Is Clean Air Possible? A Critical Analysis of China's Intended Nationally Determined Contributions for the United Nations Climate Change Conference 2015.

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Table of Contents

Foreword

This Major Paper was written to satisfy component 5.0 in Amanda Turner's official Plan of Study for the Faculty of Environmental Studies at York University in Toronto, Ontario. Component 5.0 states that the final Major Paper will consist of a thorough examination of the Intended Nationally Determined Contributions made by China at the UNCCC in 2015. There are 2 learning objectives specified within this component; 5.1. To gain sufficient knowledge in China's United Nations Climate Change Conference 2015 Intended Nationally Determined Contributions and target dedications, and 5.2. To analyze the feasibility, both politically and economically, of policies created by China as a result of their commitment to achieving their Intended Nationally Determined Contributions. The component and its associated learning objectives have successfully been satisfied by this Major Paper.

Abstract

In December 2015 at the 21st Conference of the Parties of the United Nations Framework Convention on Climate Change in Paris, 195 countries signed to the world's first comprehensive climate change agreement; The Paris Agreement. Subsequently 155 of these countries have ratified the agreement. This is makes apparent the global consensus that global climate change is fast becoming the most important issue facing our world today. Being the largest contributor to global emission, China is a significant player in this agreement and therefore their Intended Nationally Determined Contributions merit a closer examination. Under the SWOT framework, China's Intended Nationally Determined Contributions have been subjected to a critical policy analysis, a comparative analysis, and a feasibility study. From this, there is a determination of the likelihood of implementation. While it is determined that the Intended Nationally Determined Contributions are relatively feasible for China, there are complications in relation to the domestic enforceability of the policies that would result from changes made to current policy. The National Government recognizes the need for more enforceability of policies, however, it remains questionable as to whether coherent and cooperative enforcement will be achievable.

Introduction

Climate change, though still seemingly a largely debated topic, is nearly unanimously agreed upon in the scientific community as a stark and dangerous reality. While the term 'climate change' encompasses both natural causes of statistical changes in global climate and anthropogenically caused changes, it is widely accepted in the scientific community that there is, in fact, a change in global or regional climate patterns and that it is attributed largely to the increased levels of atmospheric carbon dioxide produced using fossil fuels[1]. Anthropogenic greenhouse gas emissions have increased since the pre-industrial era. This is determined largely by economic and population growth. From 2000 to 2010 emissions were the highest in history[2]. Historical emissions have driven atmospheric concentrations of carbon dioxide, methane and nitrous oxide to levels that are unprecedented in at least the last 800,000 years and this has led to an uptake of energy by the climate system[3]. For the purpose of this paper, therefore, 'climate change' refers to the anthropogenically caused changes to global climate, which are largely considered the most significant problem, because it is understood that these changes are accelerated due to human consumption and production of greenhouse gasses (GHG) and carbon dioxide (CO_2) emissions.

What is concerning about climate change is that it is causing a global effect of increased global temperatures that are fundamentally changing weather patterns, air quality at ground level, and even physical geographic alterations. Warming of the climate system is unmistakable. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, and sea level has risen[4].

[1] Yamin, F., & Depledge, J. (2004). *The International Climate Change Regime: A Guide to Rules, Institutions and Procedures* . Cambridge: Cambridge University Press.
[2] IPCC. (2014). Climate Change 2014: Synthesis Report. *Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, 151. (R. K. Pachauri, & L. A. Meyer, Eds.) Geneva, Switzerland: Intergovernmental Panel on Climate Change.
[3] (IPCC 2014)Ibid. at 44
[4] (IPCC 2014) Ibid. at 47

Due to the fact that the scientific community was able to discern that, as prior mentioned, the key anthropogenic contributing factor most influential is that of air pollution, namely through GHG and CO_2 emissions, it is easy to understand, therefore, that it is humanity's responsibility to manage this potentially disastrous climate change through reduction of emissions. Thankfully, carbon dioxide emissions and air pollution are controllable, though it requires dedication and large efforts from every country in the world. While the efforts to fight climate change and reduce overall global GHG and CO_2 emissions lay mostly on national governments the world over, there are two leading bodies that assist them with assessment of the overall issue, and whether or not the efforts made are making a difference. These bodies provide a forum for intergovernmental collaboration in policy making. They are both institutions of the United Nations and are governed by the countries who are signed to the United Nations, therefore. These bodies are the International Panel on Climate Change (IPCC) and the United Nations Climate Change Convention (UNCCC).

China is one of the leading contributors to climate change due to their significant carbon footprint, accounting for roughly 28% of the overall global CO_2 emissions[5]. Surpassing the United States in 2014 by nearly doubling them[6]. However, despite their massive contribution to global emissions, China's national government is working with the aforementioned international bodies to ultimately reduce their global emissions contribution.

The most recent evidence of China's dedication to climate change and emissions reduction can be found in their contributions to the 2015 United Nations Climate Change Conference held in Paris in December 2015. All countries who are participants, and who have signed to the United Nations Framework Convention on Climate Change, are required to submit to the conference, for review and discussion, their individual efforts; in the form of specific goals and targets disclosed called: Intended Nationally Determined Contributions (INDCs). China's

[5] Boden, T. A., Marland, G., & Andres, R. J. (2017). *Global Greenhouse Gas Emissions.* Retrieved from United States Environmental Protection Agency Website: https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data

[6] PBL Netherlands Environmental Assessment Agency. (2017). *One-Pager on Global CO2.* Retrieved from PBL Netherlands Environmental Assessment Agency: http://infographics.pbl.nl/website/globalco2-2015/

INDCs were submitted ahead of the conference and boast significant changes that will be made on China's behalf at the National Government level in China

Purpose

The purpose of this research paper is to uncover whether, or not, the most recent INDCs submitted by China will have any effect on both policy making in China and on their reduction of carbon dioxide emissions. As well as to shed light on an existing paradigm surrounding China's enforceability of their environmental policies. To determine this, there are several questions that will be addressed within the paper:

Research Questions and Aims

The most significant question that was addressed by this paper, through an in depth critical analysis and feasibility study, is: Are the targets set out in China's INDCs at the UNCCC in 2015 feasible within their proposed timeframe goal of 2030?

However, in order to inform this question other matters needed to be addressed alongside it. It is of importance that it be determined what the overall targets set out at the UNCCC Paris Agreement is, in general, and if China's INDCs are feasible within that target. Yet, more significantly perhaps, is the issue of whether, or not, China's INDC targets will be feasible given current actions, policies and technologies within the country. In conducting the feasibility study, special attention was paid to what the economic impact of striving to achieve their INDC targets is and whether it is feasible politically therefore. Lastly, in terms of feasibility, it is of significant importance that this study examined whether the policy outcomes of China's INDCs are realistically enforceable, and as such, are they likely to be enforced? This particular question leads to whether, or not, China's INDC targets are realistic, when comparing them to China's past actions, policies, goals and their achieved outcomes.

It is also beneficial to the discussion of this paper to examine, through a brief but informative comparative analysis, what other countries with similar targets have set out in their INDC documents in their efforts to reduce global carbon emissions. Finally, this paper will attempt to determine what is realistic for China, and potentially, what needs to be changed in directing their INDCs.

Research Method and Framework

Given that policy research is both macro and micro level, the lens in which this paper was framed is that of an analysis of the INDCs policy formation and enactment. The study was conducted using the SWOT Framework. It involved specifying the objectives of China's INDC and identifying the internal and external factors that are favorable, or unfavorable, to achieve that objective. The SWOT framework was beneficial because it allowed for the understanding of strengths, weaknesses, opportunities and threats posed within the INDC and China's goals, and helped to identify their potentiality for achieving climate change mitigation. Under this framework, three research methods; a critical analysis, brief comparison analysis and feasibility study were conducted in an attempt to decide whether this particular piece of policy, China's INDC, was capable of forming new policy for China that is enactable. These three methods had fit within the SWOT framework naturally as they act to determine the same purpose. Research was conducted using much of the information available on what China's current and past climate change or environmental policies, strategies, practices, technologies and economics are and examined them alongside the INDC to understand the INDC and its feasibilities.

Various academic sources were used in the background accumulation stage of this paper. It should be noted that different sources highlighted the different subjects examined; such as academic Journals and China's Governmental reports and data were used to develop an understanding of policies, strategies, practices and technologies. United Nations data was used in regard to understanding China's INDC and UNCCC information. World Bank data was

examined to understand China's economics and technologies, and lastly, various books and articles about climate change were used in the understanding of climate change in general.

During the critical analysis, comparative analysis and feasibility study, the INDC document, submitted to the UNCCC in June 2015, was used directly as well as three of China's own national policy pieces; the 12th and 13th 5-year plans and the National Climate Change Programme (NCCP).

China issued their first NCCP document in June 2007. The NCCP document was the country's first global climate change policy initiative. It prompted the government, and significant actors, to adopt its measures, affecting areas of law, economy, administration and technology, which when all combined aimed to reduce greenhouse gas emissions and instill within the country, a flexible approach to climate change. The policy document set out the basic principles, objectives, policies and measures to address climate change up to 2010 and so its usefulness to this paper is in the content of the policy but also in that its effectiveness can be assessed and measured.

