Experts and the science-policy interface in China's climate policy

Chen, L.-Y.

Publication date
2022

Chapter 1: Introduction

1.1 Purpose of thesis

On 12 December 2020, the United Nations (UN) held a virtual summit to mark the 5th anniversary of the 2015 Paris Agreement on Climate Change (UNFCCC, 2015). Yet, rather than celebrating, UN chief Antonio Guterres urged world leaders to declare a 'state of climate emergency' and keep taking aggressive action to reach the target of carbon neutrality. As Guterres warned, although the Paris Agreement is a landmark in the history of the multilateral climate negotiations, "Nations' current commitments were 'far from enough' to limit temperature rises to 1.5°C" (France 24, 2020: Paragraph 3). His words indicate that current climate policymaking and implementation is not enough and there is a need to ramp up country ambitions.

Anthropogenic climate change is a complex environmental problem. It has many characteristics that make it hard to tackle with normal scientific procedures and demands new ways of interfacing science and policy (Van der Sluijs, 2010: 31). Over the past three decades, we have witnessed a paradoxical phenomenon of the ways in which all countries in the world recognise and deal with global climate change (Bulkeley and Newell, 2010). Growing scientific certainty about the causes and consequences of climate change has brought it to the top of the international political agenda. Among all kinds of scientific organisations, the Intergovernmental Panel on Climate Change (IPCC) is a prime example of an effective institution that stands at the intersection of science and climate policies in the international arena (Haas and Stevens, 2011). It was established by governments through a UN General Assembly Resolution (UNGA, 1988) to assess the literature on climate change and make it understandable for policymakers, raising concerns of global climate governance (Gupta, 2014 (b)). But despite the exponentially growing knowledge on climate change, current action taken by political leaders to address the 'climate emergency' has been slow and insufficient. The effectiveness of the international climate regime has been assessed as modest (Haas, 2004; Siebenhüner, 2002, 2014; Andresen, 2014). There is a persistent gap between knowledge production and use in combating climate change (Lemos, Kirchhoff, and Ramprasad, 2012). Mediating the science-policy interface (SPI) thus becomes a critical challenge for humankind. In addressing an unstructured (i.e., where there is lack of consensus on science and values) and wicked (i.e., where the costs and benefits fall on different people/countries) problem like climate change, scientists/experts and their expertise are indispensable in trying to promote consensus on science if not on values in the governance process that drive policy change. In 2019, anxious young people assembled for the Climate March around the globe to push for strong governmental policies and behavioural change on climate change. Echoing the Climate March, scientists further pointed out that the core of the problem is not science but politics: "Science and technologies to drastically reduce CO_2 emissions already exist. It now requires first and foremost political courage" (Scientists for Climate, 2019: 1).

In the dynamics of (global) climate governance, the relationship between science and policy is far from a simple linear rational model where "science informs policy by producing objective, valid, and reliable knowledge" (Van der Sluijs, 2010: 33). Rather, while the scientisation of climate policymaking can be recognised, the production of scientific knowledge, the function of (international) scientific communities, and the translation of knowledge into action are inevitably affected by political dynamics (Betsill and Pielke, 1998; Lövbrand, 2009; Hoppe, 2010 (a); Naustdalslid, 2011; Rietig, 2014; Lidskog and Sundqvist, 2015). Scholars have noticed that in the terrain of climate change, science sometimes becomes a 'proxy' for political battles (Pielke, 2007). While humans expect science to resolve political conflicts, the process of scientific debates itself is like political debate (Beck, 2011: 302). Further, while scientists seek to enhance their influence on climate policymaking, they have to negotiate with some critical trade-offs, such as the balance between credibility, relevance, and legitimacy (Sarkki et al., 2014; Beck and Mahony, 2018; Pearce, Mahony, and Raman, 2018).

Against this background, this thesis examines the relationship between science, politics, and climate policy. More specifically, it explores the ways in which experts engage in the climate policy process and how politics influences the mediation of science and policy simultaneously. I chose the Peoples' Republic of China (PRC) as a case study due to its significant role in global climate governance and its unique political characteristics: First, it is impossible to address global climate change without engaging China in mitigating greenhouse gas (GHG) emissions (Lewis, 2007, 2009; Harris, 2011; Wang-Kaeding, 2015: 31; Gupta, 2016 (b)). China has overtaken the United States (US) as the world's largest GHG emitter in 2007 (PBL, 2007) and then surpassed the US in 2009 as the biggest energy consumption entity (IEA, 2011) (see *Table 1.1*).

Considering its size, geography, resource endowment, and central role in the global supply chain and larger international economic architecture, China will keep playing a critical role in global climate governance (Lewis et al., 2010; Balme, 2011).

Second, the PRC's multi-level government system (e.g., the national, provincial, and prefectural levels) allows me to examine SPI at each government level and in cross-level dynamics of China's climate policy. Third, while previous studies rarely touch upon SPI in the illiberal/authoritarian context (Jones, 2019; Wan et al., 2020), this study can enrich the theoretical discussion on SPI by contextualising SPI in China.

Table 1.1 Top emitters of GHGs (total amount) in the past thirty years

	1990	2000	2005	2010	2015	2019
Top 1	US	US	US	China	China	China
Top 2	EU+UK	EU+UK	China	US	US	US
Top 3	China	China	EU+UK	EU+UK	EU+UK	EU+UK
Top 4	Russia	Russia	Russia	Russia	India	India
Top 5	Japan	Japan	Japan	India	Russia	Russia

Source: Author compiled the data from the International Energy Agency (IEA), *Data and Statistics*, https://www.iea.org/data-and-statistics.

In what follows, Section 1.2 defines the societal and academic problems, Section 1.3 explains the overarching question, sub-questions, and research focus and limits of this study, Section 1.4 discusses the policy relevance of this study, including the SPI on climate change at the global level and Chinese level, and lastly, Section 1.5 presents the structure of the thesis.

