Actors, implementation and implications of China's climate-related energy policies: analyses of the Clean Development Mechanism (CDM) and the Energy Conservation and Emission Reduction Scheme (ECERS)

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ABSTRACT

China faces great challenges in climate change mitigation and energy security due to a coal dominated energy structure, a large population and an energy and resources intensive economic structure. In order to address climate change and energy issues simultaneously, relevant Chinese actors have worked to develop a range of policies and programs. China actively participated in the international climate change mitigation program, the Clean Development Mechanism (CDM), and has become the world's biggest CDM hosting country. China also launched the domestic Energy Conservation and Emission Reduction Scheme (ECERS) since the beginning of the 11^{th} Five-Year Plan (2006). ECERS is the largest scale climate-related national policy ever carried out in China, and has accomplished 19.06% energy intensity reduction during the 11^{th} Five-Year Plan (2006-2010), and a further 20% reduction during the 12^{th} Five-Year Plan (2011-2015).

This thesis analyses the actors involved in and the implementation of these two parallel policies during the 11^{th} and 12^{th} Five-Year Plan (2006-2015) period. It explores the roles of the actors, their impact on policy formation, and their feedback on policy implementation. By doing so, the strengths and weaknesses of the two policies can be unearthed and implications for addressing the identified deficiencies can be drawn out. The thesis first sets out the background, research questions, theoretical framework and methodology used for this study. It then analyses the roles and relationships between relevant actors, i.e. central ministries, provincial governments, think tanks, enterprises and civil society, and identifies what has affected their cooperation. The thesis then turns to the specifics of CDM, arguing that

it has benefited China in terms of facilitating sustainable development, promoting renewable energy and improving climate awareness but also has a number of potential problems, such as reduction of low-cost abatement options and additionality and integrity issues. An analysis of ECERS in the energy sector follows. Specifically, this thesis analyses multiple aspects of this policy in the energy production sector, including the closure of small coal-fired power plants and their replacement with large efficient ones, the development of renewable energies and the obstacles it faces, and the wastage of wind and solar power in China's northern provinces. It also covers a relatively new market mechanism in China from the energy consumers' perspective, Energy Performance Contracting (EPC), by exploring its development, effectiveness and challenges. Throughout the thesis, a wide range of sources have been used including interviews with relevant actors, media reports and discussions in public online forums. These invaluable insights into the details of the policies are often untraceable from the official documents, which therefore give us a fuller and richer picture of them. Finally the thesis draws out implications to address the weaknesses it identified, with the aim of providing innovations and alternative approaches to improve current policies.

DECLARATION

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Signature: Date: 1/11/2017

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Chapter 1

Introduction

1.1 Background: Climate change, energy security and China

Greenhouse gases such as CO_2, water vapour, and nitrous oxide are important components of earth's atmosphere. They play a crucial role in maintaining a comfortable temperature for earth's inhabitants by trapping the sun's long-wave radiation. They also provide the basic nutrients for the earth's flora, which forms the foundation of the food chain and supports a diverse range of fauna (Le Treut et al 2007, pp. 96-97; Obbard 2010, p. 69). We can say that humans would not exist without greenhouse gases. Greenhouse gases in the atmosphere had stayed relatively stable throughout human civilisation before industrialisation. However, since industrialisation, greenhouse gases, especially the CO_2 concentration in the atmosphere, have been growing excessively and rapidly. The predominant cause of the increasing level of CO_2 in the atmosphere is the burning of fossil fuels such as coal and oil which were formed from large deposits of ancient flora and fauna 360-290 million years ago. CO_2, as one of the emissions of these fossil fuels, traps heat and thus strengthens the greenhouse effect of the atmosphere (Le Treut et al 2007, p. 100; Oberthür & Ott 1999, p. 3). The early greenhouse effect theory was proposed by the Swedish chemist Svante Arrhenius (1896) more than a hundred years ago. During the 1950s, Charles Keeling recorded and reviewed the first set of accurate data of the rising CO_2 concentration levels at the Hawaii Mauna Loa Observatory (Anderson

2001, p.11). By now, the CO_2 concentration has raised 35% from the level of that in 1750 (Obbard 2010, p. 73).

There is a range of scientific evidence that increasing amounts of CO_2 in the atmosphere cause a stronger greenhouse effect which will alter the standard climate patterns on earth, leading to more frequent floods, hurricanes, droughts and bush fires, and cause sea level rises and gradual loss of biodiversity (Allison et al., 2009; IPCC, 2007). Therefore, effective climate change mitigation is urgently needed in order to secure future prosperity of human societies.

Facing the threats of global climate change, a range of international mitigation attempts have been carried out by multi-lateral cooperation over several decades. As early as the 1980s, the scientific concern of global warming was developed, and this set out the scientific foundation for future climate change mitigation efforts. From 1985 to 1988, climate change was transformed from a scientific issue into a policy issue through a range of international conferences and the agenda of climate change mitigation was established. Since then, governments started to be involved in the negotiation process for climate change mitigation (Bodansky 2001, pp. 23-24). China started to engage more in international environmental affairs during this period as its reform and opening up deepened (Chen G 2012, p.1). China's participation in and attitude towards climate change would have a significant impact on the outcome of climate stability due to its large population and rapidly developing economy (Schreurs 2011, p. 449). In 1992, China signed onto the Rio Declaration and ratified a non-binding agreement at the Rio Earth Summit which aimed at stabilising greenhouse gas emissions at 1990 levels through individual country's specific policies and measures

(Mckibbin & Wilcoxen 2002, p. 41). The Rio Earth Summit was seen as a landmark for the earliest international negotiation on global climate change policy (Bodansky 2001, p. 23).

However, China's involvement in the Rio Earth Summit did not mean that China took a proactive approach towards climate change mitigation. Instead, China proposed the principle of "common but differentiated responsibilities" towards climate change mitigation (Kobayashi 2003, p. 88). It argued that developed countries should bear responsibility for climate change and should aid developing countries in financial and technological terms to facilitate mitigation and adaptation (Chen G 2012, p. 5; Wu FZ 2013, p. 780). Such an argument had earned broad support from developing countries.

It was, however, very unfortunate that few significant policies had been successfully implemented after the Rio Earth Summit and greenhouse gases emissions continued to soar (Höhne et al 2003). In an attempt to address the deficiencies of the UNFCCC at the Rio Earth Summit, the first "conference of the parties" (COP) meeting was held in Berlin in 1995, which aimed at beginning a new round of international negotiations which would adopt legal instruments and form a strong international protocol. The result was the Berlin Mandate. The Berlin Mandate did not propose new objectives but established a reviewing board to assess specific policies that could be potentially adopted by developed countries. It also set up reduction targets and timeframes for these countries (Oberthür & Ott 1999, p. 46). Following this, the COP 2 meeting held in Geneva in July 1996 assessed the progress of the Berlin Mandate and determined "quantified legally-binding objectives for emission limitations and significant overall reductions within specified timeframes" for developed countries (McKibbin & Wilcoxen 2002, p. 43).

In December 1997, the COP 3 was held in Kyoto and the Kyoto Protocol was drafted. The Kyoto Protocol was the first international treaty that set detailed legally binding obligations for industrialised countries to cut greenhouse gases emissions (Chen G 2012, p. 7). The protocol set up emissions targets for 39 developed countries which aimed for 5% emission reduction from 1990 levels within the next fourteen years. The protocol included three mechanisms: international emissions trading (IET), joint implementation (JI) and the clean development mechanism (CDM)[1] (UNFCCCa n. d., n. p.). China, as a developing country, was not required to meet specific greenhouse gas reduction targets under the Kyoto Protocol as industrialised countries were. However, it was welcomed to participate in the emission offsetting mechanism CDM (Chen G 2012, p.7).

Although China was not required to meet any legally binding emission reduction under the Kyoto Protocol, it did complete its domestic ratification in 2002 by setting up national emissions inventories for reporting national programs and exchanging information with other nations. The publication of the "National Climate Change Program" confirmed the seriousness of global climate change, which was an initial

[1] It is true that CDM was designed by UNFCCC as a greenhouse gases offsetting mechanism which can be adopted by any qualified developed countries. However, how each country uses this mechanism is in their own hands. Different participating developed countries have different responses and different detailed policies for its implementation. For instance, China charged a high levy to all industrial gas programs and used the funds to support its renewable energy program. This is different from other CDM hosting countries. In other words, China has the ability to shape CDM to its own requirements. It is for this reason that this thesis regards the local implementation of the CDM program within China as a Chinese policy. This is discussed in further detail in Section 5.2 of the thesis.

sign that the Chinese government started to treat climate change seriously at the national level (NDRC 2004, p. 7). Moreover, China actively participated in regional climate change mechanisms such as the Asia-Pacific Partnership on Clean Development and Climate, which focused on voluntary participation and energy efficiency improvement. These actions set out the contrast between China and the US, which had by now withdrawn from the Kyoto Protocol (Heggelund & Buan 2009, p. 302)

The Kyoto Protocol was a turning point where China's attitude towards global climate change mitigation switched from passive to proactive. There are multiple reasons behind this attitude switch, ranging from the domestic energy challenge (Yao & Chang 2014), to the public's voice in treating air pollution (Ho & Nielsen 2007), to the concern over establishing a positive international image (Yu 2008; Zhang ZH 2003). Among all these reasons, the domestic energy shortage and concern for energy security was the most powerful driver, as argued below.

Behind the glamour of China's rapid economic development lies the shadow of its energy crisis. China has constantly experienced energy shortages since its reform in the late 1970s, except for a couple of years after the 1997 Asian Financial Crisis when energy supply could basically meet demand (Ye 2013, p. 128). In 2002, China's energy shortage intensified after recovering from the financial crisis. In 2004, 24 provinces out of 31 experienced black-outs, causing enormous disturbance and loss to the economy (Lin J 2007, p. 916). Former Premier Wen Jiabao identified the shortage of coal, electricity, petroleum and transportation as being one of the most pressing problems at the *Third Session of the 10th National People's Congress* on March 5, 2005, where the most important and urgent domestic issues were proposed and discussed (Wen JB 2005, n. p.).

China has been heavily reliant on imported oil for a few decades, which is a potential threat to the nation's energy security (Zhang ZX 2011, p. 7612). The existing high energy input style industries, inherited from the Soviet Union, further worsen the problem (Mackerras, Taneja & Young 1998, p. 149). As a result, a demand for efficiency improvement emerged in China. Although China has relatively rich coal reserves and currently coal serves approximately 70% of China's total energy needs (Wu Y & Zhang 2016, p. 126), this does not provide complete relief for its energy outlook. This is because coal mines are dispersed unevenly across the country, being mainly located to the west and the north, while the major high energy demand regions are in the south and east along the coast. This has caused coal-fired power plants to fail to deliver electricity from time to time during energy demand spikes. The 2008 snow storm in southern China was such an example. Railways were out of use due to the weather conditions, trucks loaded with coal were stuck on the frozen highways and, as a result, the urgently needed coal was not able to be delivered to power plants to generate electricity for essential heating (Zhou Y 2010, p. 3756). Apart from the concerns about domestic energy shortages, China also cared much about its international image.

Acquiring a positive image through involvement in international climate change negotiation is another driver behind China's attitude switch. In the report *China's Policies and Actions on Climate Change 2014,* it was clearly stated that:

> Pursuing green, low-carbon development and actively addressing climate change is not only necessary to advance our [China's] ecological progress and put our development on a sustainable path, but will also demonstrate to the world that China is a responsible country committed to making an active contribution to protecting the global environment (NDRC 2014, p. 1).

ZH Zhang (2004, p. 78) also pointed out that China used climate change to both strengthen its relationship with other developing countries during early negotiations by proposing "common but differentiated responsibilities" and to enhance its relationship with developed counties in the later stage by actively participating in the CDM. This can be reflected from the website of the National Development and Reform Commission (NDRC), the central ministry responsible for climate change and energy policy development. On the Chinese version of the site, the home page is dominated by a range of important national economic plans, strategies and projects. While on the English version of the site, the home page contains six news releases from 2013 to 2015, with five of them related to climate change (NDRC 2016, n. p.). The dramatic difference in contents between the two versions of these websites further demonstrates that a positive international image is what the Chinese government actively pursues, and global climate change mitigation provides an important opportunity for this.

Apart from concerns about China's image on the global stage, the voice of the Chinese people demanding clean air is another reason for the Chinese government to reconsider its stance on climate change. This is because proactive climate policies can bring significant co-benefits towards the treatment of air pollution (Aunan, Mestl, & Seip 2003, p. 287). In early 2015, Chai Jing, a former China Central Television (CCTV) host, presented a 103 minute self-funded documentary *Under the Dome*. It discussed the causes of city smog, its impacts on public health and provided several suggestions to deal with it. This documentary attracted huge attention from the public, and started a national conversation on the issue of air pollution. The documentary received 31 million clicks within 24 hours on six mainstream video sites including qq, youku, sohu tv, letv, tudou and qiy (360doc 2015, n. p.). Even the Minister in charge of the Ministry of Environmental Protection (MEP), Chen Jining, sent Chai Jing a thank you message after watching the documentary. Although there were mixed comments including both praise and complaints, it was undeniable that Chai Jing's documentary was a summation of the Chinese public's increasing environmental awareness. It was also very significant that the public used such media as a tool to express their concerns to the government in a national manner.

Moreover, investment in green technology for energy saving and emissions reduction will bring China vast economic benefit. Currently, five of the world's six top solar-module manufacturers, five of the largest wind turbine manufacturers, and six of the ten major car manufacturers committed to electrification are all Chinese-owned. Meanwhile, China is dominant in the lithium sector which covers batteries, electric vehicles and so on. Moreover, China is a global leader in smart grid investment and other renewable energy technologies (Pope 2018, n.p.). All of these initiatives have brought China enormous economic benefit. For instance, China's photovoltaic (PV) industry has undergone dramatic development in recent years and is now the global market leader (H Sun, Zhi, Wang, Yao & Su 2014, p. 221). Exports of PV modules exports reached 37.9 GW for the year of 2017, an increase of 16.6 GW in comparison with 21.3 GW for 2016. Exports of polycrystalline modules reached 31.8 GW, accounting for 84 percent of the total, while that of monocrystalline modules added up to 5 GW for 13.2 percent. The income gain from PV modules export has further boosts the industry and strengthen China's world leader position in the PV solar industry (Y Liu 2018, n.p.). Therefore, the economic rationale is another driver behind China's move towards a more proactive attitude towards climate change. Due to the influence of these factors, China continued its commitment to reduce emissions on a voluntary basis, but the bottom line was that China did not accept the imposition of an absolute cap on the quantity of emission reduction. Even during the later negotiation stage when China committed to more ambitious targets in combating climate change, it still firmly held this bottom line. For instance, at COP 15, Copenhagen, 2009, China announced the goal of cutting its carbon intensity by 40-45% below the 2005 level by 2020 (BBC 2009, n. p.). . The Paris Agreement is argued by Falkner (2016, p. 1107) to be a breakthrough in global climate change mitigation as it "acknowled[ed] the primacy of domestic politics in climate change and allow[ed] countries to set their own level of ambition for climate change mitigation". Individual countries can set up their own framework for voluntary pledges as long as these programs can be reviewed and evaluated internationally. This is because the Paris Summit realized that major powers would not accept a pre-determined and drastic emissions reduction target.

Clemencon (2016, p. 3) described the Paris Climate Agreement as “better than no agreement” because it did not proint out a clear blueprint for how to stabilize climate change in order to avoid catastrophic temperature increase. Many countries’ voluntary reduction targets and procedures were presented prior the conference, which left the negotiation of the common goal difficult. In this sense, the Paris conference was considered less ambitious compared with the Copenhagen conference of which legally binded emission targets were still the objective for developed countries. Apart from lacking legally binding emission reduction targets, the Agreement also misses the following elements such as specifics on financial support, liability for financial compensation for loss and damage of least developed countries and island states, and the tackle for the fundamental capitalist consumerism and fossil-hungry development style (Clemencon 2016, pp. 10-11).

But nonetheless, the Paris Climate Agreement also offered hope. First of all, it called for the “holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels (UNFCCC 2015, p. 22). This goal has a significant meaning for reduing catastrophic impacts of climate change. However, the key lies in how fast individual countries can transform their energy production into renewables on large scale.

China faced great pressure at the Paris conference due to it increase of per capita CO_2 emissions up to 6 tons, which is high compared with the least developed countries. China committed to a 60-65% carbon intensity reduction from the 2005 level by 2030 (NRDC 2016, n. p.). China’s pledge was interpreted into a 4% annual energy intensity reduction instead of the 3% in previous announcements (Carraro 2015). However, there is concern as to whether or not the treaty of the Paris Summit can truely deliver the urgently needed outcome of de-carbonized development. From previous experience, governments tend to avoid tough decisions for emission cuts in bottom-up emission reduction programs with a voluntary logic, such as those which happened in the Rio Earth Summit (McKibbin & Wilcoxen 2002, p. 41). For China, carbon intensity reduction is related to how efficiently fossil-based energy is used rather than the total quantity that is consumed, and therefore still allows emission growth even if greater efficiency is achieved.

China’s stand is understandable in the sense that it faces not only the climate challenge but also the energy challenge. With the world’s largest population and a coal dominated energy structure, China faces possibly the greatest difficulty in effectively mitigating climate change and simultaneously guaranteeing sufficient energy supply for its growing economy. Population growth, on-going industrialisation, a manufacturing and exporting dominated economic pattern and people’s demand for improved standards of living have all driven up the energy demand (Guan, Hubacek, Weber, Peters & Reiner 2008; Guan, Peters, Weber & Hubacek 2009; Wei, Liu, Fan & Wu 2007; Zweig & Bi 2005).

China became an oil importer in 1993 (Lheem 2008, p. 173), and accounts for 41% of the world’s oil demand growth and is currently the largest net oil importer in the world (Tian 2016, p. 36). China’s acquisition of overseas oil in the Middle East, North Africa, Russia and Central Asia can temporarily relieve its domestic energy shortage, but it cannot fully guarantee the nation’s future oil supply. This is because, firstly, the reality must be faced that the world is fast approaching the peak of many fossil fuels. Some argue that peak oil is very close (Aleklett et al. 2010; Leder & Shapiro 2008). Some also argue that since 2015 the world's conventional crude oil production can no longer match the demand, and thus crude oil has already peaked (Murray & King 2012, p. 433; Pennock, Poland & Hancock 2016, p. 180). Nonetheless, this indicates the world's oil reserves are fast depleting. Peak gas is also not far away, possibly in just a few decades' time (Laherrère 2004), and peak coal is predicted to arrive before 2050 (Mohr & Evans 2009). Secondly, China's acquisition of overseas energy resources also imposes potential diplomatic or even military conflicts between China and the USA. This is because many of the countries China buys oil from are countries that the USA tries to isolate, such as Iran, Sudan and Burma (Lheem 2008, p. 182). Such countries are usually viewed as potential threats within the USA's sphere of influence. The USA fears China's involvement in such regions will challenge its military dominance and break the balance of power (Zweig & Bi 2005, p. 26).

Securing sufficient energy resources has been seen by many as one of the most important conditions for national security (Raphael & Strokes 2016; Stringer 2005; Wu & Storey 2007; Yergin 2006). Viewing energy security from a traditional geopolitical standpoint, serious competitions or even conflicts among nations over scarce energy resources are unavoidable due to the limited energy stocks and the world's increasing energy needs (Garrison 2009, p. 1; Griffin 2009, p. 11; Goldthau & Witte 2010, pp. 1-3; Nyman 2015). This argument is accepted and embraced by the Chinese government to a significant extent in its traditional energy policy development, as it reflects the reality that China is in a zero-sum situation against other nations when it comes to searching for overseas energy resources. Zweig and Bi (2005, pp. 26-27) described the situation this way:

> Although China's new energy demands need not be a source of serious conflict with the West in the long term, at the moment, Beijing and Washington feel especially uneasy about the situation. While China struggles to manage its growing pains, the United States, as the world's hegemon, must somehow make room for the rising giant; otherwise, war will become a serious possibility.

Realising the limits and possible conflicts caused by the acquisition of overseas energy resources, the Chinese government adopted a range of other measures for energy security, such as those dealing with energy efficiency improvement and development of renewable energies (Glomsrød & Wei 2016; Mathews & Tan 2014). This alternative path towards energy security is the focal point of this thesis. It explores China's energy policy options within the context of climate change.

1.2 Central Research Question

Therefore, the central question this thesis asks is:

How can China optimise its current energy policies in order to achieve better outcomes in climate change mitigation?

In order to answer the central question, this thesis will evaluate two important climate-related energy policies, namely the CDM and the domestic Energy Conservation and Emission Reduction Scheme (ECERS) during the 11th and 12th Five-Year Plan period (2006-2015). The reason why CDM and ECERS were chosen is that they are the two largest scale and most widespread climate-related policies ever carried out in China, with one residing in the international context focusing on the market approach, and the other in the domestic context, mainly using the administrative approach. The timeframe of the two policies roughly coincides with each other, therefore, the two policies can demonstrate China's major climate change mitigation achievements within the same era.

CDM, as a component of the Kyoto protocol, allowed Annex I developed countries[2] to invest in greenhouse gases emission reduction projects in developing countries, so that developing countries can benefit from sustainable development, and investors can obtain Certified Emission Reductions (CERs) to offset their emissions or to trade on the international market (The World Bank 2004, n. p.). Currently, there are over 8000 CDM registered projects worldwide, representing approximately US$300 million investment in clean energy and emission reduction projects. In 2014, CDM projects achieved 300 million tons of CO2e emission reduction, which accounted for 1% of total global emissions (Hone 2017, n. p.). Hence, without CDM, the world's total emissions would be 1% higher. Unfortunately, the future of CDM is uncertain under

[2] List of Annex I countries: Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, European Union, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom of Great Britain and Northern Ireland, United States of America (UNFCCC) http://unfccc.int/parties_and_observers/parties/annex_i/items/2774.php

the Paris Agreement (2016) due to a significant drop in the CER price. CDM might no longer hold its original status as an important international mitigation mechanism. However, the significance of CDM to China is longer term than the life-span of the mechanism itself. This is because the Chinese government regards the true value of CDM as introducing the concept of a carbon market and market mechanism in climate change mitigation. The fluctuation of the CER price had only a minor impact on the government's belief in the benefits of CDM (Interviewee 1).

China has gradually embraced CDM and established a set of implementation and management mechanisms. By 23 August 2016, the Designated National Authorities (DNA) of China had approved 5074 CDM projects. China is so far the world's largest producer of CERs, generating over 50% the world's total (Department of Climate Change, NDRC 2016, n. p.). CDM not only introduced the concept of mitigating climate change through a market mechanism but also assisted China's sustainable development, and contributed greatly to energy efficiency improvement and renewable energy development.

Among all of China's domestic climate-related energy policies, ECERS is of the greatest significance. ECERS is a nation-wide scheme that aims to achieve energy conservation and emission reductions in all sectors, including the energy generation sector, the manufacturing sector, the building sector, the transportation sector and the agriculture and forestry sector (The Central People's Government of PRC 2006, n.

p.)[3]. It was initially proposed in China's 11th Five-Year Plan for National Economy and Social Development. It is a long-term scheme which had been carried out through the 11th Five-Year Plan (2006-2010), the 12th Five-Year Plan (2011-2015) and is now being implemented for the 13th Five-Year Plan (2016-2020). ECERS, as a domestic climate-related energy policy, therefore coincides with the international CDM in terms of timeframe and the focus on energy efficiency improvement and renewable energy.

ECERS achieved overall positive results. From 2006 to 2015, China cumulatively forced the closure of approximately 100 million KW small thermal power generation capacity (NEA 2015, n. p.; State Grid Corporation of China 2012, n. p.). A range of advanced energy-saving technologies were applied to qualified conventional coal-fired power plants, and the net coal consumption per each KWh of electricity generation dropped by 38gm, which was approximately a 10% reduction (Ye 2013, p. 143; Wang Y 2015, p. 87). This achievement had a significant meaning to China's carbon intensity reduction and overall carbon emission reduction due to the large proportion of coal power in China's energy mix. During the 11th Five-Year Plan, the national energy intensity per unit of GDP dropped 19.06% (NEA 2011, n. p.). During the 12th Five-Year Plan period, again ECERS achieved over 20% reduction in energy intensity which exceeded the planned 16% (Xu 2016, n. p.).

[3]The purpose of this thesis is to cover the ECERS as a whole in the energy sector, but not to investigate one specific aspect of it. Therefore, it has to include a range of instruments used in ECERS in the energy sector and to investigate their strengths and weaknesses, so that the overall effectiveness can be discussed. Specifically, this thesis analyses this policy in the energy production sector, including the closure of small coal-fired power plants and their replacement with large efficient ones, the development of renewable energies and the obstacles it faces, and the wastage of wind and solar power in China's northern provinces. More detail is given later in Chapter 6 of the thesis.

The development of renewable energies was also rapid under ECERS. During the 11th Five-Year Plan, China's wind power capacity increased from 1.27 GW in 2005 to 44.73 GW in 2010, which increased over 35 folds (Kang, Yuan, Hu & Xu 2012, p. 1907). During the 12th Five-Year plan, wind power capacity increased four fold (NEA 2016, n. p.). During the same period, China's solar energy capacity increased 168 fold (NEA 2016, n. p.). By 2014, China surpassed Japan and the USA to become the world's largest PV modules consumer (iiEnergy 2016, n. p.). In fact, the proportion of China's renewable energy already reached 17% of the national energy mix by mid-2015, which was earlier and faster than the planned 15% of renewable energy in national energy structure by 2020 (Xinhua News 2015, n. p.).

CDM and ECERS are of great significance as they were designed to address China's energy security and climate change issues simultaneously. However, are they the most effective policies? Are there any weaknesses associated with them? If there are, how can the weaknesses be addressed? Therefore, in order to answer the central question of this thesis, the following sub-questions will be addressed:

1. Who are the major actors in China's climate-related energy policies and what impact do they have on the formation of the policies?

2. What are the strengths and weaknesses of the CDM program as a means of climate change mitigation in China?

3. What are the strengths and detrimental side-effects of ECERS?

4. What adjustments can be made to these two studied policies in order to address the weaknesses?

These sub-questions are important for addressing the central questions. Sub-question 1 deals with the "who" factor in public policy. It will identify major actors in China's climate-related energy policies and their power struggles, relations, and impacts on policy outcomes and implementation. It will also set up the context for sub-questions 2 and 3. The CDM to be dealt with in sub-question 2 and ECERS to be dealt with in sub-question 3 are two of the most influential, high input and widely spread climate-related energy policies in China. The investigation of their weaknesses, especially those exposed during implementation, is significant for understanding their overall effectiveness. Sub-question 4 aims to address the weaknesses and provide implications for future modification or as insights for new policy development.

1.3 Significance of the research

This thesis is significant for a number of reasons. First of all, it avoids the cliché topic of whether or not China should do something about global climate change or what China should do; rather, it explores how China can better achieve its emission reduction goal through optimising its energy policies. This is what is lacking in the current literature through enriching the theoretical understanding of China's fragmented authoritarianism with new findings of internal conflicts, coordination challenges and institutional innovation in China's energy sector. Second, the data collected for this thesis is of great significance. It includes interviews with people who play important roles in policy making and whose views are not generally available in exisiting studies. It also includes empirical and thematic analysis of online forum discussions of the general Chinese public. These are invaluable sources which complement the readily available official data, and avoid the acknowledged limitations of official government data – an issue in all countries, but especially in the Chinese context. Third, this thesis provides evidence-based strategies for addressing every weakness identified in the analyses of the policies in question. Last but not least, this thesis is of global significance due to China's status as the number one greenhouse gases emitter. This is because any recommendations that lead to the optimization of China's climate-related energy policies will benefit the world greatly in terms of climate stabilization. Moreover, other major developing countries can also learn from this evidence base and undertake policy transfer. Each of these contributions is explained in further detail in Chapter 7.

1.3.1 Focusing on problem-solving

Many of the existing studies on China's climate governance discuss China's role in climate change mitigation from a political and international relations perspective and as such often investigate why China holds its current stance towards climate change and what impacts such a stance may have (Delman 2011; Schreurs, 2011; Yu 2008). Scholars rarely go into the details of China's climate-related policies and their effectiveness. Literature on China's climate-related policies does of course exist (Li L, Tan, Wang, Xu, Cai & Hou 2011; Xue, Zhao, Dai & Wang, 2013). However, the majority of this type of work focuses on what China has achieved, and is therefore more of a descriptive nature (e.g. Hou, Zhang, Tian, Yuan & Yang 2011; Hu & Cheng 2013). In cases where policy weaknesses do get identified, the authors often conclude the study by simply stating that such and such a weakness should be addressed, but they do not say how this should be done. For instance, in Li L, Tan, Wang, Xu, Cai and Hou's (2011) analysis of the energy conservation and emission reduction policies in China's electric power sector, the authors only provided very general suggestions for how to improve the outcomes along the lines of China should take such and such actions, but did not specify how these could be implemented in practice. Kostka and Hobbs (2012) identified the conflicting priorities of the local and central governments as a significant obstacle to the implementation of energy efficiency policies in their study of Shanxi Province. However, they did not offer any suggestions for how this issue should be addressed. Similarly, while Harrison and Kostka (2014, p. 450) correctly state that implementing climate change mitigation policies "requires careful balancing of competing priorities and deliberate strategies to bring different interest groups on board", their study is primarily a descriptive account of how governments have attempted to do this in China and contains no concrete solutions for improving outcomes. Another typical example is Zhang, Aunan, Seip and Vennemo's (2011) study of Shanxi Province's implementation of energy intensity targets. In contrast, this thesis focuses specifically on how to address these weaknesses in great detail. It, therefore, stands out from previous studies (ie. Harrison and Kostka 2014; Kostka and Hobbs 2012; Zhang, Aunan, Seip and Vennemo 2011).

1.3.2 Significance of the data

This thesis is also significant from a methodological perspective. It does not limit its data sources to official government data only, as is a significant portion of work produced in China. Instead, it uses a wide range of data sources, including interviews with Chinese officials, scholars, energy company managers, ENGO personnel, media reports and online forum discussions.The views of Chinese officials and policy makers represent China's official stance on the issue of climate change and climate-related energy policies and are thus very valuable. However, such views are not commonly presented in existing studies because it can be difficult to arrange interviews with such people. They are usually very busy and have limited time to give interviews, and may only be approachable through personal connections. This makes the interview data presented in this thesis unique. Such views are academically valuable because understanding the views inside the bureaucracy and the party helps us comprehend the policies and their limitations and implications more clearly. This would not be possible without incorporating such views. Interviews with energy company managers and ENGO personnel are also significant. They use their first-hand experience to point out problems in their industry which are often disguised and unreported in official reports, and can be difficult to see elsewhere. In addition, they are not widely incorporated into previous studies.

Media reports and online forum discussions show the studied policies from another angle, namely the general public's focus on climate-related issues. It is one of the few options available to researchers to easily access what the Chinese public think and believe, and is therefore also of great importance. All of the data combined provides a fuller picture of the analysed policies than exists in the current literature.

1.3.3 Significance of the implications from the domestic perspective

As mentioned above, this thesis not only works on the identification of policy weaknesses, but also on how to address them to make the policies more effective. The implications this thesis raises are detailed and specify the solution to each identified weakness. Therefore, it fills the gap in the existing academic literature which does not do this. The thesis's significance is not limited to purely academic value however. It also has great practical value because if these implications can be utilised in future policy adjustments or the development of new policy, they will benefit the Chinese government and public through improved energy security, better air quality, greener transportation and more reasonable unemployment relief.

1.3.4 Significance of the implications from the global context

By extension, the policy implications this thesis presents potentially have global significance. Because China is the world's biggest greenhouse gases emitter, its emission reduction will play a great role in global climate change mitigation and the future of the world. Moreover, many of the implications can be applied to other developing countries' climate-related policies with similar characteristics as China. The majority of future emission growth will come from large developing countries such as China, India, Brazil and Indonesia. This thesis provides an evidence-based example for significantly improving a developing country's climate-related policies to achieve optimal emission reductions. Such countries can use this as the basis for policy transfer in the domain of climate change mitigation. As a result, it is significant in the global context of climate change mitigation.

1.4 Plan of the thesis

This thesis consists of six chapters in addition to this introductory chapter which has already provided the background and articulated the research questions for this study. Chapter 2 develops the conceptual framework by exploring the key concepts in and approaches to public policy and policy analysis, and explains how they apply in China. Chapter 3 details the methodology this thesis adopts. Chapter 4, 5 and 6 are the major analysis chapters, dealing with sub-question 1, 2 and 3 respectively. Chapter 4 deals with the actors in China’s climate-related energy policies and their impact on policy development. Chapter 5 analyses the strengths and weaknesses of CDM in China, and Chapter 6 investigates the strengths and detrimental side-effects associated with ECERS. After this major analyses, Chapter 7 puts forward implications to address the weaknesses raised in Chapter 4, 5 and 6 and concludes the thesis.

Chapter 2

Public policy and policy analysis: key concepts and approaches

2.1 Introduction

The main focus of this thesis is the investigation of the strengths and weaknesses of two significant Chinese climate-related policies, CDM and ECERS, with particular attention given to the major actors in the development and implementation of these policies. With this focus in mind, this chapter will review important literature on the key concepts of and approaches to public policy and policy analysis.

"Policy analysis is a social and political activity", according to Bardach and Patashnik (2015, p. xv). This activity aims to address social, environmental and economic challenges which have an impact on the general public and/or national interest. Policy analysis is obviously relevant to the research questions this thesis has proposed because climate change poses significant challenges to both the Chinese government and the general public. The purpose of this chapter is to outline the key components in the public policy domain, focusing in particular on governance, institutions, and policy process and evaluations. Significantly, this chapter also extends this literature by explaining how such components can be applied to climate-related energy policies in China. This will enable a detailed analysis of Chinese institutions and policies to be carried out in later chapters.

In order to fulfil these purposes, this chapter first sets out the Chinese governing tradition of rule by the emperor and the class of Confucian scholars and its influence on modern Chinese policy development and implementation. This is because analysis of Chinese policies can only be fully understood within the Chinese context. Following this, three major approaches to solving environmental problems, namely the administrative approach, the democratic approach and the market approach, will be introduced and their relevance to China's environmental governance will be discussed. The chapter will then outline the current state of policy analysis, with special attention given to institutionalism and its application in China as a form of fragmented authoritarianism.

Institutions play a significant role in policy development and implementation as they provide predictability and stability (Peters 2016, p. 63). This applies to both democratic and authoritarian countries, but the Chinese public sector institutions play a more important role due to the fact that "party core groups are nested within – and lead – each government ministry" (Lieberthal & Oksenberg 1988, p. 40). The negotiations, bargains and compromises among top ministries on policy decisions strongly represent the top leaders' political will. Therefore, the coordination and conflicts between government institutions figure strongly in the formation, implementation and revision of China's public policy.

Following the review of China's institutions, two technical domains of policy analysis will be covered, namely the policy process and policy evaluation methods. These are also important as they provide practical guidance for conducting policy analysis.

Finally, three selected policy analysis examples, each focusing on policy actors, policy options and recommendations, will be presented. These examples conducted analysis from different perspectives but all have a common focus on energy and climate change. The evaluation in these examples will provide some inspiration for the analysis to be carried out in later chapters. Before proceeding further, however, the next section will discuss the influence of the Confucian tradition in China's public policy because this tradition is still relevant to China's contemporary government, politics and policies.

2.2 A Confucian tradition in governance

Public policy is defined by Peters (2013, p. 4) as "the sum of government activities, whether pursued directly or through agencies, as those activities have an influence on the lives of citizens". This definition is indeed modern; however, the concept of "citizenship" which comprises the essence of the definition, can be traced back to the direct democracy of ancient Greece (Guarnizo 2017, p. 12; Pocock 1998, p. 33). Although there is no universally agreed-upon definition of citizenship, the development of the notion has almost always occurred around two spheres: membership and exclusion; and rights and obligations (King 2016, p. 9; Zarrow 1997, p.4). It is this evolution of citizenship throughout Western civilisation that paved the way for modern Western democracies (Wasson 2015, n. p.).

It is the participation of citizens in public affairs which distinguishes democracies from other systems of government. When switching our lens to the East during the same era and narrowing our focus to China, the concept of citizenship was mentioned by none of the ancient Chinese philosophers, regardless of the fact that the Spring and Autumn and Warring States periods (770BC – 221BC) were eras when several Chinese classical philosophies flourished. In fact, such a concept has never been proposed by native Chinese scholars until it was introduced from the West in the late nineteenth century (Jakimow & Barabantseva 2016, p.168). According to Zarrow (1997, p. 4), citizenship is generally regarded as a notion of the Western civilisation but has little to do with the East.

In ancient Chinese society, imperial power was seen as paramount. The emperor was regarded as the Son of Heaven, standing above all beings on earth (Link, P 2015, p. 25). One poem of *The Books of Songs*[4] stated that: "all territories under the sky belong to the emperor, all people who reside on lands and waters are subjects of the emperor". The emperor was granted absolute power by heaven, but he was also expected to fulfil the greatest duty to carry out virtuous ruling and look after his people (Creel 1953, p. 23). The majority of ancient Chinese societies were built on hierarchies and orders based on Neo-Confucian principles (theories developed by Confucius' disciples and later followers) known as the *Three Cardinal Guides* and *Five Constant Virtues*[5]. The *Three Cardinal Guides* set up the structure of social order as: ruler guides subjects; father guides son; husband guides wife. The *Five Constant Virtues* regulate interpersonal relations by promoting the qualities of benevolence, righteousness, courtesy, wisdom and trust (Yang CL 2016, p. 184; Su 2011, p. 32).

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[4] *The Book of Songs,* formerly called *Poetry*, is a collection of 305 ancient Chinese poems from the early Western Zhou Dynasty (the 11th century BC) to the mid-Spring and Autumn Period. It is said that they had been compiled by Confucius. *The Book of Songs* contains three sections based on its contents, namely *Feng* (*ballads*), *Ya* (*poems from intellectuals or aristocrats*), and *Song* (*songs for praying*). The poem mentioned here is from *Xiaoya*. *Gufengzhishi, Beishan.*

[5] Western Han Confucian scholar Dong Zhongshu modified Confucius' thought on social hierarchy and status and theorized the *Three Bonds/Cardinal Guides* and *Five Constant Virtues* in his work *Chun Qiu Fan Lu*.

The hierarchy from the top was the emperor, then the class of officials, and the ordinary people at the bottom. The emperor held absolute power; the officials assisted the emperor in managing the ordinary people by providing advice; while the ordinary people looked up to the emperor and officials and wished for their benevolent governance. The ordinary people in ancient Chinese societies were passive and obedient and had little say in public affairs and policies. They were generally content with such status and believed it was the emperor and government's responsibility to implement good policies and guide the empire towards the correct direction. As Liu and Liu (1997, p. 40) put it, "the consciousness [of being subjects] penetrated deeply into people's hearts and dominated their political behaviour. The rise of a new dynasty was nothing but another cycle in traditional cultural attitudes."

The existence of a class of intellectual officials was another distinct characteristic of Chinese feudal society. The officials were selected from the ordinary people through examinations and worked as a kind of "think tank" for the emperor. This system was considered advanced at the time. The leading figure of Western Enlightenment, Christian Wolff (1679–1754), said in an oration, "in the Art of Governing, this nation [imperial China] has surpassed all others without exception" (Creel 1949, p. 256). The formation of ancient China's intellectual class was based on Confucian principles which held that the government should be comprised of talented people, and only the knowledgeable and wise could develop and implement good policies for the nation (Link 2015; Bell 2010; Creel 1954). Only if the officials were indeed talented, knowledgeable and ethical, could they convince and influence the people through setting positive examples, and the ordinary people would look up to the officials, as explained by Confucius:

> If you desire what is good, the people will be good. The moral power of the gentleman is wind, the moral power of the common man is grass. Under the wind, the grass must bend (*Analects*, 12.19 translated Leys 1997, p. 58)[6].

Therefore, typical policies of imperial China were derived from the works of the sages and the intellectual class. These works were studied by ancient government officials, not only as study materials for their examinations but also as guidance for their duties after they assumed office.

Rules and laws of imperial China were called "*Wang Fa*", or, as the name suggests, the emperor's laws. The emperor's laws were developed by the emperor's think tanks (the intellectual class) and decided by the emperor; the ordinary people had little influence on the legislation (Zhang JF 2014, p. 450). It is obvious that in imperial China policy development and decision-making followed a strict hierarchy and worked in a top-down fashion. The ordinary people needed to wait for the wise officials and emperors to spot social problems and then address them. The emperor's vision and the officials' capacity played a very important role in the management of the society and consequently the outcome of people's well-being.

[6] For Confucius, a gentleman is someone who is 'benevolent, wise, and reverent' (Van Norden 2011, p. 20). Some scholars use the term exemplary person instead of gentleman (see for example Bell 2000, 2006).

Through the course of interaction between China and Western countries, a wide range of modern governing concepts and techniques were introduced to China from the West. Some of these have been adopted such as the separation of the executive, legislative and judicial powers, however, the Chinese government's policies and activities still maintain unique characteristics resembling this Confucian tradition (Ogden 2005; Yan 2013; Wang, Wang, Ruona & Rojewski 2005). For instance, the Chinese government's reliance on think tanks and intellectuals for public policy development remains heavy. There are various views on the relationship between the Chinese government and its think tanks. Ogden (2005, p. 113) doubts the independence of Chinese think tanks as they rely on the government for funding and promotion, and therefore tend to only work within the boundaries set by the Chinese Communist Party (CCP). Shai and Stone (2004, p. 142) see the reliance on intellectuals as damaging as it "operates within a closed policy context that is distant from civil society". Zhu (2009), on the other hand, argues that the closeness between the Chinese government and its think tanks possesses strengths which the Western system cannot match. For example, how to effectively transfer expert knowledge to policy outcomes and increase the influence of expert knowledge remains a challenge for scholars to tackle in the Western political system. There have been many attempts by Western scholars to build models and micro-mechanisms for solving this problem to ensure evidence-based policy outcomes (Amara, Ouimet & Landry 2004; Lavis, Robertson, Woodside, McLeod & Abelson 2003; Nutley, Walter & Davies 2007). In China, the transfer of expert knowledge to public policies appears relatively easy compared with that in the West. As Zhu (2009, p. 339) points out, Chinese think tanks are institutionalised and are located within government departments who are directly involved in the drafting of important policies, information release and initiating policy studies. They are also invited to important government meetings and seminars for immediate policy advice. Furthermore, many think tank scholars are appointed to important decision-maker positions in government departments (Zhu 2013, p. 29). This further enhances the role of the think tank in Chinese policies.

Another distinct characteristic of the Chinese system is the existence of administrative linkages between many semi-official think tanks and the relevant government departments. For example, scholars from public institutions and universities can pass on their research products to their supervising units[7] in the government as a range of alternative considerations for policy decisions (Li C 2009, p. 16). Leonard (2008, p. 17) even regards the Chinese intellectuals as an essential force in articulating a broader range of social concerns in a society without opposition parties, independent trade unions and a free press.

This Confucian tradition of rule by the wise with minimum direct involvement from ordinary people still has great influence on China's modern environmental governance. In fact, the constant engagement of intellectuals and experts in China's modern environmental policy development process resembles the discourse of administrative rationalism, as will be explained below.

2.3 Administrative rationalism - a mainstream policy approach for China's environmental problems

[7] The majority of the famous Chinese universities, such as those listed in China's "211 Project" and "985 Project", are state supervised, and therefore have their supervising units within the government (Ministry of Education of PRC 2015)

Dryzek (2013, p. 75) defines administrative rationalism as a "problem-solving discourse which emphasises the role of the expert rather than the citizen or producer/consumer in social problem solving, and which stresses social relationships of hierarchy rather than equality or competition". As a problem-solving discourse, administrative rationalism is not about public participation, but about "rational management in the service of a clearly defined public interest, informed by the best available expertise" (Dryzek 2013, p. 88). This is to say, public interest, in such an approach, is uncovered and conceptualised by experts through technical procedures such as professional policy analysis rather than articulated and raised by the general public.

There are a range of institutions and practices involved in administrative rationalism when dealing with environmental problems. These often include bureaucracies of national resource management, pollution control agencies, regulatory policy instruments, environmental impact assessment, expert advisory commissions, planning, and rationalistic policy analysis techniques (Dryzek 2013, pp. 76-84). A top-down approach to planning is the most predominant characteristic of China's governance of its environmental problems. The central government usually sets up a national goal and then divides and appoints the tasks for provincial and municipal governments (Lo K 2014, pp. 238-239) such as those in its ECERS during the 11^{th} and 12^{th} Five-Year Plans. Rationalistic policy analysis, such as cost and benefit analysis, is widely performed by the experts in the policy process. However, the national resource management bureaucracies, pollution control agencies, environmental impacts assessment and regulatory policy instruments are weak in China (Carter & Mol 2013). This situation is caused by China's previous pursuit of economic development at all cost. Nonetheless, this situation is gradually changing as China started to realise the importance of resource conservation and pollution control on the way to a harmonious society (Zheng & Tok 2007). As a result, the status of national bureaucracies for resource conservation and pollution controls has gradually improved.

Bureaucracy is essential in a system of administrative rationalism. The 19th century German sociologist Max Weber's theory of bureaucracy provided foundation for the management of environmental problems under administrative rationalism. It was believed that isolated individuals were unable to solve increasingly complicated social and economic problems, therefore, coordinated solutions were required. Bureaucracy provided the framework for this to be achieved, in which complex problems could be divided and then sub-divided into portions small enough for assigned individuals or small groups to work out a solution (Weber 2009). Such a system has advantages when implementing large-scale programs, for instance, China's renewable energy development program. The central government sets up the national goal for renewable energy expansion within a five-year time frame, and then divides the tasks and distributes them to each province. Each province further divides and appoints the tasks to municipal governments.

The idea is simple and the implementation is reasonably straightforward. However, such a system also exhibits weaknesses, such as the quality of implementation. Under administrative rationalism, monitoring and auditing are especially important procedures for all levels of the administrative hierarchy. However, such procedures are often lacking at lower levels of government where the central government's influence is weaker. As a result, the quality of the policy implementation at the local level is sometimes poor. The gap between what the government aims to achieve and what is actually achieved at the local level is often termed as the "implementation deficit" (McLaughlin & Krantzberg 2011; Mitchell 2014; Weale 1992). Developers and polluters under a municipal or a county government's administration are often unwilling to comply with the central government's policy decision as this causes the reduction of profits. (Dryzek 2013, p. 95). To monitor and audit such behaviour within the vast scope of the lower end administrative system would require a large amount of energy and resources, which is, in most cases, lacking. Therefore, the "implementation deficit" appears to be a difficult problem to address. This is exactly the situation that China faces in the management of its environmental problems (Zhang B & Cao 2015).

In order to overcome the "implementation deficit", Sabel, Dung and Karkkainen (2000) proposed the so-called "rolling rule regime". Under such a regime, the central goals and standards are still decided by the central government, but the compliance and detailed implementation procedures are negotiated at the local level. This adjustment promoted decentralisation and diluted administrative rationalism by allowing local feedback into the policy process. Hajer (2011) promoted the concept of environmental governance in which local actors facilitated the central government in accomplishing goals through networking and negotiations rather than controlled by the central government. It was suggested such an initiative could be achieved through regular face-to-face meetings at the city level, where individuals and interested companies could express their opinions on local environmental affairs. Meanwhile the government should also be willing to consider the citizens' information input and formulate policies based on the input (Hajer 2011, pp. 31-32). Although not without their weaknesses such as lack of resources and monitoring, local resistance and corruption (Jia & Nie 2017; Madariaga & Klein 2016), these new approaches do serve a purpose of utilising a democratic approach to soften the overly concentrated power and expertise at the top of the hierarchy.

Administrative rationalism puts great emphasis on expert knowledge but far less on the consultation of the general public at the local level (Dryzek 2013, p. 90). It is assumed that under administrative rationalism the experts at the top of the pyramid know better than those at the bottom. However, in reality, it is impossible for the centralised experts to know every single detail of a social problem at the ground level, especially when the problem is complex and the scale is vast. Moreover, as Ogden (2005, p. 112) points out, the Chinese intellectuals mostly carry out their work in their work units such as the Chinese Academy of Social Sciences (CASS), universities and research institutes within the government departments in big cities. They rarely have interactions with the ordinary people such as farmers and factory workers. This disconnectedness makes it harder for a central policy to cater for every locality's situation (Shapiro 2012, pp. 57-58). The participative approach is an alternative approach that can overcome this deficiency of the top-down approach (Mertha 2008). It is believed that local people have a better understanding of local affairs and can make the best decision for themselves. This is another important approach to the solving of environmental problems.

2.4 A participative approach

A participative policy approach is highly valued in many Western democracies, and is starting to spark discussions on its feasibility in developing countries such as China. Such an approach may yield the best possible policy solution if the majority of the stakeholders understand what the best option is for their locality and agree with each other upon the implementation of such an option. However, the participative approach may also fail to deliver any feasible policies when stakeholders' views completely contradict each other.

Lovell, Bulkeley and Owens (2009) examined the convergence of the UK's energy and climate change policy sectors and the actual policies. They identified that the convergence process of the UK's energy and climate policy sectors were surprisingly free of conflicts. They reviewed this phenomenon and identified four primary storylines: climate change as a problem of energy supply; climate change as a problem of energy demand; climate change as a market-efficiency problem and climate change as an international problem. They then analysed the views and attitudes of government, non-governmental organisations, business and policy advisory bodies on these four storylines. They found that there were no distinct conflicts or contradictory views among the actors along the four storylines. The authors concluded that in the case of the convergence of the UK's energy and climate change policies, competing actors were absent. Under this circumstance, the policy process is relatively straightforward, and policy focus can be more technical, for instance, focusing on the existing energy infrastructure and technology trends. As such, the policy outcome represents optimal policy option that jointly decided by relevant stakeholders.

Stevenson (2009) identified a range of conflicts among stakeholders (Technical Advice Group – TAG) during the redrafting of Welsh renewable energy planning policy (Technical Advice Note 8 – TAN8). The author attended all TAN8 consultation meetings and gained firsthand information on different stakeholders' stands and the entire consultation process. In order to explain the mixed attitudes of stakeholders towards a wind farm development and the difficulties in the policy development process, Stevenson (2009) adopted a Foucauldian discourse coalition approach by evaluating power, discourses and policy rationalities among different actors and the discourses they held. Three discourse coalitions were identified in the re-construction process of TAN: the global "climate chaos" coalition who strongly emphasised the role of wind power in fighting global climate change; the traditional conservationists and preservationists coalition who believe renewable energy could only be accepted at certain scale and location; the ecological modernisation coalition who believed economic growth and the resolution of environmental problems could be reconciled. Although these three discursive coalitions all believed in the concept of sustainable development, their opinions on the development of wind power in Wales varied. As one of the Welsh local government association representative stated in Stevenson's article (2009, p. 519),

> It started to go a little bit pear shaped, because Friends of the Earth and what I could call, proper green people, were saying 'great, fantastic, windfarms are happening at last' and the other people, who also call themselves environmentalists, started getting very agitated about the landscape impacts.

In Stevenson's (2009) example, a participative policy process was not capable of overcoming contradictions and conflicts. Under such a circumstance, the author believes the state should remain the "vehicle" which decides the target in policy making. The role of public consultation should be appreciated but should not be overly enlarged or seen as the purpose of policy process. Just as Rydin (2003, p. 69) put it, "the key to success here is not consensus but building a position based on divergent positions". Nonetheless, decisions have to be made even if there are contradictory stakeholder views.

The authors of the above two cases showcased the role of stakeholders in a participatory approach towards public policy. When stakeholders share common understanding and form a unanimous decision, the solution to an environmental issue can be effective. However, there are also cases when stakeholders hold contrasting views and yield no solution, or stakeholders may agree upon a solution but the solution may be far from ideal or optimal. The participative approach therefore has both strengths and weaknesses, depending on these conditions.

The public jury is another form of participatory approach. The German legal corporatism is a typical example. In the German system, the size of national government offices is usually small and they focus on coordination with a large number of regional and local offices. During this process, private interest groups are encouraged to express their opinions and raise initiatives to the government, and public standing can be gained through the means of laws (Dryzek, Downes & Hunold with Hernes 2003, p. 31-39). The public jury approach also has a place in other democracies. For instance, in November 2016, two thirds of the 350 members of the South Australian citizen jury rejected the plan for hosting a high grade nuclear waste facility in South Australia. The citizen juries debated the risks associated with the technology and the profitability of the nuclear repository plan. They also paid respect to the voice of the traditional owners by stating: "There is a lack of Aboriginal consent. We believe that the government should accept that the Elders have said NO and stop ignoring their opinions" (Green 2017, n. p.). The citizen jury in South Australia on the nuclear waste repository plan showed the strength of the public jury approach in representing public opinions in decision-making.

Nonetheless, there is a pre-condition for participative approaches to be implemented successfully. The decentralisation approach and the citizen jury approach both require a democratic setting where citizens have a say in local affairs. Public consultation and networking among the general public, local entrepreneurs and local governments are essential. However, in China's context, the essentials of citizen consultation are lacking. This indicates that the participative approach to solving environmental problems in China is not yet feasible.

Democracy is generally believed to have a positive impact on the control of pollution in the developed world (Farzin & Bond 2006; Li & Reuveny 2006). For developing countries, Mak Arvin and Lew (2011) also argue that democracy is conducive to improving environmental quality. For China, some decentralised initiatives have been seen in local economic management and village elections (Epstein 1997, p. 406; Landry 2008, p. 221; Wang & Yao 2007), however, a democratic approach in solving local environmental problems is not common. Instead, China has more often adopted the approach of authoritarian environmentalism in its environmental governance.

According to Gilley (2012, p. 288), "authoritarian environmentalism can be provisionally defined as a public policy model that concentrates authority in a few executive agencies manned by capable and uncorrupt elites seeking to improve environmental outcomes". Under China's authoritarian environmentalism, public participation is narrowed down to a small group of key stakeholders such as experts, responsible government officials and major participating SOE managers. The general public are expected to follow the state-led implementation and obediently participate in the programs. In theory it is believed that, "authoritarian governments are better equipped with institutional and procedural features that allow for faster and more rigorous responses to environmental problems than are possible in democracies" (Ahlers & Shen 2017, pp. 1-2). However, in Ahlers and Shen's (2017) analysis of two of Hangzhou City's authoritarian measures in reducing air pollution, namely the restrictions on the use of private cars and the (re)location of industrial facilities, they identified that the implementation outcomes of these local policies are more complex than what are usually captured by the authoritarian environmentalism concept. This is because the Chinese authoritarian environmentalism has seen more actors involved during the local implementation process, including not only the local government, but also businesses, EPBs and the general public. The interaction of different actors will lead to dispersed implementation outcomes. For instance, Ahlers and Shen (2017, p.18) pointed out that the Hangzhou government chose a highly centralised implementation method for the restricting the usage of private cars. Although the general public was unhappy with the constraints and the government's authoritarian implementation style, they appear to accept the policy more easily when labelled as "air quality protection" rather than "easing traffic congestion". However, this mixed mode of both authoritarian and democratic inputs was only observable in the local implementation process rather than at the national scale. The democratic inputs were also seen more in the domain of climate change rather than water and soil management (Gilley 2012, p. 289).

A significant weakness associated with China's authoritatian style environmental governance is the implementation deficit. Scholars have investigated this problem from a wide range of angles. Lieberthal and Oksenberg (1988) identified China's fragmented vertical and horizontal administrative structure as a causal factor for the changing shape of a central policy when passing down to localities. Eaton and Kostka (2014) explained how frequent position rotations and changes of office of local officials could lead to a wider implementation gap, as local officials tend to choose quick and low quality measures to the implementation of environmental policies. Economy (2006) also attributed this phenomenon to China's decentralised governing trend in which local government started to gain more power, and as a result, could choose favourable policies to implement but igore or pay less attention to the ones they disliked. Ran (2013) blamed the cental government's faulty incentive structure as the causal factor for local governments' poor implementation or non-implementation in environmental policies. While a batch of other authors pointed out that the conflicting interests between cental and local governments, i.e. the central government called for environmental protection while local officials paid greater attention to economic development and tax revenue, are the foundamental cause for the implementation gap (Van Rooij, 2006; Mol and Carter 2006; Kostka and Hobbs 2014; Kostka and Hobbs 2013).