The 5-year plan policies are China's most significant policy pieces, laying out the national government's longer-term priorities. The plans carry significant weight as it seems that all major actors: provincial and local governments, banks and big companies, seem to attempt to align themselves to these plans and often change their strategies and actions to match them. The 12th 5-year plan was additionally advantageous to this paper because its time limit has lapsed and therefore it provided insight into what was achieved by China in its specific time frame. The 13th 5-year plan is the most recent policy enacted in China and covers the time frame of 2016-2020 and so is relevant to the potential enactment of China's recent INDC.

All three national policy pieces provide the forum for INDC implementation as they, similarly, provide policy mechanisms that can be changed to include those set out in the INDC. Various journal articles and statistical data were used, additionally, to add context and validity to these sections as well. All sources throughout the entirety of the paper were published within the last decade, from 2007 to 2017 which keeps this study recent and relevant. The oldest outlying reference dates to 2004, however, it remains academically significant and thus it is included.

The critical policy analysis examines China's INDC in greater detail and draws on outside data in related journals and Chinese policy to gain a deeper understanding of the policy implications. The comparative analysis covers four comparative countries' INDC documents drawing out the similarities found between them and China's INDC, as well as the ambitiousness of China's INDC goals. The topics examined in determining feasibility are: economic, environmental, political, schedule (timing), and technical. When all the information had been gathered, and analyzed, it was possible to decide on whether the proposed INDC policy changes are a worthwhile venture to create and enact new policy from.

Literature Review

Imperative to the discussion in this research paper, is the providing of a significant background understanding of China's current and past efforts regarding climate change and reduction of emissions. Therefore, the literature reviewed in this section will focus on four main background topics; economic background, strategies, practices and policy background. This background research not only lays the groundwork for determining the feasibility of the INDCs' potential for new policy development, but also sheds light on an existing paradigm of enforcement of policy in china.

In first attempting to understand the economic trends, and inevitably, understanding the economic boundaries that may be present in conducting an economic feasibility one must consider the over all economic state of China. The World Bank is the most well-known platform for uncovering the state of a country's overall economic standing, and therefore was the first source consulted. They provide brief descriptions for each country on their website and from this it was revealed that GDP growth in China has averaged nearly 10% per year[7].

This, according to the World Bank, is the fastest sustained expansion of a major economy in history. Accordingly, China has reached all of the Millennium Development Goals (MDGs),

[7] World Bank Group. 2017. *World Bank Countries: China; Overview.* http://www.worldbank.org/en/country/china/overview#1

set out by the World Bank, as of 2015. China has also become the second largest economy in the world, and plays a significant role in the global economy[8]. However, due to the fact that China's per capita income is still far below that of advanced countries, and its market reforms are to date incomplete, they are still only considered a developing country. China's 12th Five-Year Plan covering the time between 2011 and 2015, as well as their newly approved 13th Five-Year Plan projecting between 2016 and 2020 forcefully address issues regarding environmental imbalances such as setting targets to reduce pollution and to increase energy efficiency. The annual growth (GDP) target in the 12th Five-Year Plan was 7 percent and the growth (GDP) target in the 13th Five-Year Plan is 6.5 percent[9]. China currently is projecting to double their GDP by 2020[10].

Along with providing an overview of current situations for countries, the World Bank publishes periodic update reports on country economies. In their most recent 2016 report, *East Asia and Pacific Economies Update*, they reveal that China's GDP grew by 6.7% within the first half of the 2016 fiscal year, however this is down 0.2% in 2015[11]. What is most interesting to note is that the service sector in China has all but replaced the manufacturing sector as the economy's primary driver. The service sector generated 54% of the overall GDP for the country in the first half of the 2016 fiscal year[12]. This could have some favorable effects on the likelihood of China's government placing focus on environmental and climate change policy, but may also detract from production of renewable or clean energies.

China's GDP growth is expected to continue curbing, as structural adjustments and policy efforts to address accumulated financial vulnerabilities move ahead[13]. The government has projected an official growth target of 6.5 to 7.0 percent for 2016[14]. Growth is expected to steadily moderate from 6.7 percent in 2016 and 6.5 percent in 2017, assuming continued reforms, both to enable economic restructuring, as well as, to address the vulnerabilities built up since the

[8] (World Bank Group 2017) Supra. Note 7
[9] (World Bank Group 2017) Supra. Note 7
[10] (World Bank Group 2017) Supra. Note 7
[11] World Bank. (2016, October). Reducing Vulnerabilities. *East Asia and Pacific Economies Update*. Washington, DC: World Bank. doi:10.1596/978-1-4648-0991-0
[12] (World Bank 2016) Ibid. at 115
[13] (World Bank 2016) Ibid. at 116
[14] (World Bank 2016) Ibid. at 116

global financial crisis.[15]A key short-to-medium term challenge facing China's economy will be to address the buildup of financial risks and to facilitate orderly deleveraging of the economy.[16] Policies, such as those regarding environment and climate change, may have some negative short-term impacts on overall growth, however they are essential for satisfying speedy growth over the longer terms. Likewise, delaying these policies might also increase their overhead costs in the future. In order to attempt to alleviate some of the negative economic effects of environmental and climate change mitigation polices and strategies, a specific economic strategy is currently being employed by China, and other countries around the world. Moarif and Rastogi highlight not only what market-based climate mitigation policies are available, but also have a special section on which of these policies and strategies China has been using, in their report *Market- Based Climate Mitigation Policies in Emerging Economies*.

For the purpose of their paper, and the understanding of the definitions of a market-based climate mitigation policy, this term is defined as a policy or strategy that provides financial enticement for the consumers, as well as the producers, who are responsible for green house gas (GHG) emissions to espouse lower-emitting behaviors or technologies.[17] Most enticements carry the goal of removing some of the financial barriers associated with mitigation actions. Most markedly, in this case, attention is paid to the higher cost of renewable energy and the higher initial costs of energy efficient investments.[18] Moarif and Rastogi point out that China has adopted industrial development support policies which are focused on the development of seven new strategic and emerging industries, three of which relate to GHG mitigation; which includes new energy; in the form of nuclear, solar, wind and biomass. As well as energy saving and environmental protection policies and strategies and making more significant the use of clean energy vehicles.[19] They highlight that nearly 50% of china's GHG and CO_2 emissions come from three main sources; (Coal) Power Generation, Steel production and cement manufacturing.[20]

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[15] (World Bank 2016) Supra. Note 11 at 116
[16] (World Bank 2016) Supra. Note 11 at 116
[17] Moarif, Sara, and Namrata Patodia Rastogi. 2012. *Market-Based Climate Mitigation Policies in Emerging Economies.* Arlington VA: Center for Climate and Energy Solutions
[18] (Moarif and Rastogi 2012) Ibid. at 1
[19] (Moarif and Rastogi 2012) Ibid. at 10
[20] (Moarif and Rastogi 2012) Ibid. at 10

Therefore, the Market-Based policy instruments spoken toward in their article target these sectors.

Moarif and Rastogi imply that China is making use of three specific market-based climate mitigation strategies; 1. Trading systems, namely a cap-and-trade project. According to the report, in 2012 seven pilot regions were selected for the Emissions Trading System (ETS) in China based on their per capita income, mature market systems and infrastructure, and strong political will and support. Facilities in covered sectors would need to participate in the program if they emitted over 10,000 tons CO_2 per year on average in the 2009-11 period, however those below the threshold could participate voluntarily.[21] However, beyond the pilot programs, not much is uncovered regarding whether or not the trading scheme has been working. Aside from providing the explanation that monitoring and registries have been set up, Moarif and Rastogi have not given any substantial information about the mechanics of such a scheme, and especially not results. 2. Subsidies, namely direct subsidies to manufacturers and consumers, feed-in tariffs, restricted and encouraged lending and preferential financing[22]. As with all subsidies, the goal is to encourage both consumers and producers to sign onto more environmentally friendly ends. Some of the subsidies China is offering cover benefits to consumers and producers who make use of vehicles with low-fuel consumption, hybrid and electric vehicles, as well as energy-efficient appliances, solar photovoltaic (PV) power projects and the production of wind turbines[23]. No additional data is supplied here, again, by the authors of this report and so it cannot be determined whether the subsidy programs are benefiting the GDP. 3. Taxes, namely tax incentives and differential electricity pricing[24]. Moarif and Rastogi provide and excellent chart describing the pros and cons of each of these types of market- based climate mitigation strategies and make it easy to determine if these particular strategies and policies worked for China in the past (see Figure 1 in appendix).

