; and informational campaigns.*

Instruments for enhancing the efficiency of buildings can be both mandatory and/or voluntary. One of the benefits from using mandatory instruments (taxes and building codes are often mandatory), is that a certain minimum level is set for architects and contractors, which they must comply with. The drawback to mandatory instruments is that levels often are set very low because of worries not to create burdens too heavy for the construction industry, and therefore results are mixed (Lee and Yik 2004: p.478). As opposed to mandatory control some argue that voluntary instruments produce better results. The advantage of voluntary approaches, it is said, is that it holds greater flexibility for building owners in reaching targets, and that it promotes dialogue between legislators and industry in a better way. Voluntary instruments have also shown moderate results though (Lee and Yik 2004: p.478). In recent years studies indicate that a mix of mandatory and voluntary instruments gives the best results when it comes to improving energy efficiency of buildings. Besides from setting a minimum level, mandatory schemes can at the same time augment the benefits from voluntary instruments. Voluntary standards can for example use mandatory standards as a baseline and provide an incentive for developers to aim for efficiency levels that go beyond existing standards (Lee and Yik 2004: pp.486-489).

#### **6.1.1.1      *Standards and codes***

Building standards are today the main instrument for increasing energy efficiency in new buildings in many European countries and often consist of a bundle of different requirements to a building, such as fire safety, means of access, energy efficiency etc. Building standards are usually aimed at different types of buildings, e.g. residential, public etc., and can be designed as mandatory national standards, which are to be complied with or as voluntary standards, often involving stricter requirements for

energy efficiency. In larger countries, as the U.S. and Japan, climatic variations result in the issuance of national standards often consisting of a guideline or a set target, which are to be specified and implemented by local governments. Building regulations are mainly targeted at new dwellings and studies have shown that they can be an efficient instrument in efforts of lowering energy consumption for heating in residential buildings (see Schaefer et al. 2000).

In order for building standards and codes to work as an efficient instrument, enforcement of regulations are crucial. Unfortunately enforcement is ineffectual in many countries (Laustsen 2008: p.63). Different countries work with different types of enforcement. In some countries enforcement of the energy performance of buildings is conducted as part of general inspection of all requirements, while in other countries inspection of efficiency in buildings is carried out separately by specially trained independent inspectors. The EU developed Energy Performance of Buildings Directive, EPBD 2003, is an example of a set of guiding principles for the performance of buildings, including inspection of buildings, by for example outlining requirements for inspectors (EPBD Buildings Platform 2009). Denmark has used this directive to develop and introduce new standards for certification of buildings. In Denmark inspection regulations are aimed at both a buildings energy efficiency on paper, which is to be set beforehand, and on the actual performance after construction in an examination by independent experts who holds the right to issue a certificate of compliance or deny the use of a building (Laustsen 2008: pp.63-64). Use of independent experts ensures a professional inspection of buildings and thereby minimising construction of non-compliant and often inefficient buildings.

As mentioned earlier, a relatively adequate set of building standards already exist in China, but rarely are these standards complied with. Voluntary standards are also in use, both Chinese developed standards and American LEED. While the success of the Chinese developed voluntary standards is debatable, the number of buildings applying for LEED certification is increasing. Although it is without doubt that a LEED certification vouches for better energy efficiency, LEED does not provide a full solution

for China. So far, only upscale residential buildings and class A office buildings have applied for LEED certification in China, and this only in the largest cities, leaving the bulk of the build environment; affordable housing for present and future urban residents, still energy inefficient.

The major problem with building codes in China is enforcement. In theory the Chinese system of enforcement should work; buildings are to be approved beforehand and also have to meet requirements in actual testing and commissioning. This is where enforcement fails. Today inspections are carried out by ministerial or other public institutions which are underfunded and lack the expertise to carry out thorough inspections. Just as importantly, according to experts they are not totally independent as traditional ties between developers and government still exist. In order to change this scenario it will be necessary to establish a system of independent and professionally trained inspectors.

#### **6.1.1.2      *Taxes and price on energy and/or CO<sub>2</sub>***

Taxation instruments can exert influence on the energy demand in short term by changing heating and airing behaviour of occupants, and in the long term by influencing the investment decision concerning insulation measures and energy efficient equipment. Although taxes are known as an efficient instrument in theory, in reality barriers exist which lower the efficiency of taxes such as incomplete information, not fully rational behaviour and principal-agent problems (Schaefer et al. 2000: pp.5-6).

In China present taxation and energy pricing systems have great influence on building energy efficiency, especially in the heating zone. Today residents in northern China pay for heating according to living area, rather than by actual consumption, hindering improvements in buildings energy efficiency. As consumers are not charged by their actual consumption, they have no incentive in demanding more efficient buildings. Therefore a reform of the heat-pricing system together with mandatory installation of individual thermostats in homes is essential.

### **6.1.1.3        *Subsidies, soft loans and tax credits***

These instruments are mainly used for introducing new technologies or retrofitting already existing old buildings. Subsidies can also be effective in cases where occupants of a building wish to improve the efficiency of the building but lack the economic liquidity (Schaefer et al. 2000: pp.100-103). Subsidies can be given on a basis of compliance with minimum standards or on a stricter basis of meeting requirements in the field of energy efficiency. A problem with subsidies are that they are not necessarily supporting the development of the most efficient technology, but often merely support new technologies in general. Therefore subsidies can be seen as an instrument which can be effective when it comes to innovation, but not necessarily in terms of the most efficient reduction of energy consumption.

An example of successful use of subsidies as instruments for enhanced building energy efficiency is found in Austria. In some provinces the use of additional insulation, more efficient windows, installation of solar heaters or photovoltaic systems etc. are rewarded with subsidies, a system which has resulted in most new buildings being more efficient than required in building codes (Laustsen 2008: p.64).

Soft loans are usually given under more favourable conditions than traditional bank loans and are often granted by banks cooperating with or owned by the state. From governments point of view soft loans are often preferable as an investment is made in energy reductions, but with less public spending compared to subsidies (REEEP 2009: p.23).

Today subsidies in China are only given for some energy efficient building materials and cover only 10 percent of the additional expenses for building energy efficient. This leaves developers with little incentive for going green, as they do not benefit from reduced energy consumption due to split incentives. Augmented subsidies, tax exemptions for energy efficient buildings and the facilitation of soft loans would provide economic stimulus for developers and building owners.

American LEED AP and expert on green buildings in China, Geoffrey Lewis, argues that

in order to be able to value the affordability of for example affordable housing in China, it is necessary to look at the Total Cost of Operation (TCO); including rent, taxes, maintenance etc. This way the true value of a building will be become apparent to both developers and tenants. According to Lewis specific measures are to be taken by government though if the use of TCO is to succeed. First of all government needs to commit developers in a long-term scheme where costs above a set level would be on the account of the developer and costs lower split between developers and tenants. Secondly, government should encourage the introduction of soft loans for sustainable buildings (Lewis 2009). Lewis talks about measures to be taken to specifically enhance the efficiency of affordable housing in China. I agree that these measures are necessary, but believe that they could and should be used on a broader scale and be targeted at all sectors of the construction industry: residential, commercial and public buildings.