In response to the implementation gap, the Chinese government actively experimented with a range of new initiatives to strengen the implementation channel of environmental policies. One of the most significant and successful initiatives was the target responsibility system (TRS). Under TRS, each level of officials/large SOEs were appointed specific targets (i.e. greenhouse gases emission targets; energy saving targets) to be accomplished within a certain timeframe. Punishment would be applied if targets were not achieved. In Koskta's (2016) words, the mandatory "binding" (yueshuxing) environmental targets under TRS are especially effective for government departments and enterprises in achieving their energy efficiency and carbon emission targets in China's 12th Five-Year Plan. Specifically, these binding environmental targets are clearly "written into local cadres' annual responsibility contracts and are crucial criteria in cadre promotion decisions, thereby incentivizing officials at each layer of government administration to fulfil upper level governments' environmental mandates" (Koskta 2016, p. 5). The introduction of TRS in China's environmental governance showed the central government's effort in making environmental protection a national priority. It also sent out a clear signal to local governments that they should carefully work with competing interests between economic development and environmental protection, as environmental targets started to become an important indicator for their promotion. The TRS did not just stop there; the central government continued to work to improve it. For instance, they set up specifically tailored sector and regional targets which made targets and responsibilities clearer and sophisticated. The government also introduced third party auditing agencies to provide more comprehensive guidance on target measurement and verification standards (Ye 2013, p. 281). Moreover, the central government even collected bottom-up feedback in the planning process in order to set up more realistic targets for the provincial and local governments and enterprises (Koskta 2016, p. 5). This guaranteed the satisfaction of important stakeholders prior to implementation and were therefore more likely to achieve positive outcomes in the implementation.

Nonetheless, China remains an authoritarian country and the realisation of democracy in China may take a long time. Therefore, the solution for many environmental problems still follows a top-down approach. Using a democratic approach to solve environmental problems seems a long way away, but China's adoption of the market approach is fast and ambitious, especially in its management of climate change. The third approach, the market approach, to solving environmental problems will be discussed in the following section.

2.5 Market mechanisms in China's climate change mitigation

On top of the mainstream administrative approach, the Chinese government also actively explores market options to solve its environmental problems. China's top leaders have long realised the power of the market. China's economic growth since its introduction of a market economy also proved this (Morrison 2009, pp. 4-6). On the management of climate change, the Chinese government experimented with two market-based mechanisms, namely the CDM introduced in the early 2000s, and the pilot emission trading scheme (ETS), introduced in 2012. The national ETS is scheduled to commence by the end of 2017 (Swartz 2016 pp. 12-17). Stavins (2003, p. 298) defines market-based instruments as follows:

> Market-based instruments are regulations that encourage behaviour through market signals rather than through explicit directives regarding pollution control levels or methods. These policy instruments, such as tradable permits or pollution charges, are often described as "harnessing market forces" because if they are well designed and implemented, they encourage firms (and/or individuals) to undertake pollution control efforts that are in their own interests and that collectively meet policy goals.

According to Stavins (2008, p. 300), traditional administrative instruments tend to set up uniform technological and performance-based standards for firms and distribute shares of pollution control duties to them to accomplish regardless of cost. This may end up being very expensive because different firms may require different technologies in controlling their emissions. Under the uniform standard, firms may spend more on the required pollution control procedure rather than the most cost-effective procedures specially catered for their own situations. Market-based instruments, in contrast, provide flexibility. In theory, the maximum environmental benefit can be achieved with minimum cost through intelligently designed and implemented market-based instruments (Lockie 2013). This is because market-based instruments provide incentives for firms to adopt the most cost-efficient abatement options to achieve the optimal emission reduction outcome rather than following the set standard method (Baumol & Oates 1988; Krupp 2007; Tietenberg 1995).

Flexibility and cost-efficiency are the predominant advantages of market-based instruments, however they are not without flaws in reality. Neuteleers and Engelen (2015, p. 253) argued that there should be good reasons to question the integrity of market-based monetary valuation in the environmental domain because it could be morally problematic in the commodification process of environmental goods. Spash and Aslaksen (2015) stressed the challenges of traditional environmental economics in the valuation of the ecosystem and biodiversity. Kroeger and Casey (2007, p.321) also pointed out that in reality markets fail in delivering efficient allocation of ecosystem services on many occasions. In such cases well-designed government interventions will be required to protect the public interest. Dryzek (2013, p. 130) indicated that the tumbling emission permit price and the broken down EU ETS after the hit of the 2008 global financial crisis were due to the initial design flaw of the scheme, where it did not set up a stringent enough sum of emission permits. The initial over allocation of permits was a very significant trigger of the collapse of the permit price. Therefore, it is possible for market mechanisms to fail.

China's market-based instruments in the management of climate change have some special characteristics. First of all, these market mechanisms were still heavily influenced by China's administrative power. As Lo and Howes (2014, p. 397) pointed out, "The Chinese carbon markets are characterized by a hierarchical relationship between the regulator and many regulated enterprises". According to Kossoy and Guigon (2012, p. 98), China's Department of Price may play an important role in deciding the price of carbon and managing its fluctuation in the context of a regulated power market if the power sector is to be included in the national trading scheme. Regulatory authorities contributed greatly to the good compliance results in the pilot carbon trading programs as failure in compliance means losing face for the responsible authorities (Lo & Howes 2015; Shen 2015).

The second characteristic of China's climate change market instruments is that they are economic and security-driven rather than emission mitigation driven. Lo (2013, p. 73) saw China's carbon trading as an incentive for corporates to carry out low-carbon economic development, but carbon emission reduction was only a co-product. It was regarded as primarily an economic policy providing some environmental benefits instead of an environmental policy initiated by an environmental agency. This was due to the heavy involvement of NDRC, an economic planning commission, in the policy process. Lewis (2010) argued China's active participation in international CDM was due to its concerns for the negative impacts of climate change on its economically advanced regions in the eastern part of the country. Its participation was also for the purpose of attracting international finance for its renewable energy development. These characteristics indicate that market mechanisms, even as an approach that China embraces, have a hue of administrative colour.

This section so far has introduced the three major approaches which are used to solve environmental problems, namely the administrative approach, the democratic approach and the market approach. China generally adopts a top-down administrative approach in managing its environmental problems. The democratic approach is of less relevance to China. Market-based instruments, including CDM and ETS, have been introduced to China's climate change mitigation and have been seen fast development, but have also been influenced by the prevailing authoritarian top-down approach. The next section explores the ways to interpret and evaluate these approaches, namely policy analysis.

2.6 Modern policy analysis

Policy analysis is described by Parsons (1995, p. xv) as "an approach to public policy that aims to integrate and contextualize models and research from those disciplines which have a problem and policy orientation". Policy analysis cannot be determined solely by disciplinary borders according to Wildavsky (1980, p. 15), as each case has its individual characteristics, even within the same discipline, and therefore can only be defined by "whatever appears appropriate to the circumstances of the time and the nature of the problem". Harold Lasswell (1968; 1971) summed up the nature of policy analysis as being: multi-disciplinary; multi-method; focused on problem-solving; oriented towards the contextuality of the policy process; focused on options and outcomes; and the incorporation of knowledge into the analysis of public choices and decision-making. This section provides brief background to and introduces key components of policy analysis. It starts by introducing the development of modern policy analysis. It then moves on to the role of institutions, and institutions under China's fragmented authoritarianism. Last, it explores policy processes and evaluation methods.

2.6.1 Development of modern policy analysis

The position of policy analyst initially emerged as a profession in the US during the mid-1960s. A number of professionals trained in the disciplines of humanities and social sciences had specialized in and been actively engaged in producing advice for public policies since then (Mintrom & Williams 2013, p. 3). Mintrom and Williams (2013, p. 3) used the term "movement" to describe the growth of the field of policy analysis. The earlier policy analyses focused on advice-giving, just as Weimer and Vining (2017, p.1) put it, "the product of policy analysis is advice". They were usually conducted by analysts in internal government agencies and the advice was mainly produced for a small number of decision-makers within the government (Lindblom 1968, p.30). In a way, these activities were very similar to those conducted by the think tanks in China. As the 'movement' went on, the audiences of policy analysis became wider. Apart from government departments, external agencies, corporates, and even not-for-profit organisations started to adopt policy analyses for their target setting, investment, marketing, and operations. As a consequence, the role of policy analyst became more common among other sectors of the society. The involvement of interest groups and the general public in a range of social issues and policy processes is another characteristic of the policy analysis movement (Radin 2000, p. 37).

The focus of policy analysis also shifted over time as the movement went along. Parsons (1995, p. 75-77) took the US as an example and summarised the switch of focus in public policy analysis over three decades. In the 1960s, the focus of policy analysis was on how to improve decision-making, or how to make government more rational. The core discussion back then was the issue of power. It questioned how decisions were made and what sources comprised the input (Bachrach & Baratz 1963;

Dror 1964; Dror 1967; Etzioni 1967; Lindblom 1961). At the same time, it was believed that the government can perform effectively and fix problems through improving its capacity. Moving to the 1970s, the focus of policy analysis shifted to policy implementation issues by investigating the reasons behind difficult implementation and comparing the effectiveness of top-down and bottom-up implementations (Kirby, Kroeker & Teschke 1978; Rondinelli 1978; Sabatier 1986). By the 1980s, belief in the force of the free market became dominant over the effectiveness of bureaucrats and institutions. It was argued that public policy should be oriented around public economic choices; the market alone would reflect the best decision option. Government interventions were ineffective and would only make problems worse (Martin 1993, p. 12).

Throughout the 1980s and beyond, there were another two distinct trends that gradually became the focal points of policy research. The first one was the exploration for new models. Researchers aimed to develop models beyond the investigation of the relationships among government, administration, legislatures and interest groups, and therefore the concept of policy networks and communities was born. For example, Bὂrzel (1998) reviewed multiple policy network concepts in different countries and compared the German concept of policy network to that in the Anglo-Saxon literature, and believed it to be an effective alternative governance approach to hierarchy and market. The second one was the increasing interest in the study of the effect of institutions on policy development and outcomes, or, how institutions can shape the formation and outcome of public policy. It was argued that institutions and their organisation should not be overlooked because this is where policy formation takes place (Parsons 1995, p. 223). This new institutionalism holds that the institutional arrangement has the ability to shape people's behaviour, and therefore how institutions are organised should be the primary focus (March & Oslen 1983, p. 738). As Oslen put it:

> Institutions dispose of authority and power, but also of collective wisdom and ethics. They provide physical, cognitive and moral frames for joint action; capacity for intervention; conceptual lenses for observation; agenda, memory, rights as well as duties as well as conceptions of justice; and symbols you may identify yourself with. (Oslen 1988, p. 35)

Peters (2016) confirmed the impact of institutions on policy choices through their role in articulating policy ideas. However, he also pointed out that the two advantages associated with institutions, namely predictability and stability, could turn into disadvantages if they were overly strong. This is because the over emphasis on predictability and stability can prevent innovations and necessary policy changes within the institutions which may lead to institutional inertia (Carter 2012, p. 423; Peters 2016, p. 67). To avoid this situation, an institutional approach should pay attention to flexibility, changing policy environment, and communication with other institutions and individuals. Nonetheless, institutions are important for the formation and implementation of public policies, there is a need to investigate the operation and behaviours of institutions.

Among the problems associated with institutions, institutional fragmentation is a common phenomenon which appears in many, if not all, countries' governments (Zelli & Asselt 2013, p. 1). When it comes to environmental governance, the fragmentation among institutions often appears prominent. This is because many environmental problems are termed wicked problems, which require multiple government departments to work across departmental boundaries. Furthermore, environmental problems often involve multiple stakeholders with conflicting interests. In many cases, the representatives on the environment side are, unfortunately, weak or even non-existent (Buzbee, 2003; Lazarus, 2000). Such a situation further complicates the government's decision-making process because the different departments which work together on the problem each represent a different stakeholder's interests. The following example serves to demonstrate this.

Doremus (2009) investigated the CALFED, a program in which the US federal and state governments collaboratively managed water allocation and ecosystem restoration in the California Bay-Delta, as an example to display the impact of institutional fragmentation on a large-scale environmental problem. As Doremus (2009, p. 731) pointed out, the collaborative approach towards managing water resources and eco-restoration of California Bay-Delta delivered mixed results. A new set of networks were established to address fragmentation and enhance the connection of existing agencies. This innovation improved the understanding of the Bay-Delta System. However, the cooperation between agencies was not smooth because it became difficult to identify each agency's responsibility and accountability. The goal of achieving a healthy aquatic ecosystem and the goal of maintaining a reliable water supply could not achieve the win-win balance, and stakeholders behind the two goals created great political pressures in reality. Consequently, Doremus (2009, p. 731) called for the development of a new and comprehensive institution which featured "strong leadership, external political support and a mechanism for resolving interagency conflicts". Whether or not these proposals can fundamentally solve the conflicts among agencies on similar large scale environmental projects is not certain, and can only be tested in the development and delivery of relevant policies in reality over time.

In OECD countries, scholars and social scientists actively explored the feasibility of joined-up government or whole-of-government (WG) with the UK being one of the most active representatives. Pollitt (2003, p.35) defines joined-up government as follows:

> 'Joined-up government' is a phrase which denotes the aspiration to achieve horizontally and vertically coordinated thinking and action. Through this co-ordination it is hoped that a number of benefits can be achieved. First, situations in which different polices undermine each other can be eliminated. Second, better use can be made of scarce resources. Third, synergies may be created through the bringing together of different key stakeholders in a particular policy field or network. Fourth, it becomes possible to offer citizens seamless rather than fragmented access to a set of related services.

This definition, according to Pollitt (2003, p. 35), addresses four goals of a joined-up government. The first one aims at making policies more effective; the second one focuses on how to better use of resources; the third one aims at the means of generating more good ideas and improving cooperation among stakeholders; and the last one aims at producing a more convenient “one-stop shop” type of services to citizens.

The convergence of London’s urban planning and transport policy was one successful example of the WG approach (Allmendinger & Haughton 2009; Rode 2017; Thornley & West, 2004). Rode (2017, p. 9) analysed the integration of London’s urban planning and transport sectors since the early 1990s. The research provided evidence for the improvement of London’s integrative planning capacity. Through the joined-up work of the urban planning department and the transport department, London’s traffic condition improved and new infrastructure made city life more convenient. Interviewees commented on the integration as “a particularly positive experience with transport”, “London is in a much better shape in terms of planning and transport integration than it was pre-2000”, and “This is the best situation ever”. However, the successful integration of London’s urban planning and transport policies does not mean the WG approach guarantees success in other situations elsewhere.

In theory, the notion of joined-up government is ideal, however, the perfectly joined-up government is very rare in reality. This is because real social, economic and environmental problems often face multiple stakeholders, difficult monitoring and evaluating tasks, risks and even communication breakdown (Pollitt 2003, p. 38). Huxham and Vangen (2000, pp. 1159-1160) pointed out a range of potential weaknesses of joined-up practice. For instance, the blurred accountability makes it difficult for funding allocation and delivery of policy and services. It also leads to great difficulty in monitoring impacts of programs due to lack of capable monitoring and auditing systems to cope with the joined actions. The financial costs of setting up and maintaining new patterns of working arrangements are usually high. There are potentially high organisational and transitional costs involved for introducing new joined-up approach. Cope and Goodship (1999, p. 13) even question the feasibility of joined-up government. They critiqued a range of UK government initiatives towards joined-up government such as the joined-up auditing system of the Public Audit Forum and argued the progress of joined-up government would be extremely slow or even impossible without the parallel action of joined-up regulation. Taking a different stand, Peter Wilkins (2002, p. 119) suggested a "fuzzy accountability" approach for auditing different agencies' efforts in a joined-up program, and claimed "a fuzzy logic goes beyond the restriction of true or false categorisations…fuzzy accountability can enable more flexible approaches to complex problems".

Christensen, Fimreite and Lægreid (2014) conducted analysis on Norway's welfare administration reform which aimed at bringing passive beneficiaries back into the workforce and achieving user-friendliness, efficiency and connectedness by working across traditional policy boundaries and administrative levels. The analysis found out that the WG reform in Norway's welfare administration was still struggling to be implemented in many aspects, and especially so in the vertical coordination between the central and local agencies due to the complexity of a hybrid administrative structure. The accountability of the WG reform become blurry. Among all streams of accountability categories, only the legal accountability managed to advance through standardising and formalising local welfare units. Political accountability remained the same. Unfortunately, administrative accountability, professional accountability and social accountability all performed less than ideally due to the complexity of cutting through responsibility and expertise boundaries and dissatisfied customer feedback.

However, the fuzzy accountability approach is not without its drawbacks either. Bache, Bartle, Flinders and Marsden (2015, p.65) pointed out that the "fuzzy governance" and "fuzzy accountability" worked as shields for national and local governments' "blame avoidance" game in the UK's transport-related climate management under the *Climate Change Act 2008*. Due to politicians' preference for fuzzy accountability, all four cities that the authors conducted analyses on had shifted the policy focus from carbon reduction to economic growth and job creation (Bache, Bartle, Flinders and Marsden 2015, p. 64). The shifting of policy goals which completely disobeyed the purpose of the *Climate Change Act 2008* ended up finding no one to blame due to the blurred accountability.

A similar blame avoidance game has been observed in China. Ran (2017) utilised the framework to examine how blame avoidance behaviour has shaped China's environmental governance in a decentralised fashion. The author pointed out that the chain of blame in China was shaped by the hierchical structure in which the blame was often pushed around between environmental policy makers and implementers. During implementation, local governments often bare the blame for negative environmental outcomes.

Therefore, careful planning around these identified weaknesses should be incorporated when applying the WG approach. Questions should be asked before applying the WG approach to government agencies. For instance, what are the deficiencies of the current status of agencies? Is WG the most appropriate approach to address the deficiencies? Are the candidate agencies from unrelated fields and are their capacity and expertise sufficient to support the merge? (Christensen & Lægreid 2006, pp. 18-20). All in all, institutional fragmentation is a common phenomenon for bureaucracies. The application of WG approach requires cautious judgement as it does not suit all situations. The next section will be dedicated to exploring the fragmentation within China's bureaucratic system.

2.6.2 The fragmented authoritarianism framework

The fragmented authoritarianism framework was first highlighted by Lieberthal and Oksenberg (1988) in their study of the politics, bureaucratic structure and process of China's energy policies. The authors argued that understanding of the bureaucratic structure and policy process was of great importance in the analysis of Chinese politics and public policies. They argued that "the complex structure of the Chinese state itself as a significant determinant of political process and policy outcomes" should not be overlooked (Lieberthal & Oksenberg 1988, p. 3). Lieberthal and Oksenberg's analysis showed that fragmentation was a significant characteristic of China's energy sector and the Chinese bureaucratic system as a whole. This fragmented authoritarianism tended to encourage competition among ministries with the same level of authority. Among the top leaders and the central ministries, the politics were played based on hierarchy. Ministries, even those on the same level of the hierarchy, may have different levels of influence on policy decisions based on the ranking of top leaders behind them. The higher ranking officials had the power to raise their policy preferences among competing options. Therefore, the agenda setting and policy decisions at the centre were a reflection of the power, status and views of the top leaders (Lieberthal & Oksenberg 1988, p. 23). On the other hand, although the top leaders were very efficient and effective at commanding the central bureaucracies, the implementation outcomes at the provincial and local levels could vary dramatically from Beijing's pre-set policy goals. This was because the policy implementation process also involved multi-bureaucratic bargains, negotiations and compromises as a means for overcoming the fragmentation. For instance, a province believed to be of more economic significance by the top leaders can get more resources. However, if a less significant province wants to obtain more resources, the provincial officials have to seek to build up connections with the central leaders (Liebertal & Oksenberg 1988, p. 32). Lieberthal and Oksenberg's fragmented authoritarian theory set up an important framework for the study of Chinese politics and public policies. Several decades have passed since the proposal of Lieberthal and Oksenberg's theory. There have been changes and new insights in China's politics, bureaucratic structures and policy processes. However, the basic characteristic of fragmentation within the Chinese authoritarian system remains unchanged.

Gilli, Li and Qian (2016) identified this continued fragmentation in China's social welfare sector. Their analysis concluded that the top-down policy process combined with serious competition among vertical bureaucracies for resources had resulted in inefficiency in resource allocation and insufficiency in infrastructure input. Marks (2010, p. 972) also confirmed the continuity of fragmented authoritarianism in China's recent climate change policy processes. He noted that extensive negotiations and bargaining happened both among central bureaucratic agencies during the policy formation process and at all levels of bureaucratic agencies during the implementation process. The more powerful regions and bureaucracies had the power to shape the policy towards their preferences. This lengthy negotiation process twisted the policy into different outcomes when it finally reached down to different localities (Marks 2010, p. 976).

Nonetheless, things are improving. Although the fragmented authoritarian system is prone to problematic implementation due to, for instance, bureaucratic competition, the pro-development local officials, and weak legal and environmental state (Marks 2010; Rooij, Stern & Fürst 2016; Shirk 2014), there has been a rapid growth in China's renewable energy sector, which are the result of a set of more logical and coherent policies. Lema and Ruby (2007) analysed the policy change in China's wind energy sector during a 20-year (1986-2006) time period. They concluded that this process reflected the policy transformation from fragmentation to coordination in China's wind energy sector. In Lema and Ruby's analysis, the central government's pragmatic approach towards energy was the main driver for the policy changes in the wind power sector.

This echoed one of Libertal and Okenberg's (1988, p. 3) hypotheses that Chinese policy change was due to the top leaders' pragmatic reaction to an emerging or urgent issue. In the 1980s, the power shortage which had impacted one fifth of the nation's industries forced the state to abandon its monopoly of the energy sector by allowing private investments into small-scale power plants (Lema & Ruby 2007, p. 3880). In the 1990s, the top decision-makers realised the harmful consequences of coal-burning on human health and the environment. This new consciousness led to China's participation in multiple international environmental treaties, including the Kyoto Protocol. This process paved the way for a slightly improved regulatory capacity of the renewable energy sector. However, problems such as coordinating difficulty, unstable demand of wind power and investment risks could not be overcome during the implementation because provincial grids could not be convinced of the profit of wind power, and therefore were unwilling to connect wind power to the grid (Lema & Ruby 2007, p. 3882).

In response to these problems, the central government adopted two procedures in the early 2000s including centralising the energy bureaucracy and decentralising the market. The multiple competing and overlapping bureaucratic agencies involved in the renewable energy sectors were merged into one renewable energy department under the National Energy Administration of NDRC, which was to say, renewable energy policy was governed by only one agency with the ability to produce coherent policies since then. In terms of market decentralisation, energy production and transmission were separated. Two grid SOEs, the National Grid Corporation of China and China Southern Grid Corporation were established. The original China State Power Corporate was divided into five energy SOEs: Huangneng, Huandian, China Datang, Guangdian and China Investment Group, in order to create competition. The more coordinated central policies and increased competition led to fast development of China's wind energy in the early and mid-2000s (Lema & Ruby 2007, p. 3882). However, since the late 2000s, this rapid increase of wind power capacity started to present new problems, which will be explored later in this thesis.

The transformation of China's renewable energy policy from fragmentation to coherence demonstrates that fragmented authoritarianism can be reformed. However, it required the vision of the top decision-makers (Lieberthal & Oksenberg 1988, p. 34). Any unwise decisions could lead to completely different consequences. Therefore, consideration of the outside opinions from the non-state stakeholders such as private investors, NGOs and the general public would be a step forward for China's policy development and implementation.

Three decades after Lieberthal and Oksenberg's proposal of the fragmented authoritarianism framework, new perspectives have emerged on China's fragmented authoritarian style policy development. Mertha (2009, p. 996) identified that the Chinese policy process embedded in the fragmented authoritarian system started to provide opportunity for non-traditional policy actors such as NGOs, journalists, and even influential individuals to enter the policy process, providing fertile ground for policy changes. In Mertha's (2009, p. 997) words, these newly emerged policy actors "adopt the strategies [bargains, negotiations, pressuring, etc.] that traditional actors in China have used for decades to pursue their agendas and institutional mandates".

Among the new policy actors, Mertha (2009, p. 997) identified the tight connection between the media and the NGOs, due to the fact that many NGO leaders were trained as journalists or editors. The most common way the media and NGOs recruited support was through the articulation of convincing narratives from an unconventional angle, which opened up debates for policy issues. This issue framing process is important as it delivers critical stories in a way that the general public can understand and are interested in, which in turn accumulates support and enhances the bargaining power in the policy negotiation process. The issue framing is also a process for the new actors to test out the boundaries of the authoritarian government. In reality, the new actors tend to work strategically in the policy process. Rather than completely opposing a policy, they carefully work within the political boundary by seeking only partial modification to certain parts of the policy in order to manoeuvre the policy outcome closer to their goal. Mertha (2008, p. 151) terms such actions as “a kinder and gentler fragmented authoritarianism”, because the new policy actors “do not threaten – and are not seen as threatening – the legitimacy of the government or the Chinese Communist Party”. Other scholars termed the allowance of non-state actors’ involvement as “responsive authoritarianism”, which was regarded as an improvement in China’s policy processes towards a more plural and inclusive governance (He & Warren 2011; Reilly 2011; Weller 2008).

China’s current bureaucratic system and policy priorities are obviously different from that when Lieberthal and Oksenberg outlined the fragmented authoritarianism framework. However, ministerial bargaining and fragmentation still persist, as pointed out by Grünberg (2017) in China’s current energy sector. For instance, in Grunberg’s analyses, China’s Leading Small Group was seen as a potential coordination solution for fragmented bureaucracies at the subnational level. Therefore, the fragmented authoritarianism model “has not altogether lost its value as an analytical framework to describe the important structural features and operational mechanisms of China’s political system” (Grünberg 2017, p. 16). The main structure of the Chinese system remains unchanged. In Lieberthal and Oksenberg’s original hypothesis describing the structural fragmentation of the Chinese authoritarian system, they stated:

> Policy X resulted from a bargain among Ministries A, B, and C and Province D...Disgruntled Ministries E and F, losers in the deal, planned to pursue strategies to erode the agreement. The bargain sought to reconcile the conflicting organisational missions, ethos, structure, and resource allocations of the ministries involved (Lieberthal & Oksenberg 1988, pp. 3-4).

This hypothesis is still applicable to contemporary China's bureaucratic structure and policy process. However, there should be a new element added to it, namely the emerging but limited input of new policy actors in the fragmented authoritarian system. In later chapters (4, 5 and 6), this updated version of fragmented authoritarianism will be used as an analytical framework for China's climate-related energy actors and policies. In the following section though, the policy process will be explored to explain the sequence of rational policy making and analysis.

2.6.3 The policy process

So far, this chapter has discussed institutions, China's fragmented authoritarianism and its impacts on policy outcomes. In this section, it will discuss another domain of public policy, namely the rational policy development process. The policy cycle is a commonly used model for policy development and analysis which utilises a clear sequence of steps. It is also known as the stagist approach or the rational decision-making process (Howlett & Giest 2013, p. 17). Parsons (1995, pp. 78-79) summarised a range of influential scholars' work on the process of policy formation (Figure 2.1). Although terms and expressions that the scholars cited in Figure 2.1 used may vary slightly from one another, the essence of the modern policy cycle is made up of the following five steps: agenda setting, policy formation, decision making, implementation, and evaluation (Howlett & Ramesh 1995, p. 103).

Figure 2.1 Major scholars' work on policy process

Scholar	**Policy Stages in Model**
Simon, HA 1947, *Administrative Bahaviour*	• Intelligence • Design • Choice
Lasswell, HD 1956, *The Decision Process*	• Intelligence • Promotion • Prescription • Invocation • Application • Termination • Appraisal
Mack, R 1971 *Planning and Uncertainty*	• Deciding to decide: problem recognition • Formulating alternatives and criteria • Decision Proper • Effectuation • Correction and Supplementation
Rose, R 1973 'Comparing public policy'	• Public recognition of the need for policy to exist • How issues are placed on the agenda of public controversy • How demands are advanced • The form of government involved in the policy-making • Resources and constraints • Policy decisions • What determines governmental choice

	• Choice in its context • Implementation • Outputs • Policy evaluation • Feedback
Jenkins, W 1978, *Policy Analysis: a Political and Organisational Perspective*	• Initiation • Information • Consideration • Decision • Implementation • Evaluation • Termination
Hogwood, BW & Gunn, LA 1984 *Policy Analysis for the Real World*	• Deciding to decide (issue search or agenda-setting) • Deciding how to decide (issue filtration) • Issue definition • Forecasting • Setting objectives and priorities • Options analysis • Policy implementation, monitoring and control • Evaluation and review • Policy maintenance, Succession, and termination
Bardach, E & Patashnik 2015, *A practical guide for policy analysis: The eightfold path to more effective problem solving*	• Define the problem • Assemble some evidence • Construct the alternatives • Select the criteria • Project the outcomes • Confront the trade-offs • Stop, focus, narrow, deepen, decide!

	• Tell your Story

Source: Adapted from Parsons (1995, p. 78-79) and Bardach & Patashnik (2015, p. xvi)

Although the policy cycle approach is a commonly used framework for policy development and analysis, it is not without critics. For instance, Sabatier and Jenkins-Smith (1993, pp. 1-4) detailed five major criticisms of the policy cycle questioning the rationale behind the sequence, the hard to prove validity, the top-down style, ignorance of real world government hierarchies and the absence of analysis within each step. Viewing the concerns from another perspective, Lindblom (1968) argued that rather than focusing on the sequence, public policies should emphasise broader social forces such as business due to limits of human capacity and policy analysis. This is because in reality some issues are so complicated that going through the whole process of the policy cycle is impossible, especially when time and money are limited (Lindblom 1961, p. 80).

It is undeniable that real world affairs are complicated and lacking the tidiness we desire, however, the policy cycle is not without value. As Bridgman and Davis (2004, p. 32) explain,

> The best process in the world cannot substitute for high quality thinking and analysis. Likewise, the most creative and technically exacting thinking can fail to produce good policy if there is no process to integrate the complex web of activities that marks any public policy endeavour.

The policy cycle only provides a rational structure. However, within each step, different information, questions, methods, techniques, stakeholders and social factors which are relevant to the specific task of the step can be used for individual analysis (Cook 1985, pp. 43-48). The policy cycle is not a meaningless diagram; rather, it can be enriched at each step, which is to say analyses can be carried out in all steps within the policy cycle. In this way, the policy cycle not only reduces the complexity of social affairs to an extent that human minds can manage, but is also to guide target specific analysis for each stage of the policy process (Howlett & Ramesh 1995, p. 12).

Lynn (1981, pp. 146-149) initiated a "game" concept in differentiating types of analyses within the policy cycle. The "game" consists of three tiers, namely the "top game", the 'middle game' and the "low game". The "top game" deals with information gathering and agenda setting. The analysis within the "top game" focuses on problem recognition by explaining what the issue is and how the issue is defined. The analyses in this "top game" can be selected from various sources such as reports from the government think tanks, academic articles, and public opinion polls which will shape the perceptions and views on the targeted issue. The "middle game" in Lynn's game concept focuses on the analysis of the decision-making process by asking why and how a certain decision is made and its advantages over other alternatives. Or as Hogwood and Peters (1982, p. 231) put it, this was a stage where analyses focused on formulation of alternatives and decisions proper.

In Lynn's "low game", policy implementation, evaluation, modification and maintenance are the main targets. Parsons (1995, p. 82) classified the analysis in this stage as a "delivery analysis". It mainly deals with the "effectuation", "correction" and "supplementation" of the policy. Dunn (2012, p. 5) summarised three questions that ought to be asked in this policy stage:

> (1) What policy outcomes are observed, as distinguished from the outcomes expected before a preferred policy is implemented?
>
> (2) Did the preferred policy actually result in reduced emissions?
>
> (3) Were other factors such as political opposition to governmental regulation responsible for the limited achievement of emission targets?

Chapter 5 and Chapter 6 of this thesis focus on analysing the strengths and weaknesses of two of China's existing policies, CDM and ECERS, in which the above questions will be covered. This is to say, the "low-game" analysis will take up a great proportion of the entire thesis. In the next section, the variety of policy evaluation methods which can be used for the 'low game' analysis will be explored.

2.6.4 Policy evaluation methods

Evaluation is an activity that policymakers, funding organisations, planners and a range of other stakeholders carry out to distinguish worthwhile social programs from ineffective ones so that existing programs or policies can be revised, modified and new ones proposed in order to achieve desired results (Rossi, Lipsey & Freeman 2004, p. 3). Dye (1987, p. 351) recognized the consequence-focused nature of evaluation and broadly define policy evaluation research as “the objective, systematic, empirical examination of the effects ongoing policies and public programs have on their targets in terms of the goals they meant to achieve”. Vedung (2009, p. 387) puts evaluation in a narrower context within the boundaries of government intervention and defines evaluation as follows:

> Evaluation is careful assessment of merit, worth, and value of organisation, content, administration, output, and effects of ongoing or finished government interventions, which is intended to play a role in future, practical action situations.

Vedung (2009) categorized modern government intervention into two classes, namely the process-oriented intervention and the substantive intervention. Process-oriented intervention aims at assessing the organisation management and performance of the public administration system itself. While substantive intervention covers a broader range of functional disciplines such as environment, energy, natural resources, economic development, housing, health, welfare, transportation and so on (Vedung 2009, p. 3). This thesis, as outlined in Chapter 1, investigates the effectiveness of both institutions and detailed policies, therefore, evaluations of both process-oriented and substantive interventions will be included.

The selection of evaluation criteria of merit depends on the specific purpose that the evaluation is aimed at. Evaluations are carried out for various reasons: some may be intended to improve program performance; some may be aimed at generating discussions for decision making; while others may be conducted for assessing program efficiency. Therefore, the first task for an evaluator is to identify the purpose of the evaluation (Rossi, Lipsy & Freeman 2004, p. 34). Vedung (2009, p. 258) identified four major criteria of merit for evaluating government interventions, or say, government policies and programs. They are 1) effectiveness; 2) productivity; 3) efficiency (cost-benefit); and 4) efficiency (cost-effectiveness) (See Figure 2.2).

Figure 2.2 Four Important Criteria of Merit in Program Evaluation

1) Effectiveness	= degree of outcome goal achievement , cost disregarded
2) Productivity	= output through cost
3) Efficiency (cost-benefit)	= monetarized value of program effects through monetarized program costs
4) Efficiency (cost-effectiveness)	= program effects in physical terms through montarized program costs

Source: Vedung (2009, p. 258)

Within the effectiveness criteria of merit, there are six evaluation models: goal-attainment model, side-effects model, relevance model, client-oriented model, stakeholder model and collegial models (Vedung 2013, pp. 388-398). The goal-attainment model asks whether or not the results are in accord to the pre-set goals and what impacts will the intervention pose. The side-effects model aims at assessing side-effects beyond the expectation of the original target. The result of side-effect evaluation can be used as evidence for modifying current intervention or for developing new interventions. The relevance model adopts complex criterion by questioning the worthiness of the existence of intervention. The client-oriented model allows stakeholders to provide feedback. It is widely used in the contexts of nursing home, public housing, mental health and recreations. Collegial models also refer to peer review, self-evaluation or combination of the above, which are often used in the evaluation of research and higher education.

Regardless of the different foci of the above six models, they share one common characteristic that they do not deal with the costs of the program. However, when utilising efficiency as criteria of merit for evaluations, the discussion of cost cannot be avoided. Cost-benefit analysis and cost-effectiveness analysis are two common ways of measuring efficiency (Dryzek 2013, pp. 85-86). Efficiency in cost-benefit analysis is demonstrated by the ratio of the monetarized value of results to the monetarized costs of the program. It requires that the costs and benefits of the project are “known, quantified and transformed to a common measurement unit” (Vedung 2009, p. 258). If the market price of costs and benefits are unknown, estimation may be adopted as used as the term of shadow pricing. While in cost-effectiveness analysis, efficiency is expressed as units of result achieved in material terms to costs expressed in monetary terms. Cost-effectiveness analysis is regarded as an extension of the impact assessment, therefore, an *ex post* analysis is more often performed than an *ex ante* analysis and is often used for comparing costs of projects with similar goals (Rossi, Lipsey & Freeman 2004, pp. 362-363). However, cost-effectiveness analysis should be more often performed throughout the process of policy cycle. *Ex ante* analyses are useful in comparing different policy options before decision-making. It can also be altered to make predictions on the units of outcome of different policy options under the same amount of investment cost.

As mentioned earlier, cost-benefit analysis and cost-effectiveness analysis are the mostly commonly performed policy evaluation methods in a top-down policy process through the administrative approach such as that in China. Large-scale cost-benefit analysis requires substantial resources and technical expertise and are usually carried out within the government or by government appointed agencies.

All the above methods have roles in policy evaluation depending on the specific requirements of the case. They can be used individually or combined. Dunn (2012, p. 3) pointed out that policy evaluation methods should not be confined to any specific analytical routines because of the diversity of policy problems. Policy analysts should embrace their freedom to select from a wide range of evaluation methods from qualitative to quantitative as long as they generate reliable knowledge and are suitable for the case studied. In the next section, I will demonstrate this by presenting three policy evaluation examples in the discipline of climate change and energy policies.

2.6.5 Examples of the "middle game" and "low game" analysis

In this section, examples analyses of climate-related energy actors and policies which adopt different analysis approaches will be presented. These aim to provide some insights for the analyses to be carried out later in this thesis. The first example, Grünberg's (2017) *Revisiting Fragmented Authority in China's Central Energy Administration*, focuses on the relationship between major policy actors in China's fragmented and authoritarian energy sector, which discusses how decisions are made in the "middle game". The second and third examples focus on the "low game" analysis. Yamamoto's (2014) *Japan's Role in Climate Change Issues* compared two policy options in the mitigation of climate change: 1) through domestic effort and 2) through CDM carbon offset. This is very similar to the analyses conducted in this thesis. In this thesis, these two options are also analyzed in China's context. As such, it is an appropriate example to include here. Zhu's (2014) *Resource-environmental Foundation for Green and Low-carbon Development in China* conducted evaluation of China's low-carbon development program and provided recommendations to overcome the weaknesses in the program. The last two examples serve the purpose of identifying the strengths and weaknesses of existing policies.

Example 1:

Grunberg (2017) conducted an analysis of the changing bureaucracies and policy actors in China's energy sector under the theoretical framework of fragmented authoritarianism. He described the reforming processes from the mid-1950s to the early-2000s as of a "continuous protracted and incremental nature" which showed the ineffectiveness of the re-structuring of China's central energy administration. This was particularly reflected through the failure of National Energy Commission (NEC) which set up as a coordinating agency.

NEC was set up to manage the fragmentation among different energy-related ministries which dispersed across multiple horizontal ministries. However, this goal could not be achieved due to relevant ministries' resistance to power-sharing over energy issues (Grunberg 2017, p. 19). In the ministerial power struggle process of energy decision-making, more powerful ministries had more influence over the final decision. For instance, NDRC, as the supreme authority among top Chinese ministries, has the strongest influence over energy policies.

In 2013, the National Energy Administration (NEA) was established as an all-inclusive agency and was placed under NDRC. Since then, the centralisation of energy policies had been realised as NEA included comprehensive energy-related departments such as coal, renewable energies, hydro-power and petroleum. However, the challenges that NEC experienced were not resolved under the new structure as it was located under NEA, which was managed by NDRC. Consequently, NEC completely lost its function as a coordinating agency due to its lower ranking and overlapping responsibility with NEA and NDRC. This was in contrast to Germany's small but coordination-driven bureaucracies. The functions of NEC and NEA overlap. The existence of NEC lost its significance after the establishment of NEA and became a waste of administrative resources. Grunberg (2017, p. 21) saw that the power concentration of NDRC had both advantages and drawbacks. On one hand, the powerful status of NDRC exerts enough political weight throughout the system and ensures the implementation; on the other hand, it weakened the departmental coordination on energy-related policy issues beyond NDRC's bureaucratic boundaries. For instance, NDRC overpowers MEP in the management of energy-related pollution issues.

Grunberg (2017, pp. 31-32) believed that collective decision-making among multi-ministerial top leaders was one effective approach to address the fragmentation in China's energy-related policies. The National Leading Group on Climate Change and the National Leading Group on Energy Saving and Emission Reduction were such examples. These two leading groups consisted of the many relevant top ministers and were chaired by the Premier. The purpose of creating these Leading Groups was to overcome the fragmentation and make collective decision-making for complex climate change and energy policies. The creation of the Leading Groups was also seen as a potential solution for fragmented bureaucracies at the sub-national level. Due to the direct involvement of multiple relevant ministers, the leading groups are able cut across the ministerial boundaries, and therefore, able to conduct more transparent and comprehensive discussions on the policy issues.

Grunberg's analysis is of significance because it provided new insights into China's energy policy process under the framework of fragmented authoritarianism. It is a useful update of Lieberthal and Oksenberg's (1988) initial investigation of China's energy bureaucracy. More significantly, it pointed out one possible solution to the fragmentation of authority in China's energy sector – a multi-ministerial leading group approach. It is anticipated that such an approach can be one step forward towards the reduction of fragmentation and malign competition among relevant departments, and result in better coordination and policies. Such an approach can also be seen as a sign of a more deliberative policy process within the authoritarian system.

Example 2:

The meltdown of two nuclear power plants at Fukushima, Japan, was seen as a turning point for Japan's ongoing energy and climate change policies. Yamamoto (2014) conducted an analysis of Japan's on-going energy strategies towards its emission reductions targets. Yamamoto (2014) first reviewed Japan's original target of 25% emission reduction of the 1990 level by 2020. Before the Fukushima disaster, this target was planned to be pursued through increasing nuclear power capacity and a mix of renewable energies. After the accident, strong opposition to nuclear power had forced the Japanese government to maximise the production load at some regional thermal power plants. As a result, Japan's emissions rose significantly. The Fukushima incident altered Japan's original energy and climate policy direction and target. After the incident, Japan focused more on pursuing emission abatement overseas through programs such as CDM. Yamamoto (2014) compared the costs of CDM abatement and domestic abatement and analysed the advantages and weaknesses of CDM. The author also suggested a range of new approaches for emission abatement such as the voluntary GHG emission targets for industries set by the Japanese Business Federation, the Sectoral Crediting Mechanism proposed by the EU and the bilateral offset crediting mechanism proposed by Japan which uses low-carbon technology transfer to developing countries as a means for emission reduction.

This example is selected because it demonstrated a mix-method approach in the analysis of climate-related energy policy. It first adopted an interpretive approach in analysing public opinions before and after the Fukushima incident. This qualitative analysis told why there was a need for policy change. Following this, the author listed two alternative options to the original nuclear option: carbon offset and domestic abatement. The author then conducted quantitative analysis in comparing the cost of two alternative options, and concluded that carbon offset was a more economical option. This comparison demonstrated the effectiveness of a quantitative approach in the evaluation of policy options. Similar analysis will be carried out in Chapter 5 on China's CDM program.

Example 3:

In 2010, China announced a national project aimed at achieving a low carbon economy through experiments in five provinces (Guangdong, Liaoning, Hubei, Shaanxi and Yunnan) and eight cities (Tianjin, Chongqing, Shenzhen, Xiamen, Hangzhou, Nanchang, Guiyang and Baoding). In order to evaluate the efforts to achieve green and low carbon development, Zhu (2014, p. 74) proposed seven indicators as guides, namely per capita carbon emission, carbon productivity, technical standards, energy structure, carbon emission elasticity, impact of imports and exports and environmental carrying capacity. Zhu evaluated China's performance against each indicator and compared China's result with that of other developing and developed countries judged against the same criteria. Through the evaluations, Zhu (2014) identified that China fell behind many advanced developed countries and even some developing countries in terms of carbon productivity, technical standards, and carbon emission elasticity. In order to address this issue and work actively towards the target of a low carbon economy, Zhu (2014) proposed a range of recommendations through policy-making mechanisms and technology innovations. Zhu (2014) urged the Chinese leadership to de-carbonize China's economic structure; optimise energy structure by cutting back coal and oil consumption and increase the proportion of low carbon energy sources; invest more in R&D of advanced technologies to reduce energy intensity; and incorporate low carbon targets into local socio-economic planning and management. Zhu (2014) also suggested the establishment of a toolbox for low carbon management containing three databases: 1) a checklist of records of emission sources from all sectors, 2) a list of records showing energy consumption levels of different types of buildings or configurations, and 3) a list of emission factors of different transportations.

The highlight of Zhu's (2014) analysis was the recommendations he proposed based on his analysis. The proposal of a toolbox data base was a practical and feasible initiative in the management of low-carbon development, which would bring convenience and efficiency to planning, monitoring and the day to day work of low carbon projects. The comprehensive information and standards in the toolbox data base are exactly what is lacking in the current practice of low carbon development.

The examples in this section demonstrate that even policies in the same domain can be evaluated with different methods and approaches. These examples highlight the use of quantitative and qualitative evaluation methods in the analysis of energy and climate change related actors and policies. They further prove Dunn's (2012) point that policy evaluation methods should not be confined to any specific analytical routines, but should be catered for each specific policy situation.

2.7 Conclusion

The purpose of this chapter was to set out the conceptual framework of this thesis by exploring the current competing academic understandings of public policy and policy analysis. Of course, public policy and policy analysis are vast concepts which are impossible for this chapter to detail in their entirety. Therefore, it identified from the academic literature those concepts and approaches which are key to understanding, analysing and evaluating China's climate change and energy situation. This chapter demonstrated how the administrative approach, the democratic approach and the market approach can be applied to climate-related policies in China. In particular, it explored the ongoing relevance of the fragmented authoritarianism framework as a means of analysing such policies from their design to implementation, and proposed an extended version of this framework to incorporate other actors beyond the government. In doing so, this chapter prepared the ground for the analyses of China's institutions, actors, and their roles in CDM and ECERS. The next chapter will discuss the methods used for such analyses.

Chapter 3

Methodology

3.1 Introduction

In Chapter 2, the conceptual framework of public policy and policy analysis in the Chinese context was established. This chapter moves on to the methodological foundation used to address the research questions. It begins by outlining the philosophical foundation of the research, then proceeds to explain why a mixed method approach was adopted. Following this, the case study research design used in this thesis will be elaborated, within which sources including documentation, archival records, elite interviews and online forum discussions were used.

3.2 Paradigm and pragmatism as the philosophical foundation for research

A paradigm (Guba & Lincoln 2005; Mertens 1998), also known as a worldview (Creswell 2009), epistemology and ontology (Crotty 1998), or broadly conceived research methodologies (Neuman 2000), is “a basic set of beliefs that guide action” (Guba 1990, p.17). It is generally shaped by one’s personal experience and the natural and cultural environment one inhabits. When it comes to research, Creswell (2009, p.6) sees a paradigm as “a general orientation about the world and the nature of the research that the researcher holds”. It can be influenced by the researcher’s academic field, past research experience, beliefs of the researcher's advisers/supervisors and the culture of the institution in which the researcher works (Creswell 2009, p.6). Since the researcher's paradigm reflects how he/she understands the world and the kind of actions that he/she takes to interact with the world (Guba & Lincoln 2005), it is important to identify the paradigm that a researcher holds before the research is conducted so that the researcher is able to select logical, clear structured and effective research methods.

This thesis, which was described in Chapter 1 as problem-solution oriented, follows the paradigm of pragmatism. The role of pragmatism in social science research was established by a gradual process. The pioneer who initiated the pragmatic philosophical movement was the American philosopher Charles Sanders Peirce (1839-1914). Early pragmatists including Charles Sanders Peirce and his followers such as William James, John Dewey, George Herbert Mead and Arthur Bentley had a common focus on questioning whether the traditional single "scientific method" was competent in solving "real world" problems in social sciences (Maxcy 2003, p. 52). However, it was not until the late 1960s that pragmatism flourished as a philosophical foundation for modern social science research (Maxcy 2003, p. 53).

The distinctive advantages of pragmatism in social science research are its flexibility, broadness, and the invaluable touch of common sense. Morgan (2007, p. 73) described pragmatism as an "abductive–intersubjective–transferable" approach for addressing social issues. Being abductive, pragmatism allows researchers to use both induction (theory/qualitative) and deduction (data/quantitative) and work with them back and forth. The intersubjective characteristic of pragmatism provides the opportunity for pragmatists to better communicate with their research objects, peers and audiences and to create a shared ground for both disagreement and common beliefs. Being transferable, pragmatism encourages researchers to think whether the result of one approach of evaluation can be applied to another similar situation, and how much of the existing knowledge can be reapplied.

With all these features, the main focus of pragmatism can be summarised as identifying problems, using all approaches to understand the problems and developing solutions to the problems (Patton 1990; Rossman & Wilson 1985). Pragmatism does not commit to any one means of conducting research, which is to say researchers who follow pragmatism have the freedom to choose any methods, techniques and procedures that are applicable to their research (Creswell 2009, p. 10).

The question this thesis aims to investigate is: How can China optimise its current energy policies in order to achieve better outcomes in climate change mitigation? The work a policy analyst conducts is largely problem-oriented and most of the time complex. Some social problems are so complex that policy analysts categorise them as "wicked problems" which are impossible to solve with success (Head 2008, p. 101). As Roe (2012, p. ix) put it, "Policy analysts never have the last word, they could always use more information or time, and this is nowhere truer than when dealing with complex and uncertain policy issues". It is true that the complexity of social problems creates great challenges for policy analysts. In this thesis, the nature of the investigated country, China, being the world's largest developing country, largest greenhouse gases emitter, most rapidly developing economy with the largest population and a nation truly facing energy challenges, all compound the complexity of the problem. In order to analyse the complex problem, I put myself in a policy analyst's shoes in this thesis. Wildavsky described the distinctive work of a policy analyst this way:

> Economists tell you what you get for what you give up. Political scientists tell you who gets what and why… policy analysts create conceivable solutions that enables us, as citizens, to learn what we ought to want in relation to what's available to get it with (Wildavsky 1979, p. 386).

The nature of a policy analyst's role requires that I consider various aspects in the evaluation of China's current major climate-related energy policies, be it political, social, environmental or economic. Therefore, pragmatism provides me with opportunities to adopt a wide variety of methods for data collection and analysis. The evaluation of a public policy is a complicated task, and pragmatism serves as a suitable philosophical foundation for such a task.

3.3 A mixed method approach

Facing a complex research problem and embracing pragmatism as the philosophical foundation, this thesis will carried out its research with mixed methods. Mixed methods research is, in Johnson, Onwuegbuzie, and Turner's (2007, p. 113) words, "an approach to knowledge (theory and practice) that attempts to consider multiple viewpoints, perspectives, positions, and standpoints (always including the standpoints of qualitative and quantitative research)". The analysis of China's current climate-related energy policies follows this by adopting both qualitative and quantitative approaches. Creswell and Clark (2007, p. 5) define mixed method research as follows:

> Mixed method research is a research design with philosophical assumptions as well as methods of inquiry. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis of data and the mixture of qualitative and quantitative approaches in many phases in the research process. As a method, it focuses on collecting, analysing, and mixing both quantitative and qualitative data in a single study or series of studies. Its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone.

Both qualitative and quantitative methods have their advantages when used appropriately within specific investigations or sections of investigations (Johnson & Onwuegbuzie 2004, p. 17). The qualitative method branches from a phenomenological paradigm which assumes reality is understood through definitions. It is more often used to explain a specific social phenomenon through adopting theories, observation, participation, interpretation and experience. The quantitative method is from a positivist foundation which works with facts and an objective attitude rather than the beliefs of individuals. It aims to explain the changes in social phenomenon through measurements and numerical data, and often adopts experiments and statistical techniques to eliminate bias and errors (Firestone 1987, p. 17). All in all, the primary difference between qualitative and quantitative methods lies in the adoption of either induction (theory) or deduction (data). However, in the process of actual research design, data collection and analysis, being purely theory-driven or data-driven is simply impossible. As Morgan (2007, p. 71) put it, "Try to imagine acting in the real world for as long as 5 minutes while operating in either a strictly theory-driven, deductive mode or a data-driven, inductive mode – I certainly would not want to be on the same road as anyone who has such a fatally limited approach to driving a vehicle!".

There is need and advantages in combining qualitative and quantitative methods. Brewer and Hunter (1989) pointed out that one should attempt to "attack a research problem with an arsenal of methods that have non-overlapping weaknesses in addition to their complementary strengths" (p. 17). This is because, according to Webb, Campbell, Schwartz and Sechrest (1966, p. 3), "Once a proposition has been confirmed by two or more independent measurement processes, the uncertainty of its interpretation is greatly reduced. The most persuasive evidence comes through a triangulation of measurement processes". Burnham et al (2008, p. 40) also confirmed the advantages of a mixed method approach by stating that the adoption of a combination of methods has the ability to deliver complementary data to strengthen findings. Yin (2009, p. 63) also stated that for research with complicated research questions, the mixed method approach enables the researcher "to collect a richer and stronger array of evidence to address the research questions".

The research question of this thesis, “How can China optimise its current energy policies in order to achieve better outcomes in climate change mitigation?” is of great complexity. In order to answer this question, the overall effectiveness and unexpected side effects of China’s current major climate-related energy policies will be studied. This is a challenging task and requires investigation from various angles. For instance, qualitative methods such as media analysis and elite interviewing will be utilised for the investigation of the CDM and ECERS’s institutional and operational effectiveness; at the same time, quantitative analysis will be used for evaluating the results of renewable energy and energy efficiency projects within the two policies. The quantitative data used for CDM is acquired from China’s official CDM website sponsored by Department of Climate Change, NDRC. Quantative data for ECERS is acquired from China’s policy documents related to renewable energy and energy efficiency under ECERS and used for the analysis of scale and efficiency of relevant ECERS programs. The nature of the data and the quantitative analysis are explained in details below. Of course, the proportions of qualitative and quantitative analysis are not equal in this thesis. The quantitative analysis will only take up a smaller proportion, with data drawn from official Chinese sources, but qualitative analysis will take up a much bigger proportion with data gathered from media reports, policy documents and interviews. This is because one purpose of this thesis is to uncover policy weaknesses that are not immediately obvious, and official numerical data usually cannot achieve this (Wallace 2016). Qualitative analysis, on the other hand, has the capacity to identify such weaknesses through narratives provided by relevant stakeholders, which in turn provide a richer and fuller picture of the policies. The qualitative and quantitative data will be worked back and forth in this thesis to display

China's current status in climate change mitigation through CDM and ECERS. Such an approach has the capacity to provide a more comprehensive analysis[8].

3.4 A case study research design

An appropriate research design is important as it plans, structures and provides strategies for the investigation so that the research questions can be answered effectively (Kerlinger 1986). This thesis selected a case study research design. Yin (2009, p.18) presented a twofold definition of case study:

> 1. A case study is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.
>
> 2. The case study inquiry copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result benefit from the prior development of theoretical propositions to guide data collection and analysis.

With this definition in mind, Yin (2009, p. 2) further argues that a case study research design is generally preferred when the following three criteria are met:

[8] As outlined in Chapter 1, the focus of this discussion is on renewable energy and energy efficiency (see pp. 4-15 for more details).

(a) “How” or “why” questions are being posed,

(b) The investigator has little control over events,

(c) The focus is on a contemporary phenomenon within real-life context.

The research question “How can China optimise its current energy policies in order to achieve better outcomes in climate change mitigation?” meets the three criteria above. Being an obvious “how” question, this thesis focuses on the investigation of how China’s current major energy policies work in the context of climate change mitigation. I have little influence over what policies are implemented and the outcome of the policies. As explained earlier, climate change mitigation and energy security are two of the most important issues facing the world today and have many serious real life consequences. Therefore, case study research design is appropriate for this thesis. Furthermore, a case study research design allows a wide range of variables to be collected on a single policy area, so that the complete analysis will be more comprehensive and convincing (Burnham et al 2008, pp. 65-66).

A research design serves as a blueprint for research. It aims to identify four major issues of research: research questions, relevant data, data collection method and data analysis method (Philliber, Schwab & Samsloss, 1980). For case study research designs, there is no standard format (Merriam 1988, p. 193). This is due to the diverse nature of possible cases. For example, a case study designed for the global financial crisis can be very different from that designed for studying classroom performance. Although case study research designs can vary greatly in format, the basic four issues mentioned by Philliber, Schwab and Samsoss (1980) should be covered and arranged in a logical order. Based on this approach, this case study adapted Yin’s (2009, p. 27) design because it is logical and suitable for the cases in this thesis. The design, as explained below, covered the following five components: 1) The thesis' central question; 2) Theoretical propositions; 3) units of analysis; 4) the logic linking the data to the propositions; and 5) the criteria for interpreting the findings.

3.4.1 Theoretical propositions

As explained above, the nature of the thesis's central question has indicated the case study approach as an appropriate research design. However, asking "How can China optimise its current energy policies in order to achieve better outcomes in climate change mitigation?" does not directly point out what should be studied. In order to answer this central question, I propose the following propositions:

1. The relationship among the major actors of China's climate change related energy policies is complex, presenting not only conflict and competition, and but also innovation and potential. This proposition was based upon the existing literature on stakeholder relationships within China's fragmented authoritarian system and policy process.

2. China's current major climate-related energy policies, namely the international CDM and domestic ECERS, both have positive features, but at the same time a range of weaknesses have been exposed during their implementation.

These two propositions were hypothesised because they cover the development and implementation processes of China's climate-related energy policies. Such policies shape the outcomes of China's climate change mitigation and energy status. Therefore, these propositions were very applicable to the investigation of China's climate change mitigation and energy status.