[21] (Moarif and Rastogi 2012) Supra. Note 17 at 11
[22] (Moarif and Rastogi 2012) Supra. Note 17 at 11
[23] (Moarif and Rastogi 2012) Supra. Note 17 at 12
[24] (Moarif and Rastogi 2012) Supra. Note 17 at 13

It is interesting to note that China has accomplished a 19.1% reduction in energy consumption per unit of GDP output after their 11th Five Year Plan[25]; the most significant piece of environmental policy in china and which is periodically revisited every few years. The 11th Five Year Plan was set to focus between the years 2006 to 2010 and had established a target to reduce the economy's energy intensity, or energy consumption per unit of GDP output, by 20% between 2005 and 2010.[26] It leaves one to wonder, therefore, if this is attributed to their use of market-based climate mitigation policies and strategies overall. One should take caution, though, in using this information for economic oversight as Moarif and Rastogi do not source information on actual monetary gains or loses from these programs and thus it can only be presumed, given by percentages, that the GDP is effected significantly by these policies and strategies.

One of the most prominent ways of achieving climate change mitigation and emissions reduction in China is through governmental enacted policy, as was hinted to in the economic background. It is important to gain a significant background, therefore, on the area of current and past policy actions in China. Not only is it important to the context of this research paper, but it is also important because this paper, likewise, intends to determine if new policy development will be a feasible and a worthwhile venture for China based on their newest ambitions found in their INDCs.

Through this background research it was discovered that there are three levels of government in China responsible for the development, enactment and enforcement of policies pertaining to climate change; National, Provincial and Municipal. While all three levels of government seem to promote environmental and climate change mitigation policies, there are some very clear discrepancies between policy ambitions and enforcement.

The National Government in China has undertaken many efforts to promote their dedication to climate change mitigation and to reduce their global emissions footprint. They willingly participate in United Nations Climate Change Conferences and have drafted many

[25] (Moarif and Rastogi 2012) Supra. Note 17 at 10
[26] (Moarif and Rastogi 2012) Supra. Note 17 at 10

National policies over the years to attempt to address these issues. According to Ming-Teh, et al, in *China's Response to Climate Change: A Policy Analysis*, roughly in the 1990s, China had begun setting up several special institutions devoted to responding to climate change. The leading institution for China's efforts in producing policies to respond to climate change is the National Coordination Committee on Climate Change (NCCCC). This institution is responsible for the establishment of China's policy *Agenda 21 – White Paper on China's Population, Environment, and Development in the 21st Century*.[27] This piece of policy is regarded as the policy that set China's overall strategic framework for sustainable development and contributes to efforts on issues of climate change, though it encompasses more than issues of climate change and is not necessarily policy that places specific rules of practise.

Another influential policy piece is that of the 11th Five-Year Plan. Again, the plan highlights some specifics in terms of paying attention to climate change, but does not specify targets directly. The *National Climate Change Programme* is China's first policy document in full response to climate change, which was introduced in 2007.[28] The paper states in detail China's response policies towards climate change before 2010, including the mid-term reduction target of one billion tons of greenhouse production.[29] In the same year, China introduced the report *Scientific and Technological Actions on Climate Change*, corresponding to the National Programme's emphasis on technological advancement and innovation as important measures to be taken in response to climate change.[30]

While it is very clear that the National level of government in China expresses a significant dedication to climate change policy action and mitigation, they are not the only level of government with the power and responsibility to enact policy in this regard. It is even significant to mention that provincial and municipal governments hold a significantly more powerful position in terms of the actual enforcement of policy for the country and in the outcome

[27] Ming-Teh, Hung, and Tony Tai-Ting Liu. 2011. "China's Response to Climate Change: A Policy Analysis." *Journal of Alternative Perspectives in the Social Sciences* 3 (2): 362-375
[28] (Ming-Teh and Liu 2011) Ibid. at 370
[29] (Ming-Teh and Liu 2011) Ibid. at 370
[30] (Ming-Teh and Liu 2011) Ibid. at 370

of real climate change mitigation and emissions reduction. Therefore, they are deserving of a greater investigation.

According to Zheng, et al, in their article *The Impacts of Provincial Energy and Environmental Policies on Air Pollution Control in China*; several provincial governments of China responded to the national government's environmental protection activities. Provincial governments are taking an increasingly significant lead in shaping the policies that are meant to aid in climate change mitigation and reduction of emissions. Many of their policy actions have been focused on cleaner production, energy saving and comprehensive resource utilization.[31] Zheng, et al, suggest that this has been mostly accomplished through revisions of local standards for emissions reduction policies. Their study uses statistical data to demonstrate the relationship between provincial governments' energy saving and emission reduction policies and local air pollution outcomes. With respect to the national government's *Energy Conservation Law of the People's Republic of China*, 4 provinces enacted provincial energy saving regulations. This set the groundwork for several other provinces to follow suit in later years.

What is notably interesting is that, while provincial governments have taken policy action toward achieving national government promoted laws for environmental protection and climate change, many of the provinces shape their level of commitment to emissions reduction. Zheng, et al, indicate that provincial government regulations are consistent with normal policy and contain various chapters such as introductions to universal rules, incentive schemes and legal liabilities, however they also contain unique characteristics reflecting individual provincial situations. Two examples were given by Zheng, et al; the energy saving regulations of Guangdong province openly encourage the development of renewable energy via solar, ocean and wind energy, so that local renewable resources can be employed. However, the regulations of Shanxi province, who have historically depended on its natural coal resources, required the adoption of gauge power generation and comprehensive utilization, and the application of energy-efficient manufacturing technologies instead.[32] This adds question to the ability of universality of the national

[31] Zheng, Shiming, Hongtao Yi, and Hui Li. 2015. "The impacts of provincial energy and environmental policies on air pollution control in China." *Renewable and Sustainable Energy Reviews* 49: 386-394.
[32] (Zheng, Yi and Li 2015)Ibid. at 390

government's environmental protection laws. If provinces can tailor make their own regulations, they can easily disregard parts of the national government's laws and only apply what they will find works for them. However, this still implies that provinces can, and do, influence the environmental protections and climate change regulations which is instrumental in achieving promoted climate change mitigation.

Another key piece of national government legislation that is used in the Zheng, et al, study in determining whether, or not, the provincial regulations have any effect on carbon emissions reduction is that of the *Cleaner Production Promotion Law*, which made provinces subject to cleaner production audits, those of which are also are mandatory for key polluting enterprises.[33] It is indicated that 8 provinces have enacted cleaner production regulations within their boundaries following the enactment of this law.

In their concluding discussion, Zheng, et al, suggest that these provincial level policies play a vital role in actual reduction of carbon emissions for the provinces that have enacted them. Their study shows that; therefore, the provinces play a crucial role in enforcing national government laws and that regulations coming from provincial governments actually do present results.

However, as mentioned before, there is a significant discrepancy in the enforcement of policy actions. Both provincial and national governmental policies are still subject to interpretation, as it were, at municipal level. It should be noted that all three levels of government seem to promote the increased need to devote policy and actions to environmental and climate change. Municipal governments, however, have notably failed to live up to their own promotion of environmental and climate change ambitions, as evident in at least two significant studies on the failure of China's policies on climate change and emissions reduction.

The most notable take away from Wu, et al, in *Incentives and Outcomes: China's Environmental Policy*, is that of the highlighted fact that while the importance of environmental protection was repeatedly emphasized by the National government, evidenced in the Five-Year

[33] (Zheng, Yi and Li 2015)Supra. Note 31 at 390

Plans, local governments allocated less resources to urban environmental improvements.[34] This seems to be something rather significant to note in terms of success chance regarding environmental and climate policy, as there is an apparent disconnect from the national government's policies and the actual execution by local governments. What is shown by Wu, et al, is that investment in transportation infrastructure, such as roadways, bridges and public transportation, took precedent in the budgets of local governments.[35] Also of significance is understanding the correlation of environmental improvement investment on local air quality. In their paper, Wu, et al, discuss using a graph, the significance (see Figure 3 in appendix), here is that it is important to notice that there is as positive correlation, as suggested by Wu, et al. This means that as local governments invest in environmental improvements, their city's air quality improves.[36] What is striking, though is that it would make sense that investment in transportation infrastructure would worsen air quality as more vehicles would likely be used and more CO_2 inevitably would be produced. So, the question is raised, why is it that promotion of environmental infrastructure investments is so high by the national government, as well as the global promises made by China, yet local governments barely, if at all invest any of their budgets on these improvements and instead invest on more polluting?

Wu, et al, hint toward this in their concluding discussions. They suggest that spending on transportation infrastructure raises both GDP growth and land prices.[37] It seems that land lease sales are local governments' major source of additional revenues and policies that raise land prices local governments survive, given the discrepancy of their heavy spending responsibilities and insufficient fiscal transfers coming from central government.[38] This gives local governments an additional incentive to favor transportation infrastructure. Investing in environmental improvements has no such advantageous consequences.[39]

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[34] Wu, Jing, Yongheng Deng, Jun Huang, Randall Morck, and Bernard Yeung. 2013. "Incentives and Outcomes: China's Environmental Policy." *NBER Working Paper Series.* Cambridge, MA: U.S. National Bureau of Economic Research, February.
[35] (Wu, et al. 2013) Ibid. at 1-3
[36] (Wu, et al. 2013) Ibid. at 33
[37] (Wu, et al. 2013) Ibid. at 26
[38] (Wu, et al. 2013) Ibid. at 26
[39] (Wu, et al. 2013) Ibid. at 26

In the working paper to the World Bank, by Genia Kostka; *Barriers to the Implementation of Environmental Policies at the Local Level in China*, the idea that there is a discrepancy in enforcement of national government laws at the local, municipal level is reinforced. Kostka's study involved in person interviews with over 190 government officials, business managers, and civil society representatives and encompassed various levels of administration.[40] This makes the study unique in its perspective in terms of a policy analysis, and subsequently, instrumental to understanding the barriers that exist here.