#### **6.1.1.4      *Energy Service Companies***

The use of Energy Service Companies (ESCOs) usually involves Energy Management Contracts (EMC). The system works with the ESCO providing funding for a client who wishes to optimise the energy efficiency of a given project. Often the ESCO will also provide different services in a project such as maintenance, monitoring, construction, design etc. After successful implementation of a project, economic benefits from the achieved energy conservation are shared between the ESCO and the client according to the contents of the EMC. This way the client, for example a building owner achieves reductions in energy consumption without additional expenses, and the ESCO achieves a quick profit from a relatively small investment.

The use of ESCOs is fairly new but on the rise, also in China. In 1997 three ESCOs were registered in China, today approximately 300 are registered. A recent study shows that 60 percent of ESCO projects in China are aimed at buildings and that 90 percent of these projects have a payback time of less than 3 years. The use of EMCs is growing in China and currently the Chinese government is considering developing the scheme further as it provides energy conservation in buildings without public spending. Theoretically the system could be used for new buildings, but in reality ESCOs in China



focus predominantly on lowering energy consumption in existing commercial and public buildings (REEEP 2009: pp.20-21). The concept of ESCOs is new, but results so far are promising, therefore use of ESCOs and EMCs should be developed further with a focus on how ESCOs can manage the performance of new buildings.

#### **6.1.1.5      *White certificates***

Closely related to the emissions trading scheme, the use of white certificates are attracting more and more interest. The concept of white certificates is quite simple; energy reductions achieved by producers or suppliers in end-use sectors are rewarded with a white certificate. The certificate can be used in target compliance or be traded to other parties. This scheme is often used with legal bonds, meaning that failing in achieving a white certificate activates an economic penalty, thus providing a clear incentive. Certificates are issued by independent institutions (REEEP 2009: p.24).

In England, Scotland and Wales *The Carbon Emissions Reduction Target* is aimed solely at the residential sector, where gas and electricity suppliers can achieve white certificates by changing light bulbs, re-insulation, renovating or changing boilers etc. (REEEP 2009: pp.24-28).

Tradable white certificates is at the moment not in use in China and would probably not be introduced in the near future as designing and setting up such a scheme require substantial funds (REEEP 2009: pp.37-39). The concept could become interesting for China in future though as market systems mature. Feasibility studies on setting up such a scheme in China in relation to the construction industry should be carried out.

#### **6.1.1.6      *Clean Development Mechanism***

Under the Kyoto Protocol, countries with a concrete greenhouse gas emission reduction target, mostly industrialised countries, have the option of implementing projects containing emission reductions in developing countries in return for Certified Emission Reductions (CER). The cores of the concept is in a win-win scenario of mitigating emissions of greenhouse gasses in a cost-effective way for developed countries, and at

the same time create sustainable advancements in developing countries. This mechanism, the Clean Development Mechanism (CDM), involves a fairly complicated process, which covers everything from identification of a project to issuance of CERs (UNFCCC 2009a).

The most persistent point of criticism against CDM is 'the low-hanging fruits' problem. Many NGOs and academics have raised concern over the model of using the cheapest abatement options now, as this will leave host countries in a difficult situation in future as only expensive abatement options are left. On the contrary many academics refute the criticism by emphasising that host-countries are heavily involved in selecting and approving projects, and point at the benefits from the 'cherry-picking' model, such as basic technology transfer and capacity building (See for example Narain and Veld 2007).

Despite its complexity and criticism against the arrangement, CDM has proven to be a somewhat successful instrument for mitigation of greenhouse gasses with, as of 1 of April 2009, 1533 registered projects worldwide, which has lead to an estimated reduction of greenhouse gas emissions of 220 million tonnes CO<sub>2</sub> equivalent each year (IGES 2009a).

China is by far the largest host country for CDM projects, with more than half of all projects worldwide, having been implemented in China. The majority of projects are centred on hydro- and wind power projects (IGES 2009b). Surprisingly enough no projects have so far been carried out on building energy efficiency in China (REEEP 2009: pp.31-34). Given the already existing amount of CDM projects in China one would expect that setting up a system of granting CERs for projects relating to energy efficiency in buildings (e.g. insulation, windows lighting, solar heating etc.), would be fairly simple and low-cost. Since China is one of the world's largest building sites, with approx half of all construction taking place in this country, there would be vast potentials for using CDM to enhance the energy efficiency in both existing and new buildings. On the political level Chinese ministers seem to be aware of the potentials of CDM, as the vice-minister of construction in 2005, Qui Baoxing, stated that, "*China's energy-efficient building constructions could be completed through international*

*cooperation in CDM projects*” (Baoxing 2005). So far though, the use CDM in China’s construction industry remains relatively unexplored. I strongly propose that new methodologies for BEE related CDM projects in China are developed.

#### **6.1.1.7      *Life cycle assessments***

Instruments for auditing the full cost of a building from cradle to grave, construction – running – demolition, holds the capacity, with the right methods of calculating costs, of presenting the total costs for a building through its lifecycle. These methods are usually known as Life Cycle Assessments (LCA), but are also known under the name Life Cycle Costing (Dale 1993, Ortiz et al. 2009: p.29). The instrument can be used for whole buildings or specific products or building materials (e.g. insulation, photovoltaic systems). In using LCAs, a buyer, contractor or developer of a building has the possibility of making decisions on a more thorough economic foundation, as the building with the lowest initial cost seldom is cheapest building in the long run when operational costs and expenses for demolition is taken into consideration. LCAs can therefore enhance the use of energy efficient materials as these are valued on a more just basis as they usually are cheaper in running costs, even though they can be costly to purchase.

When it comes to methods of calculating the costs of a building, several different techniques can be used, the most common being: Payback Period (PP), Average Accounting Rate of Return (AARR), Net Present Value (NPV) and Internal Rate of Return (IRR) (Dale 1993: pp.3-10, Lam et al. 2007: p.826), with the latter two often associated with similar Discounted Cash Flow (DCF) methods<sup>16</sup> (Lam et al. 2007: p.827). While PP is commonly-known and widely spread as a method of evaluating investments in the construction sector, it holds a few but significant limitations; namely that it does not take into account variables as inflation, interest, cash flow and taxation (Dale 1993: p.4). Therefore most academics recommend the use of DCF methods as NPV or IRR, over PP

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<sup>16</sup> As the scope of this report is not including theoretical economics I do not intend to go deeper than a simple mentioning of methods and a short presentation of limitations to PP. For a more comprehensive introduction to methods of capital budgeting in construction see for example Bull (1993), Lam et al. (2007), or for a more general introduction Shapiro (2005).

(Lam et al. 2007: p.827).