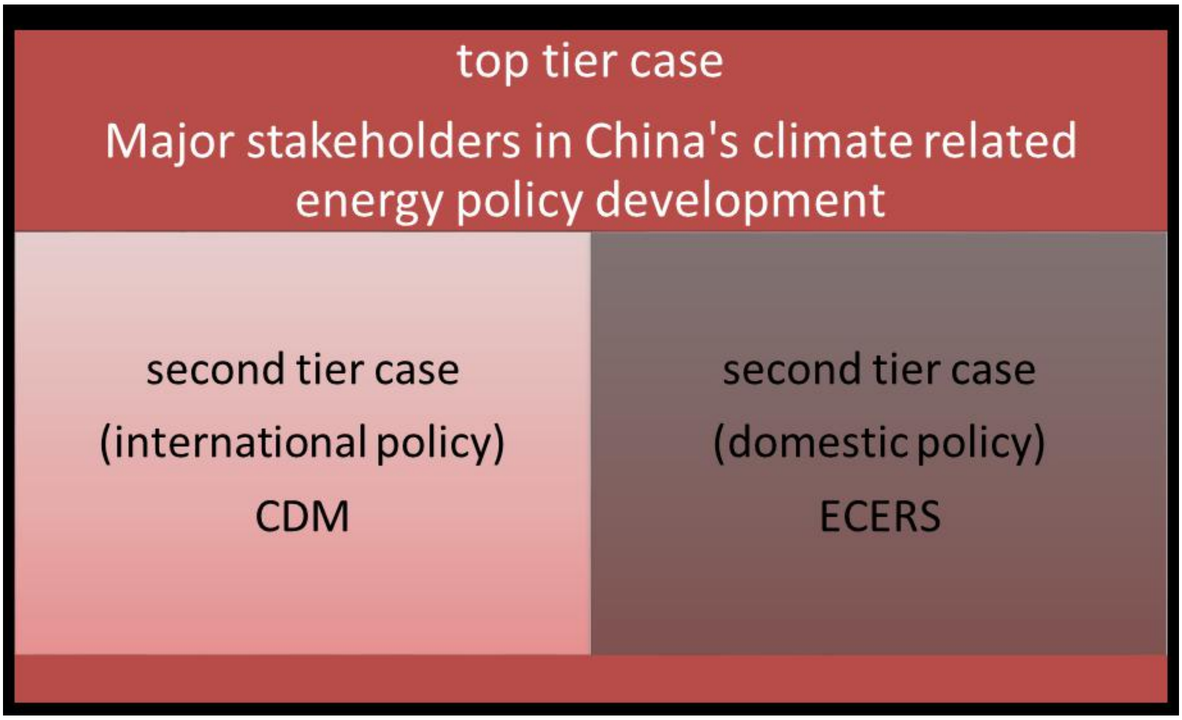
3.4.2 Units of analysis

To address the above two propositions, this thesis set out a two-tier case study (see Figure 3.1 Illustration of two-tier multiple-case study). The first tier case investigated the policy development process and dealt with the first proposition: the relationship among the major actors of China's climate change related energy policies is complex, presenting not only conflict and competition, but also innovation and potential. It investigated the relationship between major government departments involved in the climate policies development such as the National Development and Reform Commission (NDRC), MEP, and Ministry of Finance (MF). Special attention was given to the power and function of NDRC, China's major climate-related energy policy development ministry. Important actors such as industries, in particular the state-owned enterprises (SOEs), the think tanks and the increasing but still limited impact from the public and civil society were also included.

The second tier contained the two major policies, CDM and ECERS. This tier aimed at evaluating the implementation and efficacy of these policies. The reason why these two policies were chosen is that they are two of the most significant policies in shaping China's energy structure and climate change mitigation. As discussed in

Chapter 1, CDM made a significant contribution to China's sustainable development and greatly simulated the development of China's renewable energy industry. Even more significantly, CDM introduced the concept of market mechanism in emission reduction and started to engage China in the challenge of climate change mitigation in a global context. ECERS is China's single biggest domestic investment in energy saving and emissions reduction. During China's 11th Five-Year Plan, the government invested 200 billion *yuan* (approximately US$35 billion) in ECERS which brought along approximately 2000 billion *yuan* (approximately US$350 billion) of social investment (The Central People's Government of PRC 2010a, n. p.). During the 12th Five-Year Plan, ECERS achieved over 20% energy intensity reduction. Renewable energy reached a quarter of the world's total capacity (State Council of PRC 2016, n. p.). The purpose of the second tier analysis was to justify the second proposition by analysing the strengths and weaknesses exposed during the implementation of the policies. Selecting these two policies as study targets had a significant meaning in understanding the challenges China currently faces in the energy and climate change domain. Moreover, a range of provincial and local analyses on the studied policies' implementation are carried out in great detail in Chapter 5 (especially sections 5.3 and 5.4) and 6 (especially sections 6.2 and 6.3), which provide a fuller picture to the studied policies. The implications provided after the analyses will be useful for policy modification or raising insights for future policy development.

Figure 3.1 Illustration of two-tier multiple-case study



When it comes to data collection for case studies, Creswell (2007, p.75) pointed out that a case study can consider a wide range of sources and information. The extensiveness of the sources will enhance the comprehensiveness of data analysis (Burnham et al 2008, p. 189). Therefore, multiple sources of data were collected for this case study, including documentation, archival records, online forums discussions and elite interviews, which will be discussed in detail in the following sections.

Documents such as UNFCCC negotiation texts Chinese government reports and news clippings were evaluated for useful information. The information gathered through these sources was of great value for the case study. Primary sources such as records and preceedings of the UNFCCC COP meetings, announcements and the statements of the Chinese speakers at COP meetings were also used to support the analysis. There were used to confirm the findings of the other sources. Secondary sources such as energy policy documents developed by NDRC, tax policy developed by Ministry of

Finance (MF) and reports on climate change and energy jointly released by multiple ministries of the Chinese government, and journal articles and books written by a range of academics and policy makers were also included where applicable.

Documentation gathering was mainly through internet and library searches. Although information from news articles is widely available through the use of the internet, it has several drawbacks. As Yin (2009, p. 103) explained, “documents must be carefully used and should not be accepted as literal recordings of events that have taken place”. One reason for this is that documents only present the public face of what happened at events, not the informal or backroom conversations. They also don’t tell the story of how a final position was arrived at – what was given up and by whom and in exchange for what. Documents may also represent a biased view due to the author’s own judgement or due to the researcher’s incomplete collection. Therefore, in order to use documents appropriately, this case study also used archival records, elite interviews, and online forum discussions as triangulation.

National archival records are arguably the most important source for policy researchers. If used appropriately, archival records offer the best insights into how governments approach and implement public policy (Burnham et al 2008, p. 200). This is because archival records have the following advantages. Firstly, they provide the researchers with a greater quantity and variety of information than would be available from other sources. Secondly, by looking at records of lower levels of government, for example, provincial and local governments, it is possible to see whether and how the policies of the central government are implemented. Thirdly, archival records also contain statements from government officials and leaders on various issues which demonstrate their thoughts and positions. Finally, the archival records show which factors a particular government department perceives as important in their policy making and how they approach the issue (Lowe 1997, p. 240). Archival records are especially relevant when research involves quantitative analysis as archival records often contain numerical data (Yin 2009, p. 106). For this case study, archival records of central NDRC were the main focus as it is the most important ministry which is responsible for both China's climate change policies and energy policies. Archival data gathered from NDRC was used for quantitative analysis of CDM and ECERS. Data was mainly obtained through official government websites and fieldwork in China.

Electronic data sourced from online forums were also used. This type of data represents the voice of the general public's views on climate-related issues, which presents a valuable supplementary source to the formal official data. It is widely agreed that formal public consultation and engagement in China, although gradually increasing, is still limited (Ho 2001; Johnson 2010; Tang, Wong & Lau 2008). However, the internet provided an alternative platform for the public to express their opinions (Jiang 2009). Since connecting to the world-wide web, China reached 668 million internet users by December 2015. The internet had penetrated over 50% of the population (China Internet Network Information Center 2016, p. 45). This thesis selected three popular Chinese forums: *tianya*; *baidu tieba*; and *zhihu*. The first two forums are more popular among the general public. The third one, *zhihu*, attracts mainly professionals with higher levels of education. This selection aimed at providing multi-dimensional views from different social groups. Online forum data has its advantages. Firstly, it allows participants to interact asynchronously within their own comfort zone and at convenient times. Secondly, it allows participants to stay anonymous so that confidentiality is ensured (Im & Chee 2006, p. 268). Finally, the data itself is also widely accessible, safe and easy to collect and use. It should nevertheless be acknowledged that there are still many Chinese people who do not have access to the internet, and therefore, their views cannot be captured through these online forums. This is a limitation of this thesis, but given the diverse groups of participants in these three forums, they still give an indication of prevalent views and opinions.

To obtain useful data from the above forums, I first conducted searches on the above mentioned sites for threads related to climate change and atmospheric pollution, ECERS and associated side-effects and challenges of environmental protection using the search function on these sites. I entered the search terms such as “under the dome”, “closure of small coal-fired power plants” which were hot media topics in China’s climate and energy debate. I identified threads most relevant to the purpose of each section of the thesis. For instance, to analyse public opinions on China’s air pollution, I examined the posts from all the identified threads on these topics during 2006-2015 period. I categorised the public’s views into different themes, so that the major streams of public opinions could be summarised and analysed, as explained below. I extracted data into separate Word files for each themes in preparation for thematic analysis. In the next section, I will move on to the data collected through interviews.

Interviews, as a broad term, include a wide range of interactions between interviewer and interviewee(s). It can be a casual conversation or a highly structured formal interview (Wolcott 1999, p. 52-58). For this thesis, the elite interviewing technique was adopted. This is because elite interviewing, when used effectively, can broaden and deepen our understanding of a specific policy area, in this case, China's climate-related energy policies. Elites are also the most influential people in the formation of such policies (Burnham 2008, p. 231). Semi-structured interviews were chosen because they allowed focus on questions relevant to the research while also offering interviewees the chance to express their views and opinions freely. In addition, this type of interview meant I was able to follow up on points raised by the interviewees by probing for more detail. Semi-structured interviews with set open-ended questions were carried out with following categories of interviewees:

1. government officials from the Centre for Energy, Environment and Climate Change, Energy Research Institute, NDRC and Foreign Economic Cooperation Office, Ministry of Environmental Protection;

2. academics from the Research Centre for Sustainable Development and Division of Climate Change Economics of the Chinese Academy of Social Sciences (CASS) and China Institute of Global Development Strategies;

3. personnel from traditional coal-fired power plants and renewable energy industries that participate in CDM; Quanlian New Energy Commerce which is an NGO which provides assistance and service to CDM projects;

4. personnel from several ENGOs who preferred to stay anonymous.

The reason why these interviewees were selected is that government officials and academics have high levels of knowledge in terms of China's climate and energy affairs. Some even have experience participating in China's policy development process. It is also a common occurance in China that government official involve academics in the formation of policies, as discussed by Williams (2014). Personnel from traditional coal-fired power plants and renewable industries are important stakeholders in the ECERS and participants of CDM. They have firsthand experience about the advantages and drawbacks of these policies. ENGO personnel's responses to the interview questions were used to unearth many unreported weaknesses during the implementation of these policies. Such information is unlikely to be obtained from other sources, and therefore, interviews played an important part in the data collection of this case study.

This thesis altogether interviewed 14 people with knowledge and experience relevant to the research questions. The majority of the interviews were carried out in person in Beijing. One was carried out in Adelaide, also in the form of a face-to-face interview. The people I interviewed are, as explained previously, were peak representatives from all the relevant key sectors and agencies. While more interviews may have been valuable, the other data collection techniques used meant that essential data needed to answer the research question was captured. Under other circumstances, a second round of interviewing of the same group would have allowed for more nuance and updating of data, but the time and resource limitations of a PhD candidature meant this was not possible.All interviews were conducted in Mandarin and then translated into English.

I made initial contacts via personal and professional networks. A snowball sampling technique was also adopted here for my interviews. Snowball sampling is also called chain referral sampling. It gathers study samples from initial interviewees and from their referrals with similar expertise. This method is widely used in qualitative research in sociology and is especially suitable to studies of sensitive issues such as those involving private matters which requires the insiders to locate people for study (Biernacki & Waldorf 1981, p. 141). However, the reason why a snowball sampling technique was adopted for this study was in fact the limited time and resources available to conduct fieldwork. The snowball sampling technique enabled me to interview the maximum amount of government officials, scholars, industrial stakeholders and ENGOs in the domain of China's climate-related energy policies within the limited timeframe. It was anticipated the initial interviewees would be able to refer me to additional interviewees whom they had connections with. This did in fact happen.

For government officials and academics, I prepared the following five questions:

1. What do you think of China's climate argument for reducing carbon intensity without setting an absolute carbon reduction target?

2. Do you think China has the ability to invest more to mitigate climate change? If yes, by how much? If not, what are the obstacles?

3. What are the institutional strengths and weaknesses for China to develop better climate-related energy policies?

4. Does CDM bring China solely benefits? What improvement or inspiration can we gain from CDM?

5. Do you think the ECERS has reached its maximal capacity? Why or why not?

There are several reasons why these questions were selected. Question 1 and 2 inquired about China's fundamental attitude towards global climate change and the answers pointed out the big picture of China's future climate-related energy policies. Question 3 inquired about China's institutional strengths and weaknesses in developing climate-related policies. The interviewees' responses addressed the first proposition of this thesis. Question 4 and 5 focused on the quality and effectiveness of CDM and ECERS, which addressed the second proposition. These questions were all targeted at the policy level. They required the vision of government and a high level of professional knowledge and expertise. Therefore, relevant government officials and academics were the suitable candidates to ask.

For industry stakeholders, the following questions were asked:

1. Do you think you receive sufficient support from the government and foreign funding companies?

2. Does your company have any difficulties in the initial set-up, daily operating and electricity distribution and marketing phases?

3. What is the future development tendency of your industry? Do you have any plans for expansion or reduction? What challenges do you face?

The purpose of these interview questions was to obtain comments and feedback on CDM and ECERS from different industrial stakeholders. This was critical because industrial stakeholders in the traditional coal power industry and the renewable energy industry are in the front line of the implementation of CDM and ECERS. Their feedback reflected the most direct outcome of the policies. The difficulties that the majority of them endured are likely to point out the weaknesses of the policies. Therefore, these interview questions articulated useful information to address the second proposition of the thesis.

In order to utilise the interview data in my analyses, I adopted a thematic approach. I first read through the transcripts multiple times to familiarise myself with the data and translated the data from Mandarin into English. I then identified the main themes in the data related to the propositions. This was followed by further readings of the data during which I identified sub-themes related to each main theme (Figure 3.2). After this, I used the data in the sections of the thesis most relevant to each theme in order to support my argument and assist my analyses.

Figure 3.2 Main themes and sub-themes for analysing interview data

Main Themes	Sub-themes
Policy actors	• elationship between relevant central ministries (NDRC, MEP and MF) • elationship between relevant central ministry and provincial governments • he role of large energy SOEs • he role of small private renewable energy enterprises • he role of think tanks • he role of ENGOs and the public
CDM	• hat CDM means to China • he benefit that CDM brought • he challenges of CDM • otential detrimental impact of CDM
ECERS	• losure of small coal-fired power plants • stablishment of efficient large coal-fired power plants • chievements and challenges in renewable energy development under ECERS • trengths and weaknesses of Energy Performance Contracting (EPC)

There are potential challenges when using interviews as a data collection technique. This may include difficulty finding willing participants, insufficient knowledge of the interviewees' language and culture, trouble gaining trust from the interviewees and unable to accurately record interview data (Fontana & Frey 1994, pp. 366-368). I was able to largely solve the first two problems due to contacts that I had built up in China through living, studying and working there. The Chinese way of contacting people is through mutual acquaintances. In addition, my status as a PhD student at a university reassured interviewees and put them at ease during interviews due to the traditional Chinese culture of respecting intellectuals and scholars. The interviews were recorded on a digital voice recorder and transcribed shortly after the interviews concluded. A spare copy of the interview record was saved at the school office of my college at Flinders University to ensure its safety.

In summary, this case study mainly drew information from four sources: documentation, archives, online forum and elite interviews. The next section will identify the logic of linking the data to the theoretical propositions, namely the data analysis strategies and techniques for this case study.

3.4.3 The logic linking the data to the proposition

The data analysis strategy for a case study serves as a framework for what is to be analysed and why (Yin 2009, p. 126). For this case study, the data analysis strategy known as "relying on the theoretical propositions" was be used. This is to say, all questions were asked with the aim to investigate whether the propositions hold their ground or not. Along with this general strategy, the analytic technique of "explanation building" was used throughout the analyses of the cases. According to Pentland (1999, p. 771), explanation provides answers to what has caused the observed outcomes, which is "essential to theory and practice". Sutton and Staw (1995, p. 378) also believe that explanation holds "the answer to queries of why". Glaser and Strauss (1967) hold the position that explanation building can be seen as a process of justifying hypotheses. Its final goal is to propose new ideas for further research instead of concluding a study. This function of explanation building is especially applicable for this case study, as the purpose of the case study was to investigate the weaknesses of China's major climate-related energy policies. If such weaknesses are found, new policy directions will be proposed to overcome these deficiencies. Therefore, the explanation building technique was used throughout the analyses of all second tier case elements. Specifically, all questions and the analyses of the answers to the questions served the purpose of substantiating the propositions and then discussing alternative policy directions.

To address the first proposition, "the relationship among the major actors of China's climate change related energy policies is complex presenting not only conflict and competition, but also innovation and potential", the top-tier case aimed to answer the following questions:

1. What is the relationship and power distributions between central ministries which are involved in China's climate-related energy policies, namely, the NDRC, MEP and MF? How does this relationship impact the effectiveness of policy development?

2. What is the relationship between provincial government and provincial MEP branches (Environmental Protection Bureaus – EPBs)? How does this relationship affect the implementation of policies?

3. What is the role of the think tanks in China's climate-related energy policy development? How are experts valued in the process of policy development?

4. For enterprises, what are the different roles played by large SOEs and small private enterprises in the policy development process?

The reason why the different types of energy SOEs are analysed is that 57% of China's electricity generation capacity is controlled by SOEs. China's energy sector accounts for approximately 50% of the country's total CO_2 emissions. This is largely due to the dominance of coal in the country's energy structure (IEA 2011, p. 594). Within the energy sector, coal-fired power plants generate 97% of total CO_2 emissions. Therefore, Chinese energy SOEs hold great potential in emission mitigation if they could adopt climate friendly measures (Baron, et. al. 2012).

China's coal-fired energy generation is dominated by five large energy SOEs, namely China Huaneng Group, China Power Investment Corporation, China Guodian Corporation, China Datang Corporation and China Huadian Corporation (JF Shen, et. al. 2014, p. 350). There are also small-scale power generators managed by provincial and township governments. Together with some private generators, they take up a relatively small proportion of 29.92%

of the total generation capacity (SERC 2011, n. p.). Bergsager and Korppoo (2013) argued that SOEs as a key actor for the mitigation of China's CO_2 emissions deserved primary attention from policy analysts in the field of climate policies. SOEs exert their political and economic influence upon the formation and implementation of climate-related policies through their formal and informal connections with relevant bureaucracies. They bargain for the best possible support from the government such as compensation, tax breaks and free technological updates. Therefore, they play an important role in China's climate-related energy policies and treated as one of the significant actors in Chapter 4.

5. How much impact do the ENGOs and the general public have on the formation of China's climate-related energy policy?

Documentation, archive reviews and interviews were used to analyse China's institutional dynamics and power distribution within these dynamics. Such an analysis was necessary as Burnham et al (2008, p.313) explained that "the disciplinary history of political science in a particular country, the way that a country's government is structured and prevailing cultural norms can all affect the forms of interaction between political scientists and policymakers". The documentation and archive reviews served the purpose of illuminating how a socialist authoritarian government is organised and spotting potential obstacles in the policy development process. Interviews and documentation were also used for the analysis of the role of the think tank and enterprises. Online forum discussions were used extensively for evaluating the weight of ENGOs and the general public as this was an effective and efficient way for accessing and analysing public opinions. This is due to state control of the media and its limited scope for expression of diverse opinions. To the best of my knowledge, no publically available societal surveys on such issues have been conducted in China.

The second tier cases focused on reflecting the second proposition:

> China's current major climate-related energy policies, namely the international CDM and domestic ECERS, both have positive features, but at the same time have a range of weaknesses

There were two main questions to be answered through the analysis of second tier cases with Question 1 addressing CDM and Question 2 addressing ECERS:

1. What are the strengths and weaknesses of CDM in China's climate change mitigation and sustainable development?
2. What are the strengths and weaknesses of ECERS in energy structure optimisation, renewable energy development and energy efficiency improvement?

In order to answer Question 1, the following sub-questions were asked:

1A: How much greenhouse gas emission reduction did Chinese CDM projects achieve and does it count as China's achievement in climate change mitigation?

1B: How and in what aspects does CDM bring benefit to China?

1C: What are the weaknesses of current CDM projects?

The answers to these questions reflect China's current status of market-based carbon offset mechanism in renewable energy and energy efficiency projects. The analysis of CDM highlighted opportunities for China on a global platform and more importantly provided insights for the development of domestic policies based on the same principles. Archive data from Department of Climate Change, NDRC (http://cdm-en.ccchina.gov.cn/) was used in the quantitative analysis for addressing Question 1A. Interview data gathered from the NDRC official who was involved in climate-related energy policy development was also used extensively for addressing Question 1B and 1C. Documentation and interviews with NGO personnel who had first-hand experience in facilitating CDM projects were used to answer Question 1C.

To answer Question 2, the following sub-questions were asked:

2A: What are the achievements and problems in the closing down of small inefficient coal-fired power plants under ECERS?

2B: How does the "*Zhua da fang xiao* (grasping the big and dumping the small)" approach contribute to China's energy structure optimisation and overcall carbon emission reduction?

2C: What are the achievements of ECERS in renewable energy development? What obstacles does the renewable energy industry face?

2D: What are the strengths and weaknesses of Energy Performance Contracting (EPC) as a market mechanism for energy efficiency improvement under ECERS?

ECERS is the largest, broadest and most significant policy for China's energy saving and emission reduction. This thesis focused on the analysis of the energy sector due to two distinctive characteristics within the sector, namely the coal-dominated carbon-intensive energy structure and the impressive development speed of renewable energies. The EPC is also studied in order to investigate its potential as a new market based mechanism for all energy users with low efficiency. All four sources of data, documentation, archive, online forums and interviews, were used for the analysis of ECERS due to its complexity. The analysis aimed to spot hidden problems during the implementation of ECERS.

3.4.4 Criteria for interpreting the findings (quality control of case study analysis)

In order to achieve quality data analysis, this case study judged the analysis against two criteria. First of all, the analysis must reflect the research questions at all times and utilise case study evidence as extensively as available. Second, the analysis must focus on the most important issue, namely the effectiveness of China's current major climate-related energy policies. Once the case study analysis was completed, if the propositions of the case study were not substantiated, the thesis would conclude that China's major climate-related energy policies have only strengths and are very effective. Therefore, continuing implementing the current policies will ensure optimal climate change mitigation and meeting energy demands. If, however, the propositions were substantiated, the thesis would provide implications for overcoming the deficiencies of the studied policies. This will be elaborated on in the proceeding chapters. Figure 3.3 below provides a simple diagram which displays the methodology used for this thesis.

Figure 3.3 Summary of methodology in diagram

3.5 Conclusion

The methodology this thesis employed used pragmatism as its philosophical foundation. It adopted a mixed method approach by using both qualitative and quantitative data. A two tier case study research design was selected for investigating two processes: policy development and policy implementation. The investigation of the two processes relied on the propositions and explanation building, which was enriched by multiple data sources including documentation, archive reviews, interviews and online forums. Such a design set out a clear structure for the investigation of the research propositions. The next chapters report the data and analysis in detail, starting with Chapter 4's discussion of China's climate relevant policy actors.

Chapter 4

Actors in China’s climate-related energy policies

4.1 Introduction

Policy analysis has become a more standard procedure for modern governments to solve challenging problems in societies (Patton, Sawicki & Clark 2016, p. 2). As mentioned in Chapter 2, policy analysis is multi-dimensional, and can be either content-focused or actor-focused. Walt and Gilson (1994, p. 353) argued for the importance of actor-focused analysis. This is because actors, or stakeholders, play an important role in policy formation and implementation. The analysis of actors helps to answer the question of how and why policies succeed or fail to deliver desired outcomes. Climate change is of great complexity and interconnects multiple actors on numerous social and environmental issues such as air pollution, energy structure, transport policy, renewable energy and carbon sinks (Dryzek, 2013, p. 9). Therefore, the analysis of relevant actors, the interactions between actors, and the impacts of such interactions are important for the understanding of why and how climate-related policies are developed and implemented. China, although managed under an authoritarian government, has seen an increasing number of actors involved in its climate-related policies (Williams 2014, p. 1). This chapter identifies four major actors in China’s climate-related policies, namely the relevant government departments, the think tanks, enterprises and civil society. It examines the behaviour and power of these actors and their influence on China’s climate-related energy policies. Through this analysis it was anticipated to gain an understanding of which actor plays the most significant role in China's climate-related energy policy formation and implementation processes, and what this status means for the pursuit of better climate-related energy policies.

This chapter is arranged as follows: the main body contains four sections. Section 4.3 analyses the conflicts and competitions within the government sector. Section 4.4 identifies the impact of the expert community in the development of climate-related policies. Section 4.5 investigates the roles of different types of energy enterprises in shaping China's climate-related energy policies. Section 4.6 discusses the role and limitations of China's civil societies. But before this analysis is carried out, section 4.2 will provide some background information regarding the social environment in which these four actors reside.

4.2 Decentralisation and actors in China's climate change affairs

China has undergone nationwide reform since 1978. The opening up to the outside world has allowed China to work with a range of international organisations. This process has encouraged transparency in Chinese decision making processes. Interest groups and individuals outside the Chinese government have also increased in number, with the purpose of having their say and influence on Chinese public policies (Sutter 2008, p. 39). Overall, reform has led to a decentralisation process in both administrative and fiscal terms (Christensen, Lisheng & Painter 2008, p. 352;

Montinola, Qian & Weingast 1995; Xu 2011, pp. 1076-1080). Although the Chinese Communist Party (CCP) and the central government continue to hold absolute power in governing the nation (Landry 2008; Tsui & Wang 2008; Yang 2006), the provincial and municipal governments have been granted more power and resources for local affairs (Williams 2014; Xu 2011). Continuous administrative reform has also allowed more discussions and debates among central ministries on a range of social and economic affairs (Christensen, T, Lisheng, D, & Painter, M 2008). According to Sutter (2008, p. 39), fiscal decentralisation increased the proportion of privately owned enterprises, and enabled SOEs to compete in the market. As China's economy progresses, the business sector has gained increasing influence on a range of economic and social policies (Shirk 1993, p. 16). Other social actors, such as the expert community and civil society, have also grown to various extents against a background of reform, and opening up of the general decentralisation trend (Richerzhagen & Scholz 2008). The diversification of actors is also seen in climate change affairs, where they seek to influence the policy direction and shape the policy outcomes.

Currently, China's central government is the main actor in forming climate-related policies (Richerzhagen & Scholz 2008, p. 318). Provincial and local governments play an important role in the implementation of the central government's climate-related policies. The think tank community, or the experts, has gained increasing influence on China's climate-related policies due to the relatively new status of climate affairs and the lack of expertise within the government. Large energy SOEs play an important role in the efficiency improvement of coal-fired power plants, and therefore, have great capacity in China's climate change mitigation (Bergsager & Korppoo 2013, pp.

40-41). Private investors, especially those that have invested or plan to invest in renewable energies, embrace the central government's decisions in tackling climate change and welcome a range of incentive-driven policies. Environmental NGOs (ENGOs) and the public play an increasing but restrained role in the making of China's climate-related policies (Richerzhagen & Scholz 2008, p. 318).

This section has provided an overview of the actors that play different roles in shaping China's climate-related policies. In the following sections, the power and dynamics of each of these actors will be discussed in detail. By doing so, it will set the foundation for the analyses of CDM in Chapter 5 and ECERS in Chapter 6.

4.3 Government ministries

The investigation into the politics of climate change in China requires a hierarchical approach (Qi & Wu 2013, p. 301). Understanding the dynamics within the central government and the interactions between the central leadership and local authorities are the keys to comprehending how national climate change policies are developed and implemented. This section highlights these two sets of dynamics within China's fragmented authoritarianism, the horizontal relationship within the central ministries and the vertical relationships between central, provincial and local governments. It does so through an analysis of major ministries involved in climate change affairs and their relations with provincial and local governments.

The central government of China holds responsibility for decision making on climate-related policies which is the most powerful actor in China's climate affairs. At the top, China's National Leading Group on Climate Change was established on June 12, 2007 by the State Council, the chief administrative authority of China. The Leading Group aims at coordinating the complex decision-making process of climate-related policies (The Central People's Government of PRC 2007). It includes most ministers within the central government and is now chaired by Premier Li Keqiang[9]. A parallel leading group, the National Leading Group on Energy Saving and Emission Reduction, consists of the same set of members. Although having two different names, the two leading groups are actually one and the same organisation. It can be referred by either name depending on the tasks it carries out (i.e. international negotiation or domestic energy saving policy) (The Central People's Government of PRC 2007). These leading groups have a similar function to that of the cabinet committees in the Australian context, where a group of ministers can make collective decisions (Williams 2014, p. 7). Climate change is a complex issue and this approach enhances discussions and debates among relevant ministries which is a positive attempt towards a WG approach. Although the possibility of conflict and competition cannot be

[9] Members of the Leading Group: Zhang Ping (Deputy Secretary of the State Council), Ma Kai (Director of NDRC, Director of the Energy Office), Yang Jiechi (Minister of Foreign Affairs), Wan Gang (Minister of Science and Technology), Zhang Yunchuan (Director of the National Defense Science and Technology Committee), Huang Shuxian (Deputy Minister of the Ministry of Supervision), Jin Renqing (Minister of Finance), Xu Shaoshi (Minister of Land and Resources), Wang Guangdao (Minister of Construction), Liu Zhijun (Minister of Railways), Li Shenglin (Minister of Transport), Chen Lei (Minister of Water Resources), Sun Caizheng (Ministry of Agriculture), Bo Xilai (Ministry of Commerce), Gao Qiang (Minister of Health), Li Rongrong (Director of the State-owned Assets Supervision & Administration Commission), Xie Xuren (Director of the General Administration of Taxation), Li Changjiang (Director of Bureau of Quality Control), Zhou Shengxian (Director of Environmental Protection Bureau), Yang Yuanyuan (Director of Civil Aviation Administration), Xie Fuzhan (Director of Bureau of Statistics), Jiang Zhibang (Director of Forestry Bureau), Jiao Huancheng (Deputy Secretary of the State Council and Director of National Government Offices Administration), Cao Kangtai (Director of Legal Affairs Office), Bai Chunli (Vice president of Chinese Academy of Sciences), Zheng Guoguang (Director of Bureau of Meteorology), You Quan (Chairman of State Electricity Regulatory Commission), Sun Zhihui (Director of State Oceanic Administration), Jie Zhenhua (Deputy Director of NDRC).

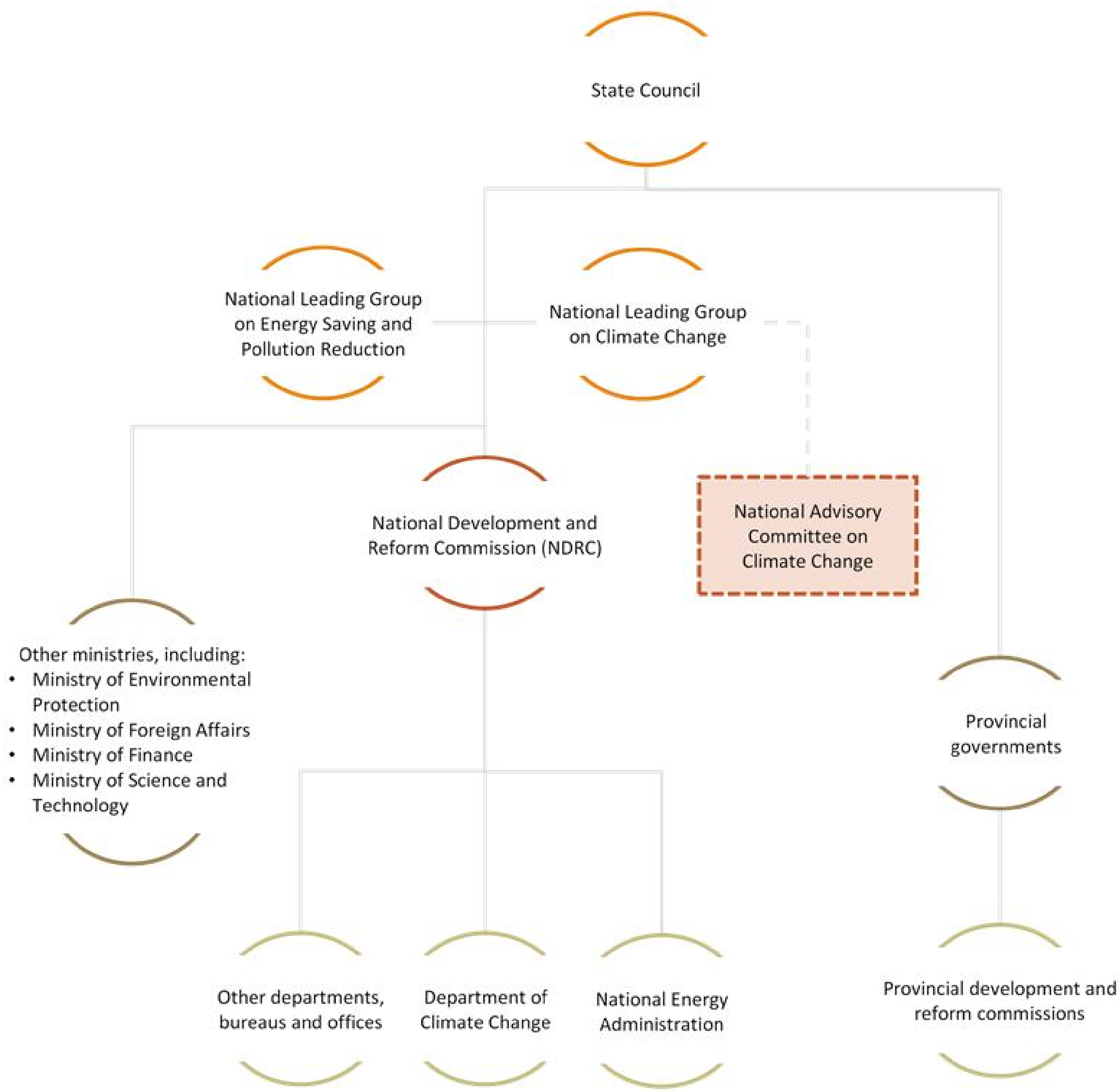
completely eliminated, the collective decision-making approach, in theory, leads to more rounded and sensible policy decisions (Shirk 1993, p. 7).

NDRC is the chief ministry that takes charge of China's climate change governance. This arrangement is backed up by the argument that climate change is not only an environmental issue but also an economic and developmental issue. NDRC manages China's macro-economy and makes important decisions on energy policies; therefore, it has the capacity for better coordination of energy and climate change (Lewis 2008, p. 158). Following NDRC, there are other central ministries which already have influenced or seek to influence China's climate policies (Figure 4.1). Among these ministries, the Ministry of Foreign Affairs (MFA), Ministry of Science and Technology (MST), MEP and MF are of great significance. They represent the international aspect, the technological aspect, the environmental aspect and the mitigation methodology aspect of the development of China's climate policies respectively (Heggelund 2007, pp. 173-175). MFA has played an important role in China's international negotiations on climate change. It has a cooperative relationship with NDRC in the development of negotiation strategies. MST also works closely with NDRC providing technological support for NDRC's climate-related policies such as renewable energy and clean cars (Chang, Leung, Wu & Yuan 2003, pp. 463-465; Heggelund 2007, p. 174).

Contrarily, MEP and MF are two ministries that hold opposite opinions towards NDRC's absolute authority on the management of climate change. MEP does so due to a range of practical obstacles caused by NDRC's poor economic planning when fulfilling its environmental protection duties. As China's atmospheric pollution worsens, MEP bears increasing blame from the public. However, MEP, as a weak environmental ministry, has little power in the planning and the approval of polluting enterprises. The majority of its work is described as "end of pipe", for instance collecting fines after the pollutants are emitted into the atmosphere. NDRC takes absolute charge of China's economic planning and climate change affairs, however, MEP regards some of NDRC's economic planning as contradictory to the principle of climate change mitigation and air quality preservation (Interviewee 3). As a result, after gaining full-ministry ranking in 2008, MEP started questioning some of NDRC's controversial approvals of heavy polluting projects by taking a firm stand on Environmental Impact Assessment, and openly demanding a voice in the planning process of industrial projects which had high impact on air quality.

The relationship between the MF and NDRC on the issue of climate change can be described as competition for administrative power. MF argues strongly for a carbon tax. It disagrees with NDRC's trial carbon trading scheme even after carbon trading pilot program was implemented. The reason why MF insists on a carbon tax but is against carbon trading is that taxes are managed by MF. The management of carbon tax can broaden MF's administrative power and portfolio (Williams 2014, p. 8). In this chapter, special attention is given to the analysis of the conflicts between MEP and NDRC, and competition between MF and NDRC in order to gain a better understanding of the dynamics of China's government institutions in the climate-related policy domain.

Figure 4.1 China's climate change governance structure



Source: Williams (2014, p. 8)

4.3.1 Status of the NDRC

The NDRC is the most significant top-ranking ministry responsible for China's macro regulation. Its major responsibilities include: making long-term development strategies and important socioeconomic policies, improving economic structure, approving significant national projects and supervising overall economic reform. NDRC also takes charge of a wide range of specific social and economic affairs which include the research, development and supervision of the implementation of China's climate change policies (NDRC 2017, n. p.). (Figure 4.2 Departments of NDRC).

Figure 4.2 Departments of NDRC

• General Office • Department of Policy Studies • Department of Development Planning • Department of National Economy • Bureau of Economic Operations Adjustment • Department of Economic System Reform • Department of Fixed Asset Investment • Department of Foreign Capital and Overseas Investment • Department of Regional Economy • Department of Western Region Development • Department of Northeastern Region Revitalisation	• Department of Climate Change • Department of Social Development • Department of Employment and Income Distribution • Department of Trade • Department of Fiscal and Financial Affairs • Department of Price • Bureau of Price Supervision and Anti-Monopoly • Department of Laws and Regulations • Department of International Cooperation • Department of Personnel • Office of National Economic Mobilisation • Office of Key Project Inspectors

• Department of Rural Economy • Department of Basic Industries • Department of Industry • Department of High-Tech Industry • Department of Resource Conservation and Environmental Protection	• The NDRC Party Committee • Bureau of Retired Officials • State Bureau of Material Reserve • State Grain Administration • National Energy Administration (NEA)

Source: NDRC (2017)

Although NDRC is currently the most powerful ministry within the State Council and oversees a wide range of socio-economic affairs, the ministry's authority has shown an overall declining trend (Song, Zhang, Wang & Li 2008, p. 56). According to the Director of NDRC Xu Shaoshi, in 2013 alone, NDRC delegated 416 types of approval authority to lower levels of government. The purpose of this is that NDRC can better focus on the most important tasks such as the supervision of the macro-economy.

The predecessor of the NDRC was the State Planning Commission, established in 1952 (Yang & Xia 2014, n. p.). As the name indicates, it was set up to manage China's planned economy and controlled almost all aspects of socioeconomic affairs from national goals at the top such as setting up annual national GDP targets to the most trivial details of people's lives such as determining the prices of basic consumable goods (Worthley & Tsao 1999, p. 573). The functions of the State Planning Commission gradually changed after 1978 when China decided to switch its planned economy to a socialist market economy. During the 1998 administrative reform, the State Planning Commission was re-named the State Development Planning Commission. The new commission's main duty focused on managing the national economy and exploring developmental strategies. Its intervention into the micro economy was reduced (Ngok & Zhu 2007, p. 227). In 2003, after Premier Wen Jiabao took over, the State Development Planning Commission was renamed again as the National Development and Reform Commission. Since then, the word "planning" was completely abolished from the Commission (Song 2009, n.p.). In 2008, the NDRC gave up its authority over relevant industrial management functions and the State Tobacco Monopoly Bureau. Meanwhile, the NDRC started supervision of the newly established National Energy Administration (State Council of PRC 2008; Downs 2008, pp. 42-43).

While the NDRC is currently the leading ministry for China's energy and climate governance, overlapping responsibilities and fragmented authority exist in the governance of both issues (Y Huang 2014, n. p.). Shapiro (2012, p. 59) identifies fragmentation as a common feature of Chinese bureaucracies both horizontally and vertically. This phenomenon was demonstrated in the data collected from Interviewee 1 at the NDRC. According to Interviewee 1, the disagreement over how to manage climate change mitigation and energy conservation causes a series of coordination problems within the ministry and between central and provincial NDRCs. He highlighted the conflicts between three departments within the NDRC:

> Both climate change policies and energy policies are led by NDRC. There are three major departments involved, the National Energy Administration, the Department of Resource Conservation and Environmental Protection and the Department of Climate Change. These three departments have different preferred strategies and methods in managing climate-related energy policies,

as a result, the standard cannot be unified. Some are in favor of calculating energy savings, some are in line with the control of total energy consumption; while others may be leaning towards the control of the total amount of CO_2 emission or its intensity. The coordination among these three departments is far from harmonious as all of these departments stick to their own preferred criteria in their policy measures. Moreover, the multiple criteria makes it difficult for lower levels of government to follow, as they need to undertake similar but not completely matched tasks and report to different departments.

The overlapping tasks among these three departments within NDRC has no doubt increased the workload for the provincial and local governments. If the three departments can coordinate with each other and work out unified criteria and measures for climate-related energy policies, their own efficiency and the efficiency of their provincial and municipal offices can, in theory, be improved. In fact, China has already been pursuing the optimisation of its administrative system through the means of administrative reform in order to address problems within the administrative system.

There have been four waves of administrative reforms since the reform and opening up in late 1970s, namely in 1983, 1988, 1998 and 2003 (Ngot & Zhu 2007, p. 218). China's administrative reforms were generally regarded as reforms with Chinese characteristics. They were seen as different to mainstream Western administrative reform in terms of unique culture, tradition, economic status, and authoritarian governance (Aufrecht & Bun 1995; Burns 2001; Ngot & Zhu 2007). However, apart from these unique characteristics, the key components of China's administrative reforms echoed the trend in the West, namely a focus on downsizing, decentralising and deregulating of the government (Burns 2000, p. 419; Christensen, Dong & Painter 2008, p. 221). The downsizing and restructuring of the original State Planning Commission in 1998 and 2003 led to today's NDRC. Compared with the old State Planning Commission, NDRC's overall sized is reduced, its functions are more specified, and its efficiency is improved (Ngot & Zhu 2007, p. 220; Worthley & Tsao 1999, p. 573). However, these reforms do not necessarily improve the governance of climate affairs. NDRC still holds the absolute power in making decisions of climate-related energy policies, and deficiencies are still present among the National Energy Administration, the Department of Resource Conservation and Environmental Protection and the Department of Climate Change.

Overlapping tasks and lack of coordination have been identified as the main deficiency among these three departments. Restructuring of internal government organisations for a simplified, uniformed and efficient administrative system had long been proposed by former Secretary of the State Council in the 1998 administrative reform as a major principle (Luo 1998, n. p.). The 2003 reform continued this trend with an emphasis on globalisation (Wang ZY 2003, n. p.). These reforms in general have brought NDRC closer to these goals, however, the coordination among the above three mentioned departments is far from optimal. The situation is caused by a combination of factors. Firstly, the Department of Climate Change is a relatively new department. It was not established until 2008 (Low Carbon of China 2011, n. p.). Before the Department of Climate Change was established, the other two departments had already governed in the fields related to climate change such as renewable energy and energy resource conservation. Therefore, it is inevitable that some tasks of the new department overlap with the other two existing departments. Second, dealing with climate change involves the management of CO_2 and other minor greenhouse gases. However, CO_2 is generated by almost all social and economic activities. As a result, it is unavoidable for the Department of Climate Change to interfere with the other departments, especially those with big mitigation potential such as energy and resources. Therefore, solving the overlapping problem will require a joined-up government approach. Finally and most importantly, the overlapping responsibilities and fragmentation have been a persistent ailment within the Chinese government and may require more fundamental administrative reform to overcome.

Back in 2005, the General Office of the State Council announced the System of Law Enforcement on Administrative Responsibility, which aimed at clarifying responsibilities and avoiding negative competition among government departments. The State Council also identified a new implementation method of "disclosing power lists mechanism", in which the responsibilities and authorities of all government departments of different levels were listed clearly on paper. A department cannot exercise authority over affairs that are not listed in its own responsibility list (General Office of the State Council 2005, n. p.). However, due to the complexity in the arrangement of the existing administrative system, the build-up of a completely clear and defined responsibility system has proved to be a great challenge in reality (Huang S 2014, n. p.).

As a matter of fact, the disclosing power lists mechanism, in the case of climate change governance, has imposed a negative effect on the coordination of the three climate-related departments in NDRC. The clearly defined, similar but slightly varied tasks for the three departments is not only a waste of administrative resources, but also increases the workload of lower levels of government and relevant industries. Therefore, to fundamentally solve this problem, simply clarifying the responsibility and authority of each department is not enough. It requires a joined-up government approach in order to enhance better communication or even a rearrangement of power and responsibility around the governance of climate change. What this might look like in the Chinese context will be discussed in Chapter 7.

Apart from conflicts from internal departments, NDRC also faces a range of conflicts and competitions from other central ministries on climate-related governance and policies, among which the MEP and MF are two of the most significant ones.

4.3.2 Status of the MEP

As stated previously, China is unique in terms of its government structure, political system, and the power distribution within the government is extremely complex, fragmented and uneven (Shapiro 2012, p 59). Lieberthal (2004, p. 186) describes China's multilevel bureaucratic system as a "Matrix Muddle", which vividly reflects the power fragmentation between central, provincial and local governments and among different departments at each level. In the centre, different ministries have different rankings. For instance, NDRC is a full cabinet-ranking ministry with top tier authority. There are also ministries with lower rankings which indicate their less significant authority. The ministries with higher rankings in the centre guarantee their provincial and local branches a higher ranking over those with lower ranking parents in the centre. Therefore, government offices with lower rankings do not have authority over those with higher ranking and those of the same rank cannot manage each other (Ma & Ortolano 2000, p. 33).

China's environmental protection sector, compared with the planning and economic focused ministries, had been in a lower position in the central government for many decades. This lower position not only determined the lower ranking of its sub-branches within provincial and local governments, but also prevented it from being involved in major policy development in the centre (Jahiel 1998, p. 758). However, this situation has changed gradually over the past two decades. Contrary to the declining power of the NDRC, the overall trend of China's environmental protection sector has been rising, except for occasional setbacks. Since China attended the 1972 United Nations Conference on the Human and Environment in Stockholm, the rank of China's environmental sector has been raised six times (Dwivedi & Vajpeyi 1995, p. 74). This signalled that China had gradually realised the importance of environmental protection.

In 1974, the National Environmental Protection Office was set up. The authority of an office is much lower than that of a full cabinet ranking ministry and it had no right to issue orders to lower levels of government. After the promulgation of China's first environmental protection law in 1979, local EPBs were established. They had direct access to local government leaders and the power to organise meetings and the right to establish specific sub-units. The status of China's environmental sector slightly improved as a result. However, during the 1982-1983 bureaucratic restructuring, which aimed to reduce the size and expenditure of the government, the Environmental Protection Office in the central government was positioned under the newly created Ministry of Urban and Rural Construction and Environmental Protection. Such an arrangement seriously restricted the independence of the administration of China's environmental protection sector, and created obvious conflicts between development and environmental protection within the ministry (Jahiel 1998, p. 768).

The consequence of the 1982 restructuring was seriously questioned by environmental personnel and scholars during the Second National Environmental Protection Conference 1983-1984, where the deteriorating status of China's environment raised great concerns. In dealing with this issue, the government set up an inter-organisational body in 1984, the Environmental Protection Commission, which specialized in facilitating communications between EPB and industrial ministries. This improved the coordination between the environmental protection sector and the industrial ministries to some extent and gave relative independence to the environmental protection sector. In the same year, the Environmental Protection Office was upgraded to the National Environmental Protection Bureau with a higher rank than other second-tier organisations (Jahiel 1998, p. 769). The concept of environmental protection was at this time set as a basic national policy and a national regulatory framework was established (Mol & Carter 2006, p. 152).

The National Environmental Protection Bureau gained complete independence from the Ministry of Urban and Rural Construction and Environmental Protection in 1988 and was renamed the National Environmental Protection Agency (Mol & Carter 2006, p. 152). But unfortunately, during the 1993-1994 government administrative reform, the local and county level EPBs were largely cut for the purpose of reducing government expenditure, resulting in heavy polluting Township and Village Enterprises (TVEs) at local level operating unchecked (Shi & Zhang 2006, p. 274).

It was not until March 2008 that MEP gained full cabinet ranking (Figure 4.3). This rearrangement was partly due to the pressure from the preparation for the 2008 Beijing Olympic Games, where a sound environment would present a positive first impression of China to foreign visitors. But more importantly, China's environmental situation had reached a tipping point where water, air and solid waste pollution were almost irreversible (Huang XH 2008, n. p.). This posed serious threats to public health and long-term environmental and economic sustainability. As former Vice Director of the State Environmental Protection Agency (now MEP) Wang Yuqing (2005, as cited in Li XW et al., 2007, p.39) said:

> The worsening ecological environment has brought about huge economic losses. It also threatens human health and affects social stability. If the traditional practice continues, the environmental situation will continue to get worse.

Figure 4.3 Ministries and Commissions under the State Council

- Ministry of Foreign Affairs
- Ministry of National Defence
- National Development and Reform Commission
- Ministry of Education
- Ministry of Science and Technology
- Ministry of Industry and Information Technology
- State Ethnic Affairs Commission
- Ministry of Public Security
- Ministry of State Security
- Ministry of Supervision
- Ministry of Civil Affairs
- Ministry of Justice
- Ministry of Finance
- Ministry of Human Resources and Social Security
- Ministry of Land and Resources
- Ministry of Environmental Protection
- Ministry of Housing and Urban-Rural Development
- Ministry of Transport
- Ministry of Water Resources
- Ministry of Agriculture
- Ministry of Commerce
- Ministry of Culture
- National Health and Family Planning Commission
- People's Bank of China
- National Audit Office

Source: The Central People’s Government of PRC (2015)

Facing the worsening environmental deterioration, the former government leaders (President Hu Jintao and Premier Wen Jiabao) identified environmental protection as an important component of the proposed Harmonious Society Concept[10]. In order to adjust the power imbalance between China's economic development and environmental protection and improve China's environmental quality, the Chinese leaders of this era started to devote more effort to environmental protection. Premier Wen Jiabao emphasised that China had to achieve the following three transitions to achieve a sound environmental outcome during the Sixth National Conference on Environmental Protection:

> (1) The transition from a focus on economic growth to a focus on environment and economic development;
>
> (2) The transition from environment as a lagging objective to equal importance with economic development;
>
> (3) The transition from the primary use of administrative methods of the [sic] environmental management to a more comprehensive system combining many approaches (as cited in Lan, Simonis & Dudek, 2006, p. 8).

Regardless of whether this was sincere or merely rhetoric, it was truly the first time that one of China's top leaders put environmental protection in a position as important

[10] Each generation of Chinese government top leader would produce an ideological work, for example Mao Zedong Thought, Deng Xiaoping Theory, Jiang Zeming's Three Represents, and Hu Jintao's Harmonious Society.

as economic development. Therefore, it is of significance for China's environment. However, the pursuit of "equally important" environmental protection and economic development simultaneously is challenging. In reality, China's city smog and climate change issues are largely caused by fossil fuel powered economic development. The conflict between these two contradictory goals is also reflected at the institutional level in the conflicts between MEP and NDRC.

4.3.3 Conflicts between MEP and NDRC

As mentioned above, China's environmental protection has always been weak and it was not until March 2008 that the Ministry of Environmental Protection (MEP) gained full cabinet rank and became level with NDRC. However, the same ranking of the two ministries did not automatically endow them with equal power. The challenges that MEP faces, unlike NDRC's internal conflicts, are the lack of actual power regardless of its rising ranks. In reality, MEP's power is restrained by NDRC on many occasions. According to Interviewee 2, MEP lacks power in important planning and policy decision processes when there are multiple ministries involved. According to Interviewee 3, MEP was only allowed to deal with the "end of pipe" problems and lacked power to do anything during the planning process of polluting industries. Many EPB staff also expressed their frustration about the difficulties they face in their daily work of environmental law enforcement on public online forums. One EPB officer explained why it was so difficult to collect evidence for enterprises' illegal pollution on the forum *Zhihu*. According to this person, many enterprises' polluting behaviours were random. For instance, some of them truly did emit pollutions illegally when the public reported the cases. However, when the EPB investigators arrived for inspection, they had stopped doing so. This caused great difficulty for EPB investigators' investigation and assessment. Therefore, the EPB officer on *Zhihu* encouraged the public to provide photo and video evidence when they report to EPBs (Zhihu 2015). The example in the following section indicates even greater challenges that MEP faces when dealing with large-scale pollution cases backed-up with NDRC approvals.

The dispute upon the approval of a 60 billion *yuan* (approximately US$10 billion) paraxylene (PX) plant at Gulei Village, Zhangzhou City, Fujian Province of southern China, proposed by Dragon Aromatics, provides one such example. On April 6 2015, 14 people were injured in an explosion at the PX plant. Villagers and houses were impacted for miles. Similar explosions had happened before on the site. The first explosion could be traced back to 30 July 2013. Interestingly, it was rarely known that such a high impact facility had never completed an environmental impact assessment. Serious conflicts had happened between the MEP and NDRC behind the scenes of the Gulei petrochemical facilities approval process (Wang T, He & Wang 2015, n. p.).

Back in October 2012, the MEP expressed serious opposition towards the PX plant at Gulei as it did not pass an environmental impact assessment. In January 2013, MEP fined the plant 200,000 yuan (approximately US$33,000) for starting construction before gaining the relevant environmental approvals. In May 2014, MEP wrote an official letter to urge NDRC to rescind the approval after receiving NDRC's *Approval for Fujian Zhangzhou Gulei Petrochemical Base Overall Development Plan*. MEP claimed that NDRC's approval process had already violated the *Environmental Impact Assessment Law*. Due to the absence of an environmental impact assessment of the above mentioned project development plan, NDRC's approval had already violated Article 12 and Article 14 of the *Environmental Impact Assessment Law*, and Article 16 and Article 22 of the *Planning Environmental Impact Assessment Ordinance*. This official letter was published on MEP's official website and it was probably the first time that MEP publicly urged NDRC to withdraw an approval (Liang 2015, n. p.).

According to the *Environmental Impact Assessment Law*, "Governments of district municipal level and above or relevant departments of provincial governments should use environmental impact assessment report and its recommendations as important evidence for decision making in approving specific planning proposals" (People's Congress of PRC 2003, n. p.). The *Planning Environmental Impact Assessment Ordinance* issued by the State Council further indicated that "environmental impact report should be included for consideration for approval; for proposals without environmental impact assessment reports, relevant planning and approval departments should not issue approvals" (General Office of the State Council 2009, n. p.). However, Feng Hai (pseudonym), an expert close to NDRC, stated that NDRC held a different opinion upon the approval for Gulei petrochemical plant. In March 2011, NDRC's approval for *Economic Development Plan Zoning Western Side of the Straits* (the so-called 'big plan') had clearly stated that the planning boundary included the entire territory of Fujian Province. Zhangzhou Gulei Petrochemical Base was located within this territory. In March 2014, NDRC approved *The Overall Development Plan of Fujian Zhangzhou Gulei Petrochemical Base* (the so-called 'small plan'). NDRC believed that an environmental impact assessment had already been done for the big plan, and therefore, it was not necessary to have it done again for the small plan (Liang 2015, n. p.).

Although MEP held no authority over the approval of the above project plan, it insisted that it would dismiss any environmental impact related documentation from Gulei, which were preconditions for approvals according to the *Environmental Impact Assessment Law*. In fact, up till now, MEP has not dealt with any new environmental impact assessment documentation from Gulei petrochemical plant. The argument between MEP and NDRC over the approval for Gulei Petrochemical Plant had been going on for a considerable period of time. In the end, NDRC claimed that in order to promote the unity of the two ministries, internal negotiation was the best way to deal with this issue, and the Gulei Petrochemical Plant case was eventually handled quietly (Liang 2015, n. p.). According to the investigation report of the '4.6' Gulei explosion released on the 16th of August 2015, the CEO of Dragon Aromatics and 12 relevant personnel in charge of production and safety were transferred to the judiciary for investigation. 11 government officials including the Executive Vice Mayor of Zhangzhou City, Liang Xinwei, Director of Gulei Economic Development Zone, Shen Yongxiang, Deputy Director of Zhangzhou Quality Supervision Bureau, Lu Weilin, and a few health and safety investigators within relevant departments, were punished according to the Party discipline guidelines. Nine managers and responsible surveyors of Dragon Aromatics were removed from their positions or demoted. Meanwhile, Dragon Aromatics was required to improve its health and safety standards. The government of Zhangzhou City was required to clarify responsibility, improve monitoring and toughen criteria for approvals in order to avoid similar incidents (RF Shen 2015, n. p.).