1.2 Problem definition

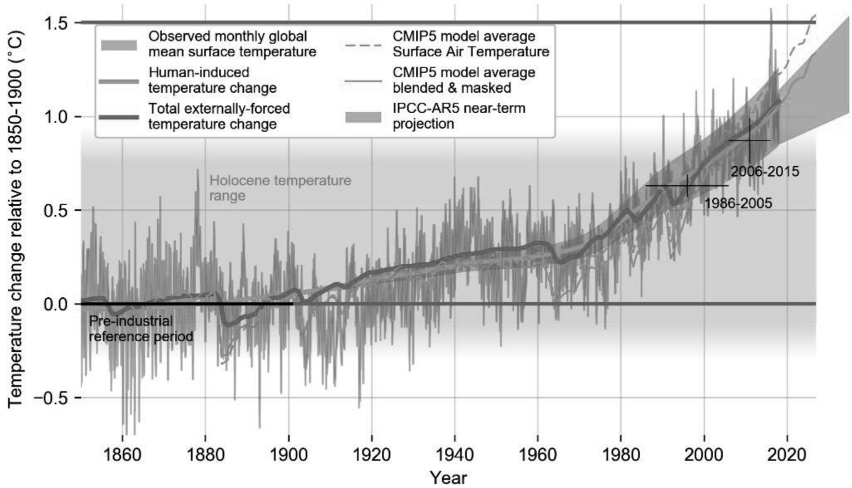
1.2.1 Societal problem

1.2.1.1 Climate change

Climate change is the most severe environmental problems facing the world. Article 1 of the United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (UNFCCC, 1992). While climate change can be attributed to human activities and natural causes, anthropogenic climate change is the problem to be addressed. Human overuse of fossil fuels and land-use changes (particularly deforestation) since the Industrial Revolution has caused rapid accumulation of GHG concentrations in the Earth's atmosphere (Bernauer, 2013: 422). The Earth's surface has undergone unprecedented warming over the 20th century, and especially in the 21st century. Since 1977, every year has been warmer than the 20th century average, with 19 of the 20 warmest years on record occurring since 2001 (NASA, 2017, 2018, 2020) (see *Figure 1.1*).

Meanwhile, climate change-induced natural disasters happen more frequently. The past decade has seen an astonishing run of record-breaking storms, forest fires, droughts, coral bleaching events, heat waves, and floods (National Geographic, 2018). In 2018, IPCC scientists released a Special Report on Global Warming of 1.5°C, warning that "Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate" (IPCC, 2018 (a): 6). This means that there is limited time for humans to keep global warming to a maximum of 1.5°C, beyond which even half a degree will significantly increase the risks of drought, floods, extreme weathers, and poverty (The Guardian, 2018; IPCC, 2018 (a)).

Figure 1.1 Rising global temperature



Source: IPCC (2018: 57).

Responses to global climate change fall broadly into two main categories of action—mitigation and adaptation. Mitigation aims to reduce the emissions of greenhouse gases and increase the sinks to absorb such emissions while adaptation refers to entitlements, assets, resources and actions taken to cope with the impacts of climate change (IPCC, 2014). Following the adoption of the Climate Change Convention in 1992 (UNFCCC, 1992), the Kyoto Protocol (KP, 1997) was adopted to curb the level of GHGs, namely carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) in the period 2008-2012. Meanwhile, adaptation aims to improve the capacity of the natural/human system to adjust, cope, and recover from the impact or given hazard of climate change (Lemos and Agrawal, 2006: 316).

Climate change is inexorably tied to socio-political contestations (Dryzek, Norgaard, and Schlosberg, 2011). First, countries debate who caused climate change, who suffers most from this problem, and who should take responsibility and action to address the problem (Gupta, 1997, 2014 (b), 2000). Among these are inequity and injustice problems which have emerged between the global North and South. On the one hand, the countries of the North have emitted a substantial degree of GHGs during the past two hundred years (Lemos and Agrawal, 2006) and the richest 10% of the population counts for almost half of total lifestyle consumption emissions (Otto et al., 2019: 82). On the other hand, the world's poorest 50% are mostly vulnerable to climate change and are responsible for only about 10% of lifestyle consumption emissions (Otto et al., 2019: 82). The North-South politics of climate change thus emerges, with some arguing for the need to differentiate the 'survival' emissions of the South and the 'luxury' emissions of the North (Agarwal and Narain 1991; Gupta, 1997; Pan, 2003; Bulkeley and Newell, 2010; Harris, Chow, and Karlsson, 2013).

Second, governing climate change is challenging in terms of the scale of the problem (Gupta, 2007, 2008; Bulkeley and Newell, 2010). GHG emissions "in one place and time contribute to increasing atmospheric concentrations which in turn will have impacts across the globe" (Bulkeley and Newell, 2010: 2). At the same time, the impact aspects and adaptation of climate change are local challenges (Bodansky, 1993). Further, tackling climate change needs a global solution because no country can combat climate change alone (Bulkeley and Newell, 2010: 2). To prevent the free-rider problem (i.e., some people benefit from the actions of others), it requires cooperation between countries to reduce emissions worldwide (Bulkeley and Newell, 2010: 2; Bernauer, 2013: 429).

Third, governing climate change leads to multi-level and cross-level governance dynamics. Political leaders may encounter difficulty visualising the problem and translating action in the specific territorially circumscribed context (Lemos and Agrawal, 2006; Gupta, 2007; Hoppe, 2010 (a)). There is no objective way to determine the appropriate level of climate change since such a problem manifests itself differently at a number of levels simultaneously (Gupta, 2007). As a global policy problem, climate change requires scaling down to appropriate policy responses. For policymakers, finding national and local solutions requires a continuous back-and-forth process among governance levels and "a dialectic between global framings of the problem and its local manifestations" (Hoppe, 2010 (a): 113). There is a need to revisit the centre-local governmental relations and the redesign of existing regulatory frameworks to effectively manage climate change (Gupta, 2007).