Surprisingly enough a study from 2004 of use of capital budgeting methods among contractors in Hong Kong revealed that few contractors make use of the more accurate DCF methods, while most contractors predominantly rely on PP methods despite its limitations (Lam et al. 2007: pp.826-827). Implications of the use of PP over DCF methods are potential dismissals of economically and environmentally viable buildings and a favouring of, in the short run cheap but inefficient buildings. As many energy efficient improvements have long payback periods these will most probably be rejected even though these investments might prove economically sound in the long run when all variables are considered.

In China few buildings are evaluated by LCA methods and besides American developed LEED and the Chinese ESGB and GOBAS, the only method used is certification of construction firms within the ISO 14000 series. While the limitations of the first mentioned have already been described, a study from 2003 indicate that ISO 14000 certified firms in the construction industry are few and the ones certified are so to be able to compete on international markets, not the Chinese (Zeng et al 2003). Chinese ISO certified firms are hence not likely to have a strong focus on for example affordable housing in China, but more on upscale office buildings aiming at a LEED certification. Clearly, there is a need for improving the use of LCAs in the Chinese construction industry, for example by law mandating a thorough LCA for all construction projects.

Since the use of LCAs relies heavily on credible sets of data from especially operation of a building, the first step in China is to set up a scheme on compulsory collection and surveillance of operational data from both existing and new buildings.

#### **6.1.1.8      *Informational campaigns***

In order for the above mentioned tools to attain an impact on the way buildings are constructed in China it is decisive to propagate the economic and environmental benefits of constructing energy efficient buildings. Often developers' reluctance to build 'green', originates in lack of knowledge or misperceptions of additional costs, and

contractors lack of knowledge in use of new technologies and constructional methods. Furthermore, as in the rest of the world, Chinese buyers have an insufficient understanding of what makes a building energy efficient – often they hold the conception that a new building is energy efficient, simply because it is new (Laustsen 2009: p.17).

In other words, only using traditional policy-tools as stick and carrot is not sufficient. The former chair of the World Green Building Council, Kevin Hydes, has stated that “*carrot, sticks and tambourines. Carrots, sticks and celebration*”, is definitely needed if China is to begin building energy efficient houses (Hydes 2008). This is similar to what the Director of Sustainable Buildings Team at Arup, Chris Twinn, has termed as the concept of *confidence building*; raising the awareness of stakeholders and establishing a ‘faith’ in the potentials of building energy efficiency (Twinn 2008). Informational campaigns aimed at all stakeholders in the construction industry are therefore a key aspect of triggering and powering a shift towards constructing energy efficient buildings in China.

## **6.2 Technology transfer and capacity building**

As mentioned earlier many contractors and material producers lack sufficient technology to be able to produce and implement energy efficient technologies and techniques. Many interviewees expressed a belief that the biggest problem for the Chinese construction industry is the lack of access to the newest technology – if only they had the technology there would be no problems (Interview 4, 6, 8, 9). The need for technology is in my opinion clearly not the only barrier for energy efficiency, but I do acknowledge that an upgrade of hard technologies used in the construction industry would be a step in the right direction. It is important though to emphasise that technology transfers in itself will not deliver any solutions. There are many examples of Chinese firms who possess the technological capacity to address environmental problems, but avoid to make use of them, as the cost appears too high (Economy 2004: pp. 198-199). This could be related to the different aspects of technology transfers; transfer of hard technology and transfer of know-how and capacity. The transfer of hard

technology will be treated in chapter 6.2.1, while the latter aspect will be discussed in the following chapter, 6.2.2.

According to late professor of economics, Edwin Mansfield, a distinction between different aspects of technology transfer have to be made. First of all, there is the difference between horizontal and vertical transfers. A vertical transfer being when information is processed through a chain from research to production, while horizontal transfers are when a technology used in for example Denmark is applied in a different country, e.g. China (Mansfield 1975: p.372). Secondly, Mansfield argues, it is necessary to distinguish between the types of technology being transferred. Three types of technology exist: general *technologies* (common information in an industry); *system-specific technologies* (technologies related to the manufacturing of a specific product); and *firm-specific technologies* (technology relating to for example production experiences of a specific firm) (Ibid.: pp.372-373). Thirdly, it is important to distinguish between the different phases of a technology transfer. Mansfield argues that in the first phase, *material transfer* involves the export of a specific product from one country to another, while the second phase, *design transfer*, involves the export of blueprints and manufacturing designs<sup>17</sup>. The third phase is the most important but also the most difficult and costly, and involves the transfer of *capacity* to adapt new technologies into existing political, social and economic contexts<sup>18</sup> (Ibid.: p.373).

### **6.2.1 Transfer of hard technology**

Transference of hard technology has on an organised level in the case of China taken place for quite some decades, and is according to experts, one of the largest importers of technology in the world. Since the 1950s China has imported technology from foreign countries, first the USSR and East European countries, and since the late 1960s mainly from the EU and Japan (Andreosso-O'Callaghan and Qian 1999: p.123). Since China introduced its open door policy, large amounts of hard technology have been

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<sup>17</sup> The first phase is referred to in this report as hard technology.

<sup>18</sup> The last two phases are in this report referred to as soft technology.

transferred as part of FDIs. Experts in this field state that although it has never been part of any official Chinese laws and regulations on investment, transfer of technology in correlation with investments have been strongly encouraged. Many foreign investors have been pressured to accept this de facto policy when discussing potential investments (Ibid.: p.129).

Speaking to Chinese experts leaves one with the perception of this more or less still being the case in China. There seem to be an exorbitant, some would say undue, attention on technology in China, also in the construction industry. Interviewing Chinese developers and experts left me with a clear impression that, although not part of an official policy, the Chinese society is still very devout on acquiring western developed state of the art technology.

As much as this offhand seems logic and understandable, on second thought the somewhat one-sided focus on hard technology appears more as a pitfall than a solution. This lies in the particular approach to new technology in the Chinese society; acquiring technology is as much about just possessing them, as in putting them in to use. As much as contractors and material producers are in need of renewed technologies, the sole transfer of hard technology will most probably prove to be a failure in the long run, as many hard technologies will not be put in to use, due to a general lack of know-how. As Mansfield stated back in 1970s, the transfer of capacity is the most crucial part of making technology transfers work.

### **6.2.2 Transfer of soft technology - enhancing institutional capacities**

When attempting to conceptualise the political and institutional inadequacies hindering a switch-over to energy efficient buildings in China, the notion of *capacity building* comes in handy. Although it is fundamentally a theoretical concept, it holds great potentials as a practical and operational instrument when seeking to pinpoint problems and demonstrate solutions.

### 6.2.2.1 The basic concept of capacity building

One of the academics who have studied and worked in the field of capacity building for quite some years, Martin Jänicke, defines capacity as,

*"[...] the concept points the objective limits to (and necessary preconditions of) successful solutions of a given type of problem [...] Lack of ecological, technological or administrative knowledge, lack of material or legal resources, the weakness of environmental organisations or institutions in relation to vested interests are well-known examples of such limitations"* (Jänicke 1997: p.1)

In other words the concept of capacities relates broadly to the capabilities of a society to 'fix' specific problems.