The above case shows that the Chinese government's pro-development tendency is unchanged and the NDRC still holds the absolute power on economic planning. This status can be confirmed by the following elements of the case. First of all, the personnel who approved the project within NDRC were neither punished nor even mentioned. The officials being punished were those in relatively less significant positions, and the "punishment according to the Party discipline guidelines" is a rather vague outcome. Secondly, Dragon Aromatics was not ordered to shut down but only experienced minor personnel change, which indicated that NDRC would hold its original approval decision. Finally, toughening criteria for the approval of major petrochemical projects was only mentioned as one of the suggestions rather than the most significant lesson learned. The role and position of MEP was not mentioned at all in the suggestions.

The fundamental reason behind the Gulei Petrochemical Plant accident is that environmental impact assessment has never been truly mandatory for planning and approving departments. MEP always loses the battle when attempting to challenge the authority of NDRC. Although sharing equal administrative ranking, MEP lacks actual power compared with NDRC. As Interviewee 2 noted, "MEP is quite weak in China. As you can see in many government policy documents, MEP is often listed at the bottom among all the involved ministries. This is because MEP does not have authority for approving and decision-making on many important planning cases, only has the right to give recommendations".

This challenging situation for MEP is also reflected through the handling of the increasingly serious issues of climate change and atmospheric pollution in China. The interviews that I conducted with MEP and NDRC officials highlighted this point. When being asked whether it is contradictory for NDRC to manage climate change affairs, Interviewee 3 from MEP strongly agreed that it was contradictory and illogical for NDRC as an economic oriented ministry to manage climate change:

> We need to have a positive and proactive attitude towards the international agreement, so we appoint this task to the most important ministry, NDRC. However, I think developing the economy is NDRC's first task and climate change mitigation is only a by-product. A bigger problem is that there is no constraint for such a powerful ministry. This leads to a situation in which NDRC can do whatever it decides to. If there are two ministries that can constrain each other's behaviour, the second department can argue under the current situation what is the more important thing to do, it will result in more smooth and sensible policies. But unfortunately for the moment, either to develop the economy or to reduce emissions, the priority is totally decided within the NDRC, which leads to great fluctuations of policy.

> In many developed countries, environment-related government departments have comprehensive functions. For example, they may have environment, energy and natural resources as one department. Not like in China, our ministry is solely environmental protection. MEP does not intervene nor has the right to intervene at the initial planning stage of a project, only being asked to check its emissions after all pollution has been made. It is totally pointless and ineffective.

Interviewee 1 from NDRC answered the same question with a dramatically different view, believing that only NDRC had the capability to manage China's climate change:

> Energy and energy conservation have always been managed by NDRC. Of course long ago they were managed by the Economic and Trade Commission. The climate change issue has a very close connection with energy consumption and energy conservation, so if you put it under the Ministry of Environmental Protection it will be very difficult to coordinate. Moreover, the climate change issue is more of an economic issue. It involves all aspects of the economy, not just pollution. Now we realise that the "end of pipe" pollution control that MEP does is not effective towards carbon emission reduction. The planning of carbon emission reduction must focus on the structure and developmental status of the entire economy. So, I personally believe that putting climate change affairs under NDRC instead of MEP is very suitable. For China, the biggest issue we are facing is the transformation of the economy. If this is achieved, then carbon emission reduction will be

achieved automatically. They are of the same direction. Therefore, NDRC managing both economic transformation and climate change makes good sense, at least for the current period of time.

From the above responses it can be seen that both ministries doubt each other's competence in managing carbon emission reductions at the central government level. MEP questions NDRC's ability in making sensible and truly environment focused policies, while NDRC to a certain extent dismissed MEP's potential in managing carbon emissions at the present time. The tension branches down to provincial governments which further intensify the conflicts between economic development and environmental protection. These conflicts are mainly reflected through the powerlessness of MEP in issuing orders to provincial and local officials who manage the economy and local EPBs.

4.3.4 Conflicts among MEP, local EPBs and provincial and local economic departments

NDRC is not the only actor that restrains MEP's administrative effectiveness. During the implementation of many environmental policies, some provincial and local officials who manage economic affairs (including but not limited to provincial NDRC officials) pose even bigger obstacles due to their unwillingness to cooperate with MEP. MEP does not carry out direct and complete management of its provincial branches, the EPBs, which is to say EPBs report to both MEP and the provincial governments in their own locations (Jahiel, 1998; Shi & Zhang, 2006; Mol & Carter, 2006). However, due to the fact that provincial EPBs' funding is provided by the provincial government and EPB personnel selection is also influenced by the provincial government, they are often more loyal to the provincial government than to their parent ministry in the central government (Jahiel, 1998; Zhang KJ, 2007). Driven by tax revenue and possible future promotion – one of the most important criteria used for judging Chinese official's performance is economic growth and significant projects in his or her governing area – the majority of the provincial governments give priority to economic development. Most project proposals are required to pass environmental impact assessment conducted by MEP before they are handed to NDRC for approval, however, due to the EPB's reliance on the provincial government, many EPB personnel are often forced to disobey relevant environmental laws and give green lights to proposals that do not meet required environmental standards (Lan, Simonis & Dudek, 2006; van Rooij, 2004). According to an expert who had extensive experience in China's environmental impact assessment, there is not much MEP and EPBs can do if the planning and approval bodies decide to completely ignore their recommendations or local governments ostensibly accept the recommendations but do not carry them out in reality (Liang 2015, n. p.).

Tax revenue from large projects is a great driver for provincial and local officials to choose economic development as a priority. Traced to the root, the Gulei PX plant accident was a tragedy caused by such a motivation. According to the director of the Administrative Committee of Gulei Economic Development Zone:

> Dragon Aromatics is a company that is willing to spend money. They authorized a foreign consultancy for design and consulting, and we have collected over 10 million *yuan* tax and fees just on this alone. The fine from MEP and the order from NDRC on adjusting raw materials will have only minor impact on the entire project (Peng & Fang 2013, n. p.).

This is very true. As shown in *Gulei Monthly Economic Report*, so far the Dragon Aromatic PX Project has reached overall 99% completion, within which designing and procurement were 100% completed and construction was 98.7% completed. A 200,000 *yuan* (approximately US$34,000) fine from MEP appears meaningless compared to the 13.780,000,000 *yuan* (approximately US$2.3 billion) investment of the PX project at Gulei. However, this is already the highest level of punishment allowable in the *Environmental Impact Assessment Law*. The cheap fine is also a reason for companies to ignore the authority of MEP.

In fact, not only is the fine cap in the *Environmental Impact Assessment Law* low, penalties contained in many other environmental laws and regulations are also light, which makes it cheaper to violate the law than to obey the law. The *Environmental Protection Law* set pollution fine caps for average polluting activity at 100,000 *yuan* (approximately US$17,000) which suggests significant regulatory failure, while according to the *Water Pollution Prevention Law*, the fine for big pollution accidents can be as high as 30% of the direct financial loss caused by the accident but cannot exceed the cap of 1,000,000 *yuan* (approximately US$170,000). The low caps on pollution fines have led to many big polluting enterprises purposely not operating their pollution control equipment. As former deputy minister of the State Environmental Protection Agency (SEPA) Wang Jirong (*People's Daily Online*, 2006 n. p.) pointed out, light penalties and caps on pollution fines have severely weakened the deterrent effect of many environmental laws. In Wang Jirong's report, a company installed a set of 200,000,000 *yuan* waste water treatment equipment. In theory, the company was capable of limiting its pollution level to the required standard. But the operation cost of the equipment was about 100,000 *yuan* per day which was similar to the cap of the pollution fine. Due to this situation, the company decided not to use the equipment. This was because as the EPB officers could not come to check every day, it was cheaper to pay fines occasionally than operating the pollution treatment equipment on a daily basis. Atmospheric pollution control faces the same problem. The pollution fine for each kilogram of SO_2 is 0.2 *yuan*, however, if coal-fired power plants treat SO_2 they need to spend 1 *yuan* on each kilogram of SO_2, which is five times as expensive as paying fines. Therefore, in order to effectively enforce environmental laws it is essential to introduce heavier penalties which make the cost of pollution much high than the cost of violating the laws. This challenge will be discussed further in Chapter 7.

The power imbalance between MEP and NDRC may not be resolved in a short period of time. MEP's direct supervision of its provincial and local branches may require another wave of administrative reform to be realised. These administrative challenges will be discussed in detail in Chapter 7 of this thesis. However, there is new hope for toughening MEP's authority from the legal perspective. On 24 April 2014, the People's Congress of the PRC passed the new *Environmental Protection Law*. The new law has been in effect since 1 January 2015 (People's Congress 2014, n. p.). The new *Environmental Protection Law* is regarded as the toughest compared with previous versions of environmental protection laws in China. It abolished the fine caps; instead, pollution fines are calculated on a daily basis. EPBs are also granted the authority to order the closure of companies and detain personnel who violate the law (People's Congress 2014, n. p.). Furthermore, this new law enabled the involvement of civil society and the general public in reporting and raising lawsuits towards polluters. ENGOs at the city level or above have the right to conduct public interest litigation towards polluters, and the Minister of MEP announced the establishment of a "WeChat"[11] Reporting Platform, where the public can easily report polluters' illegal behaviours through social media (Zhang WT & Zhang 2015, n. p.). The Public Environmental Research Centre (IPE) also set up similar platform, which enables the public to report and green enterprises to showcase their products (Yan 2017).

According to Zou Shoumin, the Director of the Environmental Supervision Bureau, MEP, the number of pollution cases they dealt with increased dramatically within the first two months of the implementation of the new *Environmental Protection Law*. There were 26 cases of fines on a daily basis nationally, accumulating 12,389,600 *yuan* (approximately US$2,000,000) of pollution fines. In 527 cases, violators were ordered to close down polluting entities, production was forced to reduce or stop in 207 cases. Relevant personnel in 147 cases were punished accordingly. The enforcement of environmental law improved dramatically since the introduction of the new law. The removal of fine caps, the newly added administrative authority of EPB investigators and the allowance for public involvement have all triggered this result (DF Li 2015, n. d.).

[11] WeChat - the most widely used social networking app. in China with over 600 million users worldwide.

Although China's MEP is weak compared with NDRC and still faces obstacles dealing with some provincial and local authorities, the continuous updates of China's environmental laws is one aspect that can potentially strengthen the capacity of MEP. There are still challenges in the enforcement of the new law such as lack of awareness of the new law, limited resources of EPB investigation teams, and insufficient coordination between the EPBs, the police and judicial authorities (Wang JH 2015, n. p.). However, these challenges cannot diminish the significance of the new law as a legal tool to enhance China's environmental protection. There is hope for China's environmental protection sector to become stronger and to have more say in important policy decisions.

4.3.5 Competition between NDRC and MF

Government departments are not merely the implementation bodies of public policies, they are also independent economic bodies that can obtain certain economic benefits from their administrative behaviour. It has been an implicit phenomenon that central ministries keep a proportion of their revenue within the ministries rather than report and hand in the total amount to the central fiscal revenue. Driven by economic benefits, competition among China's central ministries intensifies, especially among those with overlapping authorities on policies or projects with great potential for economic benefits (Xie 2007, pp. 222-223). The competition between NDRC and MF on climate change mitigation is mainly reflected through the argument on decisions of whether to adopt carbon trading or carbon tax. Both ministries attempt to hold total control of China's climate change mitigation approach due to the potential of gaining broadened administrative authority and economic benefit. NDRC emphasised its authority over climate change governance and proposed carbon trading (cap and trade) as China's major climate change mitigation method. The MF on the other hand emphasised its authority over taxation and insisted that carbon tax was a more suitable climate change mitigation tool for China's needs (Liang 2012, n.p.).

MF holds a firm stance that carbon tax should be China's primary climate change mitigation strategy. Back in 2009, the Financial Science Institute of MF conducted the special report *The Design of China's Carbon Tax System* (China Economic Weekly 2013, n. p.). At this stage, NDRC was still open for discussion between the two options, or at least did not completely eliminate the possibility of carbon tax. According to Deputy Director of the Department of Climate Change, NDRC, Sun Cuihua, NDRC was negotiating with MF on a major strategy for carbon emission mitigation. If carbon emission credits are initially auctioned to enterprises, then there is no need for a separate carbon tax system as the auction itself would have a similar effect to a tax. However, if carbon emission credits are allocated to enterprises free of charge, then there is the necessity for considering a carbon tax (Liang 2012, n.p.). Three years later, a carbon tax was still not put onto the government's policy agenda. According to the Director of the Financial Science Institute of MF, Jia Kangxiang, this situation was due to that top decision makers not reaching an agreement on a carbon tax (China Economic Weekly 2013, n. p.). However, by then, NDRC was already one step ahead of MF by setting up pilot carbon trading programs. Beijing, Tianjin, Shanghai, Chongqing, Hubei Province, Guangdong Province and Shenzhen were identified as the first seven carbon trading pilots. Even though the initial carbon emission credits were allocated to enterprises free of charge, a carbon tax was not used as a supplementary mechanism. In Sun Cuihua's words:

> Initially, free credits appeared more popular among pilot cities, companies only need to purchase credits if their free credits are running short or to sell credits if they cannot use up the free credits (Liang 2012, n. p.).

This again showed NDRC's dominance in the governance of China's climate change affairs, because there was no more mention of a carbon tax even though the initial carbon credits were allocated to industries free of charge. Interviewee 2 further affirmed the status of NDRC by revealing the certainty of carbon trading as China's major climate change mitigation strategy in future:

> According to the current situation, it is almost certain that the establishment of a carbon market is a policy priority. The pilots were all big cities of great significance such as Beijing, Shanghai and Shenzhen. These big cities are like the engines of a train. Once they start moving forward, they will lead other cities onto the track. By then, our future policy layout is basically decided. China's public policies almost always follow this rule. If a pilot program proves feasible and successful, then it will become a national policy.

NDRC's decision and implementation of the carbon trading pilot program had excluded MF's role in CO_2 abatement. MF was not satisfied with this result and continued to express its desire for the implementation of a carbon tax. In 2014, just before the Twelfth People's Congress Meeting (2nd session) and the Twelfth National Committee of the Chinese People's Political Consultative Conference (2nd session), Jia Shen, Head of the Taxation Department, MF, submitted a proposal on converting traditional pollution fines into environmental protection tax, and adding CO_2 into this taxation category. The proposal also requested environmental protection tax and carbon tax both to be collected by local tax departments. However, currently CO_2 is managed by NDRC; non-CO_2 pollutants are managed by MEP and pollution fines are also collected by MEP. MF's proposal has challenged the interests of NDRC and MEP.

Although the disagreement between MF and NDRC on whether to choose a carbon tax or carbon trading as China's major carbon emission control strategy was primarily interest driven, it did lead to serious discussions over the suitability of the two options for China's specific situation. According to Interviewee 1, research institutes under MF, NDRC and MEP have conducted numerous studies on a carbon tax, carbon trading and comparisons of the two strategies. Top universities and semi-independent research institutes such as Tsinghua University and the Chinese Academy of Social Sciences have also conducted research on these topics. The key difference between the two options are outlined below.

A carbon tax requires the regulatory authority to directly set up a carbon price - the tax rate; while carbon trading requires the regulatory authority to determine the total emission cap and leave it to the market to yield an emission price (Goulder & Schein 2013, pp. 3-4). Some may think that setting up a carbon tax is simpler and cheaper than establishing cap and trade[12] because it is just another tax and both the government and corporates are familiar with taxes. However, this is not true. In fact, carbon tax and cap and trade require a similar amount of administrative cost as both require the same level of emission monitoring. Just as Keohane (2009, p. 43) put it, “Regardless of whether emissions are taxed or capped, they must be measured”. Therefore, cost has never been the centre of the debate of carbon tax or cap and trade; instead, the decisions are usually more out of political concerns. The competition between NDRC and MF and the final decision on cap and trade in China also reflect political concerns from the international perspective, as explained below.

A cap and trade system may appear more politically attractive in Western democratic countries because it offers something for all stakeholders. Politicians can combat global climate change without using the word “tax”. Industry groups and financial intuitions are able to acquire potential profit-adding opportunities in the new market. Environmentalists are in favour of cap and trade as it has a more definite opportunity for a declining cap on carbon emissions (Avi-Yonah & Uhlmann 2009, p. 6). In China, a single party authoritarian country, the above concerns seem irrelevant. Why did

[12] Cap and trade programs designed to regulate air pollution emissions share the same basic structure. The government establishes a cap on the total emissions of a certain pollutant from a set of regulated sources over a fixed compliance period. The cap is then divided into allowances, each representing the right to emit a unit of the pollutant. The government allocates allowances among the regulated sources, and the sources may then trade them. At the end of the compliance period, each regulated source must show that it holds a sufficient number of allowances to cover the units of pollution that it emitted (McAllister 2009, p. 398).

China not choose a more straight forward alternative, i.e. a carbon tax? Lo (2016, p.81) argues that the motives behind China's decision in fact stemmed from international politics rather than domestic concerns. The pursuit for "pricing power (*定价权*)" and "power of saying (*话语权*)" on the international carbon market can be viewed as part of China's effort towards the competition for global leadership.

This thesis argues that the Chinese government's decision on cap and trade system is also a reaction towards international criticism on the amount and growing speed of China's total GHG emissions. As mentioned in previous chapters, the main criticism towards China's involvement in global climate change mitigation is that China does not set a cap on its total emission. Even when China promised sizable reduction targets on its energy intensity and accomplished these targets, there was still criticism of its continuously growing national emissions (Wang Q 2014). In response to this criticism and in order to further improve China's international image, China selected cap and trade as its national emission reduction strategy over its alternative. This is because, "Under a carbon tax, the price for emitting carbon would be fixed, but the level of emissions reduction would not be. With cap-and-trade, there would be a fixed limit on emissions. But the price of emitting carbon would fluctuate depending on ups and downs in the allowances market" (DiPeso 2009, p. 96). By capping its national emission, China leaves no more opportunity for international criticism for its climate policy. Just as Interviewee 2 stated:

> We like to be praised on the international stage. We want people to think we've done a lot [to reduce carbon emission]. And in fact, we did do a lot. But we have to make them [the international community] believe we've done it.

By the end of 2017, China's national cap and trade on greenhouse gas emission will be implemented. This will open a new era for China's climate change mitigation. Since China has already decided to implement cap and trade on a national scale, any further argument over the advantages of carbon tax and carbon trade becomes meaningless. Instead, the focus should be put on the how to optimise China's national cap and trade system and get down to the details. These approaches will be discussed in Chapter 7.

All in all, the conflicts and competitions among relevant central ministries are unavoidable. Fragmentation and coordination problems are common for governments, not just in China, but also in democratic governments. According to Kettl (2015, p. 66), the new Office of Homeland Security under the Bush government in the US faced great challenges in coordination among the FBI, the CIA, the National Security Agency, Immigration, Border Patrol, Coast Guard and many other government agencies. James and Nakamura (2014, pp. 93-94) also identified a range of coordination problems in areas of health policy and employment policy within the government of the UK. The conflicts between environmental protection and economic development also appear to be a common phenomenon in the developing world. In Indonesia, the land degradation of the upper watershed of Java was caused by export-driven, short-sighted and unsustainable forestry management (Pearce, Barbier &

Markandya 2013, p. 69). In fact, Hosonuma et al (2012) identified commercial farming and logging as the common drivers of deforestation and forest degradation in Latin America, Asia and Africa. In big cities of China and India, atmospheric pollution is largely attributed to increasing passenger vehicles, power generation from coal, manufacturing and construction (Guttikunda, Goel & Pant 2014; Rohde & Muller 2015). Developed countries, such as Australia, cannot avoid such conflicts either. For instance, Australia has faced great difficulty in dealing with the water management of the Murry-Darling Basin during droughts. On one hand, irrigators demand sufficient water for agriculture production; on the other hand, the river's already high salinity level requires a heathy flow for conservation (Koehn 2015).

Although most of these conflicts generate negative impacts on policies in general, it should also be acknowledged that these conflicts also have the ability to raise questions and generate thinking. China may achieve better climate governance and policy outcomes if efforts are made to harmonise these conflicts. Chapter 7 will highlight options in dealing with this issue. This section has concentrated on the most important actor in China's climate-related policy development – the Chinese government. In the next section, another important actor, the advisory bodies, and their role in China's climate-related policy development, will be discussed.

4.4 Advisory bodies

In ancient China, government bureaucracies were mainly made up of intellectuals, or scholarly officials. Ferdinand (1991, p. 10) argued it was the intelligentsia that moulded the structure of China's imperial bureaucracy. This tradition of valuing intellectuals' advice for government activities and polices was revived after the late 1970s. Since China's reform and opening up, intellectuals have been playing an increasingly important role in the public policy domain (Goldman 1999, p. 283). This phenomenon is more profound in the process of China's climate-related policies. Relevant research institutes within NDRC are the major advisory bodies on such policies. They are responsible for conducting primary research, drafting policies and releasing information (Zhu & Xue 2007, p. 453). However, a range of external organisations and personnel are more often seen in the development process of China's climate-related policies including academics, researchers of external agencies, and foreign experts. Williams (2014, p. 9) attributed this phenomenon to the lack of internal expertise within the government. As a result, China's climate-related policies are often the collaborative effort of government internal institutes and a wide range of external experts.

The expert community plays a very important role in the formation of China's climate-related policies because climate change is a relatively new domain for the Chinese government and as such ministers and relevant officials are unfamiliar with climate-related policies. Therefore, they rely heavily on the experts for policy advice. Climate-related policy is also complex as it involves all sectors which utilise fossil fuels and emit carbon emissions. Therefore, the government relies on the experts' expertise for technical data and evidence as sources for drafting detailed policies. Furthermore, climate change is a global problem with an international and political aspect. China's navigation of its climate-related policy will attract attention and response from the international community. Due to the concern of international image and face, the Chinese government needs to obtain the best possible advice not only on the technical aspect but also the political aspect of the policy. Therefore, the advisory bodies in China's climate-related policy are of great significance in both technical and political terms.

4.4.1 Official policy research institutes

The National Advisory Committee on Climate Change is the prominent official government agency in climate change policies. It consists of the most influential experts in this area and reports directly to NDRC and the State Council (Williams 2014, p. 9). There are also other official research institutes that contribute to the development of climate-related policies such as the Energy Research Institute (ERI) within NDRC, the National Centre for Climate Change Strategy and International Cooperation (NCSC) and the State Council Development Research Centre (DRC) (Wübbeke 2013, p. 716). Although there is plentiful expertise within the official formal advisory bodies, NDRC still experiences difficulties in developing and implementing climate-related policies due to the complexity of the climate change issue and the lack of analytical skills of lower level NDRC branches. Interviewee 1 from NDRC described this situation as follows:

> In policies I participated in developing, a range of experts in Beijing from the Department of Resource Conservation and Environmental Protection, National Centre for Climate Change, and Tsinghua University and major industries helped NDRC to do the analysis and compose a draft. This draft was then sent

> to different departments and provinces [provincial NDRCs] to obtain feedback. But there is a problem here, according to my personal experience, I am not here to depreciate or play down anyone, the research ability in the provinces is not sufficient. For example, NDRC sent a policy draft to a province. The provincial NDRC may only oppose it if it is obviously contradictory to the province's situation. Otherwise it will do nothing because it does not have the capacity to conduct the detailed analysis to give feedback to the central NDRC. Another problem may be that provincial NDRCs have a general look at the draft and believe there is no problem, but problems emerge once the policy is implemented. But it is already too late. This is why I say the bottom up strength is not sound and provincial research capacity does need to be strengthened.

The interviews I conducted parallel Williams's (2014) findings that the advisory experts on China's climate-related policies are mainly based in Beijing. The above description from Interviewee 1 on the lack of research capacity at the provincial level further echoes this situation. The lack of professional expertise at the provincial and local level creates challenges for policy development at the central NDRC and this challenge will be investigated further in Chapter 7. In the next section, a range of semi-formal external research institutes that also participate in the policy process will be explored.

4.4.2 External advisory bodies

These semi-formal institutes, like the official government research agencies, are also mainly based in Beijing. Tsinghua University and the Chinese Academy of Social Sciences (CASS) are the most frequently involved external advising organs in Beijing, according to Interviewee 1. Although these organisations have connections with the government and are classified by Zhu and Xue (2007) as 'semi-formal' think tanks, experts from these organisations are able to conduct independent research and are more likely to provide unbiased analysis on certain policy options. They are often called upon by relevant government departments to participate in the discussion of climate-related issues and their advice is valued.

Feedback from civilian organisations such as influential NGOs which work closely with enterprises on climate-related issues is also considered by the government. For example, Quanliang New Energy Chamber of Commerce is an NGO that provides consultancy services to its members in China's renewable energy industry. Interviewee 6 from this organisation indicated that the government was willing to listen to their feedback and recommendations as they had firsthand information on the performance and challenges of member renewable energy enterprises in certain new policies such as CDM. However, the channel of feedback of civilian organisations is quite different from that of official government research institutes or semi-formal research organisations. Instead of attending formal government meetings, the feedback of climate-related NGOs is often delivered through business or personal connections with certain government personnel. This is a unique characteristic of how the Chinese government absorbs external feedback. Although it would be ideal if civilian organisations could have a formal channel to express their concerns and feedback, this informal channel can still be seen as progress (Zhu 2009, p. 341). Foreign research institutes and experts who hold no hostility towards China's climate stance are also included in the process of some climate projects. Their influence can also be enhanced through personal ties with influential domestic experts, research organisations or personnel in the government.

All in all, China's expert community has played a significant role in climate-related policy development. There is a trend that semi-formal research institutes and civilian organisations have performed more actively in China's climate affairs. This is partly due to the complex nature of climate change and the insufficient internal expertise, and partly reflects that China has gradually opened up its traditional attitude towards climate change. The expert community can be seen as the next most important actor after the government institutions in the formation of China's climate-related policies. The government draws from their discussions and advice to make a decision. However, the insufficient expert capacity at the provincial and municipal level is a critical obstacle for China's climate-related polices to be well implemented. Opportunities to improve this situation will be explored in Chapter 7.

4.5 Enterprises

Enterprises are another major player in shaping China's climate-related policies. However, within this category, the attitudes of different types of enterprises towards emission reduction policies are not unanimous. Large energy SOEs and newly emerged renewable energy private enterprises hold dramatically different views on such policies. Large coal-dominated energy SOEs only welcome certain emission mitigation policies if government compensation is high and the overall adoption is profitable (Bergsager & Korppoo 2013, p. 12). Medium and small scale renewable energy companies tend to embrace such policies in general. This section will explore why this is the case.

4.5.1 Large state-owned energy enterprise

China's energy sector accounts for approximately 50% of the country's total CO_2 emission. This is largely due to the dominance of coal in the country's energy structure (IEA 2011, p. 594). Within the energy sector, coal-fired power plants generate 97% of total CO_2 emissions. According to the IEA's estimate, 57% of China's electricity generation capacity is controlled by SOEs, which is to say, Chinese energy SOEs hold great potential in emission mitigation if they could adopt climate friendly measures (Baron, et. al. 2012).

China's coal-fired energy generation is dominated by five large energy SOEs, namely China Huaneng Group, China Power Investment Corporation, China Guodian Corporation, China Datang Corporation and China Huadian Corporation (JF Shen, et. al. 2014, p. 350). There are also small-scale power generators managed by provincial and township governments. Together with some private generators, they take up a relatively small proportion of 29.92% of the total generation capacity (SERC 2011, n. p.). Bergsager and Korppoo (2013) argued that SOEs as a key actor for the mitigation of China's CO_2 emissions deserved primary attention from policy analysts in the field of climate policies. SOEs exert their political and economic influence upon the formation and implementation of climate-related policies through their formal and informal connections with relevant bureaucracies. They bargain for the best possible support from the government such as compensation, tax breaks and free technological updates.

During both the 11th and the 12th Five-Year Plans, the above five large energy SOEs have adopted a range of mitigation measures in resource conservation, emission control, renewable energy development and diversification of energy sources, and have achieved positive results. For instance, China Power Investment Corporation decreased its standard coal consumption rate by 31 g/KWh, and China Huaneng Group has a decrease of 22 g/KWh (Shen, et. al. 2014, p. 352). However, Bersager and Korppoo (2013, p. 12) also identified the tendency that SOEs were generally in favour of mitigation measures that are economically favourable but may resist those that were costly and diverged from their current goals. The inconsistency of SOEs' attitudes towards climate change mitigation measures has delayed many of China's ambitious mitigation policies. For instance, two of China's biggest grid companies, State Grid Corporation of China and China Southern Power Grid Company Limited, once openly opposed connecting renewable energy to grids due to concerns for the stability of their grids. In addition, large SOEs, although gradually embracing government mitigation measures, would lobby against big changes in policy so that they have sufficient time to adapt (Williams 2014, p. 15). As a result, the role of large energy SOEs in China's climate-related policies is often as barrier. Large energy SOEs are an actor which has great influence on the Chinese government's decision-making in climate-related energy policies due to their importance to the economy. The government and the advisory bodies have to consider their feedback and suggestions on the development of climate-related energy policies. Therefore, how to encourage large energy SOEs' enthusiasm for more ambitious climate change mitigation is an important question to address, and this will be discussed in detail in Chapter 7.

4.5.2 Medium and small scale private enterprises of renewable energies

China's private investment in the energy sector has increased steadily and is becoming an important accelerator for the development of China's renewable energies. According to *National Energy Administration Document No. 179* (NEA 2012, n. p.), China's private hydro power takes up 26% of total national hydro power capacity, and private wind power takes up 20% of the national total. Up until now, private investments have led the research and development of solar thermal, bio-energy, PV solar, solar hot water systems and batteries for solar energy, and also played an important role in the country's manufacturing of wind turbines. The government encourages private investors to get involved in the research and development of renewable energies by providing financial support, ensuring a fair market environment and offering a favourable grid price (NEA 2012, n. p.). According to the deputy director of NDRC, Chen Deming, the government sees private ownership companies and SOEs equally in the sector of renewable energies, and subsidies are distributed to all eligible companies without asking the ownership type. Based on the current market share of private investment, the government believes that private investment will become the main force in China's renewable energy industry in future (China IRN 2007).

NDRC issued a range of policies to ensure the competitiveness of renewable energy industries which acted as another layer of guarantee for private investors. For instance, all electricity end users have been charged a renewable energy surcharge since 2006. The surcharges collected are used as a subsidy for renewable energy industries for research and development, power generation, system operation and maintenance (Zhao et. al. 2011, p. 26). The government also identified a cost sharing mechanism for electricity generated from renewable sources since the 11th Five-Year Plan (2006-2010). The mechanism required that grid companies must provide service to renewable energy generation plants and must purchase electricity generated from renewable sources within their grid coverage; the higher feed-in tariff of renewable energies were to be shared by nationwide end users (Wang Q 2010, p. 706).

These policies have played an important role in reducing costs and ensuring profit of renewable energies. As a result, they have largely stimulated private investment in the renewable energy sector. According to the Director of the National Energy Commission[13] Expert Advisory Committee Zhang Guobao, among all listed Chinese

[13] The National Energy Commission was established in 2010 as a higher level coordinating committee for the National Energy Administration. It is currently chaired by Premier Li Keqiang and Deputy Premier Zhang Guoli. The twenty committee members are Deputy Secretary of the State Council, Minister of Foreign Affairs, Director of NDRC, Minister of Science and Technology, Minister of Industry and Information Technology, Minister of Security, Minister of Finance, Minister of MEP, Minister of Transport, Minister of Water Resources, Minister of Commerce, Deputy Governor of the People's Bank, Director of State-Owned Assets Supervision and Administration Commission, Director of the General Administration of Taxation, Director of the Safety Supervision Bureau, Chairman of the

renewable energy companies on the top 500 global renewable energy company list, private companies took up approximately 80%. He explained that this phenomenon was due to the fact that renewable energy is a relatively new field, and private companies are standing on the same platform as SOEs and even foreign companies. Innovation and market, rather than government planning, are the main drivers for these private investors. Therefore, what the government can do is to provide the best possible support for them to flourish (Xing 2014, n. p.). However, to implement such a proposal is another thing. Whether or not private renewable energy enterprises can really stand on the same platform as SOEs and enjoy equal support as renewable energy under large energy SOEs is doubtful in reality. The equality issue will be analysed in detail in Chapter 5.

The government's determination and policies in promoting renewable energy development are genuine. However, the renewable energy industry does face some challenges. Although the renewable energy surcharge has been raised seven times from the 0.002 *yuan* per KWh in 2006 to the current 0.015 *yuan* per KWh, there is still an accumulated 14 billion *yuan* (approximately US$2.3 billion) gap of unpaid renewable energy subsidy (Sun JB 2014, n. p.). This gap has led to delays in handing out renewable energy subsidies to some companies, which makes small scale private companies especially vulnerable. According to Zhu Gongshan, CEO of GCL Group Holdings Limited, the development of China's PV solar industry still largely relies on government subsidies. But in some regions, subsidies are only handed out once a year, which puts great pressure on companies specializing in PV solar energy. Companies

China Banking Regulatory Commission, Deputy Chief of the People's Liberation Army, and Director of the National Energy Administration (Bo 2010).

need government subsidies to maintain healthy operations. Without sufficient cash flow they experience difficulties in equity refinancing. This in turn pushes up the overall investment cost of PV solar power plants and extends the recovery period of investment (Hao 2015, n. p.). The insufficient and delayed subsidies not only put pressure on renewable energy companies, but also create a triangle debt relationship among the government, the renewable energy producers, and the manufacturers of renewable energy equipment. The government owes money to renewable energy producers; renewable energy producers owe money to their equipment suppliers; and the equipment suppliers owe money to the parts manufacturers. This shows that insufficient subsidy funding and delayed disbursement have caused major negative impacts on the health of China's renewable energy industry (Sun 2014, n. p.).

Among all renewable energy enterprises, medium to small scale companies face tougher challenges compared with those under major energy SOEs. Large energy SOEs hold more formal or personal connections with the government, and are therefore more likely to be successful in the process of bargaining for the unpaid subsidy (Williams 2014, p. 13). Small and medium scale renewable energy companies are less successful in this process. In order to ease financial pressure on medium to small businesses, the government took some actions to make up the gap. For instance, the Renewable Energy Division of NEA sent out an emergency letter titled *Please Provide Renewable Energy Subsidy Gap* to relevant renewable energy companies in April 2014. The letter required companies to provide the data of the government's unpaid subsidy accumulated from 2012 to 2014. The letter aimed at paying back the delayed subsidy, analysing the conditions of the renewable energy industry and rearranging the future budget for renewable energy subsidies (CN Stock 2015, n. p.).

Obviously, how to guarantee sufficient and prompt subsidy for the renewable energy industry is a problem that needs to be urgently addressed, and whether or not the government's new action can lead to sustainable subsidies remains to be seen. Should the government continue to rely on a renewable energy surcharge to generate the subsidies? Or should there be diversified sources? If diversified sources are in consideration, what should they be and how should they be obtained? These issues will be addressed in Chapter 7. Overall, the renewable energy sector is weak compared with the traditional coal power sector. Currently, renewable energy enterprises under private ownership face a range of difficulties. However, they have the potential to become a more important actor when China starts to implement its national carbon trading scheme. Under the national scheme, renewable energies will become more competitive and profitable. By then it is hoped that this actor will be stronger and have more power in China's future climate-related energy policies.

4.6 ENGOs and the general public

ENGOs and the general public have long been regarded as an important social actor in shaping environmental policies and influencing environmental transitions in Western democracies (Binder & Neumayer 2005, p. 527; Jänicke 1996, p. 71). It is believed that strengthening environmental institutions within the government alone is not sufficient to generate sound resolutions to many complex environmental problems. Rather, the involvement of civil society and the voice of the general public can often push environmental policies in the right direction and result in more rounded environmental solutions (Weidner 2002, p. 1365). In China, however, the emergence of green NGOs was late and their growth was slow (Martens 2006, p. 224). The general public has only limited capacity for action against pollution due to a relatively low level of income and education, and many of them are employees of polluting enterprises and rely on them for income (Van Rooij 2010, p. 63). Moreover, a traditional belief still persists among the public that authority should not be challenged if conditions are tolerable (Jing 2000, p. 216, Lin & Gil 2016, p. 145). As a result, the public tends to only react to extremely serious environmental issues such as large scale chemical explosions and environmental issues that directly impact on their livelihood, such as local water and toxic waste pollutions (Yang GB 2010, p. 101).

The climate change issue attracts relatively less attention from the Chinese public, however it is embedded in another environmental problem, air pollution, which is often perceived to be more important as it directly impacts on the majority of Chinese city dwellers' health and wellbeing (Lin 2009). In China, the majority of cities suffer from serious air pollution and only one percent of city dwellers are lucky enough to breathe air that is adequate according to EU standards (Shapiro 2013, p. 224). According to Kan, Chen and Hong (2009, p. 187), sufficient evidence has proved that China's outdoor air pollution generates negative impacts on public health as shown in increasing hospital cases of lung and respiratory diseases. The public urges the government to take actions towards air pollution, and their voice was highlighted in the production of "Under the Dome", a documentary on China's air pollution and related health problems. The documentary generated nationwide discussion on the origins of city smog (Zhang JH 2015, n. p.). As a matter of fact, air pollutants and greenhouse gases can be traced back to the same sources in the Chinese context. For instance, heavy reliance on coal for power generation and exhaust from increasing numbers of passenger cars result in both particulate matters and greenhouse gases. Therefore, in theory, any public actions against air pollution would have the potential to simultaneously push forward China's climate change policies. However, the current reality is that impactful actions in fighting against air pollution from ENGOs and the public are minimal.

Actions of many Chinese ENGOs towards air pollution are limited to recording air pollution levels, informing the public about the harm of air pollution, and providing education to citizens (Zhao 2015, n. p.). Naming and shaming top polluters who contribute to city smog can be regarded as the most radical of ENGO's actions (Lei 2014, n. p.). Also, the Chinese public's opposition towards air pollution is mainly expressed verbally through social media but in daily life people tend to tolerate or adapt to air pollution rather than protest against it. This can be reflected through the boom of the so-called "smog economy" – the record high sales of masks, air purifiers and "escape from smog" tours[14] (Wen 2013, n. p.). There are a number of reasons behind the weak performance of Chinese civil society on the issue of air pollution and climate change, among which the lack of targets for action, the practical challenges of Chinese ENGOs and fractured public opinion are significant.

4.6.1 Lack of targets for action

[14] Many of China's major travel agencies have launched "escape from smog" tours for the public, the destinations of which are often located in southern China, such as Yunnan and Hainan, or countryside areas with relatively better air quality than adjacent big cities.

The causes of city smog, similar to the causes of climate change, are complex. It may include a mixture of industrial waste gases, emissions of coal-fired power plants, dust from construction sites, car exhaust and the burning of straw in the surrounding countryside (Molina & Molina 2012, p. 664). According to Sun Junying, the Director of the Institute of Atmospheric Composition, Chinese Academy of Meteorological Sciences, Beijing's fine particulate pollutants (PM2.5) includes approximately 40% organics, 17% sulphate and 14% nitrate. The Deputy Director of the same institute, Wang Yaqiang, indicates that the origin of PM2.5 is complicated. It includes both fine particulates directly emitted from coal burning, car exhaust and fugitive dust, and secondary fine particulate matters transformed from complex chemical reactions of sulphur dioxide, nitrogen oxides and volatile organic compounds in the air (Zhi 2013, n. p.). Therefore, it is very difficult for ENGOs or the public to identify a particular target to take action against. According to Van Rooij (2010, p. 58), citizen actions are determined by two prerequisites: "naming" and "blaming". "Naming" requires citizens to understand the seriousness of the pollution, and "blaming" requires citizens to attribute the damages of the pollution to a responsible entity. Here, understanding the seriousness of the pollution is not simply the awareness of the harmful impacts, but how well they know the impacts. Unfortunately such knowledge is usually gained slowly among citizens if a particular type of pollution does not pose sudden and direct impact on local environment and public health (Alford et al 2002, p. 498). Air pollution is a case with such characteristics. The knowledge of air pollutants' origins is complex and the health impact may take a relatively long time to manifest. Both of these characteristics add complexity and difficulty to the process of "naming" and "blaming", and thus, pose barriers for citizen action against air pollution.

4.6.2 Constraints on Chinese ENGOs

Chinese ENGOs face more constraints and obstacles compared with ENGOs in the West. These include the initial government screening for registration, the annual renewal of registration, the lack of funding and quality staff, the lack of access to pollution data, the difficulty in pursuing lawsuits and over reliance on the power and publicity of ENGO leaders (Schwartz 2004, pp. 38-39). Therefore, even if Chinese ENGOs or the public have the ability to identify major air pollution sources, they still face many practical difficulties in challenging big polluters. Among all the challenges, political constraints and difficulties in pursuing lawsuits are the two major ones.

Many of China's large scale environmental organisations are government organised non-governmental organisations (GONGOs). GONGOs are established by government agencies. It is common that such GONGOs' funding and senior personnel are from their sponsoring government agency. Chinese GONGOs do not function like grassroots organisations and their audiences are mainly targeted at government officials, policy makers and foreign NGOs which can provide funding for China (Knup 1997, p. 11). Therefore, it is unrealistic to expect Chinese GONGOs to act the same way as Western ENGOs which are independent from the government. Western style ENGOs do exist in China. FS Wu (2002, p. 37) defined grassroots type of Chinese ENGOs as "private institutions that do not draw on state funding or utilise state assets, but do engage in non-profit social activities". Such ENGOs tend to be organised by individuals, small in scale, and of greater independence, however, they still have to follow the regulation and accept the supervision of relevant government departments (Knup 1997, p. 12).

Chinese NGOs are legally required to register with the Bureau of NGOs Administration within the Ministry of Civil Affairs. Before the registration, an NGO must undergo a screening process by a government department. The screening result then goes back to the Ministry of Civil Affairs for consideration of approval. If the registration is approved, the NGO will be supervised by the government department which performed its initial screening on a range of political affairs, and financial and daily activities (Otsuka 2002, p. 231). Registration of Chinese NGOs has to be renewed annually and renewal can be rejected if an NGO's behaviour is not in accordance with the *Regulation of NGO Registration and Management*. To be specific, the government has the power to close down an NGO if its activities are interpreted as:

1) Opposing the principles of the constitution;

2) Opposing the leadership of the CCP;

3) Harming national unity and security:

4) Harming national interest, social interest or interest of other organisations and citizens;

5) Carrying out activities that are contrary to social and public morals;

6) Developing sub-branch offices (Wu 2003, p. 38).

Due to the wide range of constraints and the government's absolute control of their survival, Chinese ENGOs tend to act carefully without rigidly criticizing the government's failures in managing the environment. Many Chinese ENGOs even purposely limit their size due to the concern that the expansion of membership and networks might be considered by the government as contravening government policies (Wu FS 2003, p. 39). The interview I conducted with Interviewee 4, a local EPB officer, reflected the difficult situation of Chinese ENGOs in relation to the political constraints they operate within:

> Why don't we have radical ENGOs? You should ask why we should have radical ENGOs. Are they effective in China? Do they do any good? Even if you set up a small green party like in the West, can you butt in the parliament and balance the power of the two major parties? If you can't, then you shouldn't do so. This is understood by the rich and the poor.

The above statement ironically pointed out that China's political system is the fundamental restraint for Chinese ENGOs to develop and act like the Western ENGOs. This political condition is unlikely to change in the foreseeable future, which means Chinese ENGOs are unlikely to strengthen within a short period of time. The level and scope of operation of Chinese ENGOs is eventually determined by the government.

If political restraint is a “congenital defect” of Chinese ENGOs, then legal barriers would be the hardship that many Chinese ENGOs have to endure. Environmental public interest lawsuits are commonly regarded as the most effective way for ENGOs to take action against polluters (Van Rooij 2010, p. 67). Although China’s environmental laws and regulations have been improved and strengthened over the years as discussed above, they still contain weak, impractical, and incomplete elements (Alford & Liebman 2000, pp. 740-743). When pursuing lawsuits against polluters, ENGOs face a range of legal obstacles in the process of opening a case, including providing evidence of damages, demonstrating the existence of a polluting act and finding evidence for causation (Van Rooiji 2010, pp. 60-69). They also face practical challenges such as high legal costs (Richerzhagen & Scholz 2008, p. 319). Therefore, there are very few cases in which Chinese ENGOs use the legal tool to fight against the polluters. In cases where ENGOs do pursue legal actions, the challenges they face are enormous.

The first environmental public interest litigation organised by a grassroots organisation, the Yunnan Qujing chromium slag pollution case, was one such example. In June 2011, two contractors of Yunnan Luliang Chemical Industry Co., Ltd. illegally dumped over 5000 tons of chromium slag on the hillslopes and along the roadsides of Qilin District, Qujing City. The chromium slag caused severe toxicity to the Nanpan River and killed 77 cattle that drank from the river (Li HY & Wang 2012, n.p.). The case was initiated by the Friends of Nature and Chongqing Green Volunteers’ Union in October 2011. The members of the Friends of Nature initially encountered violent insults from the security guards of Yunnan Luliang Chemical Industry Co., Ltd. during sample collection. They were also given the cold shoulder by the local government. After this, the court required water and soil samples to be examined by environmental institutions with the qualification of judicial expertise. However, environmental institutions with such expertise were extremely rare in China. In the end, Yunnan Luliang Chemical Industry Co., Ltd. broke the settlement agreement proposed by the Friends of Nature at the last minute. So the case went into a new round of trial procedure and judicial appraisal after the two-year battle. The Friends of Nature and Chongqing Green Volunteers' Union were not able to afford the cost for new court action. They planned to borrow 1 *yuan* each from one million citizens, and the money would be repaid by the defendant if they win the case (Li M 2014, n.p.). This demonstrated how slow and difficult an ENGO led environmental lawsuit is.

On 1 January 2015, the new *Environmental Protection Law* replaced the old one and took effect. The implementation of the new law brought some new hope to China's ENGOs since it emphasised the importance of public participation. It also clarified the responsibility of polluting industries and relevant government departments in providing the public with transparent pollution data. Article 57 and 58 clearly identified the public's right in reporting polluters to the government and eligible social organisations' rights in initiating lawsuits against polluters at the People's Court (Xinhua News 2014, n. p.). Many ENGOs intend to test out the effectiveness of the new law by pursuing environmental public interest lawsuits against polluting entities. However, so far, there is no case against air pollution in China (Li DF 2015, p. 34). Apart from political and legal obstacles, the Chinese public also hold fractured opinions towards air pollution and climate change, which makes it unlikely for the general public to unite to take joint action towards the problem.

4.6.3 Fractured views of the Chinese public

The internet has provided an important channel for the public to comment and debate on environmental issues in a range of public forums, and the relative anonymity of the internet has encouraged citizens to do so (Martens 2006, p.212). However, in many cases, the internet may not necessarily function to form a united and positive public opinion or push forward innovative public action against pollution. Take the documentary "Under the Dome", for example. Although it raised public awareness on air pollution, it has not achieved the goal of inspiring citizens to take action towards city smog. Instead, the focal point of air pollution was soon buried under the discussions of the producer and presenter Chai Jing's characteristics, her motivation, techniques in seeking publicity and debates on the truthfulness of scientific data presented in the documentary (Huang T 2015, n. p.). This outcome can be explained by a combination of China's current political and social realities.

First of all, China's recent public opinion atmosphere is flooded by the trend of moral criticism. Moral criticism has become the mainstream official discourse towards corrupt officials, foreign influences perceived to have negative impacts on China and controversial celebrities and professionals (He, Thornton & Cheng 2015). This official trend in mainstream discourse has heavily influenced the public's views on many issues, which, in Chai Jing's case, easily shifted the focus of the discussion from air pollution to the presenter herself. In many of China's influential public forums, such as tianya.cn, baidu tieba, and weibo, there were many threads which commented on Chai Jing's motives and personal qualities rather than the air pollution itself. Some regarded Chai Jing as a traitor because of her migration to the USA and believed she should therefore stay out of China's affairs. Some suspected Chai Jing's true intention was to get publicity. There were also negative comments about her characteristics and previous personal lifestyle. Some even took pleasure in Chai Jing's misfortunate daughter who was born with cancer, stating that the cancer was not caused by city smog but by her smoker mother's immoral celebrity life-style.

Second, the ever enlarging gap between the rich and the poor resulted in the so called "hate the rich" trend. This emotion among the poor generated radical comments on the inequality of the living environment and consumer goods between the rich and the poor, which further shifted the focal point of the discussion. There was one type of comments which ironically stated that city smog was good. This was because officials and the rich could buy imported bottled water to get away from water pollution but they could not buy foreign air and had to breathe the same haze as the poor did.

Third, increasing cases of social injustice stimulated cynicism within the public opinion sphere, which led to the public's distrust on a range of media releases. This was also why many Chinese citizens started to question the true motives behind Chai Jing's documentary soon after the initial wave of discussion of air pollution. Moreover, there were cases where arguments raised by individual intellectuals were seriously and obviously misleading. Some experts' statements even hurt the general public's feelings, such as the theory that city smog was caused by Chinese style cooking and barbecuing (Huang YS, Ren & Liu 2013, n. p.). This has further weakened people's trust in professionals.

The weak role of ENGOs and the public in combating climate change and air pollution is caused by a combination of constraints. The origin of atmospheric pollution is complex. It involves all enterprises and individuals who consume energy and produce emission. However, the major contributors to China's serious atmospheric pollution are the carbon intensive energy structure and the inefficient production model. The political constraint is something that is impossible for Chinese ENGOs to overcome in the current political situation. However, there is hope for improvements in new environmental laws, which would better facilitate ENGOs to fight against pollution through legal action. The fractured public opinion on the problem of atmospheric pollutions is another obstacle to achieve organised action towards pollution. To overcome this problem, education alone is not enough. It requires the government, business, intellectuals and influential professionals to re-establish positive moral values, show true consideration for the people and solve real problems for them. However, it has to be realised that the constraints that Chinese ENGOs and the general public face are tough and take time to resolve, and almost all of them require the government to lead the change. This explains why civil society plays a much less important role than the government in solving China's atmospheric pollution problem. Even the Chinse ENGOs are well aware of this situation. Just as Interviewee 5, an ENGO officer in Beijing, stated:

> The extent that the public and ENGOs can participate in treating city smog is actually quite limited. It has to be a top-down process using administrative tools. It requires government monitoring and innovation in pollution controls. What can we teach the public? Drive less? Eat less barbeque? Or set off fewer firecrackers on Chinese New Year? Working in the environmental field myself,

> I've seen many civil environmental actions, especially those organised by university or high school students, which are basically fantasizing and hardly have any impact on the environment. So the more I see, the more I believe that city smog has to be solved with tough administrative measures.

4.7 What the role of the above actors means

Among all the actors this chapter identified and analysed, the Chinese government played the most dominant role in the development of China's climate-related policies. This is to say, in order to improve China's climate-related energy policies, the government actor has to be strengthened. China's climate-related energy policies follow a top down approach. It requires the government to take the lead and to work in a more efficient and coordinated way to develop more sensible, effective and rational policies. At the current stage, the relevant departments in the climate policy domain are fragmented with overlapping and competing responsibilities.

Among all ministries that are involved in or wish to be involved in China's climate-related policy decisions, NDRC is the current ultimate authority. However, it is unwise to exclude MEP from the climate policy process as China's air quality worsens and the public's voice soars on treating air pollution. MEP's involvement will undoubtedly bring expertise and some restraint to NDRC's behaviour, and contribute to sensible and workable policies. Even Interviewee 1 from NDRC admitted that MEP's expertise in monitoring and statistics had already formed a relatively mature system and could be adopted in the management CO2 emission.

In terms of the debate between MF and NDRC continuing over whether to choose carbon tax or carbon trading as China's primary mitigation strategy, although was initially beneficial for generating discussions and investigating the strengths and weaknesses of both mechanisms, the discussion should not be overly lengthy. The government should realise that it should give out a clear signal to enterprises on the definite policy decision of either a carbon tax or carbon trading or the two combined. Overly lengthy debate will cause distraction and confusion among companies who already participated in the pilot trading programs or who are to participate in future programs.

The coordination between the central government and provincial and local government are also not ideal. These issues need to be addressed with a joined-up government approach in order to achieve better coordination among these departments. The government should strengthen the expertise in the climate domain in provincial and municipal government levels. This is because the expert community, who acts as the adversary bodies for the government, plays the second most important role after the government as they are the main force in the theory, debate and drafting of climate-related policies. Their capacity and involvement in the provincial and municipal level determines how the central government's policy is understood and implemented. Currently such capacity is insufficient at the provincial and municipal level. Therefore, this needs to be urgently addressed.

The energy industry, especially large energy SOEs, is a powerful actor which has the ability to shape China's climate-related energy policies. Their bargaining power and connections with the government mean their interests and the extent of willingness to mitigate have a strong influence on the final policy decision. Therefore, to encourage large energy SOEs to adopt more ambitious goals and at the same time restraining their overly powerful bargaining power may have a positive effect on the outcome of China's climate-related energy policies. The renewable energy industry holds the key to China's long-term energy structure optimisation and climate change mitigation. Therefore, it is an actor with significant future perspective in China's climate-related energy policies. The healthy development and increasing strength of this sector will have a positive impact on China's future climate-related energy policies, especially when the national carbon trading scheme is implemented. ENGOs and the public play only a limited role due to a range of political, legal and practical obstacles. However, they do fulfil their responsibility in raising public awareness of air pollution and climate change. In order for this sector to function better within the current political limits, ENGOs and grassroots groups should push forward for simpler and clearer procedures for civil environmental lawsuits.

4.8 Conclusion

This chapter identified the main actors in China's climate-related energy policies, namely, the relevant government departments, the expert communities, the energy industries, the civil society and the general public. It analysed the power and influence of each actor on China's climate policy. It is important to understand the strengths and weaknesses of these actors because they have different degrees of influence on policy outcomes. This chapter has painted a picture of competing interests and agendas, and fragmentation in China's climate-related policy development. The following chapters demonstrate how these themes play out in the context of specific policies, namely the CDM and ECRS.

Chapter 5

China's participation in CDM and its impact

5.1 Introduction

In order to simultaneously fulfil the tasks of mitigation for global climate change and sustainable development in developing countries, the United Nations Framework Convention on Climate Change (UNFCCC) proposed the concepts of cost-effective emission mitigation and flexible cross-region cooperation (Dutschke & Michaelowa 1998, p.7). The Clean Development Mechanism (CDM) is one such flexible market mechanism tailored for the above concepts under the Kyoto Protocol. It aims to reduce emission reductions costs in Annex I developed countries and to promote sustainable development in non-Annex I developing countries. CDM allows an Annex I country to invest in low cost emission reduction projects in developing countries which do not have quantified emission targets under the Kyoto Protocol. By doing so, the Annex I investor can obtain Certified Emission Reductions (CERs) (1 CER= 1 metric ton of CO_2 or CO_2-equivalent) to count towards its total emission reduction obligation. Meanwhile, the projects should also be shown to be beneficial for the host country's sustainable development (Article 12, Kyoto Protocol).

Sustainable development is China's long-term national strategy. A range of national policies aiming to enhance sustainable development have been introduced over the years. Policies on energy conservation, environmental protection and reforestation, for example, have all contributed to sustainable development and simultaneously brought positive impacts in combating climate change. The ratification of the Kyoto Protocol in 2002 gained China eligibility to participate in CDM and China gradually became a key player in this scheme since then (The World Bank et al. 2004, pp. xix-xx). So far China has hosted the largest number of CDM projects among all developing nations. Up until 5 May 2015, 5,073 CDM projects have been approved nationally. By 15 June 2015, 1,450 Chinese-hosted CDM projects have been issued CERs by the CDM Executive Board (CDM EB), which accounts for over 60% of global total CERs and an annual average reduction of 344 million tons of CO_2-equivalents (Department of Climate Change, NDRC 2015).

This chapter will evaluate the strengths and weaknesses of China's CDM program as a major component of China's climate policy by investigating what CDM means to China's climate mitigation. It argues that CDM projects do not directly contribute to China's overall emission reduction. This is because the associated CERs are purchased by buyers from Annex I countries, and are therefore counted as emission reduction for the buyer's country. However, there are certain Chinese projects which may potentially contribute to China's emission reduction. These are projects that gained NDRC approval but failed to register with the CDM EB and projects that registered with the CDM EB but failed to find CER buyers. If CERs generated from these projects can be traded in China's national carbon trading scheme, they will be counted towards China's climate change mitigation effort. The potential of these types of projects will be discussed in detail later.