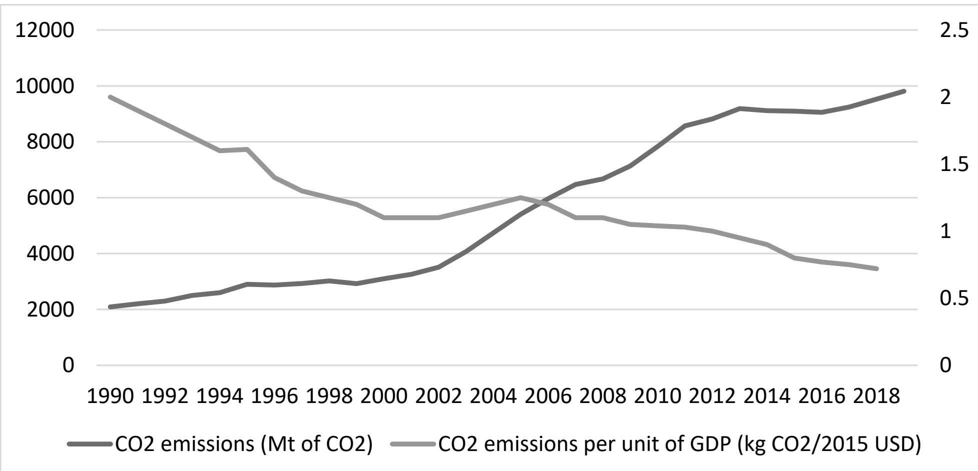
1.2.1.2 Climate change and China

The PRC is a country with the world's largest population and second-largest nominal GDP. It is also the world's fourth-largest country by area with a complex and vulnerable eco-environment and is vulnerable to the adverse impacts of climate change (NDRC, 2013: 28).

Since its 'reform and opening up' policy in 1978, China's GDP growth has averaged almost ten percent a year. Today, China is shifting from a developing country to an upper-middle-income country (World Bank Group, 2019: i). But its per capita income remains about a quarter of that of high-income countries, and about 373 million Chinese are living below the upper-middle-income poverty line of US$5.50 a day (World Bank Group, 2019: 3).

China's GHG emissions including CO_2 have increased rapidly in the 21st century. However, its CO_2 emissions per unit of GDP shows a rapid decline (see *Figure 1.2*). Since 2002, China's energy growth surpassed economic growth and led to a rapid growth of GHG emissions (Lewis, 2007: 156). Yet, since its growth in coal consumption peaked around 2010 and has declined to around 1% per year on average since 2013, the overall growth of China's GHG emissions slowed down in the 2010s (Peters, 2017). Although the COVID-19 outbreak in spring 2020 brought a temporary decrease in emissions, China's energy consumption has increased again since then (Heggelund, 2021: 10).

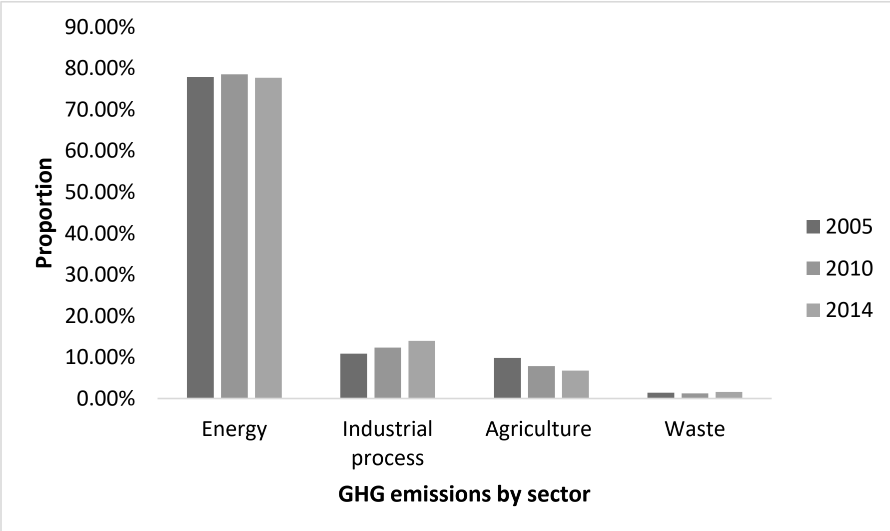
Figure 1.2 CO_2 emissions and CO_2 emissions per unit of GDP, China (1990-2018)



Source: Author compiled the data from the International Energy Agency (IEA), *Data and Statistics*, https://www.iea.org/data-and-statistics.

In terms of China's GHG emissions by sector, most of its emissions are from the energy sector. According to China's policy documents (NDRC, 2013; MEE, 2018 (c)), energy counts for 77.89%, 78.55%, and 77.71% of its GHG emissions in 2005, 2010, and 2014, respectively (see *Figure 1.3*). Meanwhile, even the second biggest source of emissions—industrial process, contributes only 10.86%, 12.34%, and 13.96%, respectively, of China's total GHG emissions (MEE, 2018 (c)). Hence, China's GHG emissions story is primarily an energy story, and energy is the core of its climate policy.

Figure 1.3 GHG emissions of China by sector in 2005, 2010, and 2014 (without LULUCF)



Source: Author compiled the data from MEE (2018 (b)).

Climate change has a profound impact on China as a whole (Lewis, 2007, 2009; X. He, 2017; Wang et al., 2019). As a group of Chinese leading climate scientists stated: "It is very likely that future climate change would cause significant adverse impacts on the ecosystems, agriculture, water resources, and coastal zones in China" (Lin et al., 2007: 1). According to the three National Assessment Reports on Climate Change compiled by Chinese experts in 2007, 2011, and 2015, climate change has led to observable patterns of change in water, heat resources and environmental factors, resulting in both direct and indirect impacts on China's natural systems and socio-economic development (X. He, 2017: 111). Based on China's National Communications on Climate Change (NDRC, 2004, 2013; MEE, 2018 (c)) and its National Assessment Reports on Climate Change (ECNARCC, 2007, 2011, and 2015), vulnerable sectors include agriculture, water resources, territorial ecosystems, coastal zone ecosystems, and human health (see *Table 1.2*).