Kostka echoes what Wu, et al, suggested; that local realities indeed do not necessarily account for national ambitions. What Kostka has revealed in the working paper, regarding local municipal governments, is that leading officials have repeatedly focused on satisfying economic growth targets, rather than creating policies that satisfy national government emissions reduction ambitions. As a result, environmental pollution continues to get worse in many Chinese cities.[41] Kostka, additionally, indicates that shortcomings in China's planning system and policy instruments, as well as, weak economic and political incentives for local implementers are major contributing barriers to implementation and enforcement of national climate change and environmental laws.[42]

Low levels of public participation and private sector involvement and insufficient implementation capacities of local agencies in charge of policy implementation also effect this evident discrepancy.[43] Of key consideration, and significantly important, for understanding why this discrepancy exists regarding implementation and enforcement at the municipal level is the idea Kostka presents; that that sociocultural and behavioral factors may also stand in the way of achieving national environmental and climate change ambitions.[44] While governments can promote the necessity for policies regarding sustainability and emissions reduction, the society

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[40] Kostka, Genia. 2014. "Barriers to the implementation of environmental policies at the local level in China." *Policy Research Working Paper.* Vol. 7016. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/102001468220778402/Barriers-to-the-implementation-of-environmental-policies-at-the-local-level-in-China .

[41] (Kostka 2014) Ibid. at 6

[42] (Kostka 2014) Ibid. at 13

[43] (Kostka 2014) Ibid. at 43

[44] (Kostka 2014) Ibid. at 43

does have a significant role to play in its outcome. Kostka suggests that there are three patterns in terms of individuals' perceptions of what constitutes a good city, as well as the values and norms that shape these perceptions; 1. While people are aware of what constitutes a sustainable city, they often prefer to live in a modern Chinese city[45]. 2. The striving of individuals to lead a modern, comfortable life has led to a strong focus on consumption, which is a leading contributor to increased emissions[46].3. Cities of assorted sizes are striving to upgrade their cosmopolitan status by renewing core areas with modern, mono-functional business districts and in this way, they don't place significant attention on emissions reduction, due to placing it therefore on growth.[47]

Even though a very evident discrepancy is shown, it is also still significant to note that policy is the main avenue for China to attempt to act on climate change. That being said, policy has so far seemed to fail them in achieving lasting outcomes.

Fan, et al, undertake a critical analysis in their article; *The failure of China's Energy Development Strategy 2050 and its impact on carbon emissions.* The particular piece of policy regarding china's efforts on emissions reduction; *China's Energy Development Strategy 2050* is the focus of their paper. In their analysis, they attempt to portray that this policy ultimately ended up being a failure, though it has not completely reached its targeted deadlines yet. *China's Energy Development Strategy* was enacted in 1985 and is set, as all energy development strategies, to predict and reach particular consumption goals by 2050. The strategy document covers the scale and structure of the supply and demand of energy. It also outlines strategies promoting energy conservation and sustainable utilization, and maintaining energy security.[48]

These strategies place significant attention on concerns for population, GDP, import and export amounts, urbanization, industrial structure, energy prices and registered vehicles and policies along with energy goals.[49] While one would think that such a comprehensive strategic

[45] (Kostka 2014) Supra. Note 40 at 33
[46] (Kostka 2014) Supra. Note 40 at 33
[47] (Kostka 2014) Supra. Note 40 at 33
[48] Fan, Jie, Qiang Wang, and Wei Sun. 2015. "The failure of China's Energy Development Strategy 2050 and its impact on carbon emissions." *Renewable and Sustainable Energy Review* 49: 1160-1170.
[49] (Fan, Wang and Sun 2015) Ibid. at 1161

policy would only lead to success, Fan, et al, have determined in their study that the goals for 2050 are completely unattainable through the strategies set in this document. Their reason for this determination is that there was a fundamental underestimating in the drafting of the targets.

The underestimations are revealed as mainly being on sustained rapid economic growth, and maintained rapid urbanization.[50] Therefore, because these key factors were underestimated, the strategies simply could not work, given that the entire document does not account for the actual levels of growth in these areas. This raises the question of whether other policies drafted by china, be it at national, provincial or municipal level, likewise underestimate the rapid growth of the economy and urbanization in China? Leaving one to wonder then if all policy in China currently is set to fail. However, Fan, et al, have also indicated that China has made great improvements with regards to slowing population growth, reducing energy consumption per unit of GDP, and reducing energy consumption by increasing the amount of clean energy resources.[51] This has ultimately created a better result for carbon emissions reduction.

Fan, et al, suggest in their concluding discussion that while this particular piece of policy should be revised now instead of later and use actual levels rather than the old predictions, some other key issues should be addressed. Their recommendations are as follows; 1. Energy efficiency should be improved by means of industrial restructuring and technological progress.[52] 2. Energy use structure should be optimized by employing more of the available renewable energy sources abundant in china.[53] 3. Universal energy conservation should be promoted by encouraging the development of public transportation and alternative energy vehicles, strictly controlling the per capita housing area of urban and rural residents, and vigorously pursue the use of green building materials and energy-saving, environmentally friendly materials.[54] Achieving these changes, and even instilling them in government policy, will greatly effect the

[50] (Fan, Wang and Sun 2015) Supra. Note 48 at 1169
[51] (Fan, Wang and Sun 2015) Supra. Note 48 at 1169
[52] (Fan, Wang and Sun 2015) Supra. Note 48 at 1169
[53] (Fan, Wang and Sun 2015) Supra. Note 48 at 1169
[54] (Fan, Wang and Sun 2015) Supra. Note 48 at 1169

ability for china to achieve future strategic energy development goals. Therefore, consideration of these recommendations will be evident in the critical analysis and feasibility studies to follow.

While policy is the main instrument for actions on climate change and emissions reduction in china, it is also significant to understand the role that technology plays in reaching policy goals. A report that was put together by the Chinese Ministry of Science and Technology; *China's Scientific and Technological Actions on Climate Change*, that highlights several realities on what China is doing in terms of the technological approach on reducing GHG and CO_2 emissions.

Of significance to the understanding of China's advancement of science and technology regarding climate change, it is important to note that China's national government has created several projects that specifically govern the research and development sectors pertaining to reduction of emissions and climate change. The report points to three particular projects; the National Hi-tech Research and Development Program, the National Basic Research Program and the National Key Technologies Research and Development Program, as spearheading the focuses of global climate change prediction and its impacts, response strategy and technologies, technologies for use of clean and efficient energies, for energy saving and efficiency, and for exploitation of new and renewable energies.[55]

The report indicates that these projects are responsible for the research and development of the following technologies; 1. Energy saving and energy efficiency technologies, 2. New and renewable energy technologies, 3. Clean and efficient coal exploitation and utilization technologies, 4. Exploration and clean/efficient development and utilization technologies of Petroleum, natural gas and coal bed/mine methane, 5. Advanced nuclear technologies, 6. CO_2 capture, utilization and storage technologies, 7. Biological and engineering carbon sequestration technologies, and 8. GHG emission control technologies through good agricultural and land-use practices[56].

[55] Ministry of Science and Technology : China. 2007. *China's Scientific & Technological Actions on Climate Change.* China Association for Science and Technology .
[56] (Minsitry of Science and Technology 2007) Ibid. at 6

While this is all very interesting to know, the report fails to identify what has actually been implemented or developed. Due to this lack of information, the report is only significant in terms of it outlining that these projects exist. Lacking anything substantial regarding technologies being used currently in China, it is therefore imperative to the technological feasibility portion of this Major Paper that greater identification be revealed.

As Takahiro Ueno highlights in his report; Technology *Transfers to China to Address Climate Change Mitigation*, addressing climate change requires global responses because its inevitably global nature. With the report undertakes to examine seven key mitigation technologies that have been transferred and implemented in China; Supercritical and ultra-supercritical coal fired power plants, Natural gas combined cycle power plants, Photovoltaic power generation, Wind power, Waste heat recovery for steel and cement plants, Energy efficient room air conditioners, and Compact fluorescent lamps.[57] Here it is shown that there are some very real technologies being used, and even manufactured in China.

In regard to the transfer of technology, Ueno speaks of two specific methods for transfer of these technologies. Technology licencing is the most frequent method for technology transfer, as well as, joint ventures and purchasing production equipment,.[58] Ueno contends that the most important factor effecting technology transfers is that of diffusion. While policy is in place to transfer technologies, the diffusion of the technologies throughout China is hindered in terms of its policy implications[59]. There are policies in place to help incentivize the diffusion of these technologies, however, like most national government policies in China, there is still some discrepancy between the policy and the implementation or enforcement of said policies. In Ueno's closing statements, it is suggested that China may become a leading manufacturer of these seven clean energy technologies, if diffusion and production can increase through policy enforcement in the coming years[60].