The major benefits CDM brings to China are of a practical nature. The first practical benefit CDM brings is the promotion of renewable energy development. The development of renewable energy has avoided the establishment of some traditional fossil fuel based power generation plants in various locations nationwide, which has a positive impact on local air quality and employment. Secondly, CDM sets up a model that aims to simultaneously deal with emission reduction and sustainable development which provides inspiration for China's future domestic carbon market. Finally and most importantly, CDM raises the Chinese public's awareness of climate change. All these practical benefits will incentivise China to take further steps in fighting global climate change because they are beneficial to China's energy structure optimisation and air pollution reduction, and may pose a more positive international image as a climate conscious nation.

However, looking beyond these practical benefits, there are also problems associated with or caused by China's CDM program. First of all, some Chinese unilateral CDM projects cannot find international buyers for the CERs they generated. Second, the additionalilty of some Chinese CDM projects need to be investigated. Third, the insufficient and immature domestic financial service is a significant obstacle limiting the development of China's carbon market. And last, there is concern that CDM may use up China's cheap mitigation opportunities and make future mitigation more expensive. However, this impact is only minor and can be overcome through the exploration of other types of mitigation options.

This chapter is arranged around three major issues which are covered by Section 5.2, 5.3 and 5.4. Section 5.2 deals with the development of CDM in China and what CDM means for China's climate change mitigation. Section 5.3 analyses the practical benefits CDM brings to China, namely the promotion of renewable energy development, the preparation for China's national carbon market and improving Chinese people's awareness of climate change. Section 5.4 identifies and analyses the weaknesses and limitations of China's CDM program. Section 5.5 concludes the chapter.

5.2 China's participation in international CDM

CDM is so far the only major international cooperation on climate change mitigation China has participated in. The development of CDM in China began slowly. By the end of 2005, there were only three registered CDM projects nationwide (Maraseni & Gao 2011, p.340). Apart from the complex and time-consuming nature of working through the CDM legal framework and administrative system, this situation was also held up by a concern that CDM might curtail China's cheap climate change abatement options, the so called 'low-hanging fruit'. The reduction of cheap abatement options may leave future abatement harder and more expensive (Castro 2012, p.199). However, after the initial hesitation, China gradually fully embraced CDM.

This shift in attitude toward CDM is due to a range of reasons. First of all, CDM is a market mechanism, and the high demand for CERs is undoubtedly the biggest drive for China's attitude shift. After late 2005, CDM experienced a boom in China. This boom was primarily driven by the high demand and rising price of the EU allowance (the primary carbon credits in EU emission trading scheme), in which prices reached a high of €30 (approximately US$36) in July 2005. The price of CERs were below that of the EU allowance because CERs were generated from cheaper abatement options in developing countries. However, CERs can be used the same way as the EU allowance by Annex I countries to comply with their emission targets. Therefore, CDM projects appeared feasible and attractive to investors (Michaelowa & Buen 2012, p.5). On top of this, the industrial gas projects, such as HFC-23 and N_2O, have further inflamed the boom and pushed forward the development of CDM in China due to their highly profitable nature. The technologies incorporated for the reduction of industrial gases were relatively inexpensive, but their warming effects are much higher than CO_2. For instance, the warming effect of HFC-23 is 11,700 times of CO_2. This is to say, by reducing only one unit of HFC-23, the investor will obtain 11700 CERs (CO_2 equivalents). This also means that CERs from industrial gas projects are among the cheapest types of all CDM projects (Michaelowa 2012, p. 19).

The majority of China's industrial gas projects were registered in the early stage of China's CDM involvement. According to Maraseni and Gao (2011, p. 342), up to 2010, HFC related projects were only 0.5% of China's total CDM projects, but accounted for over 14% of expected CDM annual emission reduction. N_2O related projects were not far behind by generating about 4% of total CDM emission reduction while only taking up 1% in proportion of total CDM projects.

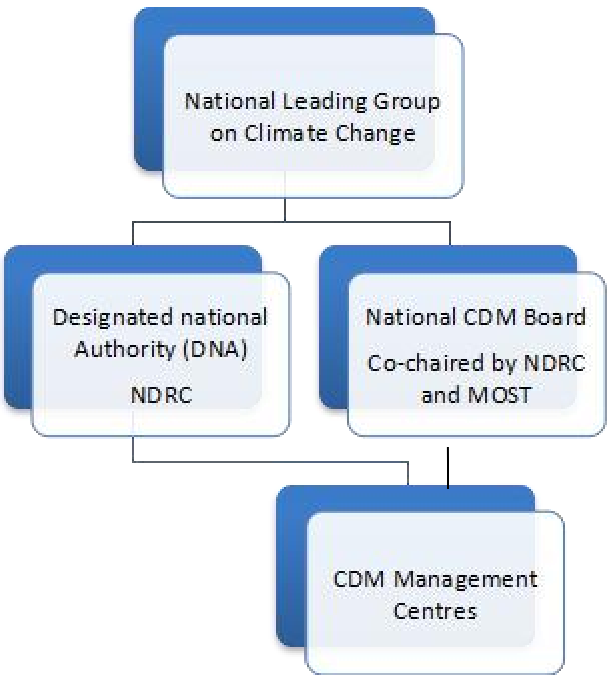
Although industrial gas projects account for a proportionally large percentage of greenhouse gases emission reduction (CO_2-equivalent), they do not significantly contribute to local sustainable development. First of all, industrial gas projects do not assist energy structure optimisation in host countries, which is to say they do not tackle the most dominant and long-lasting greenhouse gas – CO_2. Therefore, they have a weak impact on the fundamental problem when tackling climate change – how to reduce China's reliance on fossil fuels and how to switch to a mix of low carbon renewable energy sources (Pearson 2007, p. 247). So they reduce emissions, but do not force systemic change. Second, majority of industrial gas projects happened on the sites of existing facilities, and has little contribution to the improvement of local air quality, infrastructure and employment. As a result, the integrity of industrial gas projects on sustainability has been questioned by many (Pearson 2007; Schneider 2007; Schwank 2004). Furthermore, the EU has banned CERs generated from industrial gas projects after January 2013 (Gtowacki Law Firm 2013).

The Chinese government realised this problem and attempted to shift the investment focus from industrial gas projects to renewable energy projects. In the revised CDM regulation *Measures for Operation and Management of Clean Development Mechanism Projects in China* effected on October 12, 2005, Article 4 identified China's priority CDM projects are in the category of renewable energy, energy efficiency improvement and methane recovery and utilisation; Article 24 stated that all Chinese CDM projects are subjected to a tax on their CER sales. Projects in the priority categories would be charged a tax of 2%. Industrial gas projects such as HFC and PFC were charged a much heavier 60% tax; and N_2O projects were charged 30% (NDRC 2005, n. p.). *China Medium and Long Term Energy Conservation Plan* also stated that the tax collected would go to a special fund used only for climate change activities which is managed by MF and jointly decided by NDRC and all relevant ministries (NDRC 2004a, n. p.). Since then, the investment direction of China's CDM projects had been successfully redirected towards the priority categories identified by the government including renewable energy, energy saving and efficiency improvement (Wang Q & Chen 2010, p. 1996). For these reasons, this chapter will focus on two types of China's priority CDM projects, renewable energy projects and energy saving and efficiency improvement projects, which have positive and long-term impacts on China's energy structure and sustainable development. But before this analysis is carried out in sections 5.2.4 and 5.2.5, sections 5.2.1, 5.2.2 and 5.2.3 will provide essential background to CDM, including institutional arrangements, registration criteria and categories.

5.2.1 Institutional capacity building and approval process of Chinese CDM projects

In 2004, NDRC established a Designated National Authority (DNA) catered for China's CDM governance. Any project which aims to register as a CDM project has to first submit its application to the DNA. The application is then forwarded to an expert board for initial assessment. If the application passes the initial assessment, it will be passed on to CDM EB for the final decision. If the application was rejected by CDM EB, it would have a chance to revise and resubmit (Heggelund 2007, p. 181). Within the central government, NDRC and Ministry Of Science and Technology (MOST) co-chair the National CDM Board. NDRC is responsible for the policies and overall governance of CDM. MOST co-supervises CDM projects with NDRC by providing science and technology research on CDM. Both ministries follow the coordination of the National Leading Group on Climate Change (NLGCC), which was described in Chapter 3 as the top supervising authority of China's climate change affairs (Schröder 2012, p. 49). At the provincial level, CDM Management Centres were also set up. These centres were responsible for providing detailed supervision and assistance to CDM projects; they were also responsible for maintaining CDM data, organising CDM experts and reporting information to the Department of Climate Change, NDRC (Heggelund 2007, p. 181). (Figure 5.1)

Figure 5.1 Institutions for CDM governance in China



Source: Schröder (2012, p. 49)

The DNA approval process is agreed to be fairly transparent and the system appears vigorous and reliable. Priority projects were mostly handled in a hassle free and prompt manner (Heggelund 2007, p. 181). However, as the CDM EB's approval criteria changed and toughened over the years, there were some Chinese projects which passed NDRC's initial assessment but failed to meet CDM EB's criteria. Therefore they were unable to register as CDM projects. Being passed by NDRC assessment means the projects were proposed and planned according to the relevant CDM methodology, and had obtained approval for development in China. But failure to register with CDM EB means the projects cannot realise CER revenue which may put pressure on projects with high investment requirements and lower returns such as renewable energy projects. This situation is partially due to the unprompted adaptation of NDRC to EB's approving criteria updates, leaving some applications unrevised before submission. It may also be caused by the developers' uncomprehensive application documentation and the negligence of the expert board at the initial assessment. The success rate of CDM registration could have been improved through institutional capacity building. For instance, NDRC can improve the rate of its adaptation to EB policies. NDRC can also enrichexpertise and resources at CDM management centres to provide better assistance for applicants. Furthermore, NDRC should establish tighter criteria on additionality at the initial assessment. Among all these possible improvements, the criteria on projects' additionality is of great significance as EB will not approve projects that would have happened anyway in the business as usual scenario.

5.2.2 Additionality test of CDM projects

Under the Kyoto Protocol, emission reductions from CDM projects are required to be real, measurable and additional. Being additional is the key criteria for a project to gain CDM approval, which means that a project and its associated emission reduction would have not occurred without the registration of CDM (Schneider 2009, p. 243). For example, a Chinese City "A" needs to build a new power generating facility to cope with the increasing energy demand. It has coal and wind resources available. Under the conventional circumstances, a coal-fired power plant is more likely to be decided as it is a cheaper option. However, with the registration of CDM, the revenue of potential CERs will compensate part of the investment cost of a wind farm, which makes the wind farm option more feasible. Therefore, building a wind farm avoided the emissions from the coal-fired power plant. By this means, the wind farm in City "A" is additional. To the contrary, City "B" also needs to build a new power facility which only has wind resources but no access to coal or other fossil based resources. So it built a wind farm. The wind farm in City "B" would not classify as additional as it is the only option for the city and would have happened anyway. Therefore, it would not qualify for CDM registration. Identification of a project's additionality is important because, as an offsetting mechanism, it can prevent double counting of global emission reduction (Michaelowa & Buen 2012, p. 19). If the wind farm in City "B" is registered as a CDM project, then every single CER it sells would mean an extra ton of CO_2 equivalent released into the atmosphere by the CER buyer. However, with abundant coal reserve and an advanced rail and highway transport system, building coal-fired power plants is still the cheapest option currently in majority locations of China (Lin & Liu 2010). Therefore, the majority of renewable energy projects approved by NDRC where coal resources are accessible should be regarded as additional.

There are a range of additionality assessment methodologies that have been developed over the years. The "investment analysis", the "common practice analysis" and the "positive lists" analysis are among the most commonly used ones for assessing the additionality of the proposed renewable energy projects and energy saving and efficiency improvement projects. The barrier analysis requires demonstration that barriers exist that would prevent the proposed project from being carried out if the project activity is not registered as a CDM activity. The investment analysis requires demonstration that the proposed project activity is economically or financially less attractive than at least one other credible alternative. The common practice analysis requires an assessment of the extent to which the proposed project type (e.g. technology or practice) has already been deployed in the relevant sector and region. (Schneider 2009, pp. 243-244). The CDM EB can either combine barrier and investment analysis or use them separately to assess the additionality of large scale projects, and then use common practice analysis as a credibility check. For small scale projects, CDM EB would only perform a simple barrier test (Schneider 2009, p. 244). These additionality assessment methodologies are important as they not only provide guidance for NDRC to update its rules and policies over the initial assessment of Chinese projects; but they also guard the integrity of Chinese CDM projects in fulfilling the task of global emission reduction.

5.2.3 Different approaches to CDM projects under Kyoto Protocol

Under the Kyoto Protocol, Article 12 allows a range of flexible approaches to CDM projects including the bilateral approach, the multilateral approach and the unilateral approach. The bilateral approach involves both Annex I developed countries and non-Annex I developing countries (host countries). In the multilateral approach, an intermediary will arrange a set of desired complementary CDM activities for its clients. The unilateral approach refers to CDM projects solely carried out by non-Annex I countries without direct involvement of Annex I partners in the planning, financing and implementing processes (Belis 2013, p. 162). The bilateral and multilateral approaches were initially desired during the negotiation of CDM under Kyoto as it would lower the cost of Annex I countries' emission mitigation and at the same time courage the transfer of modern climate friendly technologies to non-Annex I developing countries and thus contribute to their sustainable development (Michaelowa 2007, p. 17). The majority of China's bilateral projects were concentrated at China's initial participating period. Later, unilaterally financed projects started to flourish in China. For these unilateral CDM (uCDM) projects, Annex I counties were only involved in the purchase of CERs once the projects were under production, though some might provide assistance to the registration of the projects they were interested in buying CERs from (Greiner 2009, p. 681).

It is commonly agreed upon that uCDM projects have both advantages and risks (Haites, Duan & Seres, 2006; Michaelowa, 2007; Seres, Haites & Murphy 2009). The attractive features of uCDM projects are: 1) can quickly develop a range of small scale projects with high sustainable development benefits; 2) lower transaction cost due to fewer institutional bundles involved compared with bilateral projects; 3) the host country has total control of CERs (Haites, Duan & Seres, 2006). However, it also presents a range of risks. The most obvious and widely mentioned disadvantage of uCDM is lack of technology transfer. However, the greatest risk for the host countries associated with uCDM is finance. First of all, the host country has to risk premium for potential foreign CER buyers, which requires large amount of upfront investment capital. Second, it is a long process from project planning to production and to CER sale, therefore, the financial flow is slow. Third, the potential CER revenue is not certain as it subjects to the fluctuation of global carbon market. Finally, there is a possibility for uCDM projects to be unable to find CER buyers. Under this circumstance, CER revenue cannot be realised at all (Michaelowa 2007, p. 17). Maraseni and Gao's (2011) conducted a survey with a group of key Chinese CDM stakeholders on the topic of China's uCDM, the results echoed the above statements. Understanding the difficulties and risks of uCDM projects has a significant meaning for the development of China's future small scale climate change mitigation projects. Many of the uCDM projects are of greater effect on local sustainability development and are often proposed by smaller investors and private entities. If the financial obstacles are removed and CER sales are ensured, this type of small scale projects may flourish which would bring greater benefit the local environment and encourage more investment of the private sector into climate change mitigation. This potential option will be discussed in detail in chapter 7.

5.2.4 Emission mitigation capacity of China's major energy related CDM projects (approved by EB)

The carbon emission reduction capacity of China's energy-related CDM projects is significant. Among all EB registered Chinese CDM projects, renewable energy projects and energy saving and efficiency improvement projects take up 90.12% of all types of projects. Renewable energy projects account for the biggest average annual reduction of 399,980,124 tCO_2e. Energy saving and efficiency improvement projects generate an average annual reduction of 52,289,555 tCO_2e (Figure 5.2).

Figure 5.2 Expected average annual CERs by scope (Projects registered by EB up to 14 July 2015) (Unit：tCO_2e = 1 ton of CO_2 equivalent)

Scopes	Average Annual Reductions	Scopes	Average Annual Reductions	Scopes	Average Annual Reductions
Energy saving and efficiency improvement	52,289,555	Renewable energy	399,980,124	Fuels substitute	18,546,998
Methane recovery & utilisation	51,818,507	N2O decomposition	28,181,743	Chemical pollutants reduction(HFC-23)	66,798,446
Landfill burning power generation	5,913,492	Afforestation and reforestation	156,486	Others	4,568,326

Source: NDRC (2015)

The combined average annual reduction of these two types of Chinese CDM projects reaches approximately 0.4 billion tCO_2e (NDRC 2015). This is a significant amount as it compares well with China's annual domestic effort in emission reduction. During the 11th Five-Year Plan (2005-2010), China's energy intensity dropped by 19.06% from its 2005 level. This resulted in a total reduction of 1.5 billion tCO_2e (approximately 0.3 billion tCO_2e reduction per year) (State Council of PRC 2012, n. p.). China's planned next step is to achieve a total reduction of 5.5 billion tons of CO_2 during the period 2011-2020 (Xuan & Xue 2012, p. 18). Spreading this amount over 10 years, an average of 0.55 billion tCO_2e emission reduction is required annually. The predicted annual combined CO_2 emission from the above two types of energy-related CDM projects (0.4 billion tCO_2e) is higher than China's annual achievement during the 11th Five-Year Plan from domestic effort (0.3 billion tCO_2e per annual) and is not far behind China's new domestic annual reduction target (0.55 billion tCO_2e per annual). This is to say, the two types of China's energy related CDM projects alone would have a great capacity in assisting global emission reduction, which almost equals China's total domestic mitigation effort. Thus, CDM's effectiveness as a flexible offsetting mechanism, should not be overlooked.

Although the carbon emission reduction capacity of China's renewable energy and energy saving and efficiency improvement CDM projects is high, their associated emission reduction achievements do not count as China's effort. This is because CERs from China's CDM projects are sold to Annex I entities and are therefore counted as the buyers' emission reduction. China as a host country solely enjoys the benefits CDM projects bring in terms of enhancing sustainable development, such as better local air quality and more efficient and advanced local infrastructures. It is important to make clear the right of attribution of emission reduction achievements of CDM projects so that double counting in total global carbon emission reduction is avoided. Thus, if the discussion is only oriented at the contribution of CDM towards China's total emission reduction target, the conclusion is clear that CDM does not boost China's emission reduction portfolio.

5.2.5 Projects that may potentially boost China's emission mitigation capacity

As mentioned previously, there are two types of projects that may potentially contribute to China's domestic climate change mitigation if they can be absorbed within the Chinese domestic carbon market. They are 1) projects which gained NDRC approval but did not pass EB assessment; 2) unilateral projects which passed EB assessment but had not yet found international CER buyers. According to NDRC data, there were 630 NDRC approved energy saving and efficiency improvement projects, but only 254 successfully registered with EB. Among 3736 NDRC approved renewable energy projects, 3177 are qualified for EB assessment criteria. This is to say, 559 renewable energy projects and 376 energy saving and efficiency improvement projects which have potential to fulfil the sustainable development goal can be incorporated into China's national carbon market in the future (See Figure 5.3).

Figure 5.3 Difference in number of NDRC approved projects and EB registered projects

Scopes	Project Number: Approved by NDRC/Registered with EB	Scopes	Project Number: Approved by NDRC/Registered with EB	Scopes	Project Number: Approved by NDRC/Registered with EB
Energy saving and efficiency improvement	630/254	Renewable energy	3,736/3177	Fuels substitute	49/26
Methane recovery & utilisation	474/235	N2O decomposition	43/43	Chemical pollutants reduction(HFC-23)	11/11
Landfill burning power generation	56/35	Afforestation and reforestation	5/4	Others	68/21

Source: NDRC (2015a)

As demonstrated in Figure 5.4 below, the difference in average annual reductions between NDRC approved projects and EB registered projects is also significant for these two types of energy related projects. For NDRC approved energy saving and efficiency improvement projects which fail to register with CDM EB, there is an emission reduction capacity of 46,073,829 tCO2e per year; and the annual emission reduction capacities for such type of renewable energy projects is 61,964,301 tCO2e. If these projects are implemented, the combined average annual reductions would reach 108,038,230 tCO2e, which is just under a quarter of the total EB approved Chinese CERs generated from both efficiency improvement and renewable energy projects (462,269,679 tCO2e). According to the interview conducted with an NDRC policy officer, the possibility of the implementation of this kind of project is high. The interviewee also indicated the CERs from such kind of projects will be used in China's future national carbon trading scheme.

Figure 5.4 Difference in average annual reductions between NDRC approved projects and EB registered projects (Unit：tCO_2e)

Scopes	**Average Annual Reductions: NDRC/EB**	**Scopes**	**Average Annual Reductions: NDRC/EB**	**Scopes**	**Average Annual Reductions: NDRC/EB**
Energy saving and efficiency improvement	98,363,384/ 52,289,555	Renewable energy	461,944,425/ 399,980,124	Fuels substitute	24,875,953/ 18,546,998
Methane recovery & utilisation	81,836,570/ 51,818,507	N2O decomposition	28,181,743/ 28,181,743	Chemical pollutants reduction(HFC-23)	66,798,446/ 66,798,446
Landfill burning power generation	9,040,012/ 5,913,492	Afforestation and reforestation	157,610/ 156,486	Others	11,243,941/ 4,568,326

Source: NDRC (2015)

There is another type of CDM project that may also potentially contribute to China's domestic emission reductions. These are usually unilateral CDM projects that have successfully registered with CDM EB but have not yet found CER buyers. The CERs generated from this type of project can be traded on the global carbon market. However, NDRC is also considering the utilisation of such kind of CERs in the domestic carbon market. When being asked about the options and potential utilisation of the above two types of projects, Interviewee 1 responded as below:

> We are now discussing whether we should domestically absorb these types of CERs. NDRC is considering bringing these CERs to domestic carbon market after 2012. As long as the procedure is according to CDM methodology and is approved by NDRC, even though it is not approved by EB or approved by EB but cannot find buyers, these CERs can be traded in the domestic carbon market. And I think it is a very promising aspect. Although the detailed method for operation such as where it can be used among the seven [carbon trading] pilot programs and how it can be used in future national carbon market are not decided yet, the government will definitely recognize and accept these CERs. This is because you [the investors] have done the good things for the environment and the government won't make your effort in vain.

To sum up, CDM, as a global scale flexible market mechanism, mainly reduces GHG emission in Annex I developed countries. However, two types of projects may potentially boost China's domestic climate change outcomes. These are projects which have been approved by NDRC but have not passed EB assessment and CDM projects successfully registered with EB but fail to find CER buyers. The mitigation capacity of these two types of projects is significant (more than 0.1 billion tCO2e per annual) when considering China's total mitigation target is 0.55 billion tCO_2e per annual. However, there might be concerns over their additionality even if they are used as a national offsetting mechanism. Some implications will be provided in Chapter 7 in terms of project additionality. In the following section though, the most significant feature of CDM from developing countries' point of view, the promotion of sustainable development, will be discussed in the context of China.

5.3 The strengths of China's CDM program and the benefits for sustainability

Whether CDM promotes sustainable development, or to what extent it does, has attracted much attention. The conclusions vary depending on different conditions of the host countries and different criteria used to evaluate this (Lloyd & Subarao 2009; Nussbaumer 2009; Olsen & Fenhann 2008; Schneider, Holzer & Hoffmann 2008; Sutter & Parreño 2007). It is argued here that CDM does promote sustainable development in China in the following aspects: promoting development of renewable energies; providing inspiration for China's future domestic market mechanism and raising corporate awareness of climate change.

5.3.1 Promoting China's renewable energy development

The ability of CDM in promoting renewable energy development is one of its most significant contributions towards sustainable development. Pearson (2007, p. 247) boldly stated that "The question of whether the CDM is promoting sustainable development can be framed primarily in terms of whether it is promoting renewables in developing countries and thus assisting in the transition away from fossil fuel". Boyd et al (2009) evaluated this matter through an in-depth analysis of 10 CDM projects' sustainability benefits. They concluded that CDM only enhances sustainability to a high extent by installing small scale renewable energy in remote regions of developing countries to cover the newly emerged or growing energy demands. Regardless of the different criteria for defining sustainable development, it is most commonly agreed upon that the development of renewable energy in appropriate regions with a purpose of replacing or avoiding traditional fossil fuel based energy has a positive impact on sustainable development.

New and renewable energy-related CDM projects account for 83.5% of China's total approved CDM projects. Up until 14th of July 2015, among all 3806 EB registered CDM projects, 3,177 are in the category of new and renewable energy projects (NDRC 2015a, n.p.). China registered more than 40GW of wind power and 30GW of hydro-power capacity under CDM, which is larger than the total combined Australian national grid (Scotney, Chapman, Hepburn & Jie 2012, p. 7). Within the category of renewable energy, wind power is an emerging strength after China's traditional hydro power and attracts much attention. It is dominated by the five large energy SOEs mentioned above, and received abundant funding from the central government (Luo, Li, Tang & Wei 2016, p. 1191). Solar power, with the greatest development potential, has also experienced rapid development with the stimulation of CDM. This is where private investment has seen the most rapid growth (Zhang & White 2016).

5.3.1.1 Wind power

Wind power in China experienced a slow development in the initial stage and experienced a boom since the mid-2000s. The early wind power projects in China were often very small in scale in remote areas and were not connected to the grid. Since the mid-1990s, the wind power and related manufacturing industries emerged after the initial identification of domestic regulation detailing wind power installation target and the availability of relevant funding. However, the wind turbines installed were mainly imported as a result of foreign manufacturers' internationalisation plans. Even though foreign manufacturers could provide grants or loans for setting up wind power plants in China, the enthusiasm on the Chinese side was still low. This was due to a combination of reasons including lack of a unified pricing mechanism, banks' unwillingness to lend, high transaction costs and investment risk and fear of unpopularity of high electricity prices among the public (Buen & Castro 2012, pp. 64-66). The development of China's wind power has been underestimated by the authorities for quite a long period. For instance, the Research Team of China Climate Change Country Study (RTCCCCS) (1999) has predicted that China's wind power installation capacity would be 2 GW by 2020; while in 2010 China's wind power capacity had already reached 44.7 GW (Global Wind Energy Council 2010, p.30). During the 11th Five-Year Plan (2005-2010), China's wind power experienced an average annual growth rate at 105%, which is 7 times higher than the growth rate of the nation's total energy capacity. By 2010, China's wind power generation is 32 times higher than that of 2005 (Kang, Yuan, Hu & Xu 2012, p. 1909). China's global share of wind power production also raised dramatically during this period from 2.1% in 2005 to 22.4% in 2010 with nearly half of the global newly added capacity from China. By now, China is the biggest wind power producer in the world (Chinese Wind Energy Association (CWEA) 2010). The sudden boom of China's wind power and related manufacturing industry after 2003 was led by a range of supportive domestic policies and triggered by the introduction of CDM (Buen & Castro 2012, p. 73).

The first step that the Chinese government took towards a successful wind power industry was to establish a market for wind power products and to protect domestic wind turbine manufacturers and wind power developers from competition. Specifically, it provides concessions for development of large-scale wind farms; provides loans and tax benefits; requires developers to purchase 50-70% of equipment from the domestic manufacturing industry; makes sure that energy generated from wind farms will be purchased at an optimal price and issues long-term power purchasing agreements for 25 years (Buen & Castro 2012, p. 70). All these measures have set up a solid foundation for the prompt development of China's wind power industry. In 2009, the revised version of the Renewable Energy Law further confirmed that it is the utility companies' obligations to accept renewable energies into their grids, and renewable energies must be purchased continually throughout the power plant's life time. The additional cost of renewable energy will be shared among all consumers nationwide instead of by local consumers where renewable energy is generated. Furthermore, the national grid will accept renewable energy generated from regional areas where power cannot be completely consumed locally (The National People's Congress of PRC 2013, n. p.). Such guarantees from the revised Renewable Energy Law have further enhanced the robustness of the wind power industry. Take Gansu Province for example, the grid connection of wind power increased significantly since the implementation of the new *Renewable Energy Law*. In 2013, the total amount of electricity generated from wind power in Gansu increased 29.73% compared with previous year.

Among all renewable energy CDM projects, the Chinese government has given high priority to wind power projects. This is a strategic plan for China's relatively dry northern and western regions where wind resources are rich but water resources are scarce which limits the development of energies that require large amount of water for production. Hydro power, which is the cheapest renewable energy option in many locations of China, requires both abundant water and suitable geology. Generation III nuclear power plants also require large amounts of water as coolant. Therefore, wind power became the clear choice for China's *Developing the West and Revitalising the Northeast Plans*. Also, wind power has price and technological advantages. It is among one of the cheapest renewable energies and the technology is relatively mature (Wang & Chen 2010, p.1993). For large wind projects that have been approved by EB, their CDM revenue is estimated at about 10% of their total revenue, which appears attractive to investors (Castro et al 2011, p. 221).

5.3.1.2 Solar power

Solar energy is a renewable energy of the greatest potential for satisfying the world's future energy demand. According to IEA's prediction, solar power will account for over a quarter of global energy generation in 2050. PV solar will contribute 16% of the world's electricity needs and solar thermal will provide 11% (Evans 2014, n.p.). China's solar resource can be described as super abundant compared with other renewable resources such as wind and hydro resources. There are approximately 100 billion KW solar resources that can be utilised in China, while the total available wind resource is only 1 billion KW and economical hydro resource 0.4 billion KW (Yin et al. 2012, p. 166). Therefore, the research and development of solar energy has a significant role in satisfying China's long-term energy demand and climate change mitigation. China has become the leading player in the world's PV solar market since 2013, followed by Japan and the US. China is expected to continue to lead the global market, accounting for about 37% of global capacity by 2050 (IEA 2014, p. 5). The biggest problem with PV solar is the high requirement of upfront investment, thus the primary task in the development of PV solar energy is to lower the upfront cost (IEA 2014, p. 1). As technology matures, the price of PV solar energy will drop. According to China's *Medium and Long Term Energy Development Plan*, the generation cost of PV solar electricity will decline to 0.6 *yuan*/ KWh in 2020, which will be very close to the electricity generated from coal-fired power plants in price (Yin et al. 2012, p. 190).

China's solar thermal is currently concentrated in the utilisation of solar hot water systems. So far China has become the biggest manufacturer of solar hot water systems.

Solar hot water systems are already commercialised in China without any government grants and subsidies. China's next step is to push forward compulsory installation of solar hot water systems for buildings under 20 levels through legislation. The government will also provide incentives for manufacturers to speed up the research and development of solar thermal utilisation (Yin et al. 2012, p. 214).

5.3.1.3 Future outlook of China's renewable energy industry

Nonetheless, the road for China's renewable energy CDM projects is not completely smooth. As a market mechanism, CDM was unavoidably affected by the 2008 global financial crisis and CER price dropped constantly afterwards. Although it received both domestic and international support, China's renewable energy industry is still impacted by this circumstance. When being asked about the impact of the CER price tumble on China's renewable energy CDM projects, Interviewee 6 from Quanlian New Energy Commerce stated:

> Renewable energy is a kind of investment associated with high cost and relatively low return, but with CDM, the CERs will compensate some of its investment cost and make it relatively more profitable. However, if market demand for CERs is lower than predicted then the investors' profit would definitely shrink. But the good thing is that I haven't heard of any bankruptcy [of CDM renewable energy projects]. It [the financial difficulty] also depends on the type of project though. For example, small hydro-power, the investment

> requirement is small, even private entities do not face the danger of bankruptcy.

Interviewee 1 responded to the same question this way:

> I think it [the price drop of CERs] does not matter, because from the point of view of the government, what CDM brings to China has little to do with money. Firstly, through CDM the concept of climate change is already delivered to the Chinese public, and secondly, projects that are beneficial to climate change mitigation and sustainable development are done. These are both good things.

It can be seen from the above responses that although the global financial crisis brought inconvenience to China's renewable energy CDM projects, the negative impact is not severe enough to deny the true benefits CDM has brought to China. This is probably why Michaelowa & Buen (2012, p. 1) describe the popularity change of CDM in China as a transformation from 'Cinderella to fairy princess'. The 'fairy princess' has certainly shown resilience even under the negative impacts of the global financial crisis in 2008 and failure of the Copenhagen conference in 2009. There was even a last minute rush for the registration of CDM projects due to the policy that the EU will only accept CERs generated from the least developing countries after 2012 (Michaelowa & Buen 2012, p. 30). This means China can only enjoy the benefits generated from projects registered before 2012. The investment in renewable energy may slow down without the stimulation of CER revenue. However, if the government provides other kinds of incentives or similar stimulation as CERs, the investment in renewable energy may sustain. The next important benefit is that CDM introduced a model of new market mechanism to China which can be studied and used for China's future national carbon market. The participation in CDM had prepared China with essential institutional, legal, implementing, monitoring and auditing skills for operation of carbon trading.

5.3.2 CDM as a preparation for China's national carbon market

CDM has experienced ups and downs during the years. As a market mechanism, it cannot avoid the influence of the global economy. However, China's attitude towards CDM has stayed positive even though post-2012 CDM projects have mainly focused on the least developed countries. China has gradually recognised the strengths of this form of project-based mechanism and has adopted it as a co-program for its domestic pilot carbon trading program. The Chinese government has given out positive political and economic signals on the tackling of climate change. Politically, it has been actively seeking policy solutions. In 2012, the State Council issued the Work Plan for Controlling Greenhouse Gas Emissions during the 12th Five-Year Plan Period (2011-2015), within which all provinces and autonomous regions have been appointed individual carbon intensity (carbon emission per unit of GDP) reduction tasks. Nationally, carbon intensity is set to be reduced by 17%; new and renewable energy proportion is set to reach 11.4% of the total primary energy mix (NDRC 2012, p.9). The central government has also published the Action Plan for Addressing Climate

Change in Industry (2012-2020), the National Plan for the Development of Science and Technology on Climate Change during the 12th Five-Year Plan Period, the Interim Measures on Low-carbon Products Certification Management, the Plans for Energy Development during the 12th Five-Year Plan Period, the Plans for the Development of Energy-Efficient and Environmental-Protection Industries during the 12th Five-Year Plan Period, the Suggestions on Speeding up the Development of Energy-Efficient and Environmental Protection Industries, the Industrial Energy Efficiency during the 12th Five-Year Plan Period, the 2013 Implementation Plans for Industrial Energy Efficiency and Green Development, the Action Plan for Green Architecture, as well as the National Ecosystem Protection during the 12th Five-Year Plan (NDRC 2013, p. 10). Economically, carbon trading has been decided as the desired model. Interviewee 1 described the experiment of domestic carbon market as a slow process.

> Strictly speaking, China's involvement in carbon trading started with CDM. But the domestic carbon market took many years to establish. From 2008 to 2011, the voluntary trading was not in good shape. There were no [carbon credit] buyers apart from a couple of companies that aimed at polishing company image for the Olympics. Now we have seven pilot programs[15] and things are getting serious. They cover different types and numbers of industries because there are such big differences between regions. This is why NDRC choose seven rather than one pilot as we aim to explore more detailed options that are suitable for China's situation.

[15] The seven cap and trade pilot programs in China are Beijing, Tianjin, Shanghai, Chongqing, Shenzhen, Guangdong province and Hubei province.

When asked to provide insights and feedback on China's carbon trading pilot programs (October 2013), Interviewee 1 answered:

> As far as I know, only the Shenzhen cap and trade is under operation at the moment. They started on the 18th of June [2013]. The remaining six are in the designing and planning process. But they must be in operation before the end of the year [2013] according to NDRC's deadline otherwise they don't have much time left [to compete the pilot program], only next year and the year after[16]. The core purpose of cap and trade is to give out the appropriate carbon price signal, and the appropriate carbon price signal depends upon emission reduction cost and the cap you set. The EU's experience is that the cap is too high and the price of carbon dropped significantly. It is difficult to say what kind of cap is appropriate, as it is all according to calculations and assumptions. I've heard that the Shenzhen pilot was very strict, but recently some entities are selling their allowance. This might indicate that they received more allowance than they needed. But we don't know how much more in total. This is really a difficult issue to handle. Therefore, we'll keep on monitoring and modifying the system.

The establishment of China's carbon trading pilot program is a positive sign which indicates that China holds a more proactive attitude towards climate change mitigation. According to the insights of Interviewee 1, the Chinese government will definitely invest more towards climate change mitigation, as the direction of this investment

[16] Up till April 2015, seven carbon trading pilots have all been in operation with an accumulated total turnover 1.3 billion *yuan*. NDRC plans to start a national trading scheme in the end of 2017.

parallels with China's transition to a low carbon economy. The government's goal is to send out both political signals and economic signals to industries and the general public on the importance of climate change mitigation as Interviewee 1 stated below:

> At the moment, the political signal is being given out, such as building ecological civilisation and transition to a low carbon economy. But the price signal is not given out yet. That's why we are having seven carbon trading pilot programs. Price signals such as environmental tax, carbon tax and cap and trade will give industries a clear signal to help with their decision-making on whether or not to convert to low-carbon production. We are also learning from the experience of developed countries such as the EU cap and trade and Australia's carbon tax. …We'll certainly have a bigger move towards emission reduction and the signals will be more and more obvious.

The Chinese government's recent consistent and systematic policy approach on climate change mitigation may contribute positively to China's low-carbon development. On the 19th of November 2015, China's climate change special representative, Jie Zhenhua, announced the start-up of national carbon trading in 2017 at the State Council News Conference (Liu Y 2015, n. p.). This announcement corroborated the statement of Interviewee 1 in late 2013 and indicated the Chinese government did carry out a range of experiments and investments as promised. According to the World Bank (2014, p. 38), many financial institutes such as investment banks and trading houses have started to quit the international carbon market due to the global economic downturn and reduced demand for carbon credit.

Within this global environment, China continues to commit to investments in renewable energy, energy efficiency improvement and other types of low carbon environmentally friendly projects, which showed the importance and strengths of consistent national climate policies and the government's determination.

5.3.3 Raising awareness of climate change

CDM is of great significance in lifting people's awareness of climate change and how to deal with climate change in a scientific manner. In Schneider's report which evaluates whether CDM is fulfilling its environmental and sustainability objectives, the author concluded that "One of the key contributions of the CDM is its impact on the awareness and understanding about clean technologies, emission trading and future action for climate change both in the private and public sector" (Schneider 2007, p. 73). China, as the host country of the largest number of CDM projects, has benefited greatly from this aspect. NDRC official Interviewee 1 explained this important impact of CDM as follows:

> The greatest benefit of CDM is to let Chinese people, and especially the Chinese companies, know about climate change, and they can get benefit from emission reduction. It contributes greatly to the improvement of public awareness on climate change. Take the 11^{th} Five-Year Plan for example, we have achieved a lot in energy saving and pollution reduction, and public awareness in energy conservation has improved a lot. This is because we gave

publicity to environmental protection and energy conservation for the last 30 years, and people's awareness improved gradually. But climate change is an urgent issue, we don't have another 30 years to build up the awareness, and CDM did the work.

In fact, signs of the positive impact of CDM on public awareness can already be seen in the business sector. For instance, Chinese entities which participated in CDM have adopted a set of more standardised operation systems in terms of carbon measurement and auditing. Interviewee 6 from CDM NGO Quanlian New Energy Chamber of Commerce stated:

> The operation process of CDM itself is a systematic operation process for a company, just like the ISO9000[17]. Many small enterprises in China do not have a standardised operation system, but if they have operated under CDM, their operation such as data monitoring and shifts and other procedures will be more standardised. This is very helpful for the company.

From this we can see that the on-going implementation of CDM has a positive impact on business awareness by providing learning opportunities to Chinese companies for more advanced and standardised operation procedures when dealing with climate change.

[17] This refers to a series of standards developed and published by the International Organisation for Standardisation (ISO), which define, establish, and maintain an effective quality assurance system for manufacturing and service industries.

A recent national telephone survey of 4,169 Chinese adults, conducted from July to August 2012 by the China Centre for Climate Change Communication, echoed the statements of the above interviewees. The survey focused on investigating Chinese people's awareness, beliefs, attitudes, policy support, and environmental behaviours towards climate change. The results show that majority of the Chinese public are aware of climate change, believe human activities contribute to climate change and wish the government to pay more attention to climate change (see Figure 5.5 for detailed information).

Figure 5.5 National survey of the Chinese public's awareness on climate change

Factor	**Main Results**
Awareness	93% of respondents say they know at least a little about climate change. 11% say they know a lot, 54% know something, and 28% know just a little about it. 7% have never heard of climate change.
Belief	55% say that climate change is caused mostly by human activities, while 38% say that climate change is caused mostly by natural changes in the environment.
Attitude	78% of respondents say they are either very (23%) or somewhat worried (55%) about climate change. 14% are not very worried and 8 percent are not at all worried.
Experience	69% say that people in China are already being harmed by climate change, while another 8% say they will be harmed within 10 years.
Responsibility	89% of respondents agree and 9% somewhat agree with the statement: 'The government should pay great attention to the issue of climate change'.
Source of information	Majorities of respondents trust scientific institutes (89%), the government (86%), the news media (82%), and their own friends and family members (64%) as sources of information about climate change. Fewer trust NGOs (41%) or corporations (38%).

Source: China Centre for Climate Change Communication (2012)

This is a very positive outcome regarding the Chinese public's climate change awareness, given China's traditional reluctant attitude towards climate change mitigation. It is also a significant improvement compared with the survey conducted on the same issue by Lin and Gil (2016). This improvement in people's climate change awareness will have positive impact on public understanding and facilitate China's future climate change mitigation plans.

5.4 Weaknesses of China's CDM program

The benefits CDM brought to China were numerous including promoting the development of renewable energies, preparing for China's national carbon market and lifting people's awareness for climate change. However, some problems also presented from the financial perspective and the future perspective. First, the involvement of domestic financial institutions was insufficient and small to medium scale CDM projects financing appeared difficult, which created barriers for the healthy development of the national carbon market. Second, consideration needs to be paid to China's future low-cost climate change abatement options.

5.4.1 Insufficient involvement of domestic financial institutions

Carbon finance refers to “all financial transactions concerning reduction of carbon emissions, including bargaining transaction, investments, and speculations of carbon emission right and its derivative products” (Zou, Yang & Yu 2011, p. 1886). In China, carbon finance is most often associated with financial activities around CDM. According to the International Energy Agency (IEA 2008, p. 224), in order to reduce global emissions by 50-85% by 2050 from the 2005 level to avoid catastrophic climate consequences, a total of $45 trillion in investment in research and development and commercialisation of a range of low carbon mitigation procedures are needed globally, and a big proportion of this investment needs to be realised in China.

The flush of carbon finance in China was brought along by foreign financial institutions such as the World Bank with the introduction of CDM (Ye 2013, p. 89). The global CER market was valued at approximately $14 billion in 2009 (UNEP, SEFI & New Energy Finance 2009, p. 16). Although the CDM-driven carbon finance was only 1-2% of China’s total power investment, it accounted for approximate half of China’s renewable energy investment (Lewis 2010, p. 2877). In this sense, international carbon finance has a significant impact in pushing forward China’s renewable energy development. Domestically, the Chinese government indeed provided a large amount of funding for domestic low-carbon development in renewable energy and energy efficiency improvement, however, the majority of the funds were distributed to large-scale projects through direct or indirect investment by the central or provincial government (Ye 2013, p. 82). CDM financing for domestic small scale enterprises appeared difficult. The smaller enterprises need to secure loans from commercial banks as they do not received direct funding from the government like the major energy SOEs do. But because commercial banks require 8% profitability and most small CDM projects would never meet this profitability level, financial situations for China's small scale CDM projects are not optimistic (Ye 2013, p. 90). Therefore, dealing with the financial obstacles that the small investors face has a significant meaning for the healthy development of China's small scale offset projects and the sustainability of private investment in climate-related low-carbon development.

5.4.1.1 Limited development in the domestic carbon finance sector

China's Industrial Bank was the first domestic commercial bank to provide low-carbon financing to a range of energy efficiency and renewable energy projects. In 2006, China's Industrial Bank cooperated with International Finance Corporation (IFC) under the World Bank to provide funds and services to energy conservation and emission reduction projects. According to the initial agreement of the above two organisations, IFC provided 200 million *yuan* (approximately US$33 million) principle loss share into Industrial Bank's 460 million *yuan* (approximately US$80 million) loan portfolio; Industrial Bank shall only provide loans to enterprises which focus on energy efficiency, renewable energy, emission reduction in general or those approved by IFC (Zou, Yang & Yu 2011, p. 1887). By September 2008, IFC has provided 2.8 billion *yuan* (approximately US$ 470 million) in total to the Industrial Bank to finance China's energy saving and emission reduction projects, which was predicted to reduce over 10 million tons of carbon emission (Liu JG & Shen 2011, p. 215).

The involvement of IFC is an important causal factor to the Industrial Bank's initiative in carbon finance. IFC signed a loan loss sharing agreement with the Industrial Bank. It works as an effective risk compensation mechanism which reduced risks for the Industrial banks (Liu & Shen 2011, p. 215). For instance, the Industrial Bank injected 1.5 billion *yuan* (approximately US$230 million) to low carbon financing during the second phase of the joint agreement with IFC during 2007 to 2008. IFC provided US$100 million as risk sharing fund during the same period (Ye 2013, p. 88). However, without the involvement of international finance institutions, it is doubtful if a domestic commercial bank would independently invest large amounts of funding into carbon finance due to numerous risks associated with the carbon market. So far, only a few Chinese commercial banks deal with CDM loans. Industrial Bank is the only one which carried out detailed research into CDM finance. According to the product development manager, Cao Bin, Industrial bank was the first commercial bank to launch a carbon financing product kit after their comprehensive study on CDM market since 2008, which aimed at providing diversified banking services to key CDM stakeholders (CDM China 2010, n. p.).

Nonetheless, the Industrial Bank's move is a significant step forward as a domestic commercial bank to specialise in loans for low-carbon enterprises. However, the amount of funds available is still insufficient compared to the vast demand from the low-carbon sector such as the renewable energy and energy efficiency projects (Li & Liu 2011, p. 1066). Following the Industrial Bank's initiative, only a couple of small banks followed suit. For instance, Shanghai Pudong Development Bank launched

Green Credit Service to enterprises in the low-carbon development category. In 2009, it independently provided CDM related consultation and services to two hydroelectric projects in Shanxi Province. Investment Banking, a sub branch of the Agricultural Bank, provided financial assistance and services to 10 CDM projects across the country (Zou, Yang & Yu 2011, p. 1887). In theory, carbon finance should play an important role in CDM and the development of a healthy national carbon market (Amran, Zainuddin & Zailani, 2013; Labatt and White, 2007), however, the participation of China's domestic financial institutions is very limited. Fuhr and Lederer (2009, p. 337) noticed that Chinese banks are "have no interest in [carbon] trading, hardly an interest in project financing". This statement indeed described the current attitude of majority banks, however, it did not dig deep to uncover the fundamental reasons behind the Chinese banks' stance. The fact is that it is not that Chinese banks are unwilling to get involved in carbon finance, but they do not know how and fear the risks of doing so.

5.4.1.2 The reasons behind Chinese banks' passive participation in carbon finance

Carbon finance is a relatively new phenomenon to Chinese banks. It was only introduced to China roughly ten years ago. Chinese banks were extremely cautious with carbon finance due to lack of understanding, the complexity of CDM and a range of market and policy risks. Lack of expertise and experience is the first practical barrier for Chinese commercial banks to get involved in carbon finance. As Heggelund (2007, p. 185) put it, "lack of market understanding and awareness among decision makers and stakeholders in the financial sector could be one factor affecting

China's allocation of [CDM] projects". The lack of understanding has made Chinese financial institutions reluctant developing financial products and providing financial services related to emission reduction and climate change (Shen W 2015, p. 347). According to Lo and Yu's (2015, p. 375) interview with a Chinese commercial banker, it is not that Chinese commercial banks have no interest in the carbon market; they haven't embraced carbon finance because they "don't understand the market", "don't know how much could be lost" and "can't make judgments about market trends". Moreover, there are usually multiple parties involved in CDM projects, which further complicates the relationship among domestic and international financial institutions involved. It might even involve the application of law and territorial jurisdiction if disputes occur over the contracts and implementation processes (Zou, Yang & Yu 2011, p. 1889). The increasing level of complexity further deterred China's commercial banks from entering the carbon finance domain.

Second, the registration procedure for CDM projects was strict and complicated, which is to say, a project applying for CDM might not be necessarily granted an approval if it fails to demonstrate any CDM registration criteria. In fact, the EB approval rate of Chinese CDM projects was quite low (Wang Q & Chen 2010, p. 1994). This makes Chinese commercial banks further consider the risk factor of providing loans to some types CDM projects such as solar and wind energy projects. This type of renewable energy project may only be borderline profitable with the sale of CERs; therefore, commercial banks would have to consider the consequences if they fail to register with CDM.

Third, market and policy risks are what influenced Chinese commercial banks' decisions from the external environment. After the 2008 global financial crisis, many international investment banks and trading houses began to exit the global carbon market, and project developers also reduced investment in carbon abatement due to the declined demand of carbon credits created under Kyoto Protocol (The World Bank, 2014, p.38). The uncertainty over the future of CDM under the Paris Agreement further intensified this problem (Hone 2017, n. p.). The carbon price, as a consequence, dropped dramatically. The fluctuation of the carbon price and the majority of big global investment banks' behaviour both sent negative signals to Chinese commercial banks and therefore further influenced their decision in carbon finance.

Last, the inconsistency of international climate policy adds uncertainty to future carbon market. After 2012, the market demand for CER largely shrank. CERs were only purchased if a country decided to include foreign CERs in its domestic emission reduction policy or CDM continues as a part of post-2012 period of Kyoto Protocol (Lewis 2010, p. 2876). Although a number of domestic cap and trade program allowed international carbon offset, the allowance of percentage of CERs is restricted. For instance, EU only allowed emitting enterprises to purchase CERs from projects approved before 2012 if absence of post Kyoto agreement, and these CERs must be from the projects types approved by all member states and could only be used through to 2014 (European Commission 2008, n. p.). Regional trading scheme such as California's Assembly Bill 32 also stated restricting criteria for the purchase of future CERs (RGGI 2009, n. p.). The Paris Agreement did not even identify whether or not CDM would be used as an ongoing international off-setting mechanism (Hone 2017, n.

p.). As a result, the international outlook for future CERs market was not optimistic, which also contributed to Chinese commercial banks' reluctance into invest of carbon finance. However, the market and policy risks associated with CDM can possibly be reduced if the scale of cap and trade is downgraded from international offset scheme to a well-regulated national scheme, given that the Chinese government would provide consistent and supportive national policies. In Chapter 7, this thesis will project the financial outlook of CDM's offspring, China's domestic off-setting program CCER, and will explain what a supportive financial system means to the CCER program and China's national ETS.

5.4.1.3 Impact of financial difficulty on China's CDM renewable energy projects

The passive attitudes of China's domestic financial institutions have created financial difficulties for many of China's small-scale low-carbon development, especially in that of renewable energy projects. Most renewable energy projects have higher up-front investment requirements compared with that of traditional fossil based power plants, and therefore take longer to realise profit (Lewis 2009, p. 1208). As a result, they appear more vulnerable without long-term financial support. According to Interviewee 6, a CDM consultant, only at the start of China's CDM program, some foreign investors would provide up-front finance for establishing the projects (bilateral projects). For many of the later projects (unilateral projects), especially the small ones, project developers would have to source loans independently:

> This appeared difficult for them as they can only obtain CER revenue after production, well, if they can find buyers, and the how much they can sell their CERs for is also depending on the market situation. Banks have to consider these risks when assessing the project developers' repayment ability.

Some CDM related renewable energy manufacturing enterprises also face the same financial situation. The majority of domestic commercial banks have stopped lending to PV solar manufacturing industry due to the decreasing demand for PV solar equipment in the last a couple of years. Only a small number of domestic commercial banks continue to provide loans, however, the maximum loan term is only five years (Huang S 2014, n. p.). Some companies have to ask local governments to act as a middle man to negotiate with banks for loans. For instance, Shenzhen Topray Solar is one of the top PV solar panel manufacturers in China. The company's representative expressed that lack of financing is the biggest obstacle restricting the company's development. In 2014, Topray had no choice but to submit a petition to the Shenzhen City government wishing the government would communicate with the National Development Bank and Import and Export Bank and possibly use administrative power to persuade them to lend (Huang S 2014, n. p.). The financial difficulty many non-state-owned Chinese renewable energy enterprises and related manufacturing enterprises face is a common phenomenon. Take the low-carbon investment during the 11th Five-Year Plan (2006-2010) for example, it required 800 billion *yuan* (approximately US$ 124 billion) low-carbon investment annually to achieve the 20% energy intensity reduction. However, the Chinese central budget only allowed 83.3 billion *yuan* (approximately US$ 13 billion) annually for low carbon activities, and the majority of these funds were distributed to large SOE projects. This is to say, 1) the government budget alone was insufficient to meet the requirement; 2) small non-state-owned low-carbon projects were almost excluded from direct state financial support and had to seek financial products elsewhere. International financial organisations, some commercial banks and private entities had indeed provided large proportion of loans to China's low-carbon projects during this period; however, they were more favour of large scale projects with matured technology and operation as a way of lowering risk. Small scale projects proposed by private entities such as renewable energy projects (including CDM projects), therefore, faced a difficult financial situation – limited access to both state and non-state funding. Lack of financial assistance for private small scale low-carbon projects is a significant flaw in China's renewable energy policy and overall low-carbon development strategy. This is because, without finance, China's renewable energy development is unlikely to be sustained. The government realised the important role of private investment in renewable energy industry as stated in the *National Energy Administration No. 179 Document* (NEA 2012), thus financial availability for small investors should be made the priority discussion in future policy considerations.

5.4.2 Future low-cost abatement potential

CDM introduced a great concept of pursuing climate change mitigation and sustainable development at the same pace. Its positive impact on Chinese society is obvious. There may be some concerns that CDM has exhausted China's cheap climate change abatement opportunities, but compared with the overall benefit CDM has brought to China, it is very minor and can be overcome.

According to Castro (2012, p. 212), China has picked 32% of its low-hanging fruit through CDM, which is a very high proportion compared with other CDM host countries. This may potentially put pressure on China's future emission abatement opportunities. However, one thing which needs to be pointed out here is that the 32% is only of the identified theoretical abatement potential for CDM projects. Looking beyond the pre-identified categories including the above mentioned industrial gas, new and renewable energy, energy efficiency and fuel substitute projects, there are still plentiful low-cost abatement opportunities. According to Jiang and Tovey (2010), the building sector, which accounts for 25% of China's total emissions, leaves China plenty of opportunities for future emission abatement, as the building sector is almost untouched by CDM. Other abatement options such as contracted energy consumption reduction or efficiency improvement for households and companies, localized land-use change, and small scale revegetation based on family and community units in rural areas can also open up new opportunities for China's future emission reduction activities. Even within the renewable energy sector, abatement opportunities still exist and may upscale as long as the demand for CERs exists and the CER price is high enough to cover the gap between renewable energy and fossil fuels. As technologies advance, the cost of abatement will drop simultaneously and more low cost abatement will emerge (Michaelowa & Buen 2012, p. 26).

Moreover, abatement cost reduction can also be achieved from simplified administrative measures such as reduction in transaction costs. The high transaction costs associated with CDM projects are often considered a weakness of CDM. The transaction cost of CDM is the total expenditure on completing a transaction of CERs between buyers and sellers. It includes project search cost, project document development cost, negotiation cost, validation cost, registration cost, monitoring cost, verification and certification cost, and share of proceeds (The World Bank et al 2004, p. xxxii). Due to the existence of the high transaction cost, the majority of Chinese CDM projects, and especially the ones that are popular with CER buyers, are often big in scale with high CER returns. The transaction cost imposes great difficulty for many small-scale projects and makes them uneconomical and unlikely to register with CDM. According to the analysis of Michaelowa and Jotzo (2005) on early CDM projects, small projects with annual CER production under 10,000 would have difficulty to cover the transaction cost from the sales of CERS. In this sense, many small-scale projects have been left out by the current CDM program and conserved for the future. For example, Interviewee 7 from the Centre for Rural Environmental and Social Research, Chinese Academy of Social Sciences (CASS) mentioned that partial reforestation and the return to traditional pattern of land use in certain rural regions of China would bring great benefit to local environment and at the same time beneficial to carbon emission reduction.

> Yunnan [province] has been dry for quite a while. How can this place be dry? This is the last place nationwide which should be dry. This region undoubtedly has a very complex ecology. According to our research, we found that everywhere else is dry apart from the traditional terraced fields with forests on top of the mountains. This is because the forest on top of the mountains has a great ability in conserving water resources. But in many cases, vegetation has been completely cleared. So we are now hoping to relieve the drought through converting farmland on mountain tops into forests. The forests will not only absorb water and hold on the soil but can also absorb CO_2 and contribute to

> carbon emission reduction, so I think this will be a very good project for the local communities.