Table 1.2 Climate Change Impacts in China

Fields	Specific impact of climate change on the sub-fields
Agriculture	*Temperature*: China's average temperature has increased and the northern limits of cropping systems have shifted northward
	Disease and pests: Diseases and pests are increasing and prevention and control have become more difficult
	Crop yields: Crop yields of wheat, maize, and double-season rice have decreased, but single-season rice has increased
Water resources	*Water resources*: River runoff in rivers in southern China is stable while runoff reductions have been observed in all stations of rivers in northern China (e.g., Yellow River, Haihe River, and Liao River)
	Floods and droughts: Floods and droughts have increased; 16 provinces suffered severe droughts in consecutive years
Terrestrial ecosystems	*Forests*: Climate change has had some impacts on forest phenology, distribution, composition, and productivity, forest fires, and pests and diseases
	Grasslands: Rising temperature leads to earlier greening of grasslands in Inner Mongolia and on the Tibetan Plateau, while yellowing is delayed, and the vegetation growing season is prolonged
	Wetlands: Wetlands are contracting with a decline in their functions
	Lakes: Water levels in lakes are changing
	Biodiversity: Wildlife and wild plant distribution is changing; resident and migratory birds have moved northwards or westwards; some amphibians have been shifting westwards
Coastal zone ecosystems	*See level*: Sea level has been increasing with fluctuations
	Seawater intrusion and soil salinisation: Sea level rise and decreasing groundwater levels have intensified seawater intrusion, causing freshwater pollution and soil salinisation
	Coastal terrestrial ecosystems: Sea level rise has aggravated coastal erosion
Human health	*Human chronic diseases (e.g., cardiorespiratory diseases):* Future climate change scenario modelling suggests that this effect will become more frequent, extensive, and lasting
	Human infectious diseases: Climate change has stimulated pathogenic recovery and transmissions and influence the spatial and temporal distribution and quantity of vectors and intermediate hosts, pathogenesis, and the distribution of diseases

	Vulnerability of population groups: By region, the population in northern areas will be more susceptible to future warming due to their long-term physical adaptation, and the population in rural areas will also be more vulnerable because they will have a higher risk of exposure due to their lack of effective responses measures

Source: Author compiled the data from ECNARCC (2007, 2011, 2015) and MEE (2018 (c)).

1.2.2 Academic problem: knowledge gaps in the existing literature

With the focus on SPI of climate governance in general and on China's climate policy in particular, there are at least four knowledge gaps in the existing literature: (1) A lack of exploration of SPI in the Global South context; (2) A lack of exploration of SPI from a multi-level or cross-level perspective; (3) A lack of theoretical discussion and concept definition of SPI; and (4) A lack of exploration of SPI and China's climate policy together (see 2.2).

First, there is a lack of exploration of SPI in the Global South context. In general, the majority (72%) of SPI literature is based on case studies of the Global North countries, particularly the highly developed liberal democracies (see 2.2.1.2). Although the SPI and climate change literature shows a better distribution of case-study regions, knowledge about SPI in the Global South countries is still limited.

Second, there is a lack of explanation of SPI at multiple levels and in cross-level dynamics of climate governance (see 2.2.1.3). Although scholars have examined SPI at virtually all levels of governance (from the global level to the community level), their analysis primarily focuses on SPI at one level of governance. Most existing studies of SPI on climate policy focus primarily on the international level (Haas and Stevens, 2011; Gupta, 2014 (a), 2014 (b)) or the national level (Lahsen, 2009; Howarth and Painter, 2016; Kukkonen and Ylä-Anttila, 2020). Less than 3% of the current SPI literature has explained how science influences decision-making across different governance levels (for exceptions, see Biermann's (2002) study on the impact of global environmental scientific assessments on India's climate policy and Wilson Rowe's (2013) research on Russia's domestic response to the international scientific assessment reports on climate change).

Filling this gap is critical because of the importance of multi-level governance (MLG) and cross-level dynamics in addressing climate change (Bulkeley and Betsill, 2005; Betsill and Bulkeley, 2006; Gupta, 2007, 2008; Kern and Bulkeley, 2009; Schreurs, 2010, 2017; Jänicke, 2014, 2017; Marquardt, 2017) and the necessity for science and expert knowledge to travel across levels for effective policymaking. From a multi-level perspective, the climate change problem can be framed differently at different governance levels, such as energy, economic, scientific or environmental policy issues when scaling up and down

(Gupta, 2007, 2008). Policymakers and experts may think about the problem in terms of the international-national-provincial-local continuum (Hoppe, 2010 (a): 114). Dealing with this kind of cross-level issue inevitably involves both intellectual and political struggles about how to draw boundaries around the problem (Hoppe, 2010 (a): 115). To describe a comprehensive picture of the SPI on climate policy, hence, requires understanding the multi-level science-policy interactions (Hoppe, 2010 (a): 111).

Third, there is a lack of theoretical discussion and concept definition of SPI. Although SPI has been heavily used in studying a wide range of governance issues, it has been primarily purposefully applied without a reflective discussion. In the past thirty years, less than 10% of the extant literature has put SPI at the centre of analysis (see 2.2.1.5). A multi-level and cross-level analytical framework for analysing and evaluating SPI has not yet been developed by scholars. To address this gap, Sections 2.3, 2.4, and 2.5 will define each element of SPI and introduce problem structuring and a typology of problems as a novel theoretical approach for analysing SPI.

Lastly, there is a lack of exploration of SPI and China's climate policy together. Scholarly work on global governance (Haas and Stevens, 2011; Gupta, 2014 (a), 2014 (b)) and in social sciences disciplines such as Political Science (Keohane and Victor, 2011; Bernauer, 2013; Keohane, 2015), International Relations (IR) (Haas, 2015; Underdal, 2017), Public Policy (Fischer, 2017), and Science and Technology Studies (STS) (Hoppe, Wesselink, Cairns, 2013; Lidskog and Sundqvist, 2015; Gustafsson and Lidskog, 2018) has shown the important role played by experts and scientists in the dynamics of climate governance. However, both English and Chinese language publications on SPI and climate change have accumulated little understanding of the relationships between science and China's climate policy (there are only a few examples in the literature: Yu, 2004; Wübbeke, 2010, 2013 (a), 2013 (b); Chen, 2017; Lo and Chen, 2019). Even though Chinese scholars have used SPI to analyse climate politics and policies, they focus more on global climate politics than on China's climate policy (see 2.2.4). Given China's significant role in global climate governance, SPI and China's climate policy together is underexamined.