Jänicke argues though that the outcome of actions on for example environmental problems cannot be ascribed to one single factor, such as the political or institutional framework, but is the result of interaction between different and complex factors. The factors Jänicke list, include: *actors, strategies, structural framework conditions, situative context and character of the problem* (Jänicke 1997: pp.4-8). The point here is that analysing policy outcomes will, according to Jänicke, always include several factors and it is therefore not possible to imitate policy solutions for a given problem from one context to another, as actors, structural framework conditions, the situative context and the applied strategies, would necessitate a different outcome. Jänicke is basing this on studies on policy-outcomes of environmental problems in general. I agree with Jänicke that solutions for broad problems requires the inclusion of many different factors, but I also eye perspectives in transplanting political structures as a solution when somewhat identical problems appear in disparate contexts. This is to a large extent the case with energy efficiency in new buildings in China; many of the barriers found in this country also apply to most other countries (see for example WBCSD 2008). It could therefore turn out to be fruitful if institutional structures were copied or adapted from a country, which have been particular successful in overcoming identical barriers, to a country as China, which in many ways is struggling to get past fundamental barriers. Later in this



chapter it will hence be discussed whether the concept of institutional transplantation holds potentials for solving some of the problems with lack of capacity seen in the Chinese construction industry.

According to an assessment from the Asian Development Bank, *"more than half of the pollution discharges can be reduced at many enterprises through strengthening management rather than upgrading equipment"* (Huq et al. 1999: p.542). Even though these figures look intriguing, officials from multinational corporations contend that Chinese firms or ministries looking for cost reductions in projects always, and as the very first, cut training and education of employees from the budget (Economy 2004: p.197). As Mansfield proclaimed enhancing the capacity of a country is the most difficult challenge, but in the case of China it is an imminent and crucial job to accomplish if buildings are to become energy efficient.

Traditionally, problems in all policy-fields have been solved by governments in command and control fashion. Today ways of governing have been reshaped in most countries and now includes civil society and market actors in a form of governance. Therefore the capacities of many societies comprise capabilities and limitations of actors from various levels of society. In the case of China though, government, especially local government, is still the single most important actor, even though the market and civil society has gained more influence. In the words of Jänicke,

*"Command-and-control approaches may have their weaknesses regarding efficiency, innovation, or resistance from the target group. But if they remain latent and integrated in a strategy of 'negotiation in the shadow of hierarchy' (Scharpf, 1999) they may be very important and leave little room for criticism."*

(Jänicke 1999: p.6)

In China traditional top-down regulation is generally seen as the most efficient method of making policies work. This is due to the structure of the Chinese society, which historically has been ruled by 'one-man' (emperors), or one-party systems, resulting in

weak legal instruments. Therefore is the state generally seen as the sole provider of solutions to existing and arising problems, such as environmental degradation (Mao 1999: pp.242-248). It can thus be argued that the Chinese state works, as Jänicke describes above, in a command-and-control manner, but also as 'negotiation in the shadow of hierarchy'.

As shown earlier the majority of barriers for improved energy efficiency in new buildings lie within or are related to the institutional structure of China. Enhancing the capability in China to improve the quality in the built environment must hence focus on building the capacity of institutions. More specifically, tasks undertaken by national and local institutions, such as education of workers, architects and inspectors, preparation and management of policy-systems, and accumulation of know-how on building energy efficiency, is the Achilles' heel of China, and where the greatest weaknesses of the system are found. Any improvement of the existing system, including changes in policy, requires a synchronous build of institutional capacities.

The institutional capacity of a country is defined by The World Bank by its ability to: (1) identify problems; (2) balance interests; (3) implement policies; and (4) learn and adapt policy (The World Bank 2003: pp.96-97). According to Li and Zusman, the ability of institutions to manage these four categories is defined by the amount of financial resources and human capital held by the institution (Li and Zusman 2006: p.10617). In other words, what is needed in China is an increase of economic resources allocated to institutions working with the construction industry and increased training and education of employees within various institutions, such as agencies and bureaus responsible for, for instance the quality monitoring system, the project supervision system and the professional qualification management system, found in the intermediate layer of the construction industry (figure 8).

#### **6.2.2.2 Methods of enhancing the institutional capacity of China**

Various methods of enhancing institutional capacities can be found in existing literature. In the following a presentation will be given of some these methods, as well

as their adequacy in the case of China will be discussed. These methods focus primarily on the augmentation of human capital in institutions, education and training, and barely broach the role of financial resources, as this is a 'simple' question of allocating sufficient funds.

#### 6.2.2.2.1 *Technology transfer under the Clean Development Mechanism*

Under the Kyoto Protocol most developed countries must meet set targets of reducing emissions of green house gasses, such as CO<sub>2</sub>. Developed countries that fail to reach reduction targets by national measures have the opportunity of 'buying' or acquiring more emission credits by making use of the often debated flexible market-based mechanisms, called *emissions trading*, *Joint Implementation* and previously mentioned *CDM*<sup>19</sup>. In relation to capacity building these mechanisms offhand become interesting as their primary objective, as stated by the United Nations Framework Convention on Climate Change (UNFCCC), is to: "*Stimulate sustainable development through technology transfer and investment*" (UNFCCC 2009b). By technology transfer here the UNFCCC refer to both hard and soft technology. As argued earlier in this chapter the imminent need in China is not for hard technology but soft, therefore will the following discussion of transfer of technology under the flexible mechanisms focus solely on soft technology in form of know how etc.

Under the CDM it is possible to contribute to transfer of technology by implementing technologies which are currently not available in host countries. According to a study by climate change economist, Stephen Seres, the host countries have an influence on the level and the extent of technology transfers through the set of criteria established for approval of projects by the host country, and by tariffs on imported equipment. The result, Seres argues, is that a country like China, with its criteria, has significantly lower

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<sup>19</sup> As Emissions Trading does not involve any transfer of technology (UNFCCC 2009c), and since Joint Implementations are only an eligible mechanism to be used by Annex B Parties, both hosts and donors (UNFCCC 2009d), this excludes these two mechanisms as potential modes of transferring soft technology to China.

than average rate of technology transfer under CDM projects (Seres 2008: pp.17-18).