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[57] Ueno, Takahiro. 2009. *Technology Transfers To China To Address Climate Change Mitigation.* Japan: Central Research Institute of Electric Power Industry: Climate Policy Program at RFF. http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-IB-09-09.pdf.
[58] (Ueno 2009) Ibid. at 3
[59] (Ueno 2009) Ibid. at 8
[60] (Ueno 2009) Ibid. at 20

Having provided a significant background understanding of China's current and past efforts regarding climate change and reduction of emissions, it is clear to see that there is a discrepancy in China's policy making and its execution. Keeping this in mind, however, China is pursuing a new approach through their most recent IDNCs to the UNCCC and therefore there is a chance that all levels of government can work together to mitigate their global emissions contribution through their technological and economic strategies, as well as additional policy making. The imminent feasibility study and critical analysis of China's INDCs aims to uncover just how possible this may be.

Critical Policy Analysis of China's Intended Nationally Directed Contributions (INDCs)

To understand the feasibilities of China's INDCs it is important to take a closer look at what the country has promised to implement into their national policy. As outlined in the INDC document submitted by China to the 2015 United Nations Climate Change Conference (UNCCC); and subsequently ratified into the Paris Agreement in 2016, there are four overhead Goals of China's INDCs. These goals are the comprehensive intention of China's INDCs and every other target outlined within the document are mechanisms to reach them. Therefore, it is crucial to examine these four main goals, as well as many of the targets used as mechanisms to reach these goals, and critically analyze them. The INDC document itself does not supply one with much more than the promises themselves, and so additional sources of national policy will be looked at alongside this document in critically thinking about them; such as the current 13th 5-year plan, the 12th 5-year plan that ended in 2015 and the National Climate Change Programme (NCCP). Additionally, throughout the critical analysis, various papers and articles will be referenced for supplementation of information.

A. To achieve the peaking of carbon dioxide emissions around 2030 and making best efforts to peak early

This means China is currently emitting a significantly high amount of CO_2, roughly 10,641,789 kilotons (Ktons) in 2015 or 29.5% of the global total[61], and cannot simply reduce their emissions immediately after the INDCs have been ratified into the Paris Agreement 2016. However, with proper measures in place, in the near future China can reach a year from which the amount of emission starts to reduce. That year is called the peaking year and as is seen by this dedicated goal, that will be 2030. Some of the mechanisms for achieving this goal that are set out as targets in China's INDC are:

1. Implementing Proactive National Strategies on Climate Change

It is important to recognize that this mechanism is already being implemented by the national government in China. In 2007 China created the National Leading Group on Climate Change (NLGCC), which entails leading and managing nearly 30 national government agencies known as ministries, commissions, administrations, and offices as they coordinate policies and actions on climate change.[62] Since 2009 China's government has been actively passing climate change and environmental sustainability policies at the national level. These policies contain strategies for the mitigation and control of climate change and CO_2 emissions. The three most influential and significant national policy pieces regarding climate change in China right now are the National Program on Climate Change (2014-2020), the 12th 5-year plan (2011-2015) which contains several sections regarding climate change and sustainability, and the most recent 13th 5-year plan (2016-2020). The challenge to this mechanism is enforcement of these policies.

2. Improving Regional Strategies on Climate Change

[61] Olivier, J.G.J., Janssens-Maenhout, G., Muntean, M. and Peters, J.A.H.W. 2016. *Trends in global CO2 emissions: 2016 Report.* European Commission, Joint Research Centre (JRC), Directorate C - Energy, Transport and Climate; PBL Netherlands Environmental Assessment Agency, The Hague., Novemeber. http://edgar.jrc.ec.europa.eu/news_docs/jrc-2016-trends-in-global-co2-emissions-2016-report-103425.pdf

[62] Ye Qi, Li Ma, Huanbo Zhang and Huimin Li. 2008. "Translating a Global Issue Into Local Priority: China's Local Government Response to Climate Change." *The Journal of Environment and Development* 17: 397-400.

It is again important to recognize that many regional or provincial governments, as well as local governments, throughout China have created their own climate change initiatives and policies, insofar as it pertains to reducing their emissions. Many of them have been pursuing these aims since the latter half of 2007.[63] These regions include provinces that created special task forces to lead in, manage and deliberate on climate change and/or energy saving and pollution reduction for their region. They are Xinjiang, Shaanxi, Fujian, Gansu, Hainan, Hubei, Ningxia, Qinghai, Sichuan, Zhejiang, Guangdong, Tianjin, Jilin, Jiangsu, Shandong, Beijing, Shanghai, Hunan, Guizhou, Chongqing, Liaoning, Guangxi, Jiangxi, and Yunnan.[64] As was discussed in the literature review, the provinces tailor their legislation to the needs of their respective provinces. Nevertheless, the provinces are displaying support to the national level policies and taking a role in achieving the goal of peaking early, as well as reduction of emissions. The challenge faced here, however, seems to be in gaining support for these regional or provincial policies and initiatives at the local level, and finding funding. Additionally, gaining more provinces in the pursuit of this goal is always an issue.

3. Increasing Financial and Policy Support

Probably one of the most significant mechanisms for achieving the implementation of policy in China for climate change at all levels of government is that of financial support. Implementation and enforcement of policy is what will see to the goal of peaking early, and subsequently reducing emissions. Financial support is the most significant factor for municipal level government, but is also significant for all levels of government. At the very least, however, it is the most significant factor in municipal enforcement of either national or provincial policy, as well as making policy of their own. Presently, economic growth at local level is the most important measure of a municipal government's ability to prove they have done something during their governance and maintain their reputations.[65] This is problematic when it comes to the environment, including climate change, and social equity. The past has shown that climate change has been sacrificed by municipal governments in their attempts to achieve economic

[63] (Ye Qi 2008) Supra. Note 62 at 380
[64] (Ye Qi 2008) Supra. Note 62 at 382
[65] (Ye Qi 2008) Supra. Note 62 at 390

growth.[66] Therefore it is clear that if municipal governments are to begin to take climate change policy seriously and enforce and implement it at their level of government, funding will need to be made available as an incentive. Many national climate change programs and initiatives are often funded by international sources, it would not be much of a stretch to funnel that funding to the regional or municipal levels, likewise. Any level of government must be able to fund the initiatives that are born to achieve the overhead goal of peaking GHG and CO_2 emissions early.

4. Improving Statistical and Accounting System for GHG Emissions

This mechanism is critical to being able to determine whether, or not, this goal has been or is on target to being achieved. As it stands now there is a significantly poor statistical and accounting system for GHG emissions in China. Attempts have been made in major cities like Beijing to account for and produce statistical data for CO_2 but they fall largely behind IPCC standards and do not account for all GHG emissions.[67] As it currently stands, there are about seven different methods used in China to keep track of GHG and CO_2 emissions (see Figure 4 in appendix). Each method accounts for different GHG emissions, and contain different standards for accumulating data. This is problematic in terms of consistency and accurate reporting. It is also important to note that most of the tracking happens at the provincial level, where as it should be occurring at city level since this is where the most GHG and CO_2 emissions come from.[68] Currently only provincial level cities, like Beijing, Shanghai, Tianjin and Chongqin, are participating in GHG and CO_2 emissions accounting.[69] A universal standard should be adopted by all provinces and cities across China. Having an effective system for obtaining statistical data on emissions is not only important for knowing what the true state of emissions are, but it also provides a means of accountability and enforcement, to some degree. Therefore, it is crucial to China's success in achieving their peak in emissions by improving this system.

5. Broadening Participation of Stakeholders

[66] (Ye Qi 2008) Supra. Note 62 at 390
[67] Gu, Chaolin, Yan Li, and Ian G Cook. 2014. "China's Urban GHG Inventory and Emissions." *Climatology and Weather Forcasting* 2 (2)
[68] (Gu, Li and Cook 2014) Ibid. at 2
[69] (Gu, Li and Cook 2014) Ibid. at 2

Aside from the obvious governmental stakeholders, it is important to consider that there are many more significant stakeholders that will be effected by policy in China. The very definition of a stakeholder for this purpose is: *a group or organization that maintains an interest, legal responsibility, or everyday role in developing and implementing climate change adaptation strategies and related initiatives*. This includes the citizenry who are effected in their jobs, health and livelihoods. But, it must be noted that there are many non-governmental organizations that will be impacted by policy changes in China, such companies that emit GHG and CO_2. To broaden their participation in the policy actions and decision-making processes, China has outlined in their INDC specific methods to do so, and interestingly there is heavy emphasis on public participation. Some of these methods include increasing the obligation of business enterprises to adopt low-carbon development, strengthening the role of public supervision and participation in low-carbon development through related education and training and to fully utilize the function of schools, communities and civil organizations to advance this, as well as using platforms such as National Low Carbon Day to raise public awareness of low-carbon development throughout society, and encouraging the voluntary actions of the public to combat climate change.[70]

When examining this overhead goal, it is important to note that none of the comparison countries have made mention to a peak year in their carbon dioxide emissions, however it is generally accepted that 2030 should be the goal for all countries. This goal is both significant and discouraging. On the one hand having this drafted into an agreement allows those countries signed to it to continue to emit GHGs and CO_2 essentially unabated until 2030 in which point reduction must become evident. On the other hand, it defines a clear-cut year in which the signees must produce results in their reductions, and gives them time to implement infrastructure and policy to do so. Moreover, having this goal specifically outlined in their INDCs indicates that China does not expect to be able to produce any real emissions reduction for another 13

[70] Department of Climate Change, National Development and Reform Commision of China. 2015. *ENHANCED ACTIONS ON CLIMATE CHANGE: CHINA' S INTENDED NATIONALLY DETERMINED CONTRIBUTIONS.* Beijing, June 30. http://www4.unfccc.int/ndcregistry/PublishedDocuments/China%20First/China%27s%20First%20NDC%20Submission.pdf.

years. When that 13 years has passed, this indicator year does not have any specific numbers attached to it in terms of reduction. Therefore, assumingly, a 0.001% reduction in the year 2031 is significant reduction based on 2030 being the peak year. While the goal is ambitious, with only 13 years to create infrastructure and policy adjustments, one can be skeptical of the goal being clearly stated as it has here for China. This goal is not mentioned in either the 12th or 13th 5-year plans nor in the NCCP, therefore it is exclusive to the INDC.