The reforestation project mentioned by the above interviewee is a typical example of small-scale abatement options that can bring solid benefit to local communities. But according to NDRC statistics, among all approved CDM projects, there are only five projects within the afforestation and reforestation category, leaving vast potential for the future (NDRC 2014). This type of small-scale reforestation projects can be delivered through the unilateral type of CDM projects. Unilateral CDM projects involve solely the host party throughout the planning and implementation process, and therefore impose a lower transaction cost (Maraseni & Gao 2011, p.340; Michaelowa 2007). If further government support is provided, such as giving priority to CERs of small-scale unilateral CDM projects to be traded on the domestic carbon trading pilot program, more low-cost community-based abatement opportunities will be unearthed in the future. Therefore, currently CDM has not drained China's low-cost abatement opportunities. If financial institutions, services and the trading system mature, such small scale abatement projects can be absorbed into the national carbon market. There are also similar types of potential projects in the building and transport sector that deserve further investigation and could be utilised in China's future carbon market. These options will be discussed in detail in Chapter 7.

5.5 Conclusion

This chapter has investigated what CDM means to China's climate change mitigation and sustainable development. This investigation is of significance because CDM is the first large scale international climate change mitigation mechanism China has participated in. It not only opened a door for advanced technologies, project design methodologies, and monitoring and auditing procedures, but also brought in the concept of market mechanism and how to utilise the market to simultaneously achieve climate change mitigation and sustainable development. Therefore, the study of the impacts of CDM on China's society is valuable. Overall, CDM is more beneficial than detrimental to China's low-carbon development goals. This chapter focused on two types of energy-related CDM projects: renewable energy projects and energy saving and emission reduction projects. Both targeted the long-lasting greenhouse gas CO_2. Although they did not directly contribute to China's emission reductions, they brought China a range of practical benefits. The most significant benefit is its stimulation to China's renewable energy development, which has a positive effect on the optimisation of China's energy structure. The next important benefit of CDM is that it introduced the concept of the carbon market, and it put this concept into practice. Through this, CDM paved the way to China's carbon trading pilot program and the future national carbon trading scheme. It proved that a carefully designed market mechanism can be effective in dealing with climate change mitigation in China. Finally, CDM helped to raise business awareness of climate change among corporations which participated in CDM, which echoed the trends of climate awareness improvement among the public. According to insights of the NDRC official interviewed for this thesis, CDM would not end in China by 2012. During the writing of this thesis, the CCERs were indeed incorporated into China's carbon trading pilot program. Although CDM was not granted a definite future in the Paris

Agreement, China was not impacted by this international decision. At the symposium, *The Future of Clean Development Mechanism*, jointly held by the China Carbon Forum and Sindicatum Sustainable Resources, the Chinese representatives[18] confirmed the role of CDM in the future. When asked "Was there even a future for CDM?", the Chinese representatives stated:

> From a business point of view, it is difficult to change the fundamentals of oversupply. On the other hand, the development of carbon markets is flourishing, so the opportunity for CER uptake can only grow (China Carbon Forum 2013).

It is certain that CCERs will be carried onto China's upcoming national carbon trading scheme which allows industries to identify low-cost abatement opportunities domestically and the CCERs on the national carbon market. There is also the possibility for CERs to be absorbed in China's national carbon market (China Carbon Forum 2013).

Nonetheless, two issues associated with Chinese CDM were exposed. One is the financial difficulty that small-scale renewable energy CDM projects experienced. The other is the concern that CDM has exhausted China's low-cost abatement opportunities. Both issues are linked to the nature of CDM to some extent. CDM, as an international mechanism, required high transaction costs; therefore, large-scale projects appear more economical. As a result, the Chinese government and financial

[18] Key representatives from the Ministry of Foreign Affairs, China CDM Fund, Sino-Carbon Innovation & Investment and Enecore joined the panel discussion. 60 participants from China's climate change community were part of the audience.

institutions purposely gave priority to large-scale projects with lower costs and risks. However, many small-scale projects, especially those in renewable energy, are in fact more effective for sustainable development and bring more practical benefits to the local community and environment. Even the Chinese government admits that small private investors in renewable energy are a crucial element of China's future energy market and carbon market. Therefore, small-scale low-carbon investors' financial difficulty must be treated as an urgent problem and solved in a timely manner because it already held back the development of small scale low-carbon projects. This is the issue to be explored in Chapter 7.

The second concern over the exhaustion of China's low-carbon abatement opportunity is less crucial compared with the first one. Again, abolishing the 'big-scale obsession' is the key. It is still possible to discover abundant and diversified small scale mitigation opportunities if CDM is carried onto China's national emission trading scheme. To include and promote such kind of sustainability enhancing small projects, the government could incorporate a range of flexible measures and policies in simplifying project approval procedures and reducing transaction fees. It is certain that the policy and market risks would be relatively reduced if CDM is downgraded as a co-mechanism of China's national carbon trading scheme. In sum, the use of CDM as a policy response to climate change mitigation in China leaves significant scope for discussion and future exploration of the issues highlighted in this chapter. In the next chapter, this thesis will focus on a parallel domestic climate-related policy, the ECERS. Its strengths and weaknesses will be explored in detail.

Chapter 6

ECERS for the energy production sector and energy users

6.1 Introduction

The Chinese government implemented the ECERS from the beginning of the 11^{th} Five-Year Plan for National Economy and Social Development (2006-2010) to relieve domestic energy pressure and as a response to the international calls on climate change mitigation. By the end of 2015, ECERS had been implemented for ten years (2006-2015). ECERS focuses on energy saving and emission reduction through all sectors, which includes the energy sector, the manufacturing sector, the transportation sector, the building sector and the agriculture and forestry sector (The Central People's Government of PRC 2006, n. p.). Among all these sectors, the energy production sector accounts for one of the largest proportions of China's CO_2 emission. For instance, in 2008, the energy sector alone consumed 920 million tons of coal equivalent (Mtce) and generated 2.5 giga tons (Gt; 1 Gt = 1 billion tons) of CO_2 emission, which took up 42% of national energy-related CO_2 emission (Ye 2013, p. 105). Also, energy is consumed by other energy intensive sectors such as the manufacturing sector and the building sector. Thus, the carbon intensive nature of the energy sector is the fundamental reason for China's overall high emissions. Due to this status, the energy production sector deserves special attention and is treated as a focal point of this chapter.[19] China's current energy structure is still dominated by coal, therefore, utilising coal more efficiently in the process of energy production would produce positive impacts on resource conservation and emission reduction. Simultaneously, due to this coal dominated energy structure, how end users utilise energy also matters. Therefore, a newly initiated incentive based program, the Energy Performance Contracting (EPC) program, targeting energy end users, will also be discussed. It is anticipated that such investigations can build up the answer to the question of how China can achieve better climate change mitigation through improving its energy policies.

The goal of this chapter is to analyse the strengths and weaknesses of ECERS for energy producers and major energy consumers during the scheme's implementation from 2006 to 2015 covering China's 11th and 12th Five-Year Plans. This timeframe roughly echoes that of CDM, the parallel international climate change mitigation scheme mentioned in Chapter 5 that China participated in. The energy producers refer to China's predominant thermal power producers and new and renewable energy producers. Energy consumers refer to eligible enterprises who consume electricity power. Within the energy production sector, ECERS emphases efficiency improvement and the optimisation of energy structure, which includes replacing inefficient small thermal plants with large scale more efficient ones, and promoting the development of renewable energies. For energy consumers, ECERS focuses on

[19] As discussed in the introduction, ECERS is a national scheme that covers all major industries and this is why this thesis focuses on the energy sector. The Top 10,000 Enterprise Program applies to a wide variety of industries, including iron and steel, nonferrous metals, coal, electricity, petroleum, petrochemical, chemical, building materials, textiles and paper making. Therefore, it is not the most relevant program for the focus of this thesis. Also, including this component would be well outside the scope of this thesis.

each entity's efficiency improvement in utilising energy such as the installation of energy saving equipment in factories and sustainable energy management for businesses, schools and office buildings.

This chapter is arranged as follows. Section 6.2 discusses the strengths and weakness of ECERS in the energy production section, within which 6.2.1 and 6.2.2 focus on the traditional coal-generated energy and 6.2.3 focuses on renewable energy. Section 6.3 covers an incentive-oriented program under ECERS for energy consumers, the EPC. The evolution of EPC in China and especially the policy change on cash rewards towards Energy Service Co.s (ESCO) will be discussed and problems associated with this will be pointed out. Section 6.4 concludes the chapter and summaries the problems which are to be addressed in Chapter 7.

6.2 ECERS in the energy production sector

ECERS in the energy generation sector is the most important component of the scheme because it tackles climate change from the deep roots of energy production. It aims at improving the efficiency of conventional coal-fired power plants and increasing the proportion of new and renewable energies in the country's energy structure (The Central People's Government of PRC 2006, n. p.). Due to the fact that approximately 70% of China's energy is generated from coal (Li F, Dong, Li, Liang & Yang 2011, p. 568), efficiency improvement in the coal-power sector would be significant to China's CO_2 emission mitigation. The increasing promotion of renewable energies optimises the energy structure and benefits long term sustainability.

During the 11th Five-Year Plan (2006-2010), ECERS achieved overall positive results in the energy production sector. 768.3 million KW capacity of inefficient small thermal plants were shut down nationwide. The average coal consumption per each KWh of electricity dropped from 370g to 333g (China Electricity Council 2011, n. p.). The proportion of combined non-fossil energy capacity achieved 26.6% of the national total, which increased by 1.6% compared with that at the end of the 10th Five-Year Plan (2000-2005). The increase of non-fossil energy proportion in the nation energy structure accumulatively replaced 1.5 billion tons of coal and reduced approximately 3 billion tons of CO_2 emission. Wind power and solar energy were two of the fastest developed non-fossil energies with wind power capacity reached 310 million KW and solar energy capacity reached 6 million KW (State Grid Corporation of China 2012, n. p.). The 12th Five-Year Plan continues to work on these areas. At the end of the 12th Five-Year Plan, in 2015, to be exact, the Chinese government announced a plan to restrain coal production and coal-fired power production, which will further reduce the share of coal in China's energy structure.

This looks optimistic, but are there problems and deficiencies with the scheme? What has caused them? What are the impacts of the problems? An investigation of the scheme's strengths and weaknesses in the energy production sector is very necessary. This is because energy production is one of the most critical factors that impacts on the social economy and people's livelihood; and more pressingly, energy structure, as a fundamental indicator for a country's CO_2 emission, its optimisation will bring a very positive outcome to climate change mitigation. This is especially applicable for China due to the scale of its energy demand and a coal dominated energy structure. Without reducing the proportion of coal in the energy structure and the total amount of coal consumption, the positive impacts of many innovations and technologies applied at the consumption end would be limited. For example, the innovation of electric cars and related infrastructure will be meaningless if the cars are powered by electricity generated from coal. It might ease China's reliance on imported oil, but there will be no reductions in CO_2 emissions and urban air pollution. Therefore, to study China's energy structure and climate change mitigation, two topics must be discussed, the conventional coal energy and the renewable energies. These are the focus of section 6.2.

6.2.1 Closure of small inefficient thermal plants

Small-scale inefficient and highly polluting coal-fired power plants in China have a strong connection to the country's rapid economic development. China constantly experienced energy shortages since the reform and open up in the late 1970s. In response to this situation, the National Planning Commission (the predecessor of NDRC) announced the *Tentative Regulations on the Development of Small Thermal Power Plants* in 1986. However, China continued to experience energy shortages. In fact, the only periods that China did not suffer from energy shortage were during the years of global financial crisis, when China's economy was impacted by global economic downturn (Lin 2007, p. 916). For instance, 1998 to 2001 were the rare four years that China could basically satisfy its energy demand due to the influence of the 1997 Asian Financial Crisis. However, severe energy shortages bounced back in 2002 when the financial crisis eased (Zhou, Levine & Price 2010, p. 6439). To relieve severe energy shortages, local governments were encouraged to seek funds independently to build small-scale coal-fired power plants with a capacity lower than 25MW. These small coal-fired power plants were financially independent, and they were therefore administratively independent. Due to these financial and administrative freedoms, local governments put great effort into the development, and small thermal plants flourished across the country (Ye 2013, p. 127).

Small-scale coal-fired power plants might have temporarily relieved energy shortages, but caused enormous detrimental impacts to the environment such as severe atmospheric pollution and global climate change. Generally speaking, small-scale coal-fired power plants could not meet the efficiency level of large plants and rarely installed pollution control equipment, therefore, they are energy and emission intensive. According to the Director General of the National Energy Bureau, Zhao Xiaoping, to generate the same amount of electricity, small plants generally consume 30-50% more coal than large plants (Weipu 2007, p. 16). In order to ease domestic atmospheric pollution and respond to the international community's call on climate change mitigation, the Chinese government decided to shut down small-scale coal-fired power plants since the 11th Five-Year Plan (2006-2010). The closure of inefficient and highly polluting small-scale coal-fired power plants was clearly written in the energy sector ECERS as a major policy (The Central People's Government of PRC 2006, n. p.).

6.2.1.1 Regulations and procedures for closures

In 2007, the State Council of PRC approved the *Several Suggestions on the Acceleration of Closing Down Small Thermal Power Plants* jointly issued by the NDRC and the State Energy Office (State Council of PRC 2007, n. p.). It suggested the closure of small scale conventional coal-fired power plants within the coverage of major grid according to relevant laws, regulations and the State Council's requirements. The targeted coal-fired power plants included plants with a capacity under 50,000 KW, plants operated over 20 years with a capacity under 100,000 KW; plants which had reached life expectancy with a capacity under 200,000 KW, plants with a coal consumption level 10% higher than the province's average where it was located or 15% higher than the national average, plants with high emissions which did not meet relevant environmental protection regulations. The government welcomed units with combined heat and electricity generation functions regardless the size as they played an important role providing heating in northern China during winter. However, their efficiency level should still be monitored. For heat and electricity combined units with a coal consumption level 10% higher than the province's average or 15% higher than national average outside the heating providing period, their electricity generation was banned or restricted during the warmer months (State Council of PRC 2007, n. p.).

The implementation of the policy started with NDRC assigning decommission tasks for provincial governments and large energy SOEs. All provincial level governments were required to submit detailed implementation strategy and annual closure plans before 31s March 2007 (China Electricity News Network 2007, n. p.). A target responsibility system (TRS) containing comprehensive information of the targeted small coal-fired power plants was then established. The provincial, city and district governments played a supervising role in drafting the implementation strategies and the annual closure plans for their localities and made these documents available to the public. The implementation strategy should clearly state the division of responsibility and post-closure details, including worker arrangements and enterprises' debts and assets disposals. The annual closure plan should clearly identify the names of the targeted plants and the deadlines for closure. Energy enterprises were responsible for the direct operation of the closures, which should all be strictly implemented according to relevant provincial government's implementation plan (State Council of PRC 2007, n. p.).

All provincial governments were required to report periodically to the NDRC and the State Electricity Regulatory Commission on the implementation of the closure of small coal-fired power plants within their jurisdictions. For plants which exceeded the closing deadlines, electricity regulation agencies should immediately suspend their licenses; grid companies should disconnect them on time and no longer purchase electricity from them; power dispatching centres should no longer provide dispatching service and banks and other financial organisations should stop providing loans. The units should be eliminated straight away after closure and should not be re-constructed in other localities. For small plants which refuse to close, the relevant department of the provincial government or above could order immediate closure by suspending their licenses and terminating any future development proposal until the targeted small plants were shut down. For enterprises which cheated to avoid closure or those who closed existing plants but built similar small coal-fired plants elsewhere, the governments would order immediate demolition and pursue legal action against the relevant personnel. For local officials who acted beyond their authority for approving the construction of small coal-fired power plants, the provincial government or above would step in to investigate and withdraw the project approval documents (State Council of PRC 2007, n. p.).

Grid companies were also involved in the implementation process. They were required not to provide services to small coal-fired power plants unqualified for continuing operation. The power dispatches of all coal-fired power plants under the coverage of the large grid were required to be supervised by the provincial or higher level power dispatching centres for unified management. The dispatching method should be improved according to the principles of saving energy, protecting the environment and economic efficiency. Therefore, the power dispatching centres and grid companies were required to give priority to dispatch electricity generated from renewable sources and relatively cleaner high-efficiency coal-fired power plants but limit electricity generated from high energy consumption and high pollution units (State Council of PRC 2007, n. p.).

All levels of environmental protection bureaus should also play an important role in the monitoring and auditing of major pollutants of coal-fired power plants. EPBs should supervise the installation of desulphurisation facilities for coal-fired power plants with a single unit capacity above 135,000 KW but outside the closure category. Units which had installed desulphurisation facilities but still did not meet relevant environmental standards would not be paid a higher de-sulphurised electricity price when connected to grid (State Council of PRC 2007, n. p.).

The implementation of closure of small coal-fired power plants was largely delivered through administrative procedures. It mainly involved the government, large energy SOEs, and large grid companies with minor involvement from the MEP and lower levels of EPBs. It had minimum involvement from the public and civil society. However, this command and control style implementation was effective in China's situation and particularly so in the case of closing small coal-fired power plants. The next section will discuss why and how the administrative procedures were effective.

6.2.1.2 The strengths of closure of small coal-fired power plants

The closure of small-scale inefficient coal-fired power plants in China achieved set targets during both the 11th and the 12 Five-Year Plans (Sun 2009, n. p.; Wang Y 2015, n. p.). This was largely due to the strong central control over provincial governments and large energy SOEs and the adoption of the TRS. As mentioned in Chapter 3, China's political system is characterised by a hierarchical unitary structure. This structure, compared with many Western democratic governments, has its major drawbacks. For instance, provincial and local governments hold accountability to higher levels of government rather than the public in their administrative regions (Guo 2007, p. 378). As a result, people's voices are often ignored and are unable to reach the central government. However, in the case of shutting down small coal-fired power plants, this top down TRS was extremely effective.

First of all, provincial and local leaders' work performance was closely linked to how well they accomplished the tasks that the upper level governments appointed to them. Whether or not they completed the tasks and how promptly and by how much extra they achieved the tasks were all important indicators which would be considered for their future political promotions (Qi & Wu 2013, p. 308). Due to this mode of upward accountability, provincial governments divided the provincial task to county governments, and the county governments did the same to the township governments. As a result, the pressure was passed down the hierarchy. In order to pursue one's own promotion opportunity, higher level leaders would pass down pressure to lower level government to better complete the tasks; and majority of lower levels government leaders did their best to please their supervisors in higher levels of governments by shutting down small coal-fired power plants in a prompt manner (Xue & Yang 2011, p. 5).

Second, this top-down command and control system also allowed provincial and local governments to eliminate much public consultation. Big stakeholders such as large energy SOEs received enormous funding and support from the government. In order to maintain a good relationship with the government so as to obtain funding and future development opportunities, they were rarely against the government's policy decisions and the closing tasks the government appointed to them (Williams 2014, p. 12). Workers who were employed by small coal-fired power plants within the closure categories were those who were most affected. However, due to the fact that majority of workers' trade unions were individually located and managed by individual companies, the closure of the small coal-fired power plants also meant the disintegration of the unions. As a result, protests and large scale strikes led by unions were extremely rare.

According to Interviewee 8, an official from National Energy Administration, NDRC, the strong command and control style of governance was a key factor for the successful implementation of the closure of small coal-fired power plants.

> We realised our system still had many problems in terms of the implementation of policies, but in the case of closure of small coal-fired power plants, our system had its advantages. It was quick, strict and effective and results were seen in a short period of time. I believed this could not be achieved in any western democratic countries, given the size of the target and the short time frame.

Last, the closure of highly polluting small coal-fired power plants was generally welcomed by the majority of the public. As atmospheric pollution intensified in China, any measures that could potentially improve air quality were embraced by the local residents. Interviewee 7, an academic from CASS put it this way:

> According to my many years of experience doing research at the local level, majority of the general public don’t care about who the top leader is and what the major policies are. They want to see the results. As long as the policies bring good outcome to local environment and their livelihood, they’ll be generally happy.

Due to the above mentioned reasons, the closure of small coal-fired power plants in China was relatively efficient and effective.

6.2.1.3 Problems emerging during the closure process

China’s nation-wide closure of small coal-fired power plants during the 11^{th} and the 12^{th} Five-Year Plans both achieved the set targets. In this sense, it was a successful policy. However, there were a range of problems which emerged during the implementation process. First of all, the unemployment issue was the biggest problem. Second, the dissatisfaction of some privately owned small plants was also exposed. Last, cheating and fraudulent behaviour of some of these dissatisfied small plants seriously affected the accountability of the policy and diminished the positive outcome of the policy.

Dissatisfaction in terms of compensation and reemployment was a significant phenomenon among workers of closed small plants. The *Several Suggestions on the Acceleration of Closing Down Small Thermal Power Plants* required enterprises to make a worker allocation plan and appropriately settle laid-off workers according to relevant laws and regulations after the closures. Theoretically, an enterprise required to partially close its operations should absorb the affected workers within the enterprise. For an enterprise whose units were completely shut down, it should by law appropriately deal with compensation and social security payments. Enterprises with upgrading tasks or new expansions should give employment priority to workers from closed small plants. Local government should also supervise the allocation of workers (State Council of PRC 2007, n. p.). However, the enterprises with new expansions were mainly large SOEs. The majority of the small non-state-owned enterprises did not have the capacity to provide alternative employment opportunities for their workers, and workers' reemployment situation was difficult (Sun, Zhu, Ruan, & Wang 2008, p. 32).

When Xu Yongsheng, the Power Division Director of National Energy Administration, responded live to netizens on 13 May 2010 on the topic of "Accelerating backward productivity and enhancing energy conservation and emission reduction", he stated:

> Being people oriented is an important principle of government work. The worker arrangement of closed small coal-fired power plant was ranked the number one most concerning issue of the government. In order to

> appropriately arrange 400,000 workers, we adopted several methods. For instance, we allowed closed plants to sell their electricity generation allowance and pollution allowance so that they can obtain partial financial compensation from this. The central finance also allocated special funds as incentives during the years for closures in some inland and western provinces where the economy faced more difficulties. We also required enterprises and local government to provide training for the affected workers to improve their skills for reemployment. Large energy SOEs were required to lead the internal transfer of workers from closed small plants. Private and foreign owned enterprises were also required to provide worker allocation plans. Closures were only implemented if the worker relocation plan was sound (The Central People's Government of PRC 2010, n. p.).

There was a major problem with Wu's response to the public inquiry - lack of quantitative information on the settlement of the laid-off workers. He basically repeated the requirements and procedures listed in the policy at the start of the 11th Five-Year Plan (2006-2010) but included little data about the percentage of workers reemployed. There were few official statistics on the reemployment rates or compensation allocations. Cai, Wang, Chen & Wang (2011, p. 5998) conducted a scenario analysis on the impact of closure of small coal-fired power plants on unemployment which indicated the policy led to a reduction of approximately 559,000 direct job opportunities in the power sector. A range of cases of closed small plants workers expressed dissatisfaction on social networking websites proving the unemployment caused by the poor implementation of closure of small coal-fired power plants was real and more serious than it appeared to be. In the next section, two typical cases from two of China's most widely used public forums, *baidu tieba* and *bbs163* are reviewed.

Case 1:

Posting on *baidu tieba* (a popular Chinese public forum) by author "8`1 red collar badge" on the 15 January 2016, titled *How many laid-off workers did not receive appropriate arrangements in the Inner Mongolia West Electricity System?*

The author, as one of 175 laid-off workers from the closures of Hohhot Qingshihe No.1 and No.2 coal-fired power plants, described their prolonged and tough journey in fighting for their rights and justice. The two closed plants announced bankruptcy and dismissed all the workers. The enterprise did not appropriately arrange the laid-off workers according to the government's relevant policy, leaving the 175 workers unemployed and uncompensated. The representatives of the laid-off workers pursued petitions in November 2006, March 2007, June 2007 and September 2009 and visited the following government departments and units to appeal for help: Inner Mongolia Qingshuihe Power Supply Bureau, The People's Government of Qingshuihe township, Hohhot Power Supply Bureau, Inner Mongolia Electric Power Group Company, the Bureau of Letters and Calls of Inner Mongolia Autonomous Region Party Committee. Although the majority of these government departments showed sympathy to the workers' situation, they all attempted to shift responsibility to other departments.

The problem was still not resolved by the time the author posted their experience on *baidu tieba*. On December 28 2015, the 175 laid-off workers once again submitted their petition materials to the Comprehensive Management Department of Hohhot Power Supply Bureau, and would wait to see the government's response. Pictures below show workers of the closed Qingshuihe No.1 and No.2 coal-fired power plants pursuing petition to Inner Mongolia Power Administration on a cold day.

(Source: http://tieba.baidu.com/p/4303408279?pn=2)

Cases like this are not rare. In the next case, an unemployed worker from a small factory-owned coal-fired power plant also expressed his/her concerns over compensation and future job opportunities.

Case 2:

Posting on *bbs163* by author "llhhjj760" on the 21 August 2010 titled: *Frustration, small coal-fired power plant closed, who will care of the laid-off workers?*

(Source: http://bbs.travel.163.com/bbs/tuyou/185190528.html)

This was the last group photo taken before the closure of the small coal-fired power plant owned by CITIC Machinery on the 10 March 2010. The author, "llhhjj760", one of the laid-off workers from the closure of this small plant, used the word "frustration" to describe the workers' feelings. llhhjj760 expressed his/her concerns over the unclear compensation and job opportunities after leaving the closed plant. According to the *Labour Laws of the PRC*, closed down power plants were not allowed to force employees to have a seniority buy-out (redundancy payment), rather, enterprises should provide partial social security payment to their previous employees. In llhhjj760's case, his/her company just changed the name of seniority buy-out into "financial compensation and cancellation of contract", which basically meant a small one-off payment to the employee could be made, avoiding any further responsibility for them. Unemployment caused by the closure of the small coal-fired power plant was difficult for those it affected. Although some commented it was a necessary move towards better energy conservation and environmental protection, the allocation of appropriate social security and training for the unemployed should be well managed.

Dissatisfaction was not only among the laid-off workers who did not get proper compensation, it also existed among private owners of the closed small plants. As mentioned previously, many of China's small coal-fired power plants were established as the response to the national call during energy shortages. They were financed by private funds or local government raised funds (Ye 2013, p. 127). As a result, their closures were much more complicated compared with those owned by SOEs as they involved diverse interests and stakeholders. Some coal-fired power plants were established by local governments through the method of social fund raising, and the repayment to the public relied on the continuing production of the plants. The forced closure of such types of small coal-fired plants left many fund creditors baring financial loss or even empty-handed. There were also small coal-fired power plants operated on a shareholding system. The employees of the plants were at the same time shareholders. Once the plants were shut down, the employees were unable to cash their shares (Li XW 2007, n. p.). The national policy *Several Suggestions on the Acceleration of Closing-Down Small Thermal Power Plants* did not clearly state individual methods in dealing with different types of ownership of small coal-fired power plants. As a result, the implementation of closures beyond SOE-owned plants were not smooth and filled with conflicts of interest. A previous owner of a private small coal-fired power plant (Interviewee 9) expressed his dissatisfaction towards the closure of his company:

> A few years ago, when the plant was first approved, it was legal and all the equipment was said to be good. The government at that time encouraged my investment. But how could they suddenly require me to shut it down! I put in so much effort running it. It was my career. Although I received compensation, it was nowhere near what I had devoted to the company. I also felt sorry for my employees as I don’t have the capacity to offer them new employment opportunities. They are doing it tougher than me.

Unemployment and unfair compensation to laid-off workers cause serious social issues. Although it may not yet cause severe social instability, it has the potential to do so. Most important of all, it severely affected the livelihood of laid off workers and made their daily life a struggle. Therefore, how to appropriately solve this problem deserves much attention, and some recommendation will be provided in Chapter 7. Also, since the dissatisfaction was not uncommon among the closure non-state-owned small coal-fired power plants (Li XW 2007, n. p.), some small coal-fired power plants sought ways to exploit the policy loopholes to avoid closure; while others even secretly reopened the plants after closure.

One of the biggest loopholes in the policy of closure of inefficient small coal-fired power plants is the privilege for combined heat and electricity generation units. The government treated the combined function units differently from the single function units. The closure decision was generally made through efficiency monitoring rather than the units' size. Due to this reason, some single function small coal-fired power plants, which would have otherwise been on the closure list, converted their units into combined function units in order to avoid closure. They generated electricity business as usual and only limited the generation during inspections. Due to the lack of resources of local EPBs, the inspections were not frequent. As a result, the combined heat and electricity generation function had been used as a cover-up by some small coal-fired power plants for the purpose of continuing their operation (Cheng 2009, p. 108).

There were also small coal-fired power plants secretly re-opened after closure. According to M Zhou (2010, p. 270), this phenomenon was not rare. Some small coal-fired power plants announced closure but in reality never stopped their operations. This was partially due to the relevant government department's lack of seriousness during the implementation process. As XW Li (2007, n. p.) pointed out, the implementation of closing down small coal-fired power plants was carried out by local electricity providers under national grid companies in some regions. Their typical implementation method was to simply put a closure sticker on the boiler, and that counted as the completion of the closure. Such implementation lacked the authority and seriousness, and as a result, many small coal-fired power plants did not take it seriously and continued to operate as usual. According to Ferris and Zhang (2015, p. 68), another reason that some small coal-fired power plants dared to take the risk to re-open was that they had special connections with local governments who gave them the green light to do so. Interviewee 10, the head of an influential ENGO, discussed this problem with great concern. Interviewee 10 stated:

> Under such circumstances, even local EPBs had no way of dealing with the violation because local governments were their direct supervisors. The illegal operation after the officially announced closure was disguised due to the far reach of the central government. We recently investigated one such case. A small coal-fired power plant "shut down" three years ago was still in operation. The person in charge responded to our inquiry as that the facilities were to be sold to another country and they were just providing a demonstration to their clients as required.

Cases such as those Interviewee 10 described have to go through a legal process in order to be solved. It requires social organisations and the local public to be brave enough to get involved. However, due to a range of limitations on China's civil society and people's traditional belief that 'ordinary people should not challenge the authority', environmental lawsuits towards the cheating behaviour of some small coal-fired plants are uncommon.

Another issue of relevance to this thesis is that majority of fraudulent and cheating behaviour happened in small coal-fired power plants owned by non-SOEs. For small coal-fired power plants operated under major energy SOEs, the demolition of the facilities was usually on site, on time and strictly according to the high level government's guidelines. This reflected different characteristics of these two types of ownership enterprises in terms of pursuing profit. Non state-owned small plants obviously received less financial support from the central government, as a result, some undertook risky actions to maintain their profit, while large energy SOEs disdained to maintain small plants as they had better opportunities for future development of large projects. Although China's SOEs were regarded as an inefficient form of economic entity, their less profit-oriented nature actually helped in the small coal-fired power plants closures and contributed greatly to the successful implementation of the policy. Non-state-owned small plants, to the contrary, reduced the accountability of the policy and the officially announced policy outcome figures. Therefore, how to treat SOEs and non-SOEs differently in climate-related energy policies requires careful consideration. This was what the *Several Suggestions on the Acceleration of Closing Down Small Thermal Power Plants* clearly lacked. In this thesis, however, this issue will be dealt with in Chapter 7 with a potential solution proposed.

6.2.2 Establishment of large-scale efficient coal-fired power plants

The closure of small coal-fired power plants was the precondition of establishing large-scale new plants since the 11th Five-Year Plan. According to the *Several Suggestions on the Acceleration of Closing Down Small Thermal Power Plants*, the closure of small coal-fired power plants was an important assessment criteria for the approvals of new energy projects. The government would give priority to a company's new energy project proposal if the company had closed down a large amount of small units and made appropriate arrangements for its laid-off workers. For a new proposal of a 300,000KW coal-fired plant, the company's combined small plants closure capacity must have reached 80% of the new capacity, which was 240,000KW, so that the proposal could be included in the national electricity development plan. Similarly, the condition of a new 600,000KW unit was that its combined small plants closure capacity exceeded 70% of the new unit, where as a new 1,000,000KW unit required a closure capacity of small plants which reached 60% of the new unit (State Council of PRC 2007, n. p.).

Closure of inefficient small plants as a precondition of establishing large scale coal-fired power plants was often ignored by the Western media who simply emphasised the fast speed and big size of China's coal-fired power plant development (Stanway, 2014, n. p), which was misleading. The coal energy development under ECERS was not a blind expansion. Although the total capacity of coal energy slightly increased, the overall emissions were offset by the increased efficiency of the new units. In this sense, ECERS was effective in reducing energy intensity and carbon intensity in China's coal energy sector. However, large coal-fired power plants, although more efficient compared with the closed small ones, still could not avoid the environmental impacts associated with coal burning. In fact, the larger scale coal-fired power plants appeared to have more intense impact on local environments. Numerous complaints of local residents on newly established large scale coal-fired power plants appeared on the internet across diverse geographical locations.

In Guangdong province, resident complaints about Zhongshan Coal-fired Power Plant suddenly increased since December 2013 due to the expansion of 2 x 300,000 KW heat and electricity dual-function units. The expansion was located in between Huangpu Township and Nantou Township. It was under the energy sector ECERS scheme which aimed at replacing small coal-fired power plants with large ones. Zhongshan City government received eight complaints within the first six months for the worsening air pollution.

On July 22 2014, a nearby resident with the family name Chen complained about the air pollution:

> We are residents of Jinxiu Dongfang residential district which is just under two kilometres from Zhongshan Coal-fired Power Plant. We often smell an unpleasant smell. The smell is especially strong at night time. We request the government to conduct an investigation into the new expansion of Zhongshan Coal-fired Power Plant.

Another resident from the same residential district reflected that the air pollution is getting more and more serious recently. The residents dare not open their windows at night. The smell of coal-burning is so strong and black smoke is often seen from the chimney of the power plant. There were also residents mentioning that tough stains remain on their cars when parking outside the apartment after rains. The stains were so difficult to clean off that they suspected they were the result of the acid rain.

In response to the resident complaint, the company published a letter on the official website of Huangpu Township. According to the letter, the Zhongshan expansion project started in July 2011. Its environmental impact assessment gained approval from MEP and final approval from NDRC. The project was completely legitimate and was encouraged by the central government. The company had installed highly efficient dust and sulphur control facilities in 2012 and had already passed the completion assessment of EPB. The company was within the state-monitored category which means it had an online monitoring system installed within its unit chimney and received 24-hour monitoring from EPB, therefore, emissions from the chimney were guaranteed to meet the national standards. The company adopted a completely sealed facility and eliminated 99.5% dust, and the de-sulphurisation rate and de-nitration rate reached 99% and 89% respectively. This procedure guaranteed the sound environment around the power plant. The expansion of Zhongshan Coal-fired Power Plant had replaced 127 small units in four townships. The sulphur dioxide emission in the region had dropped from 9700 ton/year to 700 ton/year. Therefore, according to the company's statement, the expansion project had largely reduced air pollution and significantly improved air quality in Huangpu and Nantou townships (Cao 2014, n. p.).

The contradictory statements between the local residents and coal-fired power companies with coal-fired power plant expansion projects were not rare. In Heyuan City, hundreds of residents gathered together to oppose the development of Stage-II of

Heyuan Coal-fired power plant. The residents complained about the deteriorated air quality and discomfort in the throat and lungs since the completion of Stage-I Heyuan Coal-fired Power Plant. Liu Dongbin, member of the National Committee of the Chinese People's Political Consultative Conference (CPPCC), also stated that the air quality excellent days dropped dramatically from 365 days in 2011 to 129 days in 2014 during the Heyuan City two Sessions[20]. Heyuan Coal-fired Power Plant emitted nearly 30,000 tons of sulphur dioxide and nitrogen oxide since production which was a significant contributor to the more frequent and worsening smog problem. However, according to an official document of Heyuan City EPB, from 2011 to 2014, sulphur dioxide, nitrogen oxide and soot emissions of Heyuan Coal-fired Power Plant all met national standards and showed a decreasing trend year by year (Shenzhen City News 2015, n. p.).

The contradictory statements between local residents and official responses over the pollution of coal-fired power plant expansions raised suspicions as to whether bigger and more efficient coal-fired power plant really generated less emission or it just seemingly did so. According to the public relations representative of Zhongshan Coal-fired Power Plant, all the company's pollution control devices adopted advanced technology and guaranteed minimum emissions, however, whether or not the devices were used continuously was in doubt. As a public servant of EPB (web ID: Lantian baiyun zhongkeqi) pointed out on Tianya BBS in 2016, the fundamental reason for China's serious air pollution was the not lack of advanced pollution control devices but companies purposely avoiding using them to pursue maximum profit, and this

[20] Two sessions: the National People's Congress (NPC) and the National Committee of the Chinese People's Political Consultative Conference (CPPCC).

phenomenon was extremely common across the country. Even though EPBs could computer monitor pollution levels through devices installed into some power plants' chimneys, the power plants could avoid using chimneys with the monitoring system, and only using the ones without the monitoring system (Lantian baiyun zhongkeqi 2016, n. p.). Although Zhongshan Coal-fired power plant claimed the plant received 24-hour monitoring from the EPB, it was still possible for it to avoid running its pollution treatment devices. This could be done by bribing the local EPB or the local government. Heyuan City EPB's official response to the pollution problem of Heyuan Coal-fired Power Plant also attracted suspicion, as the local residents' complaints and the CPPCC member's data all indicated worsening air pollution after the completion and running of Heyaun Coal-fired Power Plant. Nonetheless, if the coal-fired power companies did strictly implement all pollution control procedures according its statement and the EPB did provide an accurate report, then the conclusion would be quite outside of expectations. It would indicate that big and more efficient coal power plants still produced large amount of environmental pollution and brought much negative impact to local residents.

The pollution caused by large coal-fired power plants is not limited to air pollution. The improper storage of coal also causes contamination to the surrounding environment. In Changchun City, Jilin province, the manager of Yuquan Bean Product Co., Ltd., Fang Wenjie, complained that each day almost half a ton of dried bean curd had been dyed black due to the coal dust which drifted from the nearby Guodian Jilin Hualong No. 1 Coal-fired Power Plant for the past year. The problem had not been resolved for a prolonged period. Fang approached the city and provincial EPBs multiple times but received no clear response. He got extremely frustrated and decided to seek help from the public media. After the media got involved, the province EPB required Guodian Jilin Hualong No. 1 Coal-fired Power Plant to manage its coal stock within a sealed complex within a time limit, however, the "time limit" was not clearly defined (Hua 2015, n. p.). There is no doubt that coal-fired power plants bring multiple types of environmental pollution and impact on people's livelihood, therefore, the key to minimize such impact is to reduce the production and consumption of coal-generated electricity.

The current reality is, unfortunately, China's national energy consumption is still on an increasing trend. And the proportion of China's coal electricity did not decrease significantly in the national energy structure. By the end of the 12th Five-Year Plan (2015), coal energy still took up 67% of the total national total energy supply. Although it only increased slowly, by 2015, China's coal consumption reached a historical peak of 4.3 billion tons (Wang YC 2016, n. p.). This is to say, to replace small coal-fired power plants with larger ones alone was not enough to combat the associated pollution and climate change consequence. ECERS in the energy sector fulfilled its energy conservation function, but the emission reduction function was still limited. In order to fulfil the emissions reduction task of ECERS, there has to be a bigger proportional increase in renewable energies - big enough in scale to replace coal energy. How to achieve this will be discussed in Chapter 7.

6.2.3 Renewable energy under ECERS

New and renewable energy development under ECERS achieved positive outcomes in terms of growth speed and scale during both the 11th Five-Year Plan (2006-2010) and the 12th Five-Year Plan (2011-2015). During the 11th Five-Year Plan, China's electricity generated from new and renewable energies (including nuclear energy) reached 880 billion KWh in 2010 which was a 91% increase compared with the 460 billion KWh in 2005. It raised the proportion of new and renewable energy generation to 21.1% of the nation's total energy production (Liu GY 2011, p. 11). According to the statistics of the National Energy Bureau, China's new and renewable energy also experienced rapid development during the 12th Five-Year Plan. The capacity of nuclear energy, hydro energy, wind energy and solar energy increased 2.4 times, 1.6 times, 4 times and 168 times compared with the 11th Five-Year Plan achievements (CCTV News 2015, n. p.). At the November 2015 Paris Climate Change Conference, President Xi Jinping displayed China's achievements in new and renewable energies. By the time of the conference, China's installed capacity of renewable energy took up 24% of the world's total, and newly installed renewable energy capacity took up 42% of the world's new growth, which made China the world's number one nation in new and renewable energy development (*China Daily* 2015, n. p.). These numbers were significant, however, the quality and efficiency problems which were often disguised by the glory numbers required much attention. The most significant problem among these was the wastage of renewable energy.

In May 2010, China's State Council announced *Several Suggestions in Encouraging the Healthy Development of Private Investment* (State Council of PRC 2010, n. p.). In early 2012, NEA and the State Electricity Regulatory Commission (SERC) published the detailed implementation methods in regards to the S*uggestions*. Following this, *China Economic Times - Energy Weekly* spent two months conducting numerous interviews with private enterprise CEOs, SOE senior managers and experts and consultants in the renewable energy field for a purpose of realistically displaying the status of China's private enterprises in the renewable energy sector and seeking suitable channels for private investment to enter the industry. The interviews found that many private renewable energy investors in fact faced incredible challenges and struggled to survive (Zhang YM 2012, n. p.). These results echoed the interviews conducted for this thesis: China's renewable energy industry developed fast at a relatively significant scale, however, the quality and efficiency of the entire industry was in question and the private investors face great challenges. Interviewee 14 from CASS explained this situation as follows:

> China's renewable energy development, especially wind and solar power, is in a blind rush. So many projects were approved and large amount of investment was put in. But in the end, many of them were not connected to grids. The ones did connect to grids were often not allowed to operate at full capacity. Many of the investors have experienced enormous financial difficulties.

The slow-down of the global and China's economy determined the decreased market demand for wind turbines and solar panels. In China, private investment performed a leading role in many renewable energy related manufacturing industries, and many of them experienced profit deficit (Shi 2012, p. 21). The major carbon trading body - the European Commission clearly indicated the prohibition on using new-project CERs unless they are from the least developed countries in article 11a (4-5) (European

Commission 2012, n. p.) Obviously, China was not in the category of least developing countries. Without further stimulation of CDM, domestic private investment in renewable energies could not maintain its previous scale and volume. The chain reaction passed onto the renewable energy related manufacturing industry forcing enterprises to either reduce productivity or be pushed out of the industry due to serious competition (Shi 2012, p. 21).

The dismal situation of the related manufacturing industry was fundamentally determined by the less healthy status of China's renewable energy industry. According to the published 2012 semi-annual report of renewable energy listed companies, the whole industry faced survival challenges. Nearly 80% of wind energy enterprises experienced profit deficit. The solar energy even faced entire sectoral deficit (Zhang YM 2012, n. p.).

6.2.3.1 Unfair competition between large energy SOEs and small private investors of renewable energy

Private investors in renewable energies were doing it even tougher as they faced more challenges and obstacles compared with renewable energy companies under large energy SOEs. According to NEA data, private investment in new and renewable energies exceeded 800 billion *yuan* (approximately US$130 billion) in 2012, and its energy production capacity exceeded 49 million KW which took up 18% of the national new and renewable energy capacity (NEA 2012a, n. p.). This percentage was not a small number when considering China's entire renewable energy investment, however, these investors were still not guaranteed a fair competitive environment.

First of all, the government was unwilling to provide specific policy to lower risks for private investors even though the capital requirement in the renewable energy sector was high. Zhao Changwen, senior researcher and Director of the State Council Enterprise Development Research Centre confirmed this point when he was interviewed by a journalist of *China Economic Times – Energy Weekly*.

> The government should provide a fair competition environment for private investors in the energy sector. However, it's up to the investors to conduct long-term strategies and risk assessment. It is a market behaviour for private capital to enter the energy sector, therefore, investors should bear their own risks and losses. It is not recommendable to interfere with private capital gains through policy intervention.

In regards to the government's claim of the fair competitive environment, Interviewee 11, a private owner of a small scale wind farm, expressed his strong disagreement and concerns. He believed the seemingly fair policies such as price sharing of higher renewable energy cost had in fact disguised the unfairness between private small investors and large energy SOEs:

> Some large energy SOEs accept renewable energy projects purely for the purpose of boosting their bargaining power with the government for future traditional energy project opportunities which are of course cheaper and more profitable. They don't care about profit margins or even profit deficit from these renewable energy projects because they have profit from large coal and gas projects to compensate this. Also, investing in renewable energy makes them look good. Meanwhile, we [small private investors in renewable energies] don't have government financial support; we don't have coal or gas power to boost our overall returns; we work hard but we are totally on our own. There is no fairness and we have to cope with it.

What Interviewee 11 described was true as renewable energy projects were indeed not large energy SOEs' focus; their focus was instead traditional thermal and nuclear energy (Liu Y & Kokko 2010, p. 5525). According to Q Wang (2010, p. 706), all large energy SOEs were required by the government to include a certain percentage of non-hydro renewable energy in their portfolio. Moreover, the government's concession wind energy projects were mainly obtained by large energy SOEs. By the end of 2008, SOEs had taken up 97% of the central government's total concession wind energy projects. Only one private company, Farsighted Investment Group Company, had ever won a small concession wind power contract (Liu Y & Kokko 2010, p.5525). This was to say, non-SOEs had been in a weak position at the investment stage when competing for the government's favourable concessions. This situation reflected the hidden unfairness between private investors and energy SOEs in terms of investment conditions and the competitive environment.

Private renewable energy investors not only faced competition from large energy SOEs but were also threatened by the new competition from large grid companies. According to Interview 12, a consultant from Saidi Zhiku Consultancy, one big problem that renewable energy faced was the difficulty in connecting to the grid. Although the government required grid companies to commit full purchase of renewable energies and grid companies did invest large amounts of money to establish a new grid to accommodate renewable energies, there were still 20%-30% of wind power projects not connected to grid (Ye 2013, p. 157). In 2015, the total wasted wind energy proportion in the northwestern province of Gansu reached 43%. Wind power failing to connect to the grid nationwide was sufficient to power Beijing for the whole year of 2015 (*South China Morning Post* 2016).

The monopoly nature of China's grid was the biggest obstacle for private renewable energy investors to enter and play their role. The investment of two major state-owned grid companies in wind energy had made things worse for small private investors. Interviewee 13 explained this situation as below:

> In June last year [2012], Southern Power Grid Holdings announced that they established Southern Offshore Wind Power Joint Development Co., Ltd.. State Grid had done this before Southern Power Grid. This can potentially cause unfair competition. We all know that competition is serious in the wind energy sector, and the grid can only accommodate a certain amount of energy

> generated by wind. Which wind farms would big grid companies give priority to connect to? Their own or some irrelevant small wind farms? The answer is obvious.

The vulnerability that small private investors endured when competing with large energy and grid SOEs was not a good sign for the general efficiency and health of the renewable energy sector. As S Chen, Sun, Tang and Wu (2011, p. 263) pointed out, the sensitivity of investment expenditure of Chinese SOEs was weaker than that of non-SOEs and investment efficiency decreased dramatically if the SOE had special political connections with the government. This echoed the view of Interviewee 11's comment that large energy SOEs did not really concern themselves much about the efficiency and profitability of renewable energy projects. Ironically, the less efficient and less caring SOEs received most resources from the government, while the private investors who genuinely cared about efficiency and profitability got little attention. This seriously contradicted the principle of the market economy. How to correct this situation deserves attention and will be discussed in Chapter 7. Nonetheless, the unfair competition small private investors faced was not yet the biggest weakness of China's renewable energy industry. The real problem was the waste of resources and the associated administrative and policy barriers, especially in the wind energy sector.

6.2.3.2 Waste of resources in the wind energy sector

In 2015, the three regions of northwest China, northeast China and north China abandoned a combined 33.9 billion KW of wind energy (NEA 2016a, n. p.). According to the NEA data, the national average utilisation of wind in 2015 decreased to 1728 hours which was 165 hours less than that in 2014. The abandoning of wind power reached a historical record (NEA 2016a, n. p.). This large-scale abandoning of wind power happened when wind resources were plentiful and wind turbine systems were in good working condition. In response to this problem, NEA officially stated that the limited local energy consumption capacity was the major cause of abandoning of wind power in these regions due to less developed economies and a small population (NEA 2016a, n. p.). Interviewee 1 (NDRC Officer) also mentioned that the unstable characteristics of wind power contributed to the problem: wind farms produce peak load of power over winter months and are stronger during night time, so that the current grid system was incapable of handling it technically (Interviewee 1, 2013).

The above explanations echoed the statements of many grid companies. However, these factors should not constrain the generation of wind power to such extent in China's northern provinces. According to Qin Haiyan, the Secretary General of Wind Power Committee of Chinese Renewable Energy Society (CRES), wind energy did not require as much peak modulation control as some argued, therefore, the so-called "unstable characteristic" should not be the fundamental reason for the abandoning of wind power. This is because peak modulation service is only required when unexpected incident happens causing sudden energy production and consumption imbalance. For instance, a sudden heat wave which pushed up electricity consumption for cooling, a working electricity generator suddenly broke down or a temporary stoppage of an energy intensive factory, these were situations that required peak modulation control and intervention such as increasing or reducing generation from certain generators. While for wind power, although elevated, 80% - 90% of its production is predictable. The only part that requires peak modulation is the prediction deviation which would be quite minor. This is to say, as Qin explained, wind energy production could be easily incorporated into the entire energy generation plan as it was not an unpredictable random energy. It was totally misleading to compare wind energy production to some sudden and unexpected incidents which could break the daily planned electricity balance. Furthermore, wind turbines did not work simultaneously on a wind farm. The larger the wind farm, the more this was so. A 1,000,000 KW wind farm would generate an average of 300,000-400,000 KW electricity during 95% of time of the day, which means a 500,000 KW grid allowance would guarantee accommodation of the electricity generated by a 1,000,000 KW wind farm. Therefore, the generation of wind power took up much less grid resources than people thought (Qin 2016, n. p.).

In China, the true reasons underpinning the so-called "limited local consumption capacity" and "incapability of the grid system" were indeed competiting interests among renewable energy companies, coal-fired power plants, grid companies, provincial governments and the central government. The first reason that wind power could not be fully consumed in China's northern provinces was due to the competition from newly added coal power in the same region which created electricity supply surplus. According to the *Electricity Industry "the 12th Five-Year Plan" Research and Planning Report* conducted by China Electricity Council (CEC), the strategic planning of China's coal power was to be concentrated in the "Three Norths" regions

(Northeast, Northwest and North China) from 2011 to 2020 (CEC 2011, n. p.). According to CEC, it was a strategic plan due to the fact that the majority of China's coal reserves were deposited in the northern regions. Establishing new coal power plants close to coal mines would significantly reduce transport costs and relieve pressure on the rail system. During the 12th Five-Year Plan (2011-2015), 66% of China's new coal power plants would be located near China's large coal mine bases and 63% during the 13th Five-Year Plan (2016-2020). Since 14 out of 16 of China's large coal mine bases were in China's "Three Norths" regions, the "Three Norths" regions would be the main area for hosting China's new coal-fired power plants (CEC 2011, n. p.).

Although wind power and coal power expanded in the same region during the same period, coal-generated electricity had always been smoothly connected to grid, purchased and consumed, and there was not a single newly established coal-fired power plant forced to shut down due to "limited local consumption capacity". This obviously contrasts to the situation of wind power in the same region. The competition between coal power and wind power in China's "Three Norths" regions underpinned the fundamental problem in China's electricity planning. Fast and large scale development of both types of energies within the same region was bound to create a winner and a loser as the energy consumption capacity was limited due the less advanced economy. The facts showed that coal power was the winner and it put a great restraint on the sustainable development of wind power in this region.

This win-lose scenario between traditional coal power and renewable energy reflected Interviewee 11's statement that Large Energy SOEs attached more importance to traditional power projects and their words weighed much heavier than those of private investors. In the large scale abandoning of wind power in China's "Three Norths" regions, private listed companies suffered the most. Yinxing Energy Co. Ltd., for example, was a joint-stock company in Ningxia Autonomous Region, whose core business is renewable energy. Within the last quarter of 2015, Yinxing Energy suffered a great net profit deficit of 100 million *yuan* (approximately US$17 million). The net profit deficit was directly caused by the Autonomous Region Government's administrative restrictions on wind power generation due to the so-called limited grid carrying capacity. To deal with the profit deficit, the major shareholders admitted they had broken their word in achieving the net profit target due to unforeseen and uncontrollable policy and regulation changes, and had to start drafting a cash compensation plan to shareholders (Zhou YX 2016, n. p.).

The restrictions on wind power appeared fatal to many wind power enterprises' survival. Forced to shut down a certain percentage of wind turbines, they would suffer a very negative impact on the revenue performance of renewable energy enterprises. According to Interviewee 13, an analyst specializing in renewable energies,

> The expenditure of wind farms mainly consisted of depreciation cost and finance expenses, which were basically fixed. There wouldn't be significant elevation from quarter to quarter, as a result, if the provincial government

purposely restricts wind power generation, the losses of wind farms would be significant.

In 2015, wind power enterprises in Ningxia were forced to abandon an average 13% of their wind energy production, which wasted a total of 1.3 billion KWh of electricity and wasted 37 times more than in 2014 (NBSC 2016, n. p.). Yinxing Energy also identified that the government restriction on wind power production contributed greatly to its large deficit in the last quarter of 2015. Since October 2015, the government of Ningxia Autonomous Region had used coal power as an engine to drive up the coal mining sector, and the leading coal power enterprises had signed a 30 million ton coal purchase contract with the local coal mines. Meanwhile, the Ningxia Economic and Information Technology Committee announced an administrative order to wind energy enterprises to restrict their energy production by up to 60%; in December, the restrictions on some wind energy enterprises' production reached up to 90% (Zhou YX 2016, n.p.).

The provincial government's preference for coal power was obviously a main contributor to the dismal situation of Ningxia's wind energy industry. To clear this obstacle which restricted the healthy development of wind power, it would require the central government to review the effectiveness of current renewable energy policies and the implementation of the renewable energy law to contain provincial governments' independent decision-making in terms of restricting renewable energy production. But so far, the only action the NEA carried out in dealing with the wastage of wind energy was to ban new wind farm development in Inner Mongolia, Jilin, Heilongjiang, Gansu, Ningxia and Xinjiang in 2016 (NEA 2016a, n. p.). There has no detailed policy in place for the existing wastage problem of renewable energies.

According to Interviewee 14, a professor from CASS, the lack of effective policy in place showed the complex nature of the problem. “It’s not that NDRC doesn’t want to solve the problem, indeed it does not have any good ideas or effective ways to do this. It is simply too complicated a problem involving the interests of too many parties”. This echoed research that conducted by the European Wind Energy Association (EWEA) on the topic of integration of large scale wind power into the European energy supply system: whether or not a significant amount of wind power was accepted by the European power system depended more upon the economics and regulations than technical constrains (EWEA 2005, p.2). This argument also applies to China where the conflict of interests and regulatory barriers are significant.

The second obstacle that restricted the sustainable development of China’s wind power was the disagreements and compromises between the central government and the provincial governments on the planning of wind power. Gansu Jiuquan Wind Power Base was one such example in which the provincial government challenged the central government’s planning decisions for the purpose of more economic gain. Jiuquan City of Gansu province was well-known for its abundant wind resources and it attracted a range of wind turbine manufacturers for its 5,560,000 KW wind power project. After the project was completed, the manufacturing enterprises were ready to move out due to limited market in Jiuquan. However, the Jiuquan city government and the Gansu provincial government both attempted to stop their move by promising more wind power projects. This was because manufacturing industries had always been big tax payers and contributed a significant proportion to provincial and local government's tax income. However, this decision was contradictory to the central government's planning as the central government had no intention of approving further wind projects in the Jiuquan area. No one knows how the Gansu provincial government lobbied the central government for more wind power projects and the details of the negotiation. Nonetheless, the Gansu provincial government was partially successful in these negotiations, in that the central government allowed them to build a further 3,000,000 KW wind farm but imposed the condition that the electricity generated from the new project must be consumed within the Northwest Grid. This condition later became the focal argument of who should be responsible for the wastage of wind power (Qin 2016, n. p.).