Although article 4.5 under the UNFCCC specifically state that developed countries should take steps to transfer 'environmentally sound technologies and know-how to other Parties, particularly developing country Parties' (UNFCCC 2009e), only 36 percent of CDM projects involve transfers of technology (Seres 2008: p.1). As stated earlier the need in China is for know-how in order to build institutional capacities, sadly transfers of knowledge alone accounts only for 15 percent of the total transfer of technology in CDM projects (Ibid.: p.10). When looking at technology transfers in relation to energy efficiency in households, figures underline a tendency that transfers of know-how under the CDM is not given enough priority; no projects involved transfer of know-how alone, and only around 15 percent of energy efficiency projects in households involved transfers of both equipment and know-how (Ibid.: p.13). Adding these figures to the fact that so far no CDM projects in China have focused on building energy efficiency, show that at present barriers exist for integrating and taking full use of the potentials in the CDM when it comes to building energy efficiency. There is no doubt that the CDM holds great opportunities for lowering mitigations of GHG *and* transfers of technology, but it is also evident that the mechanism has to be readjusted before it can fulfil its potential. I therefore propose that further studies on what barriers exist for CDM projects relating to BEE in China and how to overcome these barriers should be carried out.

Most experts on CDM agree that the mechanism is in need of a reformation and some of these propose steps to be taken in order to ameliorate the situation, in the publication *A Reformed CDM – including new Mechanisms for Sustainable Development* (Olsen and Fenhann 2008). The contributors generally point to the COP 15 to be held in Copenhagen in December 2009, as an arena in which decisions on reforming the CDM should be taken, so that the objective of facilitating sustainable development in developing countries can be fulfilled.

If the CDM undergoes reformation, and barriers for BEE under CDM projects in China are identified, then the mechanism could become of great importance for the build up of capacities in the Chinese construction industry.

#### 6.2.2.2.2 *Institutional transplantation*

The use of institutional transplantation as a political and social mechanism can be dated back at least several hundred years, e.g. the Roman empire borrowed diligently from the Greek empire and colonial powers consistently applied their own political systems in their colonies (De Jong et al. 2002a). Recent decades have seen an intensification of institutional transplantations as a consequence of the contraction of time and space in an era of globalisation; many countries and organisations borrow management practices, policies or whole political institutions from one another. Most institutional transplantations involve transfers from developed to developing countries though (ibid.: p.3). The import of the Swedish invented institution *Ombudsman*, a form of peoples' lawyer or watchdog, is an example of an isomorphic structure which today is found in many countries around the world, with regional and national differences though.

A study from 2002 on experiences with institutional transplantation from an international perspective, illustrated by case-studies, show several different approaches to applying existing institutional structures into new contexts. The 12 different approaches are: (1) *imposition*; (2) *adoption*; (3) '*xeroxing*'; (4) *adaptation*; (5) *single model*; (6) *multiple models*; (7) *endogamy*; (8) *exogamy*; (9) *concrete procedures*; (10) *guiding principles*; (11) *system upheaval and/or performance*; and (12) *protracted sense of policy dissatisfaction* (De Jong et al. 2002b: pp.284-286). The 12 approaches can be seen as opposite pairs; e.g. imposition versus adoption, exogamy versus endogamy etc.

The main lesson to be learned from the study is that transplanting different policy structures or institutions from one context to another require different approaches. There exist no ideal set of approaches which can be used in all transplantation projects; the approach working successfully in one project may turn out to be a disaster in another. The point being, all feasibility studies carried out before an actual transplantation have to thoroughly study the context of the host country.



Figure 11: Different approaches to Institutional Transplantation, paired in opposites. Source: Own production.

A policy system based on strict hierarchy will probably not work out in a country with a loose hierarchical structure, and vice versa. Several factors have to be considered before a transplant is carried through, such as: What sort of political structures are already in existence? Does the host country have a culture of adaptation or does the country have a history of rejecting unfamiliar systems? Even then there is no guarantee of instant success. As the editors of the study state,

*"Institutional systems can take lessons from one another on how to steer developments in particular directions, but introducing the institutions of one system into another does not automatically guarantee identical effects. It takes time for results of reform to become visible, because the players have to adjust to the new structure and due to the reciprocal*

*influence of the Fremdkörper [foreign body].*

(De Jong et al. 2002b: p.294)

Minor variations from the donor country to the host can affect not only the process but also the structure of the transplanted system. As countries are not static elements they constantly evolve, and has always evolved along somewhat different paths, making it difficult to predict the precise outcome of institutional transplantations, but when they succeed, and they do succeed, they provide a low-cost method of speeding up development and progress in host countries (De Jong 2002a: p.4).

So, how can institutional transplantation come to use in China and improve the quality and efficiency of the built environment? What particular institutions are in need of an upgrading and where should China look to for viable systems to import? First of all it proves interesting to identify systems and institutions relating to the construction industry which have already been transplanted from other countries. The most conspicuous foreign system in the construction industry in China is definitely LEED. Not only has this labeling system been imported in its pure form, but it has also worked as a heavy source of inspiration for the Chinese ESGB system. Here it is worth noting that the LEED system so far has proven far more successful than ESGB, indicating that a 'clean import' in this case proved more efficient than the adapted system. The apparent explanation for this being that the LEED certification system, with trained consultants and inspectors is far more developed than ESGB. Thus, a lesson learned from the import of LEED is that a fully developed labeling scheme for buildings, with the educational foundation in place, can provide a quick and efficient improvement of building standards in a developing country.

As LEED is a voluntary standard though, it does not ameliorate the problematic situation with lack of implementation and enforcement of Chinese mandatory building codes. To overcome this barrier China has to look somewhere else, for example towards countries with a similar climate as in the heating zone; Finland, Sweden, The Netherlands and Denmark, where heating consumption is up to three times lower than in cities in northern China (Li 2008: p.1737). These countries have a long experience with

building energy efficient houses and have developed well-established systems for auditing and inspecting buildings. The Danish model for instance, with professional and independent inspectors would probably prove beneficial for China, but obviously extensive feasibility studies would have to be carried out before such a transplant.

Furthermore institutional transplantation could be a viable solution for improving some of the policy-tools mentioned earlier. Especially importing systems for tax-reductions and subsidies, and systems for introducing white certificates could potentially provide quick and cost-effective solutions for China in its efforts of lowering energy consumption in buildings.

Regrettably, this report is not extensive enough in its scope to give all the answers; specifically not being able to select the optimal transplants for China. It can merely point at areas in which institutional transplantation could be a solution. These unresolved questions requires answers for which I propose further research to be carried out.

#### *6.2.2.2.3 The role of NGOs*

As discussed in chapter 5, one of the trademarks of ecological modernisation, also in China, is the increased role of actors in civil society. The civil society in China is gaining importance as an actor in society which is to depend upon for education and training of the public on environmental matters. Institutions relating to the state are thus not the only actor to focus on when addressing the need for building the capacity in the Chinese society. The role of an empowered civil society as a method of enhancing capacity will therefore also be discussed here.

As described in chapter 5.4, NGOs in China are not in opposition to the government as western NGOs often are. Western NGOs therefore often take the role as watchdogs of government and business communities, criticising actors from both spheres when they violate laws and conventions. Some environmental NGOs, such as Greenpeace, are also known for making use of civil disobedience as a means of raising awareness on given



subjects. It is highly unlikely that Chinese environmental NGOs would fling themselves into the kind of criticism known from the west, although it has happened in forms of unauthorised rallies and public protest, which have always been met with swift arrests of participants (Economy 2004: pp.252-256). Chinese environmental NGOs have had success though with exerting their influence in more traditional ways via the political hierarchy (For examples, see: Sun and Zhao 2008).