Filling this gap is critical to enrich the theoretical discussions of SPI. Scholars have pointed out that the relationships between science, politics, and policy are significantly influenced by the governance context—the politico-administrative institutional environment, bureaucratic culture, social expectations of the role of science and expertise in contemporary societies, and so on (Jasanoff, 2004; Boswell, 2009; Hoppe, 2010 (a); Freeman and Sturdy, 2014). For example, Wilson Rowe's case study on Russia shows that scientific claims and international scientific assessment reports transform into Russia's climate policymaking "in a somewhat more surprising and non-linear way than we might assume" (Wilson Rowe, 2013: 3). Considering the authoritarian feature of China's political system, whether SPI on climate policy in China presents a similar or different pattern when compared with SPI in liberal democracies remains unanswered. Hence, the Chinese case study with the contextualised examination of SPI can contribute to improving our understanding of the science-policy-politics nexus.

1.3 Research Questions, focus and limits

1.3.1 Overall question and sub-questions

In order to address the above-mentioned knowledge gaps on SPI in China's climate policy, this thesis studies the role of experts in China's multi-level climate governance. The overarching question of the thesis is: **Under what conditions and in which ways do experts influence China's climate policy across multiple levels of governance, and what does this mean for the future of China's climate policy?** To answer the overarching question, the central line of inquiry leads to a series of sub-questions (see Appendix I for the list of research questions of each chapter in this thesis):

(1) Who are the experts that are engaging with the policy process? Who are the policymakers?
(2) What kinds of science do experts generate and what kinds of science do policymakers need in order to make decisions, and why?
(3) What kinds of political considerations do policymakers take into account before making the decisions?

1.3.2 Research focus and limits

1.3.2.1 Research focus

Concerning the spatial scope of this study, I focus on experts and climate policy in the PRC. Rather than analysing policy itself—e.g., the costs and benefits of specific policy instruments, mechanisms or programmes, I focus on the process of communication between experts and policymakers. To locate SPI in a multi-level perspective, I first examine the experts' engagement with China's foreign climate policymaking and China's participation in the international climate negotiations. Then, I analyse the experts' engagement with China's climate policy process at the national, provincial, and prefectural levels, respectively. Lastly, I address SPI in cross-level interactions among the above levels of China's climate governance.

The temporal scope of this research is from 1990 to 2020. China's participation in the international climate negotiations since the 1990s is treated as the starting point of its climate policymaking (Qi and Wu, 2013). As 2020 marks the end of China's 13th Five-Year-Plan period (2016-2020) and China' National Plan on Climate Change (2014-2020), it serves as an ideal endpoint of this research. In this period of three decades, the ways in which experts engage in and the results of China's foreign, national, and local climate policy are examined in detail. Meanwhile, this period witnessed three transitions in Chinese political leadership: the Jiang-Li-Zhu Administration (1989-2002),[1] the Hu-Wen Administration (2003-2013),[2] and the Xi-Li Administration (2013 to present).[3]

Concerning the substantive scope of this study, I focus on mitigation. Since the 2000s, scholars have argued that China's climate policy is primarily a repackaging of its existing energy policies with other considerations on economic, environmental, and other related issues (Hallding, Han, and Olsson, 2009; Tsang and Kolk, 2010; Zang, 2010; Chen, 2012). In China's domestic climate policy agenda, energy-related policies have enjoyed high visibility and other advantages. Hence, I pay particular attention to experts' engagement with target-setting (See 6.3) and selection of policy instruments (See 6.5). At the higher levels of governance (international and national), the policy scope of the analysis covers the design of international climate regimes and negotiations topics (Chapter 5), and law-making (See 6.4). At the lower levels of governance (provincial and prefectural), I focus on the experts' engagement in the low-carbon province and city pilot programmes and other related low-carbon (climate change mitigation) programmes.

Meanwhile, the 'science' in my research primarily relates to the role of experts and different kinds of knowledge that they have provided to Chinese policymakers in order to inform and navigate climate policy (see 2.3.1). In addition, the 'science' in my study refers to natural sciences as well as social sciences like economics, law, and public administration.

Concerning the interface of science and policy, rather than limiting the analysis to the experts' influence on policymaking only, I take this further and explore the experts' impact on the other stages of the policy process: capacity-building, agenda-setting, policy formulation, and policy implementation. Considering that scholars have pointed out the gap between policy design/planning and implementation/real-life development (Pressman and Wildavsky, 1973; Gunn, 1978; Hinders and Peters, 1987; Hudson, Hunter, and Peckham, 2019), there is a need to study the role of experts not only in policymaking but the policy stages afterwards. Also, given that China's climate policy has moved from 'top-level design' to 'local implementation' during the past two decades (Ding and Yang, 2015), I pay attention to the intersection of science and policy progress at the local levels.

With the focus on the intersection between science and China's climate policy, I speak

[1] The Jiang-Li-Zhu refers to Jiang Zemin (General Secretary of the Communist Party of China (CCP), 1989-2002), Li Peng (Premier of the PRC, 1988-1998), and Zhu Rongji (Premier of the PRC, 1998-2003).
[2] The Hu-Wen refers to Hu Jingtao and Wen Jiabao.
[3] The Xi-Li refers to Xi Jinping and Li Keqiang.

to Public Policy and Science and Technology Studies (STS) literature. Rather than separating science from politics, I treat the political landscape and political dynamics as a factor that influences the intersection of science and policy. In other words, in addition to experts' impact on China's climate policy, I explain how political dynamics influence the experts and SPI simultaneously. This effort contributes to the theorisation of SPI since the politicisation of science and the politics of expertise has received relatively little attention in the climate governance literature (but see Gupta 1997; Lövbrand, 2009; Goeminne, 2012; Hoppe, Wesselink, and Cairns, 2013; Wübbeke, 2013 (b); Bock, 2014). At present, most of the literature pauses at highlighting that science is essentially or potentially political and that the knowledge production and utilisation process has been politicised. Yet, rarely does the extant literature discuss alternatives for mediating SPI in the political context (see M. Brown, 2015).

1.3.2.2 Research limitations

There are some limitations in terms of the spatial and substantive reach of this study. The first research limit is about the spatial scope of this study. Within China, only one province and three cities are discussed. Due to the variation in the character of Chinese territories (Chen, 2017; Heilmann, 2017), additional case studies and comparative studies of different provinces and cities are needed to create a more comprehensive picture of the SPI in China's multi-level climate governance.