The extra wind power capacity built beyond the central government's original planning, although increasing the load for the Northwest grid, should not have led to dramatic restriction and wastage of wind-generated electricity if all relevant actors had followed the *Renewable Energy Law* which gives priority to accommodating renewable energies. Therefore, the third obstacle for wind power in China was the violation of the *Renewable Energy Law*. In 2015, energy consumption in Gansu province decreased due to the overall slow-down of its economy. However, against this background, there were still large numbers of non-renewable energy projects completed and commenced producing electricity. Many existing coal-fired power plants converted into duel-function plants for heating and electricity generation for survival. Decreased market demand and severe competition from other energy sources put extra pressure on wind power. There was a lot of lobbying of the government from vested interests such as the coal mining industry, grid companies, traditional coal-fired power plants and other non-renewable energy production actors (Fenghuang Finance 2015, n. p.). The wind power industry was obviously a loser in this competition. According to Qin Haiyang, cases of local governments violating the Renewable Energy Law were numerous. For instance, Yunnan Provincial Industry and Information Technology Commission issued a directive in November 2016 requiring wind energy companies to share a proportion of their profit with coal power companies if they were to continue production. The Ningxia and Xinjiang autonomous region governments issued direct administrative orders to shut down wind farms. These behaviours were obviously violating the *Renewable Energy Law* and the principle of energy structure optimisation. For the Jiuquan case, if the provincial government and grid companies obeyed the *Renewable Energy Law*, the wind energy utilisation would have reached 1900 hours; however, in reality, the Jiuquan wind power production was limited to 1200 hours in 2015 which was an administrative restriction of 40% of its production capacity (iChina Energy 2016, n. p.). Therefore, how to guarantee the implementation of the *Renewable Energy Law* and introduce clearer and tougher penalties for violating it should be two issues of urgency for the central government. These will be addressed in detail in Chapter 7.

The last factor that contributed to the wastage of wind power was the difficulty of selling wind power to other provinces. China's big energy producing provinces were concentrated in the "Three Norths" regions, however, the economies of these big energy producing provinces were relatively less advanced. As the nation's overall economy slowed down, many of these provinces had an energy surplus, therefore, it was very difficult to sell electricity to surrounding neighbours (Interviewee 14, 2016).

Energy demand of the eastern and southeastern provinces was higher compared to the northern provinces due to their relatively advanced economic status. But the overall slowdown of the global and national economy meant that these provinces were basically self-sufficient in terms of energy supply (Interviewee 14, 2016). Even if local energy could not meet demand, the provincial and local government would prefer to build new power plants within its administrative area so that to burst local economy and employment to deal with such a situation (Wu YP 2008, p. 327). Furthermore, according to the economic analysis conducted by RF Liu, Liu, Zhang, Liu and Chen (2014, p. 63), apart from Xinjiang Uygur Autonomous Region, trans-provincial renewable energy trading in Gansu and Ningxia were not economical with only a limited feasible market. So the questions that should be asked now are: Is exporting a feasible scenario for solving the wastage of wind energy in China's northern regions? Are there other possible solutions? These questions will also be addressed in Chapter 7.

All in all, the real problem of China's renewable energy industry was the less optimistic efficiency disguised by the overall development speed and scale. There were numerous factors which contributed to this problem. The central government purposely created a "favourite child", the large energy SOEs, which made it difficult to establish a fair market environment. The traditional coal power and coal mining industry actively lobbied provincial and local governments to maintain their existing interests, which pushed aside the relatively new non-hydro renewable energies in the market place. Some provincial and local governments purposely violated the *Renewable Energy Law* and used administrative orders to restrain the operation of renewable energy companies, which sent many renewable energy companies into bankruptcy. President Xi Jinping proposed that by 2030, China's non-fossil fuel generated energy and fossil fuel energy ratio should be 1:5. China is working towards this goal by building up its renewable energy capacity. However, a large proportion of the capacity was not utilised and a large amount of renewable energy was wasted. There is no point building up the capacity but leaving it unused as it is a waste of money and resources. To fundamentally solve the problem of the wastage of renewable energy, China needs to review its current policy approach and work out two major strategies. First, how and where will renewable energies be consumed. Second, what are the appropriate penalties and how can they be effectively implemented for the violation of the *Renewable Energy Law*? These will be some of the focal points of Chapter 7. In the following section, analysis will be continued focussing on ECERS for energy consumers.

6.3 ECERS for energy end users

China is still in the process of industrialisation and urbanisation, and as a result, has a high reliance on energy intensive products for its major infrastructure. Steel, cement and building materials produced by heavy industry all consume a large amount of energy. Some of China's light industry, such as textiles, as a major exporting good, also consume a significant amount of energy (Liu C, Kong & Gao 2008, p. 1290). Therefore, ECERS also aimed to improve energy efficiency in these big energy consumers. The majority of China's energy conservation and emission reduction programs covering these big energy consumers were implemented through administrative measures. It was very similar to the previously mentioned coal power sector. It started with the central government setting up national energy intensity reduction targets for each sector and allocating reduction tasks for all provincial districts (State Council of PRC 2006, n. p.). Following this, each provincial government distributed responsibilities to high energy consuming enterprises within its administrative territory, especially within large SOEs who had potential to reduce energy intensity through technological innovation. For medium and small scale energy intensive enterprises who could not pass cost and benefit analysis for technological upgrades, the government would issue them administrative orders for closure and provide relevant compensation (Ye 2013, pp. 224-230).

6.3.1 The overall effectiveness of the administrative approach

Again, similar to the thermal power production sector, the implementation of these administrative measures was relatively smooth. This was partially due to the effectiveness of China's target responsibility system for officials and reinforced by attractive financial rewards. On one hand, the implementation results of ECERS were important indicators for the annual performance review of personnel in charge of the large SOEs and tied to local and provincial government officials' promotion decisions (Ye 2013, p. 280; Kostka 2016; A Wang 2013; Heberer & Senz 2011). As a result, senior local and provincial officials and large SEOs' responsible persons who wished to be promoted in their political career, most of whom did, would make sure their energy conservation and emission reduction targets were made. One the other hand, the government allocated sufficient financial fund for enterprises' technological upgrades which was a great incentive for enterprises to actively conduct their energy saving projects. In August 2007, *The Temporary Management Method for Energy Saving Technological Upgrade Financial Reward Fund*, issued by NDRC, stated the energy saving cash reward standards for both the eastern and western provinces. The enterprises in the eastern provinces were to be rewarded 200 *yuan* (approximately US$33) for saving each ton of coal equivalent from installing or upgrading energy saving equipment. For western provinces, it was 250 *yuan* (approximately US$42). In June 2011, NDRC raised the cash reward standards in the *The Management Method for Energy Saving Technological Upgrade Financial Reward Fund* to 240 *yuan* (approximately US$40)/tce for eastern provinces and 300 *yuan* (approximately US$50)/tce for western provinces (MF 2011, n. p.). The cash reward was very attractive to enterprises, especially those with big energy saving potential. According to Shen Hailong, President of China Energy Conservation Enterprise Association, Senior Consultant of Energy Research Centre of NDRC, the energy saving amount of some enterprises was significant which could reach up to tens of thousands tces. For instance, an average saving of 100,000 tce, would entitle an enterprise a 30,000,000 *yuan* (approximately US$5,000,000) cash reward from the government.

6.3.2 Problems with the ECERS cash rewards

The significant amount of cash reward did encourage many intensive energy consumers to take action towards energy conservation and emission reduction, especially those large SOEs under close supervision of central and provincial governments, however, there were some enterprises conducting fraudulent claims for cash rewards for emission reductions they had not achieved (Hu 2011, n. p.). This cheating behaviour often happened at the township and village level far from the reach of the provincial and central government, where effective auditing was lacking and corruption was common.

For instance, an officer of a county Economic Development Office under the Chongming Township, Shanghai, fraudulently claimed over 10,000,000 *yuan* (approximately US$1,800,000) for a small chemical factory and a small paper mill within the county. Both factories were closed long before due to poor management and outdated facilities, however, the Economic Development Office staff and the owners of the two closed factories attached fake electricity bills to their application and successfully obtained the funds from the government (Cong & Cuo 2012, n. p.).

Shandong Province Zaozhuang Cement Waste Heat Utilisation Project fraudulently claimed 8,000,000 *yuan* (approximately US$1,300,000) for a technology upgrade and 2,450,000 *yuan* (approximately US$410,000) cash reward without even conducting the project. According to relevant documents, the project was located in Zhangshanzi County Houmeng Village had gained the central and provincial NDRC's approval in April 2008. But it was not until 4 years later that a small shareholder realised the project had never commenced when the project's business license was suspended (He 2012, n. p.).

These were not the only cases. On the 13 May 2011, the Audit Commission announced the 2007-2009 auditing results, 40 enterprises either fraudulently claimed energy conservation and emission reduction funds involving a total of 205,000,000 *yuan* (approximately US$34,000,000) (Chen YY 2011, n. p.). Although this amount was small compared with the total national input of 124,187,000,000 *yuan* (approximately US$20,837,400,000), it only represented the fraudulent claims which were discovered by the auditing organisations. More fraudulent cases that were not uncovered could not be eliminated. The government realised the seriousness of the problem and actively explored more sophisticated auditing options for ECERS during 12th Five-Year Plan (2011-2015).

6.3.3 The introduction of third party auditing body

During the 11th Five-Year Plan (2006-2010), the majority of enterprises' energy savings were monitored and audited by their own energy conservation management offices. Although enterprises had the choice to conduct energy saving auditing through a third party, around 70% of major enterprises chose to do it by themselves and submitted reports to provincial government periodically. After this, provincial energy conservation authorities would arrange professionals to carry out collective auditing to the energy conservation reports that enterprises handed in to evaluate their legitimacy (Ye 2013, p. 280). Once this was completed, cross auditing among provinces would be carried out. For instance, the energy saving auditing department of the Beijing government might audit the enterprises in Guizhou province; and the Guizhou auditing department might audit the energy saving results of enterprises in Shanghai (Hu 2011, n. p.). One problem with cross auditing was the lack of unified standards. Two different auditing departments conducting auditing on the same enterprise might end up with different results. Therefore, it was urgent to introduce a range of qualified third party auditing bodies with unified national energy saving auditing standards (Hu 2011, n. p.).

On 27 September 2011, NDRC announced a list of 26 auditing organisations. Among this first group of national qualified certifying companies, eight were government institutions, four were accounting firms, and the rest were industry intermediary companies (Ye 2013, p. 281). These third party auditing bodies performed the second last check up for enterprises' energy saving data. After this was conducted, NDRC, MF would organise an expert committee to perform final reviews to the third party auditing results. Despite the fact that the government has put effort to improve auditing capacity and procedures, the number of China's third party auditing bodies was not yet in proportion to the large number of enterprises with energy saving tasks. Nonetheless, it was a positive start for a more transparent auditing system and would form a more realistic foundation for Chinese enterprises energy saving evaluation. Some suggestions will be proposed in Chapter 7 for improving auditing quality of energy saving and emission reduction. Suggestions on preventing fraudulent claims will also be given in Chapter 7.

6.3.4 Energy Performance Contracting (EPC) in China

Apart from introducing the third party auditing organisations, the Chinese government also actively experimented with market options to encourage enterprises' energy saving and emission reduction. EPC was the market mechanism that the Chinese government promoted. EPC originated in Western developed countries in the 1970s which utilised the market to promote energy saving through a technological upgrade and advanced energy management system. It usually involves an Energy Service Company (ESCO), which tailors an energy saving strategy for its clients (usually inefficient energy users). After the project is implemented, the client will repay ESCO's investment and cover its profit, with the funds obtained from energy saving. Therefore, EPC in this sense was an investment method for energy saving projects (Deng & Qi 2012, p.1). According to the European Commission Joint Research Centre on Energy Efficiency (2016, n. p.),

> The approach [EPC] is based on the transfer of technical risks from the client to the ESCO based on performance guarantees given by the ESCO. In EPC ESCO remuneration is based on demonstrated performance; a measure of performance is the level of energy savings or energy service. EPC is a means to deliver infrastructure improvements to facilities that lack energy engineering skills, manpower or management time, capital funding,

understanding of risk, or technology information. Cash-poor, yet creditworthy customers are therefore good potential clients for EPC.

EPC was first introduced to China as a concept roughly twenty years ago, and therefore had a relatively short development history (Zhang XH, Li & Chen 2011, p.1377). In China, EPC was also referred to as Energy Management Contracting (EMC) and was regarded as an advanced energy saving model. Companies who provided energy management services were described as 'energy saving doctors'. This was because they could 'diagnose' clients' specific energy problem, provide 'prescription' and 'treatment' methods and eventually cure the energy inefficiency (NDRC Foreign Capital Department Yahang Technology Support ECER Research Group 2009, p. 56).

6.3.4.1 Three developmental stages of EPC in China and major policies

EPC in China had gone through three development stages which roughly paralleled with the 10th (2000-2005), 11th (2006-2010) and 12th Five-Year Plan (2011-2015). In the initial stage, the Chinese government focused on introducing the concept of EPC and conducted a range of preparation work such as bringing in international funds and setting up demonstration ESCOs. In June 2000, the former State Economic and Trade Commission announced *The Notification for the Further Promotion of EPC*, which was the first official document announced by a central government ministry on the promotion of EPC (EMCA 2010, n. p.). In 2003 a national association for the ESCO industry was established, namely the ESCO Committee of China Energy Conservation Association (EMCA). EMCA received support from NDRC, DF, the World Bank (WB) and Global Environment Facility (GEF), and had a mission of promoting the new mechanism EPC and facilitating the sustainable, fast and healthy development of Chinese ESCOs (EMCA 2016, n. p.). Following this, three ESCO pilots were established including Beijing Yuanshen Energy Saving Technology Co., Ltd., Liaoning Energy Saving Technology Development Co. and Shandong Energy Saving Engineering Co. Ltd.. The three ESCOs received a total of US$63,000,000 low interest loan from the WB as circulating fund and a combined US$27,000,000 donation from the European Commission and GEF. By the end of 2006, the three demonstration ESCOs completed 450 EPC projects with total investment of over 600,000,000 *yuan* (approximately US$100,000,000) (Deng & Qi 2012, p. 2).

In the second developmental stage, the government focused on identifying the targeting fields of EPC and making EPC a formalized and systematic industry. For instance, on 14th February 2006, NDRC, Government Offices Administration of the State Council, MF, Central Administration of Management and PLA General Logistics Department jointly announced the *Notification on the Reinforcement of Resource Saving within Government Organisations*, which clearly required government organisations to employ professional ESCOs to conduct energy saving renovation and optimised energy management in order to achieve energy efficiency improvement (The Central People's Government of PRC 2006a, n. p.). On 4 July 2006, the Office of the Ministry of Construction (MC) released *The Outline of City Green Lighting Program during the 11th Five-Year Plan*, which raised to utilise EPC in undertaking city lighting renovations. It encouraged local governments to employ professional ESCOs in performing a range of comprehensive services such as project design, procurement, construction, training, operation, maintenance, energy efficiency monitoring and auditing for infrastructures (Office of MC 2006, n. p.). The central government also paid much attention to providing opportunities for ESCOs' to grow and improve their services. On 7 April 2006, NDRC and several other departments jointly released *The Notification about the Implementation Plans of A Thousand Enterprises' Energy Saving Activities*. The *Notification* proposed to establish a professional energy saving service system through EPC. The ESCOs in this category would provide one-stop service for the one thousand enterprises including energy inefficiency diagnosis, financing, design, construction, project operation and management (NDRC 2006, n. p.). The numbers of Chinese ESCOs increased relatively fast from 76 in 2006 to 782 in 2010 because of the supporting policies (Wang XL 2011, n. p.). However, within this stage, the central government did not provide cash rewards for ESCOs' energy saving achievements and only required local government to provide moderate prizes for outstanding ESCOs as encouragement (MC 2005, p. 55).

The Chinese government started to actively promote EPC and identified EPC as a very important channel for ECERS during the 12th Five-Year Plan, which was regarded as the third developmental stage of EPC in China. Several important EPC policies in regards to financial rewards and tax benefits were announced and implemented, which would have a significant impact to the development of China's ESCO industry.

On 2 April 2010, the State Council approved *NDRC and Fellow Departments' Recommendation on Speeding up EPC and Suggestions in Promoting ESCO Industry Development*, in which cash rewards and tax breaks were proposed for qualified ESCOs. Meanwhile it encouraged banks and other financial institutions to invest in new credit products suitable for ESCOs and to simplify the loan application process (State Council of PRC 2010a, n.p.). Three domestic banks, Export-Import Bank of China, Huaxia Bank and Minsheng Bank were appointed to circulate US$400,000,000 worth of international funds in order to better serve Chinese ESCOs' financing needs (Liu YY 2011, n. p.). *The Recommendation* also set up China's EPC developmental targets by stages. It suggested, by 2012, a range of professional ESCOs with specialty should be established, among which large and comprehensive ESCOs should be in proportion. A healthy, orderly and lively energy service market should also be established by then. By 2015, EPC should become one of the major procedures for energy end users' energy saving upgrades and renovations. A relatively complete energy saving service system should be established, where ESCOs become stronger and able to provide broader services in broader areas (State Council of PRC 2010a, n. p.).

On 3 June 2010, MF and NDRC jointly announced *The Temporary Management Method for the Financial Reward Fund of EPC Projects*, which stated the detailed amount of cash rewards for qualified ESCOs. To be qualified, an ESCO's contracted project needed to achieve an annual energy saving between 100 tce and 10000 tce (Industrial projects needed to be between 500 tce and 10000 tce). For qualified projects, the central government would reward the responsible ESCO 240 *yuan*/tce (approximately US$40), and local government should provide no less than 60 *yuan*/tce (approximately US$10) to the same ESCO. NDRC and MF would conduct continuous monitoring and management for qualified ESCOs and made the list of qualified ESCOs and their business scopes public (MF & NDRC 2010, n. p.). This policy largely accelerated the development of the Chinese ESCOs industry, however, it also planted hidden burdens similar to that of the energy saving and emission reduction cash rewards directly distributed to enterprises. Fraudulent, unlawful and exaggerated claims appeared to be a big problem during the implementation, and this will be discussed later in this chapter.

Apart from cash rewards, MF and State Taxation Administration (STA) announced the *Notification Value Added Tax, Business Income Tax and Enterprise Income Tax Policies for Promoting ESCO Industry* on the 30 December 2010. This policy temporarily exempted business tax and value added tax for qualified ESCOs; it also exempted the first three year's business income tax (counting from the first business income gain) for qualified ESCOs and charged only half of the statutory tax rate from the fourth year to the sixth year. To be qualified for the tax benefit, the technology and the contract of an EPC project should be strictly in accordance with the *General Technical Rules for EPC* released by State General Administration of PRC for Quality Supervision, Inspection and Quarantine (AQSIQ) and Standardisation Administration of PRC (SAC). This policy was implemented from the 1th of January of 2011 (MF & STA 2010, n. p.).

Nonetheless, EPC, as a relatively new phenomena, experienced high speed development during the 11th and 12th Five-Year Plan periods (2006-2015). According to EMCA statistics, China's EPC investment increased from 1,300,000,000 *yuan* (approximately US$217,000,000) in 2005 to 55,700,000,000 *yuan* (approximately US$9,300,000,000) in 2012, and the total output of EPC industry increased from 4,700,000,000 *yuan* (approximately US$80,000,000) to 165,300,000,000 *yuan* (approximately US$27,500,000,000) during the same period which led to a 34 fold growth of the EPM market. By the end of 2012, there were a total of 4175 Chinese ESCOs nationwide, whose EPC projects realised a total of 18,280,000 tce energy saving and reduced 45, 710,000 tons of CO_2 emission (China Environmental Protection Online 2013, n. p.).

6.3.4.2 Successful examples of enterprises utilising EPC for energy saving

The fast development of EPC proved to be an effective mechanism and brought much benefit to enterprises which utilised this service in their energy saving activities, and especially to medium to small enterprises who lacked technological capacity and capital but had great potential for energy savings. Many successful examples had reflected the advantages of this new mechanism.

Case 1: EPC between Jiaxing Shengdi Lighting Technology Co., Ltd. and Yicheng Textile Co., Ltd.

In 2013, Yicheng Textile Co., Ltd. of Xinteng township completed its lighting system renovation under a EPC agreement with Jiaxing Shengdi Lighting Technology Co.. By completion, 1250 sets of fluorescent lights in the workshop were replaced with LED lights. The new lighting system will save over 60% of electricity compared with the old system. The good thing about the EPC was that Yicheng Textile Co., Ltd. did not have to pay anything upfront for the renovation; and Jiaxing Shengdi Lighting Technology Co. would recoup its investment and extract profit from Yicheng Textile Co.'s energy saving fund within three years.

According to the manager of Yicheng Textile, lighting used to cost the company about 150,000 *yuan* (approximately US$25,000) a year. The fluorescent light bulbs also needed to be changed two to three times a year which increased the cost. The LED lights that Shengdi Lighting provided would use 60% less energy and would last over 25,000 hours, which meant a big energy saving and significantly smaller electricity bills for Yicheng Textile. According to the contract between the two companies, Shengdi Lighting would pay for the entire cost of the renovation of 160,000 *yuan* (approximately US$28,000) upfront; and Yicheng Textile would repay Shengdi Lighting's entire project costs within three years from its energy saving with the first year 90% of its saving, the second year 80% of its saving and the third year 50% of its saving. By the end of the three years, all the LED lighting would belong to Yicheng Textile. These two companies created a win-win solution through EPC. More importantly, Yicheng Textile's annual energy saving meant they avoided burning 42.5 tons of standard coal each year which brought positive CO_2 emission reduction and contribution to global climate stability (Alighting 2013, n. p.).

Case 2: EPC among Shanxi Qinling Cement (Group) Co. Ltd., Siemens IA&DT and a Shanxi ESCO

Shanxi Qinling Cement (Group) Co. Ltd. (Qinling Cement) has a history of over half a century and is one the China's top 60 significant cement enterprises. Cement is an important material for China's infrastructure and urbanisation, however, it consumes a large amount of electricity. Qinling Cement faced a great challenge in technological upgrade in achieving energy saving and emission reduction. Siemens spotted that China's Cement industry faced more urgent needs for energy saving compared with other industries, therefore, it led the renovation project of replacing Qinling Cement's fixed frequency kiln fans through EPC with a local Shanxi ESCO.

The old kiln fans at Qinling Cement consumed 30-40% of the factory's total electricity and were designed to run at full capacity at all times. Upgrading to Siemens' frequency conversion fans would mean a significant amount of energy saving. Siemens assisted Qinling Cement in conducting detailed technological and feasibility analyses prior the EPC, and the contract was signed successfully at the end of 2007 with the involvement of a local ESCO in Shanxi. The ESCO spent all the upfront cost in purchasing the Siemens frequency conversion fans and loaned them to Qinling Cement. During the contract term, Qinling Cement would repay the ESCO with part of the savings from its reduced energy bills. By the completion of the EPC, Qinling Cement were entitled to keep the fans, the ESCO recouped its investment and made profit, and Siemens increased its sales. This was a triple win scenario as Siemens and the ESCO both made a profit and Qinling Cement would continue saving money from new fans and reducing energy consumption and CO_2 emission (Zhang WY & Yin 2009, pp. 50-52).

The above examples indeed reflected the advantages of EPC and proved the feasibility of EPC in China's ECERS. With support from the central government and the diversification of funding sources, EPC gradually got known and recognized. However, there are some factors that restricted the large scale expansion of EPC in China. In the next section, these factors will be discussed.

6.3.4.3 Factors that restrict the flourishing of EPC in China

EPC, as an effective market mechanism for energy efficiency management has spread across multiple sectors since its introduction to China by the WB in 1996. EPC projects now cover China's industrial sector, heating, cooling and lighting of the building sector, and the transport sector. However, according to Tang and Zou (2013, n. p.), EPC should have expanded to a larger scale than it has since the government utilised EPC as one of the important market tools to achieve the ECERS results. Currently, there were some obstacles that restricted the flourish of China's EPC industry, namely ESCOs' financing difficulty, the under developed risk analysis system and difficulty in finding suitable projects.

Financing difficulty was widely experienced by many ESCOs and especially small ESCOs. According to Ju U Neng (a service platform for energy efficiency monitoring and data collection) data, over 70% Chinese ESCOs faced some sort of financing challenge (Ju U Neng 2015, n. p.). One of the characteristics of EPC was that in the majority of cases ESCOs were responsible for upfront financial input and only harvested profit after the projects' completion and clients' financial gains from energy saving. As a result, it was a long-term process for ESCOs to recoup their total investment and gain profit, which usually lasted several years depending upon individual contracts. If the contract term was especially long, it might put financial stress on ESCOs. Trying to solve the financial difficulty through banks was not easy either as the majority of Chinese ESCOs were medium to small in scale and therefore lacked of assets such as land and real estate that banks require for loans against collateral (China Environmental Protection Online 2013, n. p.).

Another risk that ESCOs face was whether or not they could fully recoup their investment. The nature of EPC is that an ESCO and an energy end user realise benefit sharing through a contract, therefore, the possibility of breaking a contract exists. Therefore, it requires an ESCO to be extra cautious when selecting clients. On one hand, there is risk associated with the credit of the energy end user. If the energy end user experienced bankruptcy before the term, an ESCO will be unable to recoup its total investment and bear financial loss. Moreover, the majority of EPC terms are quite long, which amplifies this potential risk. On the other hand, an ESCO also bears a range of risks such as financial risks, design and technological risks and the quality risks of equipment and materials passed down from its suppliers. Any of these risks may put an ESCO into a difficult position and cause dispute with its clients (Song, Zeng & Long 2011, p. 36).

Although selecting reliable clients can reduce ENCOs' risks, this is not an easy task. This is because most large enterprises with reliable credits already have the financial and technological capacity in conducting energy saving on their own; while many small enterprises that need EPC have problems such as hard to predict energy consumption and unstable energy saving during the fluctuation of the market and their operation, which makes it risky for ESCO's investment return (Ju U Neng 2015, n.p.).

Currently, a favourable credit environment and atmosphere for EPC was lacking. The Lack of trust became the biggest restriction for the development of EPC. Some enterprises worried that ESCOs' technology could be unreliable; while ESCOs were concerned that enterprises might find excuses for delaying repayments after the EPC was implemented (Wang SM 2008, p. 22). In order to target this issue, the Chinese government should investigate how to lower risk for both ESCOs and energy saving enterprises and to build up trust between the two bodies. This will be discussed in Chapter 7.

Apart from the above challenges, some ESCOs themselves posed obstacles for the healthy development of the Chinese EPC industry. According to NDRC's review on the 2010 EPC financial reward claims handed in by all localities, the exaggeration of energy saving amounts was one of the biggest problems. There were also other problems such as the amount of energy saving was not within the reward category, the technology used was not supported by the cash reward scheme, rewards taking up too big a proportion of the entire investment or the contract was signed long before the policy was implemented. In regards to these problems, NDRC and MF jointly announced the *Notification on Further Reinforcing the Supervision and Inspection of EPC Projects* on 20th July 2011. The *Notification* required local energy saving departments to liaise with local finance departments in conducting immediate onsite inspections to EPC projects within their administrative regions. The inspection should check the following aspects of EPC projects strictly according to MF's relevant documents and criteria: the authenticity, the total energy saving amount, technical and economic index, the time of contract signed, and the detailed content and procedures of the EPC projects. Local energy saving departments and finance departments should be responsible for the inspection, while ESCOs and third party auditing organisations should be responsible for the authenticity of the information they provided. ESCOs were required to return all cash rewards if they were found providing false information or cheating. ESCOs were required to return partial cash rewards if they were found exaggerating their energy saving amounts. Any ESCOs and third party auditing organisations which submitted fraudulent claims would be disqualified from business (NDRC Office & MF Office 2011, n. p.).

The financial reward scheme for qualified ESCOs was implemented through the majority of the 12th Five-Year Plan. The unlawful claims from many ENSOs shook the government's decision on the continuation of ESCO financial reward policy. On 2 May 2015, MF announced the abolition of cash rewards to ESCOs together with the abolition of cash rewards for phasing out backward production capacities in the new

Temporary Management Method for Energy Saving and Emission Reduction Financial Reward Fund [Finance & Construction 2015 Document No. 161]. By now, qualified ESCOs only enjoy tax benefit but no more cash rewards (MF 2015, n. p.).

The development of EPC in China was relatively fast but not yet on the same scale as Western developed countries. From China's evolving EPC policies we could spot that EPC faced similar problems with other ECERS programs. For instance, fraudulent claims of government cash grants could not be eliminated even through ESCOs. As a result, the government's financial input could not achieve full capacity in energy saving and emission reduction. That was why the government decided to abolish the general cash rewards scheme for the 13th Five-Year Plan and only provided funding for specific projects within the government's specific targeted areas (MF 2015, n. p.). In order to address the cost-effectiveness of ECERS, the Chinese government should pay more attention to new mechanisms that can avoid or at least reduce fraudulent claims and corruption. Discussion of one possibility of such an innovation will be presented in Chapter 7.

6.3.5 The effectiveness of ECERS

The command and control implementation procedures in ECERS can be described as effective overall, however, they were considerably more expensive than policies utilising market based instruments. According to Qi (2013a, p. 234), China's command and control style domestic ECERS was 10 times as costly as CDM projects for each unit of CO_2 emission reduction. In developing countries, CDM costed from several US dollar up to 20 US dollars for each ton of CO_2 reduction, while in China's domestic programs, it costed an average 1416 *yuan* (approximately US$220) during the 11th Five-Year Plan. It was obvious that the efficiency of China's domestic ECERS did not match the international market mechanism CDM. The Chinese government also realised the costly nature of administrative measures and actively experimented with market mechanisms such as domestic CDM and EPC. Although these two market mechanisms are not yet mature in China, it deserves thorough investigation of whether or not a combination of the two mechanism could bring some effectiveness and efficiency improvement to ECERS. This will be explored in Chapter 7.

6.4 Conclusion

Overall, ECERS contributed to China's energy structure optimisation and climate change mitigation positively. It solved tough problems such as the closure of small inefficient thermal plants within a short period of time. This is a powerful aspect of China's administrative system; the policies in this area also appeared to be innovative and effective. However, there were cases of inadequate compensation and unfair treatment of laid-off workers which need to be addressed. There were also a range of weaknesses exposed during the implementation of ECERS. Fraudulent claims of cash rewards for unachieved energy-saving and emission reduction is a serious problem. It not only wasted financial resources, but also shook the accountability of ECERS.

Small- and medium-scale renewable energy companies experienced considerable challenges compared with those under big energy SOEs. There were also cases of provincial and local governments who seriously violated the renewable energy law by giving priority to coal power, thus restricting power generated from renewable energy sources. The unfair competition and market environment was detrimental for the long-term sustainability of China's renewable energy development. In order to improve the transparency and efficiency of ECERS, the Chinese government introduced the third party auditing organisations and the market mechanism EPC, however, they could not fundamentally eliminate false reporting and fraudulent claims of cash rewards. These problems seriously damaged the overall accountability of ECERS and pushed up the total cost of China's domestic energy saving and emission reduction, and therefore, deserve in-depth study and careful consideration. In the next chapter, I will identify the implications of and provide some recommendations for the problems mentioned in this chapter along with those raised in Chapters 4 and 5.

Chapter 7

Implications and future outlook

7.1 Introduction

So far, this thesis has carried out major analyses in Chapter 4, 5 and 6. Chapter 4 focused on analysing the actors involved in China's climate-related energy policies and their roles in shaping the policy. Chapters 5 and 6 focused on two parallel policies which have great impact on China's climate change mitigation, namely the international CDM and the domestic ECERS. Through these three major analysis chapters, a range of conflicts and deficiencies have been identified among relevant actors, and the strengths and weaknesses of the two major policies have also been pointed out. In this chapter, recommendations will be provided based on the analyses in Chapters 4, 5 and 6 in order to address the deficiencies raised. This chapter includes three major sections. Section 7.2 addresses problems raised in Chapter 4; Section 7.3 addresses problems associated with China's CDM which were discussed in Chapter 5; and Section 7.4 deals with deficiencies of ECERS analysed in Chapter 6.

7.2 Importance of empowering China's climate change actors

Chapter 4 of this thesis analysed the ‘who’ factor in Chinese climate-related policies. The government, the think tanks, the enterprises and the public were all involved in China’s climate affairs to varying degrees. As an authoritarian state, the Central Government of PRC undoubtedly plays the leading role in the making of climate-related policies. However, several issues needs to be addressed in order to improve the coordination in developing sensible and effective climate policies, namely the overlapping authorities among relevant departments within NDRC, conflicts between MEP and NDRC, and competition of interests between MF and NDRC. The expert community played an increasingly important role in China’s climate-related policy formation. Expertise had been absorbed from broader sources including non-official and overseas experts. However, expertise in climate change mitigation still needs to be strengthened at the provincial level. Energy enterprises are important actors who are not just the implementers of relevant climate-related energy policies. Powerful SOEs also influence the formation of the policies through bargaining with the government. Newly emerged private renewable energy companies are also playing a more important role in climate change mitigation and the research and development of climate-friendly technologies. Therefore, it is important to provide incentives and support to these actors so that they are confident for more ambitious emission mitigation. The involvement of civil society and the general public in China’s climate affairs is still limited, but it is increasing with the broadening usage of internet and social media. There are many restrictions on the development of civil society in China. However, in order to guard environmental integrity, China’s civil society should be strengthened. In order to address the above issues and to empower China’s climate change actors this section will draw out some useful implications.

7.2.1 A joined-up government approach for better coordination among climate-related government departments

The development of climate change-related policies is complex and requires involvement and coordination between multiple departments within the government. As mentioned in Chapter 4, China's climate policy is led by NDRC - the most powerful ministry within the central government. However, there are overlapping tasks among three relevant departments within NDRC, the Department of Climate Change[21], namely the National Energy Administration and the Department of Resource Conservation and Environmental Protection. The overlapping tasks have affected the overall efficiency of the development of climate-related policies and the supervision of policy implementation. The conflicts between MEP and NDRC and the competition between MF and NDRC are also obvious. In order to overcome these deficiencies, this thesis suggests a whole-of-government (WG) approach for China's climate-related policies.

Whole-of-government (WG), earlier known as joined-up government, was first proposed by the former UK Tony Blair government in 1997. It aimed at tackling complicated problems and policies across departmental boundaries (Richards & Smith 2006, p. 187). According to the report *Connecting Government: Whole of Government Responses to Australia's Priority Challenges* conducted by the Australian Management Advisory Committee, "whole of government denotes public service

[21] Prologue: the Department of Climate Change was moved out of NDRC in 2018.

agencies working across portfolio boundaries to achieve a shared goal and an integrated government response to particular issues" (Australian Public Service Commission 2004, n. p.). The WG approach can be delivered in a formal or informal manner across traditional departmental and hierarchy boundaries, but there has to be obvious benefits such as efficiency improvement and resource saving. The WG approach is not usually used for routine and straightforward issues. Instead, it is more suitable for complex and persisting policy issues, or the "wicked problems", which often challenge the traditional bureaucratic boundaries and routines (Australian Public Service Commission 2004, n. p.).

The WG approach is a suitable approach for the Chinese government in the development of climate-related energy policies. This is, firstly, because WG can optimise both horizontal coordination among central ministries and vertical coordination between central ministries and their provincial and municipal branches without shovelling around the existing bureaucrats (Christensen & Lægreid 2007, p. 1058). As the analysis in Chapter 4 pointed out, it is currently not feasible for MEP to take over the responsibility of climate change from NDRC, nor is it possible to rearrange the departmental structure within NDRC. As a result, a system that enhances multi-dimensional coordination is needed, and WG fits this criteria. Secondly, the Chinese government is capable of pursuing a WG approach. The WG approach requires a strong central government for effective coordination and supervision (Richards & Smith 2006, p. 187). For China, the strong central control enables the implementation of WG. In fact, there are already elements of WG approach on climate-related issues within the Chinese government such as the establishment of National Leading Group on Climate Change which chaired by the

Premier and included most ministers. However, the National Leading Group's work is more symbolic than practical. WG in climate change and the energy domain needs to be applied to detailed policies and programs, and specific operating procedures of the approach should be defined and made clear to relevant ministers and departments.

As mentioned in Chapter 4, the three departments within NDRC were responsible for energy and climate policies, National Energy Administration (NEA), Department of Climate Change (DCC) and Department of Resource Conservation and Environmental Protection (DRCEP). The work of each department has its specialty but is also interconnected. However, currently the three departments mainly conducted their work individually. NEA focuses on national energy planning; DRCEP emphasises on energy conservation; and DCC works on the abatement of CO_2 emission. The lack of interaction among the three departments dramatically reduces efficiency. Three departments produced three similar sets of documentations with slightly different criteria, which increased the workload at both the central level and the provincial level.

In order to improve efficiency, the thesis suggests the establishment of a framework that enhances departmental coordination. An evidence base for this approach can be drawn from Australia. The Council of Australian Governments (COAG) institutional framework is a successful example which provides good initiatives towards the WG approach. The COAG hosts a forum twice a year for intergovernmental collaboration and decision-making on key national priorities. Mid-level public servants also meet and collaborate in between this across all departments (COAG 2017, n. p.). The National Water Initiative (NWI), for example, is one WG approach towards the better management of Australia's water resources under COAG. It included more than 40 Commonwealth–state ministerial councils and worked effectively towards improving water usage efficiency, directing investment, and balancing between the needs of the communities and the environment (Department of Agriculture and Water Resources, Australian Government 2017, n. p.).

For China, it is recommended to establish a similar institutional framework towards the WG approach. The National Leading Group on Climate Change already filfull similar function to the high level forum of COAG. However, there is need for setting up a network of smaller forums with each focusing on its special tasks. By doing so, the forums can stay focused on individual policy areas. The climate change forum could be one component of the national WG framework. It can provide the opportunity for the climate-related central departments and provincial governments to work together and conduct collaborative work plans. Specifically, the three departments mentioned earlier should produce a more comprehensive report on China's overall energy, energy conservation and climate change mitigation plan through such a framework. For instance, NEA and DCC can make co-decision on the national energy plan and emission reduction target for the energy sector. Based on these targets, DRCEP can join in to work out detailed energy conservation target, and can work especially closely with DCC for emission reduction strategies. The collaboration can be carried out through a series of formal and informal meetings. Formal meetings are planned with set schedules where other stakeholders such as energy and climate change experts, industry leaders and personnel from other ministries are also invited. Informal meetings such as video meetings and email communication on specific policy details can happen between responsible officers of these three departments as often as needed.

The conflicts between NDRC and MEP create burdens on China's overall environmental and climate change governance. The reality of China's current climate governance is that NDRC, an economic development driven ministry, takes overall control; MEP, which should have the power in monitoring climate change governance, is not often involved in climate-related policy development and implementation. This power imbalance is not beneficial for genuine emission reduction and environmental protection. However, this imbalance is very unlikely to be adjusted to an optimal degree in short time. Just as Interviewee 1 said "MEP has no capability of managing climate change, even if NDRC passes on the authority to them [MEP]". This is true because carbon emission reduction involves many industries and sectors and majority of these industries and sectors are under the supervision of NDRC. For instance, the power industry is managed by National Energy Administration under NDRC, MEP has no authority over the planning and emission reduction programs of China's energy industry. The weak MEP means a lack of constraints on NDRC's planning and programs and is detrimental for China's long term climate change mitigation and overall environment.

The conflicts between economic development and climate change mitigation are common in developing countries like China. In fact, they are also present in developed countries, especially those with large proportion of energy intensive sectors in their national economy. For instance, in Australia, the governance of climate change has been shifted around many departments due to the politics played between the two major parties and major stakeholders behind them in the last decade (Downie 2016, n. p.). Re-arrangement of bureaucracy may lead to better governance, but in Australia's case, it created setbacks in its climate change policies (Schiermeier 2014, p. 7510). Such a situation is very unlikely to happen in China due to the single-party government. The Chinese government will not experiment with large-scale shifting of responsibility among ministries either, unless there is obvious evidence that superior results can be achieved through doing so. Therefore, this thesis suggests a particular type of WG approach to address the power imbalance between MEP and NDRC through a gradual integration of responsibility.

The first step towards integration is to include MEP as an auditing body for industries and companies involved in NDRC's climate change programs. The expertise of MEP in monitoring and auditing non CO_2 emissions is mature and advanced. Therefore, when the production material and technology of an industry or a particular company are certain, the auditing results on non CO_2 emissions will reflect its CO_2 emissions. By involving MEP in the auditing process, China's carbon emission programs will no longer be managed in a single dimensional manner, led by NDRC and checked by NDRC. The carbon emission reduction results will be more objective and convincing, which in turn will lead to improved transparency, accountability and increased chances of policy success (Gao & Zhu 2010, p. 5). By doing this, MEP's capacity in China's climate change governance can be gradually improved and its overall power strengthened.

To enable MEP to perform the above suggested function, this thesis also recommends that MEP carry out direct supervision of its provincial and local branches. Although the provincial and municipal offices of China's central ministries are managed by provincial and local governments, it is advisable for MEP to perform direct supervision of its provincial and municipal EPBs. As mentioned previously in Chapter 4, provincial and local authorities' protection of polluting industries and their control of EPBs prove to be great obstacles to environmental protection. Therefore, the possibility for MEP to provide direct supervision to provincial and local EPBs deserves discussion due to China's dramatically worsening environmental status and rapidly increasing carbon and non-carbon emissions. Ideally, MEP should provide direct funding to EPBs and be responsible for recruiting EPB officers. These changes will indeed require bold reform for China's environmental protection sector. However, such reform will prove worthy in the long run as China's environmental and climate change issues deserve top priority. In the meantime, MEP attemped to improve its implementation effectiveness through a range of modifications to its supervision, however, the results appear less than optimal (XH Zhang 2017). For instance, MEP set up six cross-regional supervision centres in 2007 to monitor provinces more directly. It was described by XH Zhang (2017, p. 750) as "the first sustained effort by MEP to directly enforce an environmental policy". However, it still faces problems such as lack of resources, lack of external oversight and public participation and poor data quality. In XH Zhang (2017, p. 752)'s words, the verification programme has unfortunately changed into a "numbers game" during the implementation over time. Therefore, fundamental change of direct supervision should be considered. For instance, MEP provides direct funding to provincial and local EPBs and conduct supervison of the appointment of important personnel.

The competitive relationship between MF and NDRC was mainly around the argument of whether to implement carbon tax or cap and trade for China's climate change mitigation. Since cap and trade is already chosen as China's preferred emission reduction strategy, the competition between MF and NDRC over the authority of climate change, in theory, should be over. MF should instead accept this status and cooperate with NDRC in the design and delivery of a suitable carbon trading system according to China's specific conditions. In order to provide enough incentive for MF to get involved in the carbon trading scheme, NDRC can pass on some responsibility to MF such as in financing and finance auditing. These are two of the weakest aspects of China's current carbon market, as mentioned in Chapter 5 and 6, but MF has expertise in them. This also enhances the slow integration of the WG approach. In fact, such intergration is very possible and even likely. As mentioned previously, China's CDM fund has been jointly managed by MF and NDRC.

Overall, China's climate governance requires a whole of government approach to reduce fragmentation and unnecessary competition among government departments. Although NDRC retains its leading role in climate change governance, MEP should be included in the monitoring of CO2 emission in the national carbon trading scheme due to its expertise in this field. MF can also provide assistance to NDRC in terms of financial advice and program auditing in the scheme. Frequent and timely meetings between relevant departments should be held when necessary to conduct in depth discussion over policy development and program supervision. In addition, to fundamentally strengthen China's environmental protection sector and to truly embrace environmental integrity, China's MEP has to conduct direct supervision to EPBs. In this way, provincial and municipal EPBs will be better funded and less restricted by the provincial and municipal government when conducting pollution related investigation.

7.2.2 Strengthening climate change expertise at the provincial level

The lack of climate change expertise and research capacity at the provincial level was identified in Chapter 4. This thesis believes the quickest fix to this problem is to provide professional development for existing public officials in areas of climate-related policies and implementation procedures. According to Lin and Gil (2016, p. 148), customised training and examinations are effective ways for Chinese public servants to enrich their knowledge and capacity in the environmental protection sector. This thesis also encourages the provincial government to liaise with scholars and intellectuals from local universities with relevant expertise. Expert knowledge and advice have proved beneficial for the government's policy development and implementation. For instance, the municipal government of Cape Town, South Africa, liaised with researchers from the Energy Research Centre of Cape Town and conducted successful studies in reducing peak energy demand. The New York City government also adopted similar procedures by including talented professionals in the New York Panel on Climate Change and raised a range of initiatives in reducing carbon emission (Anguelovski & Carmin 2011, p. 171).

Furthermore, courses and topics on climate change can be provided at universities so that there will be a sustainable supply of graduates to join the climate-related sector. For instance, climate change related topics can be added to the university courses of environment, policy, and science majors. Famous scholars with climate change expertise from home and abroad can be invited to provincial universities to provide guest lectures to students in this discipline. China has a long tradition of employing foreign experts in areas such as science and education. Relevant provincial government departments and research institutions should provide graduate recruitment opportunities to university students in climate-related disciplines in order to absorb talent and expertise in climate change policy research. Training and certificate in carbon emission monitoring, trading and administration can also be provided for people who wish for a career change or who already work in the climate change field and wish to enrich their knowledge. By providing customised professional development to public servants, absorbing scholars and talented stakeholders, enriching university curriculum and society recognized training, climate change expertise and research capacity can be quickly built up at the provincial and municipal level. This build-up of expertise will not only better serve climate change mitigation programs at these level, but will also better corresponding to the central government's climate policy and providing more rational feedback to assist central government's decision-making.

7.2.3 Ways for energy corporations to carry out ambitious emission reduction

China's energy corporates are important players for its national emission reduction scheme. Major large energy SOEs hold the key for China's energy intensity reduction as they took charge the biggest proportion of China's coal-fired energy production. Private renewable energy corporates have become the pioneers in research and development in renewable energies and a new force in optimising China's energy structure. Large energy SOEs, although willing to accept emission reduction procedures such as shutting down inefficient small coal-fired power plants, lack of incentives to pursue more ambitious emission mitigation such as bigger investment in renewable energy. Medium- and small-scale private renewable energy enterprises, although ambitious, face many obstacles such as lack of finance and late and unpaid subsidies from the government. This thesis recommends establishing alternative incentives for large energy SOEs and providing more support for private renewable energy investors, as will be discussed below.

The analysis in the previous chapter shows that large energy SOEs only passively include renewable energies in their business portfolio under the government's administrative orders. Administrative orders alone are not sufficient for large energy SOEs to adopt more ambitious carbon emission reduction plans. It is true that SOEs are state owned, however, they are still involved in market competition and are profit driven. For instance, almost all large energy SOEs prefer large scale coal and gas projects because they are competitive and most profitable under current market conditions when carbon emissions are not priced. To make large energy SOEs truly willingly embrace renewable energy and make renewable energy an important and growing part of their business, it is essential to reduce the profit margin of fossil-based energy to an extent that renewable energy is more economically attractive.

The first step to make renewable energy more attractive is to put a price on carbon emissions, which will make carbon-based energy more expensive and renewable energy more competitive. This is what China is already doing by setting up the carbon trading pilot program and planning to implement a national carbon trading scheme at the end of 2017. However, according to the analysis carried out in Chapter 6, simply making renewable energy more price-competitive is not enough for large energy SOEs to truly embrace renewable energy. This is because the more competitive renewable energy price will not automatically remove the obstacles that renewable energy currently faces such as the politics played among provincial governments and the coal mining industry. Therefore, a second tier of market guarantee from certain energy consuming sectors is needed on top of carbon trading.

The Chinese government should actively promote new market sectors that consume only renewable energies. This can be achieved through administrative regulations. For instance, it could be regulated that China's electric car recharging facilities must only provide electricity generated from renewable sources; real estate development proposals with electric car recharge facilities have priority in gaining approvals; and owners of electric cars do not need to be put on a waiting list for registration in big cities like Beijing and can drive any day rather than alternate days like petrol car owners. In the northern provinces, winter central heating must consume locally produced wind-energy before using coal.

These market end regulations will provide a second tier of protection for renewable energy against the dirty politics played between some provincial government and coal mines. These will also provide more convincing incentives for large energy SOEs to actively develop renewable energy and set more ambitious emission reduction targets. These suggestions are original proposals based on the analysis in the previous chapter, and such initiatives have not been tested out yet in China.

These market end guarantees will not only provide incentive for large energy SOEs but also encourage medium to small scale renewable energy investors equally. However, for medium to small scale renewable energy to be competitive, extra supports are needed. First of all, the sources for renewable energy subsidy should be diversified rather than solely relying on the renewable energy surcharge. As explained in Chapter 6, the renewable energy surcharge alone is not sufficient to support the whole renewable energy industry. The late payments of subsidies have put many medium and small scale renewable energy companies in financial difficulties. To diversify the sources of the renewable energy subsidy, a special financial fund can be established for medium to small-scale private investors in renewable energy. This fund could be generated from the government's auctioning of carbon emission credits. If a national carbon trading scheme is implemented, this fund will be a useful source to guarantee sufficient subsidy and other financial support. Medium- and small-scale renewable energy investors will be relieved from financial pressures caused by unpaid or late subsidy.

7.2.4 Strengthening China's civil society

The involvement of Chinese ENGOs and the general public in China's climate change policy is limited. However, as discussed in Chapter 4, due to the inter-connection between climate change and China's worsening atmospheric pollution, growing attention from the general public has been observed. The government should realise that the atmospheric pollution problem is already a nation-wide problem which has caused much complaint from citizens. Many of the rich have chosen to migrate to other countries where environmental conditions are optimal. They bring along large amounts of wealth to the destination country which causes the loss of wealth to China (Cendrowski 2014, n. p.). The poor have no financial capacities to do so and therefore have to bear the high levels of pollution. As pollution levels increase and related sicknesses intensify, the poor who suffer from the diseases have no money to get proper medical treatment, atmospheric pollution will quickly transform from an environmental problem to a serious social problem which may affect social stability - something the Chinese government is most concerned about. The analysis of Chapter 4 confirmed that the political environment for Chinese civil society would be unlikely to change in the foreseeable future and China's climate change and atmospheric pollution problems were almost certain to be solved through a top-down approach. This requires the Chinese government to take these problems seriously and view ENGOs as a positive and effective actor to fight against climate change and atmospheric pollution. This is because ENGOs and the public can quickly identify local cases of pollution, which provide valuable clues for local EPB's investigations.

In order for Chinese ENGOs to carry out effective activities against illegal polluters within the set political limits, such as the pursuit of civil environmental lawsuits mentioned in Chapter 4, the government should establish a transparent and accessible environmental legal system by updating relevant environmental laws and simplifying environmental lawsuit procedures. In 2015, MEP set up the 12369 Environmental Protection Hotline where citizens can report polluters anonymously. EPBs conduct initial investigations to confirm the truthfulness of the cases and deal with them accordingly. The public greatly welcome and value the hotline, however, the outcomes of different cases in different regions turned out quite differently. Some EPBs dealt with the public report in a timely and professional manner while others did not due to a range of practical difficulties such as lack of staff and funding (Zhihu 2015, n. p.). In order to overcome the practical difficulties some EPBs face, this thesis suggests EPBs share some of the cases they receive from the hotline with a range of local ENGOs. Such cases are often of less complexity and within the capacity of local ENGOs. Specifically, the information of the cases can be published on the EPB website in the form of a reward list with clearly stated cash prize amounts. Usually the cash prizes would be smaller than the expenditure of EPBs conducting the investigation by themselves. Interested ENGOs can register to take over the cases they wish to investigate, and then conduct thorough investigations of the pollution according to the EPB procedures. EPBs will reward the ENGOs with the promised funds once the cases are completed. This form of sub-contracting will not only reduce EPBs' workloads, but will also encourage ENGOs' enthusiasm to conduct more timely investigations against polluters.

Some may argue that such an initiative is very unlikely given the closed government in China. However, two conditions have been stipulated for this recommendation. The first is that it operates within current political limits. The second is that the cases to be shared are within ENGOs' capacity and of lesser complexity. These two conditions can provide cushioning to the local EPB and ENGO relations. Although the Chinese government is often viewed as a closed government, it is generally willing to experiment with new initiatives and is generally quick to embrace them if there are obvious benefits. The pilot carbon trading program and the soon to be implemented national carbon trading scheme is one such example. Therefore, this characteristic of the Chinese government should not be overlooked. Furthermore, successful cooperation between local environmental offices and ENGOs have been carried out elsewhere in the world, which further demonstrates the feasibility of this approach. For instance, the government of Melbourne paired traditional command and control governance with an NGO, the Moreland Energy Foundation, in conducting climate change mitigation, including reducing waste and improving household energy efficiency. In Quito, the capital city of Ecuador, the environmental office provided funding directly to local ENGOs to carry out climate change adaptation training to local farmers in water management and urban agricultural practices (Anguelovski & Carmin 2011, pp. 171-172). Therefore, it is believed the potential cooperation between Chinese EPBs and qualified local ENGOs will have the capacity to bring better results to local environmental governance.

It is also advisable that ENGOs set up public blogs and use social networking software such as WeChat and Weibo to connect to the general public. In this way, the public has a channel to report local polluters to local ENGOs and the relevant ENGOs can conduct investigations and sue polluters through the legal system. Because the cases are handed to ENGOs who particularly fight against environmental problems, they are therefore more likely to be dealt with more quickly.

Consumers in China should also have the choice of purchasing green energy. In China, renewable energy costs are shared by all end users, which is to say all end users pay the same price for energy within a certain region. Consumers do not have the choice of purchasing only green energy or a certain percentage of green energy. Although it is likely that the majority of consumers would choose to purchase the cheapest energy option, there will be some environmentally conscious consumers who are willing to pay for green energy. With national carbon trading on the way, green energy will be more competitive on the market. With the education level of China's younger generation rising, the message of eco-civilisation widely spread and people's living standard improving, there should be an increasing number of consumers in this group (Wang J & Yang 2014, n. p; Zhou K 2014, n. p.). This situation provides scope for the diversification of the price of renewable energy.

Specifically, renewable energy generating companies can promote their products through multi-media channels such as TV or internet advertising, ENGOs' environmental education sessions and recommendations of energy providers. Energy providers can introduce this new green energy product to their customers and sign contracts with those who are interested. The profit gained from the new product will be distributed between the green energy producer and the energy provider in the proportion stated in their contract. This option of using green energy will provide people with a sense of fulfilment, and make them feel good as they are doing a good thing for the environment and future generations (Hartmann & Apaolaza-Ibáñez 2012, p. 1254).

This section has provided some rationale for strengthening actors in China’s energy-related climate policy landscape. It recommended that government departments should adopt the whole of governmental approach to carry out better communication and coordination. The expert community should spread their climate change expertise into the provincial and municipal level through tertiary education and training program. Renewable energies can be protected by the promotion of certain green-energy-only sectors such as electric car charging facilities and winter heating in China’s northern provinces. Medium and small investors are recommended for extra financial support generated from the fund of auctioning of carbon credits. China’s ENGOs can be strengthened by improving environmental laws and an easier legal process for environmental lawsuits. An innovation between EPBs and ENGOs can be carried out by providing sub-contracting system to deal with polluters. ENGOs should also create more channels for the general public to participate in local environmental discussions and to report suspicious polluters. The general public should also be provided with more diverse options for their energy sources. In the next section, the implications of the findings for China’s carbon market will be discussed.

7.3 Implications for addressing problems raised in Chapter 5

Chapter 5 of this thesis focused on China's participation in international climate change mitigation and analysed the impact of CDM on China's sustainable development. It confirmed that CDM had brought multiple benefits to China's sustainable development such as promoting renewable energy development, preparing for China's domestic carbon market and raising climate change awareness. However, there are also a few issues that need to be addressed. Firstly, how will uCDM projects which fail to sell their CERs to international buyers be dealt with? Secondly, how will China guarantee the additionality of CCERs? Thirdly, will the involvement of China's domestic financial institutions in the carbon market be encouraged? Lastly, what low-cost climate change abatement options are left after CDM in China? This section will focus on the investigation of these questions and discuss their implications.

7.3.1 uCDM projects and the urgent need for national CCER regulation

As mentioned in Chapter 5, uCDM projects have a number of advantages over bi-lateral and multi-lateral CDM projects such as lower transaction and administrative costs, the ability of quickly developing a range of small scale projects and hosting country holding the control of CER sales. However, they also face some challenges. One of the challenges some uCDM faced was the inability to find international CER buyers or having to sell CERs at a greatly discounted price due to the downturn of global carbon market. In order to solve this problem, Interviewee 1 from NDRC indicated that the possibility to absorbing CERs from such uCDM projects into China's domestic carbon market, and re-name this type of CERs Chinese Certified Emission Reductions (CCER) (September 2013). The domestic pilot carbon trading program accepted four types of CCER projects. Two types of projects had already been mentioned in Chapter 4. They were CDM projects approved by NDRC but failed to register with CDM EB and CDM projects successfully registered with CDM EB but failed to find CER buyers. The third type was voluntary emission reduction projects that followed and passed NDRC approved methodologies. The last type of CCER projects were those that gained NDRC approval for CDM and produced CERs before registering with EB (LN Shen 2015, n. p). CCERs from the above types of uCDM projects had been generated and used as a supplement to trading permits in China's pilot carbon trading program and could be purchased by relevant industries and companies to offset their carbon emission (Lo & Cong 2017, p. 1395). It is expected this offsetting mechanism can significantly lower the abatement cost for companies which would otherwise spend more to achieve efficiency improvement and emission reduction from internal technological updates. By now, the CCER projects as a continuation of international CDM have already been identified as an important component of China's national carbon market. This is to say, the project-based mechanism will continue to have its role in China's national carbon market (Gonzalez 2014, n. p.).