It is not pending that Chinese environmental NGOs will enter the political scene with mass rallies and the like, as criticism would undoubtedly be met by increased restrictions from government. This especially in a time where avoidance of social unrest, as a result of the economic slowdown, seem to have a very high priority for leaders of the CCP. The opportunities for environmental NGOs, both civil and government organised, hence lies in the field of raising the general awareness and knowledge of environmental degradation through education, training and informational campaigns designed in a non-confrontational and not too critical manner. NGOs, who traditionally work with preserving the nature or preventing pollution, could play a significant role in educating the general public about the potentials in building energy efficient houses, both for preserving nature, preventing pollution and improving public health, as more efficient houses would lower the amount of coal needed for consumption of especially heat and electricity. A better informed public would demand more efficient houses, thus pressuring developers to improve the quality of construction.

Environmental NGOs could also work with local government institutions on developing models for implementation of building codes, thus enhancing the capacity of political institution to act on selected problems. As earlier demonstrated, one of the characteristics of Chinese ecological modernisation is the particular role of GONGOs in the civil society. These could be appointed a more inclusive role as advisors for local politicians sharing their knowledge and help build capacities, similar to the work NGOs have done in the ecological modernisation process in the construction industry in Denmark.

#### 6.2.2.2.4 *Lessons from interagency coordination in Chongqing's Blue Sky program*

In the 11<sup>th</sup> Five-Year Plan the Chinese government set targets of reductions in emissions of sulphur dioxide (SO<sub>2</sub>) by 10 percent in 2010. This put an enormous amount of pressure on local EPBs in cities to enforce regulations and enhance monitoring activities. In many cities though, local EPBs lack the institutional capacities to execute efficient enforcement and extensive monitoring, just as their abilities to act is often hampered as they have to work together with and rely on support from local bureaus. Often, for instance construction and transportation bureaus work with different agendas and try to achieve different goals than EPBs. All efforts on reducing air pollution in Chinese cities have thus in most cases been complicated by lack of capacity and coordination between different agencies and bureaus (Li and Chan 2009: pp.55-61).

This situation is more or less identical to the problems with lack of implementation and enforcement of building standards on energy efficiency in most Chinese cities. As shown in chapter 4 one of the barriers for energy efficiency in the Chinese construction industry is lack of capacity in local construction bureaus who manage implementation and enforcement of building codes.

The municipality of Chongqing has had long-standing problems with air pollution, which resulted in a steady increase in public complaints on environmental issues. The government of Chongqing, as a response to public pressure and in fear of being put to shame by poor environmental performances, thus decided to take action in form of the Blue Sky program, setting annual targets for increases in clean air days<sup>20</sup>. The government of Chongqing, having realised the need for a clear and effective division of labour between the local EPB and local bureaus and agencies, set up a special task force to be in charge of implementing the Blue Sky program and improving coordination between involved agencies and bureaus. A supervision team was set up to direct the work between district governments and agencies and at the operational level a promotion team was set up to coordinate day-to-day work (Li and Chan 2009: pp.61-65).

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<sup>20</sup> Clean air days indicate days with air quality at or below level II in the Chinese air quality index. See <http://english.mep.gov.cn/>.

Apart from structuring the decision-making process, several other initiatives were set up to enhance the overall capacity of the EPB and local bureaus. Most importantly this included: (1) setting up a special fund for the Blue Sky program; (2) improved monitoring with an air pollution diagnosis system capable of locating specific sources of pollution; (3) organised workshops that brought together EPB officials and academics to discuss for example reduction targets and possible measures to be taken in case of violation; (4) study-trips to other Chinese cities to see how air-pollution is handled differently; (5) the set up an environmental performance responsibility system, which include that directors of agencies and bureaus sign environmental performance contracts with the government of Chongqing; and (6) the government holds regular media conferences where agencies and polluters who have failed to reach targets are 'named and shamed' in public while those who have done a good job is publicly praised (Li and Chan 2009: pp.62-64).

Since the Blue Sky program was initiated in 2004, the levels of air pollution have been reduced and the amount of clean air days have increased substantially from a percentage of clean air days of 66.4 percent in 2004 to 78.6 percent in 2006 (Li and Chan 2009: p.65), indicating that efforts on interagency coordination and institutional capacity building has had a positive effect.

The question is what the lessons from Chongqing's Blue Sky program tell us about where to place efforts on improving implementation and enforcement of building codes in China's many provincial capitals. Although the case of the Blue Sky program deals with air pollution, many parallels can be drawn to problems with Building energy efficiency; lack of coordination and institutional capacities is as much problem in the construction industry as it is in the area of air pollution. First of all, it would prove beneficial if local governments set up a clear division of labour between agencies to develop an effective decision-making process. In the case of energy efficiency in buildings it would be necessary to empower the local bureaus of construction; making them the key agencies with clear jurisdiction over implementation and enforcement of building codes. Setting up an interagency task force, as seen in Chongqing, would help to overcome barriers with a lack of clearly defined roles between involved actors in the

process of implementation and enforcement. Secondly, many provincial capitals could learn from studying efforts implemented in for example Beijing and Shanghai, where compliance with building codes is much better, and by holding workshops, knowledge about targets and measures would increase among construction bureau officials. Thirdly, increased monitoring of buildings and collection of consumption data would illustrate the potentials in energy efficient buildings and improve the basis for decisions taken by developers and buyers. Fourth, allocation of sufficient funds to relevant agencies and bureaus, especially local bureaus of construction, is crucial. And finally, developing performance contracts for bureaus, and naming and shaming in public of developers and bureaus who fail to perform and comply, and at the same time praising the good examples, would be a powerful tool in a society where shaming in public would mean loss of face – in the Chinese mindset the ultimate humiliation. Most noncompliant developers today would probably be keen on avoiding such a scenario, encouraging them to meet standards on energy efficiency in new buildings.

### **6.3 Conclusion**

This chapter has pointed at several opportunities for overcoming existing barriers for energy efficiency in new buildings in China. First of all it will be necessary to reform policy tools used for encouragement and enforcement, including the following initiatives: (1) training of independent building inspectors; (2) heat pricing reform and installation of individual thermostats; (3) increased subsidies, tax-exemptions and the introduction of soft loans for energy efficient buildings, including methods of committing developers on the energy consumption of buildings; (4) further development of the role of ESCOs specifically in relation to energy efficient buildings; (5) feasibility studies of potentials of white certificates in the construction industry in China; (6) further research on the potentials of using CDM in energy efficient construction projects; (7) introduction of mandatory Life Cycle Assessments for all construction projects, including increased collection and monitoring of energy consumption data of buildings; and (8) set up of informational campaigns aimed at all stakeholders in the construction industry.