The second limit is the focus on mitigation rather than adaptation policies. While both need an effective integration to enhance the interface of science and policy, the nature of the problem and policy practices of climate change mitigation and adaptation are different (Beck, 2011; Iyalomhe et al., 2013; Nkiaka and Lovett, 2019). Due to limited research time and capacity, I do not analyse the role of experts in China's climate change adaptation policies.

1.4 Policy relevance

This thesis has policy relevance at the global level and the Chinese national and local levels. It explains how science travels across different levels of governance to navigate climate policy, and how China can optimise its support for and use of scientific knowledge in order to make better policies. Those who want to drive global or China's climate policy development by enhancing the connection between scientific input and policymaking and implementation can benefit from this study.

1.4.1 Global level

Concerning SPI on global climate change, the IPCC has played an essential role in steering the international climate talks and international climate regime formation since the 1990s (Beck, 2011; Haas and Stevens, 2011; Hoppe, Wesselink, Cairns, 2013; Gupta, 2014 (a), 2014 (b); Siebenhüner, 2014). The climate regime is the venue for global climate governance (Young, 2011; Gupta, 2014 (a), 2014 (b)).

1.4.1.1 Why science is important for global climate policymaking

Since the climate change issue is complex and uncertain, policymakers are often unsure about what exactly their interests are and how to achieve such interests in given circumstances (Hass, 1992, 2001). Therefore, the science-based actors are helpful not only to develop causal ideas[4] and normative beliefs but also to identify state interests on a given issue. They influence the negotiated outcomes by shaping how conflicts of interest will be resolved (Haas, 2001: 11579).

1.4.1.2 How has the IPCC evolved from the AGGG onwards

In 1985, a scientific meeting was held in Villach which led to the establishment of the Advisory Group on Greenhouse Gases (AGGG) by the World Meteorological Organisation (WMO), the United Nations Environment Programme (UNEP), and the International Council of Scientific Unions (ICSU) (Gupta, 2014 (b): 43). Later, the IPCC was established by the UN General Assembly in 1988. Its initial task, as outlined in UN General Assembly Resolution 43/53 of 6 December 1988, was to "prepare a comprehensive review and recommendations with respect to the state of knowledge of the science of climate change; the social and economic impact of climate change, and potential response strategies and elements for inclusion in a possible future international convention on climate" (UNGA, 1988: 5-6). *Table 1.3* demonstrates the evolution of the focus of the IPCC Working Groups (WGs):

Since 1990, the IPCC has pushed policymakers and the international climate negotiations by releasing its Assessment Reports and Special Reports (see *Table 1.4*). Released in 1990, its First Assessment Report (FAR or AR1) asserts that emissions resulting from human activities are substantially increasing the atmospheric concentrations of the greenhouse gases: CO_2, CH_4, CFCs, and N_2O (IPCC, 1990). It provided the launching pad for political negotiations on climate change and established a skeleton agreement for the UNFCCC in 1992 (Skodvin 2000; Beck, 2011: 297).

---

[4] Causal ideas refer to the policy actors' understanding of the linkages between a set of problems and possible policy actions and desired outcomes (Haas, 1992: 3).

Table 1.3 Evolution of focus of the IPCC working groups

Assessment Report	Working Group I	Working Group II	Working Group III
First Assessment Report (AR1) (1990)	Science	Impacts	Response
Second Assessment Report (AR2) (1995)	Science	Impacts, adaptation, and mitigation	Economic and social dimensions
Third Assessment Report (AR3) (2001)	The scientific basis	Impacts, adaptation, and vulnerability	Mitigation
Fourth Assessment Report (AR4) (2007)	The physical science basis	Impacts, adaptation, and vulnerability	Mitigation
Fifth Assessment Report (AR5) (2013-2014)	The physical science basis	Impacts, adaptation, and vulnerability	Mitigation of climate change
Sixth Assessment Report (AR6) (2021-2022)	The physical science basis	Impacts, adaptation, and vulnerability	Mitigation of climate change

Source: Author.

Its Second Assessment Report (SAR or AR2), released in 1995, highlighted that “the balance of evidence suggests a discernible human influence on global climate” (IPCC, 1995: 22). Then, the Third Assessment Report (TAR or AR3) provided new and more robust evidence for both the human impact on climate change and the effect of climate change on humans. While many countries initially hesitated to ratify the Kyoto Protocol, the AR3 enhanced the confidence of policymakers (Vardy et al., 2017: 57). The IPCC’s Fourth Assessment Report (AR4), which was released in 2007, provides the scientific foundation for the 2007 Bali Road Map and the 2009 Copenhagen Accord, such as the 2°C target (Gupta, 2014 (a): 168). The IPCC’s Fifth Assessment Report (AR5), which was released in 2013 and 2014, estimates that there is a very high possibility that the temperature will exceed the 2°C threshold at the end of the 21st century. This conclusion provided the scientific foundation for the 2015 Paris Agreement which aims to hold “the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels” (UNFCCC, 2015) to strengthen the global response to the threat of climate change (Vardy et al., 2017).

Table 1.4 IPCC Assessment Reports and main conclusions of the scientific basis of climate change

Report and released year	Main conclusions
AR1 (1990)	In the past century, the global average surface temperature has risen by 0.3°C to 0.6°C, and the sea level and the concentration of GHGs in the atmosphere have also risen to varying degrees. If GHGs are not controlled, the global average temperature will be 4°C higher than the pre-industrial level at the end of the 21st century. The AR1 proposed that the world should immediately reduce the long-lived GHGs[5] generated by human activities by 60% to stabilise the atmospheric concentration of GHGs
AR2 (1995)	The AR2 asserted that "CO_2 remains the most important contributor to anthropogenic forcing of climate change" (IPCC, 1995: 9), highlighting the irreversible impacts of human activities on the Earth climate
AR3 (2001)	The observed increase in surface temperature is mainly (>66%) due to human activities; While the world will suffer more adverse effects of climate change, developing countries and the poor are more vulnerable
AR4 (2007)	The global average net effect of human activities since 1750 has been one of warming. Most of the observed increase in global average temperatures since the mid-20th century is very likely (>90%) due to the observed increase in anthropogenic GHG concentrations. Discernible human influences now extend to other aspects of climate, including ocean warming, continental-average temperatures, temperature extremes and wind patterns
AR5 (2013-2014)	Human activities are 'extremely likely' (>95% possibility) to have caused most (more than 50%) of the increase of global surface temperature since the 1950s. But downscaling to regional impacts is difficult
Special Report on 1.5 ºC (2018)	Meeting a 1.5°C target is possible but global net human-caused emissions of CO_2 would need to fall by about 45 percent from 2010 levels by 2030, reaching 'net zero' around 2050

Source: Author developed from IPCC (1990, 1995, 2001, 2007, 2013, 2018 (b)).