B. To lower carbon dioxide emissions per unit of GDP by 60% to 65% from the 2005 level

The goal is specific in its purpose, to reduce CO_2 emissions per GDP by 60-65% from 2005 levels. In 2005 emissions by China were 6174716.60 Ktons CO_2.[71] Much like the first overhead goal China's INDC document does outline mechanisms it will use to achieve this goal as well. These mechanisms are as follows:

1. Building Energy Efficient and Low-Carbon Industrial System

This mechanism in China's INDC outlines the need to build a stronger low-carbon industrial system. This is perhaps one of the most influential factors in lowering China's overall CO_2 emissions, as industrial emissions output is the highest contributor. What is interesting is that this mechanism highlights that China plans to effectively control emissions from key sectors including power, iron and steel, nonferrous metal, building materials and chemical industries through energy conservation and efficiency improvement.[72] However, it is noteworthy to shed light on the fact that it does not cite a definitive way in which it will do so. It is also highlighted in the INDC that China's national government will promote low-carbon development in agriculture; by controlling fertilizer and pesticides as well as methane and nitrous oxide in farmlands, and the service industry; by actively developing low-carbon business, tourism and

[71] European Comission. 2016. *CO2 time series 1990-2015 per region/country.* November 28. http://edgar.jrc.ec.europa.eu/overview.php?v=CO2ts1990-2015.
[72] (Department of Climate Change, National Development and Reform Commision of China 2015) Supra. Note 70 at 8

food services and suggesting that the service industry conserve energy and reduce carbon emissions.[73]

2. Controlling Emissions from Building and Transportation Sectors

It is surely inevitable that cities will continue to grow in China over the coming years, as they are a growing nation, therefore it is very proactive of China to consider building cities to be more climate change friendly. Some of the methods that the INDC highlights to achieve this mechanism are; accelerating the construction of low-carbon communities in both urban and rural areas, promoting the construction of green buildings and the application of renewable energy in buildings, improving low-carbon supporting facilities for equipping communities, as well as exploring modes of low-carbon community operation and management. Moreover, a hardline commitment to promoting the share of green buildings for newly built buildings of cities and towns to reach 50% by 2020.[74] This is significant in reducing the consumption of carbon and could see a significant reduction in CO_2 overall.

More importantly in the urban environment is the CO_2 emissions from vehicle transportation. Given that populations in the cities are so high, it is easy to understand that the sheer number of vehicles on the road would also be high. Data suggests that there has been a consistent surge in vehicle sales in China since 1990 that reflect a growth of private vehicle ownership at a rate of 20% per year.[75] In the People's Republic of China on Climate Change second national communications in 2004, it is recognized that CO_2 emissions from transportation activities was around 415.74 million tons, accounting for 7.5% of the total emissions in China for that time period.[76] With a growth rate of 20% vehicle ownership per year, it can be assumed that this number has greatly increased. Therefore, this mechanism highlights the need to proactively mitigate this issue as well, to achieve the overhead goal of reducing CO^2emissions. Some methods outlined in the INDC are; to improve the quality of gasoline and to promote new types

[73] (Department of Climate Change, National Development and Reform Commision of China 2015) Supra. Note 70 at 8
[74] (Department of Climate Change, National Development and Reform Commision of China 2015) Supra. Note 70 at 9
[75] (Gu, Li and Cook 2014) Supra. Note 67 at 4
[76] (Gu, Li and Cook 2014) Supra. Note 67 at 4

of alternative fuels, to develop a green and low-carbon transportation system, optimizing means of transportation, properly allocating public transport resources in cities, giving priority to the development of public transportation and encouraging the development and use of low-carbon and environment-friendly means of transport.[77] Additionally, a hardline commitment to promote the share of public transport in motorized travel in large and medium sized cities reaching 30% by 2020 is stated.[78] To help lower costs to the public the INDC also states a method of promoting the development of dedicated transport networks for pedestrians and bicycles in cities and to advocate green travel.[79]

3. Promoting the Low-Carbon Way of Life

This mechanism also brings to attention the need for public participation in achieving the overhead goals stated in the INDC. China recognizes the significance of its population in its overall emissions, as clearly made evident by its continues emphasis on public participation. The INDC highlights methods such as enhancing the education of all citizens on achieving low-carbon ways of life and consumption and promoting low-carbon consumption throughout China's society.[80] As well as encouraging the public institutions to take a lead in promoting low-carbon ways of life in government buildings, campuses, hospitals, stadiums and military camps.[81] These public institutions will additionally take actions to moderate consumption, encourage the use of low-carbon products and curb extravagance and waste.[82]

This overhead goal is very ambitious, and would it be an incredible achievement for China to reach it. It is noteworthy to mention that similar efforts and goals have been made in

[77] (Department of Climate Change, National Development and Reform Commision of China 2015) Supra. Note 70 at 10
[78] (Department of Climate Change, National Development and Reform Commision of China 2015) Supra. Note 70 at 10
[79] (Department of Climate Change, National Development and Reform Commision of China 2015) Supra. Note 70 at 10
[80] (Department of Climate Change, National Development and Reform Commision of China 2015) Supra. Note 70 at 11
[81] (Department of Climate Change, National Development and Reform Commision of China 2015) Supra. Note 70 at 11
[82] (Department of Climate Change, National Development and Reform Commision of China 2015) Supra. Note 70 at 11

China's national policy prior to the 2015 INDCs. In the 12th 5- year plan specified targets of 16% reduction in energy intensity or energy consumption per unit of GDP and 17% reduction in carbon intensity or carbon emissions per GDP are cited.[83] Both of these targets were set to compare to 2010 levels and were to be reached by 2015. Similar goals were outlined in China's NCCP, where a target of approximately 20% reduction of energy consumption per unit GDP by 2010, and consequently a reduction in CO_2 emissions is indicated.[84] According to the International Center for Climate Governance, China was able to achieve an 18.2% reduction in energy intensity and 20% reduction in carbon intensity by 2015.[85] This means that China was successful in achieving both their NCCP and 12 5-year plan goals. The current 13th 5-year plan does mention again a similar goal to that in the 12th 5-year plan, of a reduction in energy intensity by 15% and a reduction in carbon intensity by 18%.[86] Both goals are set to compare to 2015 levels and to be reached by 2020. It is interesting to note that the 5-year plans allow China to set shorter term goals and measure their achievement consequently. Given that there is obvious policy already in place for reductions in emissions it is clear to see that the national policy is equipped to adopt this new overhead goal of their INDC using the aforementioned mechanisms for policy changes.

C. To increase the share of non-fossil fuels in primary energy consumption to around 20%

This overhead goal seems to be a means to the end of China's emissions reduction overhead goal; however, it is a significant goal because it displays that China is dedicated to their overall emissions reductions and global environmental impact. It sets a hardline goal of reducing

[83] Lewis, Joanna. 2011. "Energy and Climate Goals of China's 12th Five-Year Plan." *Center for Climate and Energy Solutions website.* March. https://www.c2es.org/docUploads/energy-climate-goals-china-twelfth-five-year-plan.pdf
[84] National Development and Reform Commission. 2007. "China's National Climate Change Programme." *China Climate Change Website.* june. http://www.ccchina.gov.cn/WebSite/CCChina/UpFile/File188.pdf
[85] Davide, Aurora D'Aprile and Marinella. 2016. *Climate policy highlights: China's 13th Five-Year Plan and other recent developments.* Venice: International Center for Climate Governance. http://www.iccgov.org/wp-content/uploads/2016/04/2016.04.14_Seminar_Davide_DAprile.pdf.
[86] (Davide 2016) Ibid. at 4

the share in primary energy of fossil fuels (coal, oil, and gas) and increasing the share of non-fossil fuels to 20%. In 2013, approximately 83% of the share of primary energy was coal fueled[87] (see Figure 7 in Appendix). Respectively, oil was 13% and gas was 3% of the primary energy consumption.[88] However, in 2014 the share of non-fossil fuels in primary energy consumption jumped to 11.2%.[89] Even though this overhead goal itself seems to be a mechanism for achieving a 60-65% reduction in emissions, it is in fact a standalone goal and China's INDC document does outlines mechanisms for achieving it. These mechanisms are as follows:

1. Building Low-Carbon Energy System

The main direction this mechanism takes is that of reducing the carbon output of coal power in china. Many of the policy changes or initiatives highlighted under this mechanism in the INDC document make mention to this. What is interesting about this mechanism, though, is that it also highlights China's move toward changing their main energy source. It highlights initiatives such as expansion of the use of natural gas and achieving more than 10% share of natural gas consumption in the primary energy consumption by 2020, as well as promoting the development of hydro power, nuclear power, wind power and solar power.[90] It also sets hard targets such as achieving an installed capacity of wind power reaching 200 gigawatts, the installed capacity of solar power reaching around 100 gigawatts and the utilization of thermal energy reaching 50 million tons of coal equivalent by 2020.[91]

2. Promoting Carbon Emission Trading Market

The most notable target for this mechanism is that of advancing low-carbon pilots in provinces and cities. Currently China has seven local low-carbon pilots in place, with varied results. These low-carbon pilots are done through a cap-and-trade apparatus. China is the first developing

[87] (Olivier 2016) Supra. Note 61 at 36
[88] (Olivier 2016) Supra. Note 61 at 36
[89] (Department of Climate Change, National Development and Reform Commision of China 2015)Supra. Note 70 at 7
[90] (Department of Climate Change, National Development and Reform Commision of China 2015)Supra. Note 70 at 7
[91] (Department of Climate Change, National Development and Reform Commision of China 2015)Supra. Note 70 at 7

country in the world to attempt to control local CO_2 emissions through a cap-and-trade system.[92] In terms of their ability to work, nearly all regulated companies fulfilled their obligations to their emissions 'caps' in the first pilot year[93], however, trading was very thin in the same first year of the pilots and there were significantly different prices from pilot to pilot leaving data inconsistent and hard to compare.[94] Perhaps this is the reason why the mechanism highlights the need for building upon the carbon emission trading pilots. As suggested in the INDC document, China hopes to steadily implement a nationwide carbon emission trading system and gradually establish the mechanism so that the market plays a pivotal role in resource allocation.[95] Lastly, the mechanism suggests that there is a need for development of a system for reporting, verifying and certifying carbon emissions and improvement of rules and regulations for carbon emission trading.[96] Achieving this will ensure openness, clarity, fairness and justice in the operation of the carbon emission trading market.

This overhead goal is also mentioned in all the important policy pieces regarding climate change in China. The NCCP specifically mentions optimizing China's energy mix by developing low-carbon and renewable energy. The NCCP highlights the need for support in the development and utilization of new and renewable energy. Currently china is working to develop biomass, solar, geothermal and wind power in appropriate areas.[97] The NCCP highlights that the share of coal in China's primary energy mix has decreased from 76.2% in 1990 to 68.9% in 2005.[98] China's 12th 5-year plan sets a target of Increasing non-fossil energy to 11.4%.[99] Lastly it is mentioned again in the 13th 5-year plan where a 15% share of non-fossil fuel energy in primary

[92] Ringius, Lasse. 2015. *Emissions trading in China: Early lessons from low-carbon pilots.* August 17. http://blogs.worldbank.org/climatechange/emissions-trading-china-early-lessons-low-carbon-pilots
[93] (Ringius 2015)Ibid.
[94] (Ringius 2015)Ibid.
[95] (Department of Climate Change, National Development and Reform Commision of China 2015)Supra. Note 70 at 14
[96] (Department of Climate Change, National Development and Reform Commision of China 2015)Supra. Note 70 at 14
[97] (National Development and Reform Commission 2007) Supra. Note 84 at 9
[98] (National Development and Reform Commission 2007) Supra. Note 84 at 9
[99] (Lewis 2011) Supra. Note 83 at 1

energy consumption is cited. In 2010 the approximate share of non-fossil fuel energy was around 12%, therefore China had achieved its 12th 5-year plan goal.[100]

D. To increase the forest stock volume by around 4.5 billion cubic meters on the 2005 level.

As of 2003 China's forest cover was roughly 18.21% or about 12.46 billion cubic meters[101], and China has not seen particularly devastating deforestation in recent years due to policy action in China's 5-year plans. According to China's INDC achievement discussion, the forested area and forest stock volume have since increased by 2.188 billion cubic meters compared to the 2005 levels.[102] This is largely a result of the policies China has implemented. The 12th 5-year plan contains the target to increase the rate of forest coverage by 21%.[103] The NCCP indicates the need for optimizing the target-oriented management responsibility system for afforestation by governments at all levels and forestry sectors, and to accelerate the formulation, amendment, and time line of forestry related laws and regulations; including development of regulations on conservation of natural forests, transfer rights of forests, forest products, and forest land use.[104] It also places emphasis on the need to enhance the implementation of laws and regulations by improving the system, strengthening inspections, and expanding social supervision of law enforcement.[105] The 13th 5-year plan does not indicate this overhead goal specifically, but does put attention on it as an INDC main goal and therefore supports it by extension. Additionally, China's INDC outlines a specific mechanism for this overhead goal:

1. Increasing Carbon Sinks

[100] (Davide 2016) Supra. Note 85 at 5
[101] The State Forestry Administration, People's Republic of China. 2009. *People's Republic of China Foresty Outlook Study.* Bangkok: Food and Agriculture Organization of the United Nations. http://www.fao.org/docrep/014/am256e/am256e00.pdf
[102] (Department of Climate Change, National Development and Reform Commision of China 2015)Supra. Note 70 at 3
[103] (Lewis 2011)Supra. Note 83 at 3
[104] (National Development and Reform Commission 2007) Supra. Note 84 at 45
[105] (National Development and Reform Commission 2007) Supra. Note 84 at 46

As with previous mechanisms, an emphasis on public participation is placed in this mechanism. The INDC specifically outlines that there is a need for vigorous enhancement of afforestation.[106] It suggests that promotion of voluntary tree planting by citizens would greatly enhance this, but also the continuation of the implementation of key ecological programs such as; protecting natural forests, restoring forest and grassland from farmland, strengthening forest tending and management and increasing the forest carbon sink.[107] As with previous mechanisms, an emphasis on public participation is placed in this mechanism. The INDC specifically outlines that there is a need for vigorous enhancement of afforestation.

Comparative Analysis

The understanding of feasibility of China's most recent INDCs will require some comparative analysis. This analysis is mostly significant for giving validity to the ambitiousness of China's INDC, but will also provide concrete examples of similar circumstance and the outcomes of these circumstances. Therefore, a comparison will be done between China and four other INDCs. The United States of America, the European Union, India and South Korea INDCs will be referenced in comparative data. By examining INDCs by these four other parties to the UNCCC, as well as their similarities and differences in policy enforcement and development, a deeper understanding for potential feasibility will be available.

How China's overhead goals compare with the four other countries is very interesting. Each country's INDC goals for emissions reduction are vastly different from each other, despite having the same overall goal of global emissions reduction, and some of the comparative countries lack the structure and elaboration found in China's INDC. This speaks volumes to the ambitiousness of China's INDC and displays a varying level of commitment.

[106] (Department of Climate Change, National Development and Reform Commision of China 2015) Supra. Note 70 at 10
[107] (Department of Climate Change, National Development and Reform Commision of China 2015) Supra. Note 70 at 10

United States of America

The United States of America has been a historically significant contributor to global GHG emission due to their significant production and consumption habits and an investigation into their reduction strategies and policy ambitions will be a noteworthy indicator of their ability to reduce their CO_2 and GHG emissions. As aforementioned in the introduction of this paper, China recently overtook the United States of America as the number one contributor of GHG and CO_2 emissions. Therefore, it is fundamental to the understanding of feasibility to examine what, potentially, enabled this, and if it was policy related.

In their INDC, the United States of America makes a commitment of 28% reduction from 2005 levels by 2025, [108] compared to that of China's 60-65% by 2030. In 2005 emissions levels in the USA were 5886317.61 Ktons CO_2. [109] This goal of reduction by 2025 is earlier than any other country, and is even set before the assumed peak year for every country, however it is at a much lower percentage rate. It is still ambitious, though, and would take a significant amount of work by the USA to achieve.

In order to meet its 2025 INDC commitment of reducing emissions by 28% below 2005 levels, the United States would have had to implement both the Clean Power Plan and the Obama Administration's full Climate Action Plan[110], those of which were recently rescinded by President Donald Trump.[111] US policies, including the Clean Power Plan, however, would have only reduced emissions to 17% below 2005 levels by 2025[112], and more policy action and acceleration of reductions strategies would have needed to take place.