Secondly, the transfer of technology, in particular soft technology is necessary in order to build institutional capacities in China. This report has discussed four methods for enhancing the capacities in China: (1) The CDM holds great potentials for the transfer of both hard and soft technology – further research on barriers for CDM in relation to BEE in China is necessary though, as is reform of the mechanism itself; (2) Institutional transplantation – China could benefit from importing basic structural solutions, such as the set up for independent inspectors. Extensive feasibility studies is required though; (3) an enhanced focus on NGOs in China, both civil NGOs and GONGOs as trainers and educators of the public would prove beneficial, just as a more inclusive role of NGOs, maybe in a role as advisors for officials and participants in workshops would strengthen the endogenous development of know-how; (4) further introduction of structured interagency coordination between ministries, agencies bureaus etc., as seen in Chongqing’s Blue Sky program, would strengthen the institutional capacities.

## Chapter 7 Conclusion and Recommendations

### 7.1 Conclusion

This report set out to identify barriers for energy efficiency in new buildings in China and subsequently suggest methods of overcoming these barriers. In the process of completing these tasks the report has presented, discussed and analysed different aspects of building energy efficiency and general environmental challenges in China. The aspects covered have been divided into separate chapters.

*Chapter one* contained the general introduction and research question.

*Chapter two* provided the methodological background and reflections for the report. The study was carried out by a method of triangulation, using literature surveys, interviews and a case-study as the empirical foundation. The concepts of ecological modernisation and capacity building worked as the theoretical anchor for the study. Furthermore, this chapter contained reflections on conducting fieldwork in China and interdisciplinary research in general.

*Chapter three* covered the general background for the environmental challenges in China and problems with inefficient buildings illustrated by increased amounts of FDI directed into Chinese cities, which in turn has led to the possibly largest and most extensive process of urbanisation in the history of mankind. It was further more demonstrated how this migration led to a massive boom in construction in Chinese cities and most importantly how inefficient housing has led to increases in energy consumption, especially in northern China where heating is a necessity for survival. Additionally, this chapter presented and discussed present mandatory and voluntary building standards and codes in China.

On the background of literature surveys, interviews and a case study, *chapter four* presented barriers for energy efficiency in new buildings in China. The barriers identified

covered various aspects of the Chinese society in general, but the majority of findings were related to the institutional sphere. The barriers identified were related to three different spheres of the Chinese society: cultural sphere, technological sphere, and institutional sphere. Below is a short presentation of barriers found within the different spheres, in random succession.

- *Cultural sphere*: (1) Sustainability is looked upon as rapid industrialisation and technological modernisation; (2) Lack of 'demand' from buyers and tenants who prioritise other aspects of homes than energy efficiency; (3) Culture of 'rushing' projects among developers lead to quick and nasty design of buildings due to time pressure; (4) Construction projects are sometimes disconnected from local context.
- *Technological sphere*: (1) Insufficient standard of locally produced energy efficient building materials; (2) Mainly outdated technology available to contractors; (3) Inadequate level of education of workers, inspectors and other personnel.
- *Institutional sphere*: (1) Lack of clearly defined roles for government institutions, contractors, designers, developers etc.; (2) Inadequate policy in form of lack of 'carrots' for developers – subsidies, tax-refunds etc.; (3) Lack of predetermined goals and objectives in sustainable buildings; (4) Lack of capabilities, underfunding and corruption obstructs implementation and enforcement of building codes in many provinces; (5) Inadequate model for billing heat consumption; (6) Structure of the Chinese hierarchy also apply to the construction industry thus obstructing smooth switch-over to building energy efficient; (7) Testing & commissioning more of an automatic clearance rather than actual quality control process; (8) Fragmentation in the value chain.

Many of the barriers do not relate only to one sphere, but reach across spheres. Several of the barriers are not unique for China, but are found in most construction industries

globally.

*Chapter five* contained a presentation and discussion of the modernisation trends in China, particularly in relation to ecological modernisation of environmental policies. The chapter showed that the modernisation of the Danish construction industry has very much been driven forward by local municipalities and NGOs, with the state playing a reduced role. Many of the sustainable houses constructed in Denmark are sold under traditional market-based conditions and thus resemble conventional houses in design. The form of ecological modernisation seen in Denmark is characterised by what Hajer calls institutional learning, as existing structures and institutions adapt to new market demands.

As the concept of ecological modernisation is characterised by a high degree of flexibility, the type of EM identified in China varies in form and structure from the one described in the case of Denmark. In China there is stronger focus on the state as the leader of modernisation and at the same time civil society actors plays a minor role in driving modernisation forward. The tendency of ecological modernisation in China thus resembles what Hajer refers to as technocratic modernisation. China has a clear cut strategy of improving the environmental protection and at the same time sustain economic and industrial progress; a strategy which have resulted in an official strategy for ecological modernisation of the Chinese society. In this strategy the government anticipate leapfrogging in environmental protection and economic development, where China jumps several links in traditional industrialisation. This prediction is questionable though, and in this chapter I argued that the Chinese society is not about to leapfrog but rather on a path of traditional industrialisation, as seen in the west, only more intense in time and scale. Apart from a relatively small number of buildings being certified according to LEED standards, the Chinese construction has so far not seen ecological modernisation tendencies, future modernisation of the construction industry must be expected to be driven forward by the state and maybe to some degree the market.

Based on the structure and substance of the identified barriers, and with respect to the



unique modernisation tendencies in the Chinese society, *chapter six* proposed solutions for overcoming barriers and enhancing the energy efficiency of new buildings in China. These solutions were divided in two parts; one part focused on proposed changes in policies relating to the construction industry and the other part on the transfer of technology, especially the transfer of soft technology in relation to enhancing institutional capacities. Below follows a short presentation of proposed solutions.

*Proposed policy changes:*

- Set up of system with professional and independent building inspectors.
- Reform of heat-pricing system and mandatory installation of individual apartment thermostats.
- Increased subsidies, tax-exemptions and facilitation of soft-loans for energy efficient buildings. Commitment of developers in long-term schemes where costs above a set level would be on the account of the developer and costs lower split between developers and tenants.
- Promotion of ESCOs as building managers.
- Feasibility studies on the set up of a white-certificate scheme related to energy efficient construction.
- Development of new methodologies for BEE related CDM projects in China.
- Compulsory Life Cycle Assessments for all construction projects. Set up of a scheme on compulsory collection and surveillance of operational data from both existing and new buildings.
- Development of informational campaigns aimed at all stakeholders in the construction industry.

*Proposed methods of enhancing institutional capacities:*

- Promotion of a reform of the CDM, enhancing the focus on technology transfers, especially the transfer of know-how.

- Further research and feasibility studies on the potentials in institutional transplantation in order to enhance both national and local institutional capacities.
- Reforming the role of both NGOs and GONGOs, so they to a larger degree than today can work as educators of the public and as advisors to national and local government officials.
- Increased interagency coordination between local construction bureaus, agencies and ministries; empowerment of local construction bureaus as key agencies; use of performance contracts and introduction of official name-and-shame schemes.