[5] Long-lived GHGs include CO_2, N_2O and some fluorinated gases. These GHGs accumulate in the atmosphere at decadal to centennial time scales, and their warming effect on climate persists for decades to centuries after their emission (IPCC, 2018 (a)).

1.4.1.3 Evolution of the UNFCCC from the 1990s onwards

Building on the momentum generated by the IPCC reports, the UNFCCC was negotiated under the auspices of the UN General Assembly and was adopted in 1992. Since 1995, a Conference of Parties (COP) under the Convention has been held annually (see *Table 1.5*). In 1995, COP1 negotiations began with proposals to strengthen the UNFCCC's commitments, which resulted in the adoption of the 1997 Kyoto Protocol (entering into force in 2005). Industrialised (Annex I) countries committed to reducing their emissions of GHGs by 5.2% in 2008-2012 compared to 1990 levels. This was the first time binding GHG reduction targets were set for industrialised countries.[6] After the first commitment period (2008-2012) expired, the Doha Amendment for the period 2013-2020 did not enter into force and COP21 in Paris called on all countries to adopt nationally determined commitments.

Table 1.5 Key outputs in the UNFCCC negotiations

Year	COP	Short description of key decisions
1995	COP1	Parties adopted the Berlin Mandate, establishing a process to negotiate strengthened commitments for industrialised countries. The Subsidiary Body for Scientific and Technological Advice (SBSTA) and the Subsidiary Body for Implementation (SBI) were established
1996	COP2	Parties endorsed the IPCC's Second Assessment Report (AR2). The Geneva Ministerial Declaration, "which in part called on parties to accelerate negotiations on a legally binding protocol, was noted, but not adopted" (EESI, n.d.: section 19)
1997	COP3	The Kyoto Protocol (KP) was adopted. It included legally binding emissions targets for industrialised countries for six major GHGs. 38 industrialised countries (Annex I) aimed to reduce their collective GHG emissions by an average of 5.2% below the 1990 level between 2008-2012 (Bulkeley and Newell, 2010: 21), including through three Kyoto market-based mechanisms: emissions trading (ET), the Clean Development Mechanism (CDM), and Joint Implementation (JI)
1998	COP4	Parties adopted the Buenos Aires Plan of Action, establishing a deadline to finalise work on the Kyoto market-based mechanisms. "The COP also decided to review the financial mechanism of the UNFCCC every four years" (EESI, n.d.: section 17)

[6] In this thesis I refer to 'developed countries' under the UNFCCC as 'industrialised countries' as they have not reached a development status that is compatible with minimising their environmental impact on societies.

1999	COP5	Parties made significant progress on some substantive issues to fulfil the Buenos Aires Plan of Action. Parties also made progress on developing the Kyoto Mechanisms' rules and guidelines
2000-2001	COP6	After the collapse of the COP6 in the Hague (Bulkeley and Newell, 2010: 21), in November 2000, "consensus was reached on what was called the Bonn Agreement" in Bonn in July 2001 (EESI, n.d.: section 15)
2001	COP7	The Marrakesh Accords and Declaration set the rules and procedures for implementing the KP. The Special Climate Change Fund (SCCF) was established to "finance projects relating to adaptation; technology transfer and capacity building; energy transport, industry, agriculture, forestry, and waste management; and economic diversification" (FCCC/CP/2001/13/Add.1, Page 43, Decision 7/CP.7). The Least Developed Countries Fund (LDCF) was also established to help LDCs adapt to new climate realities (EESI, n.d.: section 14)
2002	COP8	The Delhi Ministerial Declaration reiterated the principle of common but differentiated responsibilities (CBDR), that development and poverty eradication are the priorities for developing countries and "called for industrialised countries to transfer technology to developing countries" (EESI, n.d.: section 13)
2003	COP9	Parties reached agreements on operational details for implementing forest projects under the CDM and guidelines for reporting on GHG emissions and removals from agriculture, forest and land-use change. The SCCF and LDCF were further developed (EESI, n.d.: section 12)
2004	COP10	Parties began discussing adaptation options, national communications; capacity building; and education, training and public awareness
2005	COP11	This conference was the first to take place after the KP entered into force. Parties addressed capacity building, development and transfer of technologies, and financial and budget-related issues, including guidelines to the Global Environment Facility (GEF) (EESI, n.d.: section 10). Parties also confirmed several implementation plans, such as the three Kyoto Mechanisms
2006	COP12	"Financial mechanisms were reviewed, and further decisions were made about the Special Climate Change Fund" (EESI, n.d.: section 9)

2007	COP13	Parties agreed to a Bali Action Plan to negotiate GHG mitigation actions after the Kyoto Protocol targets expire in 2012. The COP outcomes includes finalising the Adaptation Fund, the adverse effects of combating climate change, national communications, and some financial and administrative matters
2008	COP14	"Countries began negotiations on the financing mechanism to help poor countries adapt to the effects of climate change" (EESI, n.d.: section 7)
2009	COP15	COP15 takes note of the Copenhagen Accord without reaching an agreement on binding commitments after the KP commitment period ends in 2012. "In the context of meaningful mitigation actions and transparency on implementation, industrialised countries commit to a goal of mobilising jointly USD 100 billion dollars a year by 2020 to address the needs of developing countries" (FCCC/CP/2009/11/Add.1, Page 7, Decision 2/CP.15)
2010	COP16	The Cancun Agreements include decisions provisions on adaptation, REDD+, technology, mitigation, and finance. The Parties called for a Green Climate Fund, aiming to deliver funds to developing countries for mitigation and adaptation actions (EESI, n.d.: section 5)
2011	COP17	"Parties agreed to the Durban Platform for Enhanced Action as framework to establish a new international emissions reduction protocol. The EU agreed to extend their KP targets, which were slated to expire at the end of 2012, into a second commitment period from 2013-2017" (EESI, n.d.: section 4)
2012	COP18	The Doha Climate Gateway focuses on "ensuring the implementation of agreements reached at previous conferences" (IISD, 2012: section 1), such as establishing KP's second commitment period to 2020. The Doha Amendment was adopted
2014	COP20	(1) To reiterate the timetable for the 2015 new agreement, Intended Nationally Determined Contributions (INDCs) are the basis for reaching 2020 emission reductions. (2) Countries around the world, including DCs, promised GHG reduction for the first time
2015	COP21	The Paris Agreement was adopted by 196 Parties. Its goal is to limit global warming to well below 2°C, preferably to 1.5°C, compared to pre-industrial levels (UNFCCC, 2015)