An urgent issue associated with CCER is the lack of unified national regulation while China's national carbon trading program is set to start operating in late 2017. Up until 31 December 2016, China Certified Emission Reduction Info-Platform has announced 2742 registered CCER projects, among which 861 projects have gained approval and 254 projects have already produced 53,000,000 CCERs (Wei 2017, n. p.). But which of these CCERs can be used in the future national carbon market is still not clearly stated. During the 2013-2015 experimental period, different carbon trading pilots had different restrictions on the CCER type, time frame and origin. For instance, the Beijing market required that, to be qualified, CCERs had to be generated after the 1st of January 2013 and could not be from industrial gas projects such as HFCs, PFCs, N_2O and SF_6 (21st Century Economic Report 2016, n. p.). All pilots except Shanghai excluded CCERs generated from hydro-power or at least excluded large to medium scale hydro-power due to its significant impact to the environment. Also, Chongqing and Shanghai were the only two pilot areas that did not have restrictions on the origin of CCER. All the rest of the pilots required majority or partial CCERs to be locally generated (Zhongchuang Tantou 2015, n. p.).

These different CCER regulations were catered for different cities and regions, but, as the national carbon market fast approaching, a new national CCER regulation is urgently needed. On the occasion of China Carbon Trading Open Day, held on April 15 2016, the Deputy Director of Domestic Policy and Compliance Division, Department of Climate Change, Wang Shu, mentioned that the regulation and assessment for CCER projects of the national carbon market will be stricter and tougher. In future, the proportion of CCER projects need to be restricted and the time frame for qualified CCER projects is yet to be decided. Whether the national carbon market should accept CCERs produced after 2013, 2014 or 2015 is an issue which requires consultion with the experts to answer. Wang also indicated that earlier projects were likely to be excluded from the national carbon market and recommended investors to focus on new projects with a higher contribution to sustainable development. Industrial gas projects are likely to be excluded, however large hydro-power projects may be reconsidered for the national CCER category (21st Century Economic Report 2016, n. p.).

This thesis suggests that CCER projects as an important offsetting component for China's national carbon market should be given clear guidance, and that the regulations should be made in a timely manner in order to properly facilitate investment and truly embrace environmental integrity. This is because not only potential CCER investors need clear guidelines, but corporates which are to participate in the national market also need to time to investigate their targeting CCER projects. It is strongly recommended that the development of national CCER regulation should strictly follow the principles of sustainability and additionality, provide informative and supportive financial service to CCER projects and be innovative in abatement options.

7.3.2 Principle of sustainable development and additionality

A qualified CCER project must contribute to sustainable development and pass the additionality test. As mentioned previously, the Chinese government had the intention not to include industrial gas projects in its CCER portfolio. This is a positive decision because industrial gas CDM projects contributed little to sustainability according to the analysis in Chapter 5. However, the reconsideration of large hydro-power is not recommendable. This is because large scale hydro-power developments often pose very negative environmental and social impacts to the local eco-system and communities. China's Three Gorges Dam for example, raised numerous problems during its development. The diversity and abundance of both flora and fauna in the region have been seriously impacted due to habitat change (New & Xie 2008 p. 3157; Xie 2003, p. 1149). The built up concentration of water pollutants have even threatened the health of the East China Sea ecosystem (Mueller, Berg, Yao, Zhang, Wang & Pfluger 2008, p. 245). The negative social impacts were no less than the ecological trauma. Over 1.3 million people have been relocated causing losing farmland, unemployment and deteriorating public health (Jackson & Sleigh 2000, p. 223). The even more worrying factor is the potential risk of large earthquakes associated with the construction of the dam and the frequent fluctuation of water levels. Landslides and regional dam quakes have already happened in the regions causing loss of properties and lives. Large scale dam quake cannot be excluded from the possibilities (Hvistendahl 2008, n. p.). With negative social and environmental impacts like this, it is unethical to justify the gains of large scale hydro-power projects solely from the carbon emission reduction perspective; and obviously its contribution to sustainable development is doubtful.

Large scale hydro-power projects are also questionable in terms of their additionality. Additionality is the most fundamental criteria that an off-setting project needs to meet. If China's carbon market lets in CCER projects failing to justify their additionality, it harms the integrity of China's entire carbon trading scheme. The Three Gorges Dam was planned and constructed long before climate change mitigation was on the Chinese government's agenda and had little relevance towards CO_2 emission reduction. There are other large scale hydro-power projects which follow a similar pattern and are primarily economically driven, which would have happened anyway even if the CCER policy was not in place. Therefore, it is difficult to justify their additionality. It is irrational for the national carbon trading scheme to grant CCERs to large hydro-power proposals especially when considering their potential negative social and environmental impacts. It is recommended to exclude large hydro-power projects from the CCER project category in order to safeguard environmental and climate integrity. Instead, China should explore new CCER methodologies for smaller projects with greater contribution to sustainable development and clear justification to additionality.

7.3.3 Exploring more low-cost climate change abatement options

China was active in the exploration of new low-cost carbon abatement options. The Chinese government encouraged domestic consultancies and research institutions to develop new CCER methodologies since the start of China's pilot carbon trading program. In June 2012, NDRC announced the rules for CCER projects which closely resembled the procedures of CDM (Department of Climate Change, NDRC 2012a, n.p.). Since then, NDRC adopted all 173 CDM methodologies and developed 30 new methodologies (China Certified Emission Reduction Exchange Info-Platform, 2017, n. p.). This outcome echoes the analysis in Chapter 4 that China still has the potential to unearth new low-cost abatement options after hosting the majority of international CDM projects.

Many of the newly added CCER methodologies target smaller projects which focus more on sustainability (See Figure 7.1 for full list). For instance, a similar project methodology to the small scale eco-recovery projects mentioned in Chapter 5 has been jointly developed by the Nature Conservancy and Beijing Environment Exchange and approved by NDRC on 15 January 2015 (Methodology ID: CM-099-V01). A range of methodologies for afforestation/reforestation projects have also been developed (Methodology ID: AR- CM-001-V01; AR- CM-002-V01; AR-CM-003-V01; AR- CM-005-V01).

Figure 7.1 New CCER methodologies approved by NDRC

Methodology ID	Name	Time of approval
AR- CM-001-V01	Carbon sink afforestation	4 November 2013
AR- CM-002-V01	Carbon sink from bamboo afforestation	4 November 2013
AR-CM-003-V01	Carbon sink from forestry management	23 January 2014
AR-CM-004-V01	Greenhouse gas reduction and monitoring from sustainable management of grassland	23 January 2014
CM-096-V01	SF_6 emission reduction monitoring and calculation in GIS	15 April 2014
CM-097-V01	Utilisation of energy saving wire in new grid or old grid renovation	27 January 2015
CM-098-V01	Electric car recharging facility	27 January 2015
CM-099-V01	Small scale eco-recovery for non-coal mine sites	27 January 2015
AR- CM-005-V01	Carbon sink from bamboo forest management	25 February 2016
CM-100-V01	Waste straw substituting timber for wood based panel production	25 February 2016
CM-101-V01	Greenhouse gas emission reduction baseline and mon itoring for ready mixed concrete production	25 February 2016
CM-102-V01	UHV transmission system greenhouse gas emission reduction methodology	25 February 2016
CM-103-V01	Recovery of liquefied natural gas from coke oven gas	25 February 2016

CMS-079-V01	Greenhouse gas emission reduction from the utilisation of reactive power compensation device in distribution network	25 February 2016
CMS-080-V01	Building energy storage power station at existing or new renewable energy power plant	25 February 2016
CMS-081-V01	Ruminants farm stock emission reduction	2 June2016
CMS-082-V01	Livestock manure composting management GHG emission reduction methodology	2 June2016
CM-104-V01	GHG emission reduction methodology for the preparation of low carbon ready mixed concrete and reduction of cement ratio by using recycled powder	2 June2016
CMS-083-V01	Methodology of GHG emission reduction and carbon sink from conservation tillage project	20 June 2016
CM-105-V01	GHG emission reduction methodology for bicycle sharing system project	22 July 2016
CMS-084-V01	GHG emission reduction methodology for the utilisation of radiation pyrolysis technology on household waste	26 August 2016
CMS-085-V01	Methodology for producing metallized pellet rotary hearth furnace using metallurgical solid waste treatment technology	26 August 2016
CMS-086-V01	Methodology for GHG emission reduction from efficiency improvement procedures of vehicles and fleets	26 August 2016
CM-106-V01	GHG reduction methodology for bio gas production and sales	26 August 2016
CM-107-V01	Biogas production and utilisation from manure management system	26 August 2016
CM-108-V01	GHG emission reduction methodology for new processing method of regenerative calcium carbide	18 November 2016
CM-109-V01	GHG emission reduction for direct reduction ironmaking technology of gas based shaft furnace	18 November 2016

Source: China Certified Emission Reduction Exchange Info-platform (2017)

In order to reduce carbon emissions while simultaneously improving urban air quality, the methodology for electric car re-charging facility projects had also been developed (Methodology ID: CM-098-V01). However, it was not specified whether or not renewable energy is to be used. If using conventional mix electricity, electric cars are roughly four times cheaper to run than traditional petrol cars (calculated with medium conventional electricity price and petrol price). The cost of fuel for electric cars is much cheaper than cars running on petrol. However, the greenhouse gas emissions of electric cars are not necessarily low if powered by conventional mix electricity because around 70% of the mix is generated from coal. Although electric cars may have the ability to reduce reliance on petrol and improve urban air quality, they do not reduce carbon emissions to a significant extent if coal generated electricity is used (Pauliuk, Dhaniati & Müller 2012, p. 6). In order to achieve more significant emission reductions from the CCER electric car re-charging facilities, it is recommended that electric car charging facilities should direct purchase electricity generated from a mix of non-CCER renewable energy projects. This can be achieved through administrative measures. Such regulation will not make electric cars less attractive as even the most expensive renewable energy is still three times less expensive than petrol.

Building energy efficiency is an area that has the potential to develop new low cost abatement. In Table 7.1, the only CCER methodologies related to building energy efficiency are the ones which focus on the production of building materials such as Methodology CM-104-V01 and Methodology CM-101-V01. There is still no CCER methodology so far which targets the design efficiency of buildings. This thesis argues that the energy efficient design of building can have a great impact on China's current and long-term climate change mitigation. This is because urban infrastructure, and especially office and residential buildings, will usually have at least a 20-30 years of life span. Demolition and renovation are not likely to happen before this time, therefore, building energy efficiency has irreversible characteristics (Li J & Colombier 2009, p. 2436). This thesis suggests creating CCER methodology on building design energy efficiency baseline projects, because energy efficient designs will lead to many years of emission reduction in the future. Such projects should set the baseline requirement for energy efficiency factors including insulation, heating, cooling and lighting. Energy efficiency ratings of new buildings are to be calculated based on annual energy consumption per square meter of floor area. Only building designs with high energy efficiency ratings should be considered potential candidates for this CCER methodology. It is also recommended to include car parks with electric car charging facilities as an essential component. This way, sizable carbon emission reductions from the building sector can be guaranteed and emission reductions from the transport sector are also facilitated. It is recommended for the government to give priority to the approvals of residential and commercial buildings with the above low-carbon features.

China's newly developed low-cost emission abatement options are mostly small-scale, with consideration of sustainability. Such exploration should be continued in order to better facilitate the national carbon trading and truly embrace the essence of sustainability. To achieve this, sufficient financial support is needed. In the next section the potential of CCER will be explored to determine whether it can play a greater role in China's national ETS. The importance of CCER finance for China's carbon off-setting program and the meaning of a successful CCER program to China's national ETS will also be discussed.

7.3.4 CCER - a bigger role in China's ETS from the support of permits auction fund

The emission reduction ability and environmental integrity of certain types of CCER projects are worthy of recognition such as renewable energy projects and the newly developed small scale CCER projects mentioned above. However, it is predicted that CCER offset is limited at roughly 10% of the total national ETS allowance. The limit on the proportion of CCER is out of concern that companies may prefer to spend a smaller amount of money to buy CCERs rather than focusing on emission reductions from their own effort (21st Century Economic Report 2016, n. p.). However, this thesis argues that the proportion of CCERs should be made more flexible: a bigger proportion of CCER in China's carbon market will not harm the climate integrity of China's nation ETS if the carbon emission permits are not over-allocated. To the contrary, bigger proportion of CCERs may bring economic efficiency. This is because many of China's industries included in the national ETS have reached fairly high energy efficiency which makes further efficiency improvement extremely expensive. In China's power sector for example, the majority of the newly built large-scale coal-fired power plants were already quite efficient. The only way to make them even more efficient is to upgrade to more advanced combustion technologies such as the ultra-super-critical or integrated gasification combined cycle which can moderately improve the combustion efficiency (Shen W 2015, p. 344). However, these advanced technologies are so expensive that the installation will always be more costly than paying for the fines for failing compliance. Under these circumstances, companies would prefer to pay the penalty for failing compliance rather than install the advanced equipment. As such, the readily available offsetting option is necessary. This is where abundant and quality CCERs is needed. For industries with either limited technological upgrade potential or inability to comply just by reducing production, offsetting becomes the only solution for achieving compliance under a cap and trade system.

There are concerns that a bigger proportion of CCERs may inflame the market causing the dropping of the carbon price. However, this thesis argues that such a situation will not happen if the original carbon emission permits are not over allocated. Even better, the original permits should be auctioned off rather than directly distributed to industries. This is because, firstly, industries will conduct their own analysis to decide a more accurate amount of permits they need. Just as Benz and Trück (2009, p. 9) put it:

> The CO_2 allowance price is determined directly be market scarcity induced by the current demand and supply at the carbon market. Notably, firms by themselves are able to control market scarcity and hence the market price by their CO_2 abatement decisions.

Secondly, the government will obtain a financial gain from the action which can be fed back into the carbon market. For instance, the fund can be utilised to provide special loans to quality CCER projects. As mentioned in Chapter 5, the financing for small scale CDM projects was at a bottleneck. Small CCER projects still face the same problem today.

According to the interview W Shen (2015, p. 347) conducted within the Chinese financial sector, few mature financing products have been developed to support the development of CCER projects due to the difficulty in the assessment of profit outlook of CCER projects. The government can combat this deficiency by setting up a special CCER fund from the financial gain of permit auction. It is already recognised by many that China's carbon market follows a top-down fashion in which the state weighs more than the market (Goron & Cassisa 2017; Lo & Yu 2015; Shen W 2015). It does not hurt for the government to do a bit more to perfect the whole system. The Chinese government have already built up the framework of the national ETS, it should start to add detailed policies and guidance such as providing sufficient financial support such as special loans and other services to ETS stakeholders, and in this case to quality CCER projects. The purpose of this is show to banks and other financial institutions that financing CCER projects can be profitable. A successful outcome of the special CCER fund may have the potential to lead banks and other financial institutions to start developing CCER financial products and strengthen carbon finance in the offsetting mechanism.

So far, China inherited CDM as a domestic off-setting mechanism, however, the current policy and regulation of national CCER are still not in place. This is what the Chinese government should urgently address. Nonetheless, relevant institutions and climate consultancies were indeed very active in developing new low-cost abatement options. Majority of the CCER methodologies approved by NDRC follow the principle of sustainable development and can justify their additionality. However, contentious methodologies such as the ones for large scale hydro-electricity projects and industrial gas projects should be excluded from the CCER methodology list in order to safeguard the environmental integrity of China's CCER program and the national carbon trading scheme. Lack of financial support for CCER projects is a major drawback that restrain the potential of CCER development. This thesis suggests the government should set up examples for the financial sector by financing quality small-scale CCER projects from the financial gain of permits auctioning. These are the implications this chapter drew out in order to address the issues associated with China's domestic carbon offsetting mechanism and carbon markets. In the next section, it will focus on addressing the issues raised in the analysis of China's domestic energy saving and emission reduction policy – ECERS.

7.4 Implications for addressing problems raised in Chapter 6

Chapter 6 of this thesis analysed China's major domestic climate-related policy – the ECERS. It focused on the policy and implementation of ECERS in the energy production sector and the EPC for energy end users. The analysis identified that the major issue with China's ECERS was neither a scale problem nor a speed problem, but the integrity and efficiency problems presented in the implementation process. In total, four major weak aspects of ECERS need to be carefully addressed including laid-off workers' welfare, fraudulent claims of cash rewards, the restricted production of renewable energy and the potential of EPC. In this section, some implications will be provided for each of these weaknesses in order to improve the overall transparency and quality of ECERS.

7.4.1 Dealing with laid-off workers' welfare

The effectiveness of ECERS was undeniable in closing down heavy polluting small coal-fired power plants. However, the compensation and welfare for laid-off workers and private owners should be handled with more care. The phasing out of outdated production capacity during the 11th and the 12th Five-Year Plans can be seen as the second wave of worker redundancy since China's reform and opening up in the late 1970s. The first wave of worker redundancy was the result of the SOE reform during the late 1990s. The second wave was very different from the first wave in terms of scale and workers' perceptions. In the 1990s, greater number of workers from SOEs were laid-off and workers showed greater resistance. This was mainly because workers from SOEs were so used to the planned economy and were shocked by the concept of the market. Lee (2000, p. 271) described the workers reaction as the "revenge of history" as during Mao's era workers' income were guaranteed and interests protected. The workers' perception differs slightly towards redundancy during the recent phasing-out of outdated production capacity from previous SOE laid-off workers'. Although upset, they are less resistant to the idea of seeking new employment in the labour market or becoming self-employed. This is due to a few reasons. First of all, not all closed down small coal-fired power plants were SOEs, some of them were rural collective owned or privately owned. Therefore, the workers were not as dependent on their employers as some of the previous SOE laid-off workers. Second, some of the closed down small coal-fired power plants were already under financial pressure and heavily in debt. Workers' salaries were kept at the rate of the minimum wage or even suffered from delayed payment, and therefore there is a motive for workers to seek new and better employment opportunities. Third, recent laid-off workers are more used to the concept of the market after the three decades of market reform. The fast-developing and popular e-commerce sector provides vast opportunities for small business which require little upfront investment (Wang, Cooke and Lin 2016). Under these new circumstances, reasonable compensation and practical retraining programs appear to be more important. This section will provide some suggestions for laid-off workers' compensation and retraining.

7.4.1.1 How to make unemployment insurance (UI) incentive-based social welfare

The unemployment insurance (UI) scheme was first introduced to China in 1986 to deal with the emerging unemployment problem. The original scheme only covered SOE employees where employers pay 1% of the employee's' salary (Leung 1995, p. 144). The UI broadened its coverage over the years. Since 1999, UI became a mandated social security fund covering all urban workers with formal work contracts, to which the employers contribute 2% of their payroll and employees contribute 1% of their salary (Vodopivec & Tong 2008, n. 14). The fund provides an allowance to the qualified workers[22] for up to 24 months after their redundancy. The UI allowance should not exceed the regional minimum wage and may range between 40% and 80%

[22] To be eligible for the UI payment, workers need to meet three conditions. 1. Having participated in a UI scheme for at least 12 months before redundancy; 2. The redundancy was involuntary; 3. Registering for unemployment status within 60 days after the termination of the work contract.

of the worker's previous 12 months average salary depending on localities (The Central People's Government of PRC 2005, n. p.).

In the late 1990s, the UI fund was once severely strained due to the large number of laid-off SOEs workers. However, the UI fund in many localities today are in large surplus. For instance, the UI fund in Wu'an City was 47,910,000 y*uan* (approximately US$8,000,000) in 2013 while the UI claim was only 4,060,000 y*uan* (approximately US$680,000) during the same period (Xinhua News 2014a, n. p.). At the moment, the UI is limited to providing a minimum allowance to maintain workers' basic living standards after redundancy. Apart from this, it does not provide other forms of assistance to the unemployed. It is a cushioning payment to guarantee survival but is not very effective at encouraging workers to seek reemployment. This single purpose payment is also the main cause of the large surplus in the UI fund.

This thesis recommends doubling the current UI allowance rate but reducing the UI allowance duration to 12 months, meanwhile providing low interest or even zero interest mini-loans to eligible candidates who wish to start a small business or become self-employed. The amount of the loan can be capped at two to three times of sum payment of 12 months allowance depending on different UI funds condition. It is predicted such an adjustment will provide incentive for the unemployed to actively seek new opportunities, as explained below.

The current 24 month duration of UI allowance is quite lengthy compared with 12 months in many European countries (Vodopivec & Tong 2008, p. 31). The lengthy social security support period may weaken workers' will and enthusiasm for finding new jobs, and may even reach a status that the workers get used to living on minimum social welfare (Farber & Valletta 2015, p. 909). Therefore, the duration should be reduced. The allowance rate, meanwhile, should be doubled. This way, the total amount of cash allowance is unchanged. There are critiques of the generosity of some European unemployment benefits which create disincentives for reemployment (Nickell 1997). However, China's UI payments are much lower than that of the EU and only satisfy basic survival. Thus, the situation in EU does not apply to China. Doubling the current Chinese UI rate will allow a moderate benefit payment. The recipients can gain access to more resources such as expenditures for transport, accommodation, internet and communication during the process of seeking new employment opportunities (Tatsiramos & Ours 2014, p. 289)

In order to maximise workers' enthusiasm in seeking new employment, this thesis also suggests offering micro-loans with UI funds for the eligible candidates who wish to start a small business. For those who have successfully completed retraining, the UI loan will provide unemployed workers a wide range of opportunities in the service industries. According to Kumar, Hossain and Gope's (2015) experience in Bangladesh, micro-loans can have a range of positive social and economic benefits. The UI loan is still a loan which requires repayments, which will ensure the health of the UI fund as there will be cash flow back to the fund. However, UI loans only require repayment when an applicant's new income reaches a certain level. This is very similar to Australian university students' Higher Education Contribution Scheme

(HECS). Therefore, for applicants, UI loans are risk free. Some may disagree with this proposal by arguing that the UI is not designed to provide loans. It is the banks' function and responsibility to do so. However, a large proportion of the unemployed workers who rely on the UI allowance do not own significant assets, so it may be difficult for them to pursue a loan from the bank. Even if they have the ability to acquire a loan from the bank they may be reluctant to do so due to worries about risks and the consequences caused by failed repayments. Therefore, UI loans provide great resources for workers' reemployment. Apart from resources, new skills are also important for workers who seek re-employment. Some suggestions for workers' re-training programs will be provided in the following section.

7.4.1.2 Scholarship entitlement for retraining program

There are several problems with current workers' retaining programs. First, workers have few choices in the selection of new skills. Second, the topics offered appear unpopular in the labour market. Third, the re-training programs are usually organised by the workers' previous employers such as some SOEs or the local welfare community which are under-resourced and the training schedule is inflexible (Wu MY 2009, p. 59). In response to these weaknesses, this thesis suggests that the government should liaise with local qualified private training institutions and establish a scholarship system for the unemployed. The initial step that relevant departments of the municipal government should undertake is to research and identify several high quality and well-known private training institutions in the locality. And then each qualified unemployed worker is granted a scholarship which can be used in any of the appointed training schools. When the worker completes his/her enrolment, the UI fund will transfer the tuition fees to the relevant training institution. Being private and competitive, each of these training institutions should have already been providing skills training with specialty that is in demand from the local labour market. Therefore, the students will not only have more choices but also higher quality training, which will give them confidence and in-demand skills for re-employment or self-employment. Moreover, the combination of a scholarship system in the private training school also gives students flexibility to choose classes suitable for their own time schedule. This has some similarities to assistance provided to laid-off workers in the automotive industry in Australia. For example, the Victorian state government, federal government and Ford provided AU$135 million for grants, programs and training for automotive industry workers who lost their jobs as a results of the closure of the Ford factories in Broadmedows and Geelong. Some of these focused on finding staff jobs in industries where their existing skills were relevant, while others focused on equipping them with new skills (Toscano 2016, n. p.).

The late 1990s SOE reform had transferred large amount of SOE workers to the private sectors with many of them relocated to the light industry in the Southeast coastal regions. This process is now almost completed. The light manufacturing industry targeting the international market is already saturated and has the tendency to shrink due to the slowdown of the global economy. Therefore, the newly unemployed from the elimination of outdated production capacity are most likely to obtain new employment opportunities within the service industry. Therefore, it is essential to utilise all quality resources to provide training to workers targeting the future market and growth in the service industry. Such an initiative has been proved effective in

Taiyuan City, where free retraining has been jointly provided by the UI centre and private training organisations (Wang XP 2017, n. p.). Furthermore, the blooming e-commerce will also bring many opportunities for small business and self-employment. For instance, According to Wang, Cooke and Lin (2016, p. 292), China has the biggest population and proportion of informal employment compared with formal employment. Self-employment through online business is one example among all forms of informal employment. Mrs Liu, a laid-off worker from Xiangyang City, started her own online store selling local produce. Her business has been growing due to her hard work and continuous study of e-commerce marketing. As her business expands, she plans to employ some of her fellow laid-off workers in her business (Chen CD 2015, n. p.). This further indicates the feasibility of e-commerce as a channel for reemployment.

7.4.2 Rethinking of cash rewards as an incentive for energy saving and emission reduction

By the end of the analysis period, 2015, to be exact, the Chinese government decided to stop handing out direct cash rewards for SOEs and ESCOs, instead, it provided only tax benefits for eligible corporates' energy saving and emission reduction achievements. This is to say, the government, as shown in Chapter 6, had already realised the drawbacks of cash reward as an incentive. The cash rewards were set up with goodwill but it ended up as a bait for many cases of corruptions and fraudulent claims. According to the analysis in Chapter 6, the opportunity for fraudulent claims lies in the universal use of the administrative approach in managing energy conservation and emission reduction for enterprises of all types of ownerships. Such management was effective in dealing with large SOEs under direct supervision of the central or provincial government, but is not so for non-SOEs especially those in remote counties and towns. In such places, direct administrative supervision was far from reach, auditing from powerful administrative departments was minimal, and the third party auditing was next to none. As a result, there had been cases of fraudulent cash claims for unachieved energy saving and emission reductions. On one hand, as Chapter 6 identified, it indicated that cash reward was trouble-prone without a precise auditing system. On the other hand, it reflected mono-policy approach, the administrative approach, was not sufficient in managing all types of enterprises.

Avoiding direct cash rewards and adopting tax incentives can effectively avoid fraudulent claims. For future policy development on energy conservation and emission reduction, direct cash handouts should be avoided especially when only administrative approach is used and auditing is lacking. Also, it is important to deal with SOEs and non-SOEs with different approaches. Administrative approach is suitable for managing SOEs because the top executives of SOEs are appointed by the state, who are, in nature, equal to government officials. How well they implement central government's policy is closely related to their promotions and future status. However, non-SOEs are market entities. A pure administrative approach will not be as effective. This is because they are profit-driven and will find ways to get away with the unfavourable administrative orders especially when there is no effective auditing bodies around. Therefore, for non-SOEs, a combination of market approach, legal tools and possibly civil society watchdogs is recommended. The soon to be implemented national carbon-trading scheme will offer such a media. It will provide systematic monitoring and auditing for corporates' emissions, and will eventually bring in laws and regulations which clearly define the punishment for corporates who fail to comply with the set emission target. The effectiveness of the scheme is yet to be seen, but it does point out a new direction for China's management of national greenhouse gas emission for both SOEs and non-SOEs.

The foundation of a national carbon trading scheme is a well-established auditing system which collects reliable data of corporates' emissions through constant monitoring. This process will overcome the auditing weakness in China's traditional administrative system, which basically relies on cross auditing of written reports by randomly selected auditing departments of different regions. Although the third party auditing was introduced recently, the qualified third party auditing agencies were limited. The roll out of national carbon trading scheme will inevitably strengthen national auditing system which will make it difficult for false claims of emission reduction quantity.

Furthermore, putting a price on carbon will increase the competitiveness of renewable energy and makes inefficient coal power less attractive. In response, major energy SOEs may reconsider the proportion of renewable energies in their portfolio. Instead of passively keeping a minimum renewable energy for the sake of showing the central government they have followed the instruction, they may voluntarily increase the renewable energy proportion. For inefficiency non-SOEs, market competition and high carbon price may put pressure on their operation and survival and may eventually phase them out of the market. This result may be easier for them to accept than being forced to shut down by direct administrative order when they are still making profit.

7.4.3 How to truly and effectively utilise renewable energy

During the 11th and 12th Five-Year Plans, China's renewable energy capacity expanded in significant speed and scale. China continues to lead the renewable energy investment in the world after the 2015 Paris accord. In 2016, China's invested nearly US$88 billion in 2016 in renewable energy which was over 30% more than the U.S. In early 2017, China committed another US$360 billion into its renewable energy portfolio as a mean to combat global climate change (Shankleman 2017, n. p.). However, there is one thing that needs to be addressed: China did not utilise its full renewable energies capacity. In fact, a significant proportion of China's renewable energy was wasted.

According to the Greenpeace, wind power wasted in China increased to 17% in 2017. The unconnected wind power alone was enough to power Beijing for a whole year in 2016 (Stanway 2017, n. p.). China's grid construction was indeed a little lagged behind the speed of wind and solar capacity. However, according to the analysis in

Chapter 6, grid restriction was not the biggest obstacle of China's renewable energy wastage. After all, the wind and solar energy which did not connect to grid was only a small proportion compared with the total wasted renewable energy. A large proportion of the wasted solar and wind power was in fact connected to the grid but was restricted for production by administrative orders and dirty local politics. Many private renewable energy corporate received unfair treatment due to this.

Now the most important issue that needs to be addressed is how to restrict provincial and municipal governments' outrageous power over the decision of which power plant can operate at full capacity and which cannot. The central government's planning on the development of solar and wind power had been consistent with the development of China electricity transmission grid. It was some provincial governments that blindly installed extra renewable energy capacity beyond the central government planning for attracting relevant manufacturing industry such as wind turbines and solar panels so as to raise tax revenue; and again, for tax raising, they approved more coal power capacity when the coal mining lobbyists promised more benefits. When both renewable and coal-fired power plants were in operation, they purposely gave priority to coal-fired power plants to sustain the coal-mining industry in their administrative region, and restricted the generation of renewable energies. Such behaviours seriously violated the renewable energy law. In order to constrain provincial and municipal governments' decision-making power in energy planning and generation, this thesis proposes several strategies.

First of all, it is suggested to appoint a top official (i.e.: secretary of provincial party committee; secretary of municipal Party committee) within the provincial and municipal government to be responsible for local renewable energy development strictly according to the renewable energy law. Such initiative has been taken by Mayor of Beijing, Wang Anshun in dealing with air pollution. Wang Anshun signed up a duty pledge with the central government in the effective management of air pollution. During his current term of office, he shut down more than 2000 polluting companies, converted coal-powered central heating to natural gas heating, and controlled traffic emission through passenger car on-road schedule regulations (Liu R 2014, n. p.). These actions led by the Mayor relieved air pollution in Beijing. In the supervision for renewable energies, the renewable energy law clearly stated that renewable energy generation should be given top priority when total local energy generation exceed market demand. The responsible official should respond directly to the central or provincial government and should be questioned for any amount of wasted renewable energy. This proposed method is similar to China's Target Responsibility System (TRS) which was effective in many tough reforms, for instance, the shut-down of heavy polluting small coal-fired power plants as mentioned in Chapter 6. How well the official manages local renewable energy will have an impact to his or her future promotion. Because the appointed officials are top leaders in the provincial and municipal governments, it is unlikely that their authorities are challenged even if other members of the government are in favour of coal power.

Second, it should be made illegal for administrative authority to intervene with renewable energy corporates' production. Provincial and municipal governments have no right to order renewable energy corporates within their jurisdiction operate at certain percentage of their capacity; nor are they allowed to threaten or punish the renewable energy corporates. If there are renewable energy corporates who do have unlawful operations, the government should pass on the case to the legal system to judge and sentence.

Third, provincial and municipal governments should be punished for wasting renewable energy in their jurisdiction. In China's carbon trading pilots, corporates failing to comply with their emission reduction targets were punished. So why should the government, who purposely wasted renewable energy and prevented emission reductions, be left alone? This thesis suggests deducting whatever loss is caused by the wasting renewable energy from relevant provincial and municipal governments' tax revenue. The deduction should include both the cash value of the wasted renewable energy and the amount of CCERs they represent at market price. The money is collected by the relevant department of the higher government to put into a special fund for carbon offset. Tough penalties are necessary and will be effective for eliminating future wastage of renewable energy. It is suggested the penalties for other forms of violation of the renewable energy law should also be tougher and clearer. The *Environmental Law* has already been made stronger and penalties for various breaches increased as discussed in Chapter 4, so it can reasonably be assumed that it will continue to do so in future, and could incorporate the suggestions made here.

Apart from restraining provincial and municipal governments' power, how to increase the strength and resilience of renewable energy corporates also deserves discussion. With the establishment of national carbon market and the role out of national ETS, the renewable energy industry will enjoy a more favourable conditions. The added price on carbon emission will make renewable energy relatively cheaper and therefore make it overall more competitive. There are several issues that needs to be considered for future policies within the renewable energy sector such as creating a fair market environment; providing extra financial service to private investors; and free of discriminations against CCERs generated from small private renewable energies. These issues may take time to be fully addressed, and some policies may even come out after the national ETS is implemented and problems truly emerge. However, for current utilisation of renewable energy, this thesis suggests two possible solutions to prevent wastage.

First of all, since the development of electric car recharge facilities had been included into China's CCER project category, this thesis suggest to give priority approvals to real estate development with such facilities and make renewable energy a mandate fuel source for electric cars. According to interviewee 14, the biggest obstacle that prevents the popularity of electric cars was the lack of recharging facility and space. Many of China's older apartment buildings are without car parks. He had seen electric car owners dropped an extremely long cord from the sixth floor window to the ground to recharge the car. If the car owner cannot find an off street parking space near his window, it would create hassle. Therefore, this thesis suggests the new real estate development to be located on the outskirts of mega cities or as satellite cities of mega cities with smart urban planning and sufficient supporting facility. Business and employees are encouraged to move to the new developments where there are lower rent and housing prices. This will not only relieve the traffic condition in mega cities, reducing air pollution, but will also demonstrate the possibility of universal adaptation of electric cars and set up example for future low carbon cities. In doing so, China's future transport sector will consume a large proportion of China's renewable energies, and the demand of renewable energy can be sustained if electric car ownership become sizable.

Second, it is suggested that China's northern provinces should consider absorbing wind energies within the region rather than sole relying on exportation. The pattern of wind energy peaks at winter months, and northern provinces consume large amount of energy for central heating. At the moment, winter central heating is largely powered by coal. To be exact, an average of 130 million tons of standard coal are used annually, which roughly equals to 433 billion KWh electricity (China IRN 2014, n. p.). China's wind power production in the entire 2016 was only 241 billion KWh (China bgao 2017, n. p.), about half the demand of central heating. This is to say, wind power can definitely replace part of coal as an alternative energy source for winter central heating. It is feasible to be consumed within the northern region of China, and the lack of a north-south transmission grid for exportation will no longer be an excuse for wastage. If priority is truly given to renewable energy as required in the renewable energy law, China in theory should have wasted no wind and solar energy.

7.4.4 Innovations for EPC

EPC was an important market mechanism that the Chinese government introduced to ECERS. The purpose of EPC is to create a win-win solution for both the ESCOs and clients. The ESCOs can make a profit while their clients can achieve energy saving and emission reduction at zero cost. China's EPC is growing at a relatively fast speed. However, it also encountered some problems, namely the lack of trust among EPC stakeholders, lack of formal finance and difficulty in finding suitable projects. These problems were not isolated. Rather, they were interconnected with different EPC stakeholders. Therefore, this thesis focuses on innovations that sooth the relationship among EPC stakeholders rather than tackling each individual barriers of technology, market and finance. Just as Kostka and Shin (2013, p. 750) put it, "in the context of contemporary China...trust and networks are critical features shaping current outcomes".

7.4.4.1 Improving trust among EPC stakeholders

Chapter 6 identified that the lack of trust among EPC stakeholders was one of the biggest obstacles that restrained the development of EPC in China. Taylor (2009, p. 34) who conducted the World bank EPC programs in multiple developing countries pointed out that a successful EPC program requires sound institutional development which can effectively bring together financial providers, ESCOs, technical experts and clients. In order to strengthen the relationship among EPC stakeholders, this thesis believes it is essential to introduce a clear and sound accreditation system for the ESCO industry, meanwhile, ESCOs should also conduct more precise risk analysis when dealing with potential energy conservation projects.

The quality of Chinese ESCOs vary greatly. Kostka and Shin (2013, p. 749) conducted an extensive series of interviews with Chinese EPC industry insiders who described Chinese ESCOs as a motley collection of enterprises. The majority of Chinese ESCOs were small with limited technological and financial capacity which appeared difficult to build up trust and reputation among local businesses. Many of them, instead of designing the full energy conservation solution and service for their clients, mainly aimed at selling the products they manufacture. Some ESCOs preferred to be called so solely for the purpose of claiming financial and tax benefit. Therefore, there is an urgent need for setting up a national standard accreditation system for ESCOs in order to guarantee the consistent industry credibility. The unified accreditation system may consider multiple criteria for ESCOs such as technology assessment, human resource assessment, service assessment, finance assessment, credit assessment, and periodical auditing. Such accreditation system can be jointly developed by EMCA, relevant NDRC research institutions and experts and insiders from the EPC industry, and it should be applied to all ESCOs in China. The universal accreditation system will provide a clearer display of ESCOs' expertise. The clearer rating is expected to display a clearer guidance for potential energy conservation clients when choosing an ESCO. ESCOs with sound service quality, exceptional expertise, rich experience and good reputations are likely to obtain high ratings from the accreditation system, and therefore, can build up confidence within their potential customers. In this way, the quality and trustworthiness from the ESCO side of the relationship can be strengthened.

ESCOs should also improve their own ability in exploring and identifying quality energy conservation projects. ESCOs need to apply a more comprehensive risk analysis to their potential clients and projects. In doing so, they need to employ personnel with expertise in risk analysis. If such employment is not considered, they would need to hire professional consultancies to conduct the analysis. In a word, the risk analysis procedure should not be left out, but be conducted in a comprehensive manner to ensure sound return of their investment. Another way to reduce risk for ESCOs is to get the insurance industry involved. If certain insurance company can develop products catered for EPC projects, it would be extra layer of protection for ESCOs' investment.

7.4.4.2 Increasing the involvement of formal finance

The financial providers added a third dimension in China's EPC stakeholder relationship. Currently, the majority of EPC finance are sourced from less formal financial channels such as shareholders and strategic partners. The involvement of formal finance is limited apart from the World Bank and Chinese government appointed bank loans (Taylor 2009, p.40). Again, this is a trust issue. Banks were not only unfamiliar with the operation of EPC projects, nor were they convinced by the methods used in evaluating EPC project performance (Kostka & Shin 2013, p. 757). To turn around this situation, government administrative pressure as proposed by Gan (2009, p. 1701) alone will not work. This is because banks also need to consider their own risks and make profit. In order to fundamentally improve the involvement of formal finance, this thesis suggests building up the relationship between banks and ESCOs through solid data, categorisation and transparency. The ESCO industry should actively promote itself to its potential clients and financial providers. For instance, EMCA can initiate yearly industry report specially targeting potential financial providers. The report should contain detailed data of all EPC cases including hosting ESCOs information, methodology and technology adopted, finance, profit, etc. The report should also categorise EPC projects according to different criteria such as technology, methodology, and scale. Such a publication will give banks a clearer idea of current EPC market and leave them to explore the potential in EPC financing. To better assist the promotion of EPC, the report should be made public and easily accessed online. Potential financial providers, ESCOs and potential EPC clients should also be informed and updated by invitations to conferences catered for EPC industry and market. This provides convenience for financial organisations to conduct risk analysis and overall data of the EPC industry (Jiang & Li 2013, n. p.).

The finance bottle neck that the ESCO industry currently faced was largely branched from its own status of being new, small scale, and unknown. Banks lacked motives to approach such kind of new and less significant business form. Therefore, the ESCO industry need to actively promote itself and create opportunities for potential financiers and clients to know about EPC. Displaying accurate and rationally organised data is one possible way to achieve this and acquire trust. China has a big market for EPC due to its resource intensive and low energy efficient production model (Y Li 2012, p. 121). There are numerous successful cases in which ESCOs professionally managed energy conservation and created win-win solutions. Therefore, the key for widening up finance for ESCOs is to let financial providers know that EPC projects are effective and there is definitely profit be made in EPC market.

7.4.4.3 Establishing info-exchange platform for ESCOs and potential clients

Apart from the trust issue among EPC stakeholders, there are also practical problems. For instance, ESCOs do not have diversified channels in identifying potential clients and projects; and at the same time clients who wish to conduct EPC projects have little information about local ESCOs. This makes business difficult in the initial stage. In response to this problem, this thesis suggest to establish a range of EPC info-exchange platforms at both local level and national level. Such info-exchange platforms are web-based and open to all ESCOs and EPC clients. ESCOs can display their service, specialty and showcase projects to potential clients. While EPC clients can also publish their energy conservation project requirements on the platform to attract ESCOs with required expertise. Such info-exchange platforms are capable of creating better matches for ESCOs and clients to that to improve business efficiency. Although currently the EMCA fulfils such a role, it does so more on a national and policy level. On the local level, such services are absent. There are local initiatives for improving the communication between ESCOs and their potential clients. For example, in Shanghai, a symposium was hosted for 26 ESCOs and 100 companies which wished to improve energy efficiency. The symposium provided a face-to-face opportunity for ESCOs and their potential clients to get to know each other, where they could find the perfect match for their needs (Lu 2015, n. p.). However, such an event is not regular. If such an event can be delivered from an online network, ESCOs and their potential clients would be able to access the information they need anytime. Thus, the efficiency of ESCOs can be improved.

Also, many high quality and reputable ESCOs are located in big cities, while many companies who require energy conservation through EPC are often located in less central places where it is hard to access good ESCOs. This thesis suggests a mobile project manager approach for large and quality ESCOs. ESCOs can appoint projects managers who are willing to travel to specific locations to conduct initial assessment of an EPC project and also conduct a series of follow up services. Mobile project managers are payed a decent commission for successful EPC projects they assist to implement. This initiative can be a good way of introducing high quality EPC management to relatively remote areas where less efficient energy intensive industries are concentrated. Good results have been seen from the education sector for remote schools using a similar approach (Xi 2015, n. p.).

7.4.5 Encouraging well-established ESCOs to explore opportunities in CCER projects

China's ESCO industry is still young. However, it cannot be denied that there are high quality ESCOs existing. For instance, China's top ten ESCOs ranked by Qianzhan Industrial Research Institution are all of great quality (Qianzhan Industrial Research Institution 2015, n. p.). It is recommendable for quality ESCOs to explore CCER opportunities. ESCOs can investigate into energy efficiency projects which fit CCER methodologies. The targeted CCER projects are not limited to large scale energy efficiency improvement projects. In fact, ESCOs with sufficient resources can bundle and manage a range of small and similar CCER energy efficient projects. Instead of receiving cash rewards from the government, ESCOs now can earn CCERs on the carbon market. China's existing high quality ESCOs have the potential and capacity to cover China's energy efficiency improvement CCER projects. The two market mechanisms CCER and EPC are not contradictory. In fact, CCER can include EPC as a major force for the development of energy conservation projects. It is believed such EPC projects will be more formal and precise when measured by the more sophisticated CCER operational and auditing procedures.

EPC will have its role and great potential in China's upcoming national carbon market. However, to improve the quality of Chinese ESCOs and to enhance business between ESCOs and their clients, the trust issues need to be solved. This section has suggested a unified national accreditation system for ESCOs, adopting more precise risk management strategies and possibly introduce insurance products. To remove the financial bottleneck that many ESCOs encountered, it is recommended for ESCOs to produce annual industrial report specially targeting potential formal financial providers. In order to overcome practical difficulties, this thesis also suggests to establish info-exchange platforms for ESCOs and their clients. High quality ESCOs are also encouraged to explore business opportunities in CCER projects to keep utilising their expertise in energy conservation and energy efficiency improvement.

7.5 Summary of main findings

In order to answer the question of how China can optimise its current energy policies in order to achieve better outcomes in climate change mitigation, the thesis has conducted analyses on three objects at two levels. At the policy development level, it investigated the role of and relationships between China's major actors in climate-related energy policy. At the policy implementation level, it evaluated the strengths and weaknesses of CDM covering the energy related projects and ECERS in the energy sector during the 11^{th} and 12^{th} Five-Year Plan. The strength in the government's administrative power is worthy of affirmation. It was especially effective in the closing down of small coal-fired power plants. The government's power is also reflected in the utilisation of resources for rapid, large scale renewable energy development. However, this thesis also revealed a range of obstacles in China's institutional arrangements and policy implementation process. It concluded that China's climate-related energy policies are bold and ambitious. The major problem associated with the policies lay neither in speed nor in scale, but in coordination, efficiency, integrity and quality.

Fragmentation and overlapping policy responsibilities were common within NDRC among the three climate-related departments: the National Energy Administration, the Department of Resource Conservation and Environmental Protection and the Department of Climate Change. Conflicts of interests in the management of climate change mitigation also exist between NDRC, MEP and MF. It requires a whole-of-government approach to eliminate conflicts, enhance coordination and conduct more effective climate and energy policies. The relationship between the central, provincial and municipal government in climate change mitigation and general environmental protection is even more problematic. It is difficult for the central government to monitor policy implementation at the out-of-reach municipal level, where the municipal government usually puts economic development as its top priority for tax revenues. Therefore, this thesis strongly recommends increasing the power of MEP and MEP to carry out direct supervision for its provincial and municipal EPBs. In this way, provincial and municipal EPBs' actions against pollution and the violation of environmental laws will no longer be restricted by provincial and municipal governments.

Enterprises including SOEs and non-SOEs are also forces that shape China's climate-related energy policies. Large Energy SOEs generally have more bargaining power with the central government; while smaller non-SOEs are weaker stakeholders. The expert community has contributed greatly to the input of climate-related policy development. This is mainly due to the lack of expertise in the climate change domain within the government. ENGOs and the general public play a limited role in the formation of China's climate-related policies. Their contribution is mainly through the channels of media and public online forums, which may form only a tangential policy input. This investigation determined that the central government plays the most important role in China's climate-related energy policies. Therefore, how well the government designs the policy will have the most significant impact on policy outcomes.

Nonetheless, policy design is only one aspect that influences the outcome of the policy. The quality of the implementation of the policy has an even bigger influence on the policy outcome. ECERS has shut down over 100 million KW of small coal-fired power capacity during the 11th and 12th Five-Year Plan. This outcome is impressive, however, sub-optimal elements were also numerous. Unfair and delayed compensations to some the laid-off workers and private small coal power plant owners posed great difficulty for those affected. The corruption and fraudulent claims for closing down compensation by some seriously damaged the policy's integrity, especially in ascertaining the real level of emissions reduction. However, replacing the small coal power plants with more efficient large ones improved overall efficiency in the coal power sector. The policy fulfilled the energy conservation function, however it had little impact on overall emissions reduction in the coal power sector, nor did it fundamentally optimise China's energy structure. This would require the government to reconsider its current planning of coal-fired power plants and make some serious decisions in cutting off coal usage and replacing this with renewable energies.

A large proportion of ECERS' investment went to the development of the renewable energy industry. China's total renewable energy capacity reached a quarter of the world's total and became the world's leader in renewable energy capacity. However, serious challenges were evident in the renewable energy sector. Within the renewable energy industry, unfair competition between large SOEs and smaller private companies seriously restricted the enthusiasm of private investment in the sector. Large SOEs only passively included renewable energy projects in their portfolio because the government required them to do so. Although they received many types of government financial assistance for their renewable energy projects, their primary interest was still in the traditional fossil based energies. They basically use their renewable energy projects as bargaining power for future government approval of fossil based power plants. To the contrary, smaller private companies received little support in comparison. This unfair treatment discouraged private investment in the renewable energy industry and is not beneficial for the sustainability in long-term renewable energy development.

An even more serious problem in China's renewable energy industry was the waste of wind and solar power. In many northern provinces, wind and solar power plants were not allowed to operate at full capacity under the provincial and municipal governments' administrative pressure. Excuses such as limited grid capacity and limited consumption capacity have contributed to the wastage of up to 70% of wind power in some regions (BJX Wind Power 2016, n. p.). This situation was caused by the competition of interests from the coal mining industry, coal-fired power plants, grid companies, and provincial governments. China's wind rich regions largely overlap with China's coal rich regions. The coal mining industry lobbied the provincial government to approve more coal-fired power plants to sustain their long-term operation. Some provincial governments did so to gain immediate and sustained tax revenue. Meanwhile, for the same purpose of raising tax revenue, they also approved more wind and solar power capacity for the purpose of keeping wind turbine and solar panel manufacturing industry in their province. The blind increase of both coal and renewable energy creates energy surplus in the less developed northern and western regions. However, if the renewable energy law was followed and priority was really given to renewable energy, the vast waste of wind and solar energy in northern China would not happen. Thus, the thesis concluded the problems associated with China's climate-related energy policies was neither a scale problem nor a speed problem, but a problem of integrity, efficiency and quality.

In order to overcome the weaknesses in China's coal power and renewable power sectors and improve the integrity, efficiency and quality of ECERS, this thesis identified several implications. It included adjusting UI duration and providing small business loans and retraining scholarships for unemployed workers of the shut-down small coal-fired power plants; abolishing cash rewards for energy conservation and emission reduction and replacing it with tax measures; toughening the penalty for violating the renewable energy law; appointing the head of provincial and municipal governments to be responsible for the renewable energy sector within their authority, and any amount of wasted renewable energy will be deducted from their tax income in cash value; utilising renewable energy in electric car charging facilities; and prioritizing wind power as a source for winter central heating in northern provinces. I hope these recommendations will be able to address the weaknesses of current policy and point out new directions for future policy development.

EPC was another component that this thesis chose to investigate under ECERS. EPC was a market mechanism which targeted energy conservation and efficiency improvement by utilising better technology or management procedures or both. EPC was relatively new to China. As a new phenomenon, it has encountered several obvious challenges, including the lack of trust among EPC stakeholders, lack of involvement of formal finance, and difficulty in finding the compatible clients or ESCOs. In response to these issues, this thesis has suggested introducing a unified national accreditation system for ESCOs; conducting special EPC industry report targeting potential financial providers and creating web-based info-exchange platforms for ESCOs and clients. To further promote the development of EPC, the thesis also suggested qualified ESCOs to undertake energy efficiency CCER projects. It was demonstrated that the expertise and experience of such ESCOs have much to offer in China's national carbon market.

The analyses in this thesis covered two of the most important climate-related energy policies in China roughly from 2005 to 2015. CDM, as an international market mechanism, introduced a great climate change mitigation concept, procedures and system to China. It had brought China a range of benefits in sustainable development. It can also be viewed as an inspiration for China's domestic carbon market. ECERS was adopted in a mainly top-down administrative fashion. Compared with CDM, it was expensive and certainly much less cost efficient. Whether or not the cost-effectiveness of China's climate change mitigation will improve after the implementation of a national ETS remains to be seen. But it is certain that the Chinese government started to realise the importance of addressing climate change and atmospheric pollutions. Therefore, better energy policies with a focus on climate stability can be expected.

This thesis presented findings on the effectiveness of China's authoritarian environmentalism in the context of China's climate-related energy policies. The top-down authoritarian style of policy development, coupled with TRS for implementation, has its strengths, including the success of the order for shutting down inefficient small coal-fired power plants. However, it also has it limitations. For policy development, a highly centralised approach discourages the involvement of provincial and local government. As Interviewee 1 pointed out, due to the lack of provincial and local inputs, policies display a range of weaknesses after they are implemented. For policy implementation, local affairs are beyond the control of the central government, leaving a considerable implementation gap. Under these circumstances, a bottom up policy approach is required as a supplement to authoritarian environmentalism. The involvement of ENGOs, media watchdogs and the general public needs be encouraged to act as auditing elements for local policy implementation, as they currently do in Western contexts as was discussed in Section 2.4 of the thesis. The development of this approach is likely to take some time given the nature of the contemporary Chinese context as described in this thesis.

7.6 Future research directions

More research needs to be conducted on China's climate-related policies due to the importantance of China's role in global climate change mitigation. Similarly, research on other major developing countries should also be carried out due to the energy intensive nature of their economies and the impact of their fast increasing emissions on the world's climate. This thesis suggests four directions for future research: 1) analysis of China's climate-related energy policies during the current Five-Year Plan (the 13th) and future Five-Year Plans; 2) quantitative analysis of the cost-effectiveness of the recommended options proposed in this thesis; 3) analysis of China's climate-related policies in other sectors; and 4) research on the climate-related policies of other developing countries using the conceptual framework and methods adopted in this thesis.

Firstly, this thesis analysed the climate-related energy policies of CDM and ECERS during the 11th and 12th Five-Year Plans (2006-2015). It identified their strengths and weaknesses and identified implications to address their weaknesses. However, the analysis was limited to this time period. Therefore, future research can look at how these policies evolve during the 13^{th} Five-Year Plan period (2016-2020). It can also focus on changes in the dynamics of China's policy actors. Another focus of such research should be on whether or not the weaknesses identified in the thesis are successfully addressed. Moreover, it can explore new challenges arising in the future. Such research will be valuable as it can identify and address policy weaknesses in a timely manner by conducting long-term monitoring of China's climate-related energy policies.

Second, further research can also concentrate on conducting a quantitative analysis of the cost-effectiveness of the alternative options proposed in this thesis to address the weaknesses of CDM and ECERS. While this thesis did propose a range of alternative options to address the policy weaknesses based on its own analysis and experience from other countries, it was not able to include an ex-ante cost-effectiveness analysis to justify them due to the limitations of time, expertise and scope. This is something which could fruitfully be taken up by researchers with the required expertise and resources.

Third, apart from further investigations into China's climate-related energy policies, futher research can also explore climate-related policies in other sectors, such as those in China's transport, manufacturing and building sectors. These are all energy intensive sectors and contribute to a great proportion of China's greenhouse gas emissions. Addressing challenges in these policies and working to overcome the challenges will be of great significance to China’s overall climate change mitigation efforts.

Last but not least, future research can also use the conceptual framework and methods employed in this thesis to explore climate-related policies in other major developing countries with high emissions. Accoding to Alam, Murad, Noman and Ozturk’s (2016) analysis of the relationship between income and CO_2 emissions in China, India, Brazil and Indonesia, CO_2 emissions in all four countries have increased significantly with increases in income and energy consumption. This trend will contine into the foreseeable future. Therefore, working on developing countries’ climate-related policies to achieve optimal emission reductions will be significant for global climate change mitigation. Following the example of this thesis, such research can explore the roles of and relations among actors in climate-related policies, analyse the strengths and weaknesses of major policies and suggest improvements. Such research should draw on interviews with actors, media reports, online forums and official data and documents. This kind of research can either focus on each individual developing country’s policies, or conduct policy comparisons between countries to identify similarities and differences. It is anticipated that the second option can enable developing countries to learn from each other’s effective policies and avoid ineffective ones.

7.7 Final remarks

Five years have passed since the start of this thesis in 2012. Much has happened in China's climate-related policy domain. China completed its carbon trading pilots during this period and is to implement a national ETS at the end of this year. The ECERS of the 13th Five-Year Plan (2016-2020) is more promising as it included a clear message on dramatically reducing coal consumption and addressing the wasting of wind and solar power. Many of the implications drawn out of the analyses of this thesis provide innovative and workable solutions to the current policies. Directions on how China's emission mitigation can be improved through optimising current energy policies were demonstrated. More importantly, the data used in this thesis was not limited to official sources, but also incorporated the views of Chinese officials, scholars, energy company managers and ENGO personnel, and the general public. Therefore, it has provided a fuller picture of the analysed policies than currently exists. As a result, the findings in this thesis are valuable for China's current and future climate-related energy policies.

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Appendix A: List of Interviewees:

Interviewee 1, Officer of NDRC , Oct, 2013, Beijing
Interviewee 2, Research fellow at Research Centre for Sustainable Development, CASS, Oct 2013, Beijing
Interviewee 3, Officer of MEP, Oct 2013, Beijing
Interviewee 4, Local EPB officer, Oct 2013, Beijing
Interviewee 5, ENGO officer in Beijing (Organization name wished not to be identified) , Oct 2013, Beijing
Interviewee 6, ENGO officer Quanlian New Energy Commerce, Oct 2013, Beijing
Interviewee 7, Professor at the Centre for Rural Environmental and Social Research, CASS, Oct 2013, Beijing
Interviewee 8, Officer of National Energy Administration, NDRC , Oct 2013, Beijing
Interviewee 9, Previous private owner of a small coal-fired power plant , Oct 2013, Beijing
Interviewee 10, Head of an ENGO (Organisation name wished not to be identified), Oct 2013, Beijing
Interviewee 11, Owner of a private small scale wind farm, Oct 2013, Beijing
Interviewee 12, Consultant of Saidi Zhiku Consultancy, Oct 2013, Beijing
Interviewee 13, Analyst specialized in renewable energy, Oct 2013, Beijing
Interviewee 14, Professor from the School of International Studies, CASS, August 2016, Adelaide