The chapters together constitute the result of an intensive study of barriers for energy efficiency in new buildings in China and propose methods of overcoming these barriers. Hopefully the results can become useful in the attempts of ameliorating the situation with low compliance with building codes in many provincial capitals and cities.

## **7.2 Recommendations: A road map for enhanced energy efficiency in new buildings in China**

The recommendations presented in chapter six provided potential solutions for overcoming barriers and enhancing the energy efficiency of new buildings in China. Clearly, not all of these recommendations can be applied simultaneously as the implementation of some recommendations would require additional feasibility studies, and hence require longer implementation times than others. It is therefore necessary to establish a natural sequence in which recommendations can be implemented. Below, figure 12 provides a visual presentation of such a sequence in the form a roadmap for enhanced energy efficiency.

<i>Time Perspective</i>  <i>Mechanisms</i>	<b>Short Term</b>	<b>Long Term</b>
<b>Policy Recommendations</b>	<ul style="list-style-type: none"> <li>• <i>Training of independent building inspectors</i></li> <li>• <i>Increased subsidies, tax-cuts and soft loans for energy efficient buildings</i></li> <li>• <i>Introduction of compulsory Life Cycle Assessments and monitoring of energy consumption in buildings</i></li> <li>• <i>Reform of heat-pricing system and installation of individual thermostats in all buildings</i></li> <li>• <i>Development of informational campaigns</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Increased use of ESCOs as building managers</i></li> <li>• <i>Increased use of CDM in energy efficient construction projects</i></li> <li>• <i>Set up of white-certificate scheme relating to building energy efficiency</i></li> </ul>
<b>Institutional Capacity Building</b>	<ul style="list-style-type: none"> <li>• <i>Increased focus on interagency coordination, including performance contracts and official name-and-shame schemes</i></li> <li>• <i>Reformed roles for NGOs and GONGOs. Active use of these as educators and advisors</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Enhanced focus on transfer of know-how in CDM projects</i></li> <li>• <i>Extensive feasibility studies on the potentials of transplanting institutional structures and/or bodies from other countries</i></li> </ul>

Figure 12: Roadmap for enhanced energy efficiency in new buildings in China. Source: Own production.

These recommendations provide a sort of overall roadmap for enhanced energy efficiency in new buildings in China and if implemented they would undoubtedly aid in reforming the construction industry in general. The million dollar question is who is to head such an implementation and how should it be done in the case of China in a way that can trigger an ecological modernisation of the industry?

Here it is important to remember that although China has seen changes in forms of regulation with increased influence for actors from the civil society, and despite the increased influence for businesses, regulation in general is still performed in a traditional top-down manner by government organisations. This means that authorities, both national and local, are the key players in implementation of the before mentioned policies. Parts of the civil society could become important actors in the implementation process as advisors and educators, but the process itself has to be initiated by the government. The business itself also holds potentials in reforming the industry, but again, in the form of being helpers. This stems from the general nature of the construction industry in China which, as with construction industries globally, is characterised by a great deal of inertia. Rarely, stakeholders from the industry go beyond requirements for energy efficiency or push forward for stricter codes by themselves. Therefore, if an actual process of modernisation is to take place within the Chinese construction industry, government have to take initiative and raise the bar.

One way of doing this would be to concur to stricter reduction targets under the Kyoto protocol, which is to be reviewed in December 2009, in Copenhagen, thus creating an incentive for conserving energy and mitigating emissions of GHG. This could turn the attention to building energy efficiency, which provides a quick and cost-effective instrument for lowering the energy consumption. Given that no agreement is reached in December, China would have to go in front and take the lead, by establishing stricter national requirements for energy consumption and emissions, for example by developing a new national energy plan and re-establishing a Ministry of Energy, a manoeuvre which would remove power from the NDRC, who at present preside over energy-production- and consumption, but consolidating all aspects relating to energy in

one ministry would at the same time create a clearer frame for setting and fulfilling goals in reductions.

Fundamentally, what is needed in China is a mix of, implementation of a set of policies and instruments, which strengthens the basic mechanisms for enforcement and enhances the institutional capacities, and a general improvement of the overall objectives within energy and construction, which allows for a traditional top-down regulation; thus creating the framework for a new paradigm of energy efficiency in the Chinese construction industry.

## **Chapter 8      Epilogue: perspectives for future research**

This report has given answers to which barriers exist for energy efficiency in new buildings in China, and has proposed solutions on overcoming these barriers, but in some areas the scope of the report has come short. Some solutions require further research and studies before the full extent of their benefits can be seen.

If I was to carry out further research in the field of building energy efficiency in China, two areas would be the centre of my attention: barriers and potentials for capacity building in relation to BEE projects under CDM in China, and prospects in institutional transplantation.

Both of these areas relate strongly to benefits from enhancing institutional capacities; stronger and more efficient implementation and enforcement of building codes. So far, few studies have taken these areas under examination and their true value for building energy efficiency therefore remains relatively unexplored. As these instruments, especially the CDM, are based on market-mechanisms it would be interesting to look at the potentials in taking advantage of business to business relations; non-Chinese companies working with construction could become of great importance in exporting knowledge and production-systems, and in that way push forward for a paradigm-shift in the Chinese construction industry

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- Mogens Lykketoft, Danish Social Democrats
- Mette Holm, Journalist and author, expert on China
- Jørgen Delman, Professor in Chinese studies, University of Copenhagen
- Camilla T.N. Sørensen, Research assistant, University of Copenhagen

University of Copenhagen: *Urban Greening – Towards Carbon Neutral Buildings and Districts*, held at University of Copenhagen, The Ceremonial Hall, Frue Plads, 2008-11-03. Key speakers:

- Stephen Hammer, Director of The Urban Energy Project at Columbia University
- Chris Twinn, Director of Building Engineering Sustainability Group, Arup International
- Jacob Steen Møller, Head of Technical University of Denmark (DTU) Civil Engineering Department
- Walter Aussenhofer, Head of Sustainable Development, City of Freiburg

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## **Interviews**

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Interview 2: [Confidential], Architect, Copenhagen, 2008-12-05

Interview 3: [Confidential], Assistant Marketing Manager, Beijing, 2009-01-08

Interview 4: [Confidential], Designers, Beijing, 2009-01-09

Interview 5: [Confidential], CEO, Beijing, 2009-01-14

Interview 6: [Confidential], Energy and Environment Teamleader, Beijing, 2009-01-15

Interview 7: [Confidential], PhD researcher, Beijing, 2009-01-16

Interview 8: [Confidential], Marketing director and urban planner, Beijing, 2009-01-20

Interview 9: [Confidential], Professors, Beijing, 2009-01-22

Interview 10: [Confidential], LEED AP, Beijing, 2009-02-02