2017	COP23	The COP adopted a decision on the Fiji Momentum for Implementation. Parties agreed to set the stage for negotiations in 2018 in a transparent, inclusive, and cost-effective manner; contain the design of the 2018 facilitative dialogue (Talanoa Dialogue); and outline the importance of pre-2020 implementation and action (IISD, 2017: section 4)

Source: Author compiled from Bulkeley and Newell (2010); Gupta (2014 (b)); Clima South (http://www.climasouth.eu/en/node/41); Sustainable Development Goals: Climate negotiations timeline (https://www.un.org/sustainabledevelopment/climate-negotiations-timeline/); the Environmental and Energy Study Institute (EESI) (https://www.eesi.org/policy/international); the International Institute for Sustainable Development's (IISD) Earth Negotiations Bulletin (ENB) (https://enb.iisd.org/).

1.4.1.4 Evolution of the interface of science and global policymaking

Although questioned about its policy impact on global climate policy and its reports being deemed as 'too cautious' and/or 'too political and alarmist' (Hirst, 2020), the IPCC plays a vital role in providing negotiators with scientific input (Beck et al., 2014). Over the years, the IPCC has evolved in structure to accommodate political claims questioning its legitimacy while maintaining and even strengthening its scientific standards towards credibility (Beck et al., 2014; Siebenhüner, 2014: 132, 143). These efforts can be seen as the IPCC's response to the 'climate sceptics' since the late 1980s (Beck, 2011) and the 'Climategate controversy'[7] to win public trust (Beck, 2012). Critics of the IPCC questioned the process of knowledge production rather than the substance of that knowledge (Hulme, 2010; Beck et al., 2014). The IPCC aims to enhance its reports' policy relevance for

[7] The controversy flared in late 2009, several weeks before the Copenhagen Climate Change Summit. It began with the leaking of thousands of emails and research documents exchanged among researchers at the Climatic Research Unit (CRU) at the University of East Anglia (UEA) in the UK and the IPCC scientists. According to the leaking material, scientists have noted some possible holes in evidence that supports the assertion of human-induced climate change. Additionally, the hacked material indicates the scientists' desires to suppress the climate change deniers (Lahsen, 2013: 547). Climate change denialists (i.e., columnist James Delingpole) and the media soon popularised the term 'Climategate,' discussing the reliability issues of the IPCC reports. Because of the sensitive timing, many believed that the release of the material was a smear public relations campaign intended to undermine the Copenhagen Summit (Feldman, 2009). Similar to some previous incidents, backlash actors' charges of corruption and conspiracy did not hold up to close analysis (Lahsen, 2013: 548). At least six high-level scientific and governmental committees were organised to investigate the allegations, finding "no fraud or scientific misconduct had occurred" (Maibach et al., 2012: 290). Yet, one of the reports concluded that "there has been a consistent pattern of failing to display the proper degree of openness ...... (they) failed to recognise not only the significance of statutory requirements but also the risk to the reputation of the University and, indeed, to the credibility of UK climate science" (Russell et al., 2010: 11).

policymakers and the public (Beck, 2011).

An example demonstrating the link between the IPCC and global policymaking is its 2018 *Special Report on Global Warming of 1.5ºC*. This report was a response to the request made by COP21 in Paris, and the final report in 2018 pointed out that global warming is likely to reach 1.5°C between 2030 and 2052. In order to keep global temperature rise to within 1.5°C, we need to achieve 'net zero' CO_2 around 2050. This conclusion has been continuously used in the following international climate negotiations (i.e., COP24 and COP25).

1.4.2 Chinese level

Since China is the world's biggest contributor to GHG emissions (see 1.1 and 1.2.1), it has committed to scaling up its Nationally Determined Contribution (NDC) through vigorous policies and measures (Xinhua, 2020). President Xi Jinping announced in the UNGA on 22 September that China will peak emissions before 2030 and aim to achieve carbon neutrality before 2060 (Xinhua, 2020). According to the research released by an international think tank on climate change—the Climate Action Tracker (CAT), if China meets this target, it will lower global warming projections by around 0.2 to 0.3°C (CAT, 2020). This pledge puts the world closer to achieving the Paris Agreement's goals (Song, 2020).

Behind China's updated, ambitious goal is the strong research team that provides policymakers with rigorous science-based support. For instance, Tsinghua University's Institute for Climate Change and Sustainable Development (ICCSD) published 'China's Long-term Low-Carbon Development Strategy and Pathway' soon after President Xi's announcement in 2020 (ICCSD, 2020). Considering that addressing climate change leads to multi-level and cross-level governance dynamics, I aim to map out the experts/research institutes participating in different levels of China's climate policy (Chapters 5,6,7 and 8) in order to understand the linkages between science and policy.

1.5 Structure of the thesis

Following this introductory chapter, Chapter 2 lays a theoretical foundation for this study, including a literature review of SPI and climate change and a conceptual framework for analysing SPI. Chapter 3 explains the research methods, including the epistemological position of this research, the case study approach and case selection, units of analysis and observation, and research methods. Chapter 4 deals with the features of Chinese politics and policymaking, and the development of China's climate policy since 1990. Chapters 5, 6, 7, and 8 analyse how experts engage with China's climate policy at the international,

national, provincial, and prefectural level, respectively. Chapter 9 first explains how science flows across varied levels of China's climate policy and then evaluates the experts' impact on different policy stages and governance levels. Finally, Chapter 10 answers the overarching question and sub-research questions of this study and draws conclusions and recommendations.