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[108] 2015. "The United States of America's Intended Nationally Determined Contributions." *United Nations Framework Convention on Climate Change website.* March 30.
[109] (European Comission 2016) Supra. Note 71
[110] U.S. Department of State. 2016. "2016 SECOND BIENNIAL REPORT of the United States of America." *United Nations Framework Convention on Climate Change website: Submitted Biennial Reports from Annex I Parties .* http://unfccc.int/files/national_reports/biennial_reports_and_iar/submitted_biennial_reports/application/pdf/2016_second_biennial_report_of_the_united_states_.pdf.
[111] United States Government. 2017. *Presidential Executive Order on Promoting Energy Independence and Economic Growth.* The White House.
[112] (U.S. Department of State 2016)Supra. Note 110 at 30

The USA INDC is no longer ratified as they have pulled out of the Paris Agreement under President Donald Trump on June 1, 2017. This does not, however, effect China's commitment, nor the commitments of any of the other 195 countries the world over. The value of comparing the USA's INDC information to the feasibility of China's INDC is that it indicates China's INDC goal was in line with targets set by the other most significant contributor of GHG and CO2 emissions. It now speaks to the achievability of the goal, in an offside way, because China will now be viewed with more scrutiny by the international community since it is the largest contributor who is still signed to the Paris Agreement.

The European Union

The European Union was selected for comparative analysis because its INDCs encompass several countries and economies. It is also a leader in making environmentally concerned decisions and enforcing policy that considers environmental impacts. The opinion that the European Union sets an example of how to achieve environmental policy ambitions is what is most significant to this comparison. The European Union is one of the more influential bodies present in United Nations decision making. It is, however, understood that there are few similarities to China in the European Union with respect to GDP and it consists mostly of developed countries. Nevertheless, this provides a differing perspective with respect to understanding feasibility of INDCs by China.

A significant indication of the ambitiousness of China's goal for emissions reduction can be found in the fact that the whole of the European Union, has made a commitment of 40% reduction by 2030 with an index level set to 1990[113], as compared to China's 60-65% of 2005 levels by the same year. What is significant about this is that 1990 levels were far lower than 2005 levels, even in the EU countries, though the EU's 1990 level of emissions were higher than China's at the time[114] (see Figure 5 in Appendix). What this suggests, therefore, is that the EU

[113] Latvia and the European Commission on behalf of the European Union and its Member States. 2015. *Intended Nationally Determined Contribution of the EU and its Member States.* Riga, March 6. http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Latvia/1/LV-03-06-EU%20INDC.pdf
[114] (Olivier 2016) Supra. Note 61 at 38

countries plan to drastically reduce their emissions, nevertheless. In 1990, the EU had emissions of 4385704.78 Ktons CO_2 , and China had 2293539.57 Ktons CO_2 [115]. With that being said, it would have been much more ambitious, and perhaps unrealistic, for China to index to 1990.

Much of the methodologies and strategies for the EU to achieve their goal have been highlighted in their INDC as pending while they wait for submissions from their member states. So, it is unclear exactly how the EU plans to achieve this goal as of the writing of this paper. It is important to note, however, that the EU has been successful in reducing their emission over the period of 1990-2015 to 3469670.82 Ktons CO_2 [116], which is around 1 million Ktons CO_2 in 25 years, whereas, China has seen a drastic increase of over 8 million Ktons CO_2 within these same 25 years. This information is valuable, though, to the understanding of ambitiousness of China's goals. While the EU has set targets of reducing their emissions by roughly 1754281.91 Ktons, china has set targets for reduction by roughly 3704829.96 to 4013565.79 Ktons and thus we see that China's goal is significantly more ambitious.

India

Also, a developing country, and situated in the east Asian geolocation, India is being considered for this feasibility study because it shares many similar adverse environmental qualities with China. The two countries have large populations, lacking environmental policy enforcement, and serious air quality issues. However, with that being said, India only accounts for 7% of the total global CO_2 and GHG emissions.[117] It is therefore vital to the understanding of feasibility and ambitiousness, of China's INDC, to examine what has assisted India in maintaining such low emissions as compared to China. India's INDC document is the only other INDC in this comparative group that encompasses similar related goals as China's INDC. The other three INDC documents do not contain information about increasing non-fossil fuel energy, nor forest stock volume. Therefore, the comparison with India is slightly more significant.

[115] (European Comission 2016) Supra. Note 71
[116] (European Comission 2016) Supra. Note 71
[117] (PBL Netherlands Environmental Assessment Agency 2017) Supra. Note 6

India has made a commitment to reduce their emissions intensity per their GDP by 33-35% by 2030 from 2005 level in their INDCs.[118] In 2005 India's emissions were 1270039.97 Ktons CO_2.[119] India and China are both developing countries and within the top 6 highest global emitters of CO_2 emissions[120] (see Figure 6 in Appendix). Even though India is not required to submit emissions reduction goals, they have voluntarily submitted a previous goal to the UN of reducing their emissions intensity per their GDP by 20–25%, over 2005 levels, by 2020.[121]

India has many policies in place at national level to mitigate climate change and CO_2 emissions, similar to China, and indicate many of the same mechanisms for reduction. Some of these are: enhancing energy efficiency in industries, developing climate resilient urban centers, developing a safe, smart and sustainable green transportation network, and promoting citizens and private sector contributions to climate change.[122] India has, so far, successfully seen their emission intensity per GDP decrease by 12% between 2005 and 2010.[123] This is significant, given that they were not obligated by the UN to do so. India seems to be on their way to reaching their INDC goal of 33-35% reductions by 2030, therefore.

While China's INDC indicates increasing their share of non-fossil fuel energy by around 20% as a top priority, India is the only other INDC that makes mention it at all. India indicates in their INDC document that they want to achieve a 40% capacity from non-fossil fuel based energy resources by 2030.[124] The most notable achievement for India in terms of their non-fossil fuel energy consumption is the installation of 2,970 MW grid-connected solar generation capacity.[125] Additionally, India has mandated a Perform, Achieve and Trade (PAT) program for

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[118] Government of India. 2015. "INDCs as communicated by Parties." *United Nations Framework Convention on Climate Change Website.* October 1. http://www4.unfccc.int/submissions/INDC/Published%20Documents/India/1/INDIA%20INDC%20TO%20UNFCCC.pdf

[119] (European Comission 2016) Supra. Note 71

[120] (Olivier 2016) Supra. Note 61 at 44

[121] (Government of India 2015) Supra. Note 118 at 8

[122] (Government of India 2015) Supra. Note 118 at 8-18

[123] (Government of India 2015) Supra. Note 118 at 8

[124] (Government of India 2015) Supra. Note 118 at 29

[125] Ministry of Environment, Forests and Climate Change: Government of India. 2014. *India's Progress in Combating Climate Change: Briefing Paper for UNFCCC COP 20 Lima, PERU.* New Dehli, December. http://envfor.nic.in/sites/default/files/press-releases/Indian_Country_Paper_Low_Res.pdf.

the industrial sector[126]. It is a market based trading scheme that allows trade of energy among energy intensive industrial plants and awards Energy Saving Certificates to those who overachieve the targets[127]. It, additionally, mandates a decrease in energy consumption and this has led to a reduction of 4 to 5% of energy consumption in 2015 as compared to that in 2012[128].

Similarly, to China's INDC, India too stipulates a mechanism for afforestation. This seems to be an area of particular interest to India as it has seen an increased from 23.4% in 2005 to 24% of the geographical area in 2013[129]. India has also specified their long-term goal of increasing the forest coverage to 33% of the geographical area in their INDC[130]. The INDC indicates that these results will be possible for india through policies; such as the National Agro-forestry Policy, the REDD-Plus policy, the Joint Forest Management and through the National Afforestation Programme.[131]

Given that India's INDC is so similar, in the sense that it also encompasses additional goals and mechanisms, it is significant to compare it to China's INDC to see if China's INDC is overly ambitious or feasible. India is also a developing country and not required to submit any goals to the UNCCC but has clearly achieved many things that it has set out to achieve. This is advantageous to informing China's INDC feasibility because many of the same goals are expressed. Knowing, therefore, how India was capable of achieving their goals is worthwhile.

South Korea

Part of the Asian Pacific alongside China, South Korea can provide a unique perspective toward the accomplishment of INDC targets for China. A specific reason for choosing this country lays in the fact that both countries are considered emerging economies and share similar status as developing countries. It proves significant, that economic advancement is of specific concern to these two countries and production and manufacturing is a key element in their

[126] (Government of India 2015) Supra. Note 118 at 12
[127] (Government of India 2015) Supra. Note 118 at 12
[128] (Government of India 2015) Supra. Note 118 at 12
[129] (Government of India 2015) Supra. Note 118 at 16
[130] (Government of India 2015) Supra. Note 118 at 16
[131] (Government of India 2015) Supra. Note 118 at 16

growth. It is also noteworthy to mention their close proximity to each other, as this may provide insight into South Korea's efforts to curb their global emissions and may influence policy decision making by the national government. South Korea is increasingly being viewed globally as an environmentally concerned country and has made some significant strides in their execution of their environmental policy and therefore serves as an imperative comparison interest.

In comparing the countries and their INDC targets for reduction, we must consider that South Korea's INDC is incredibly relaxed and they are not so straight forward in their commitment. What is most significantly different about South Korea's commitment is that they do not index to a specific year, but rather to a "Business-As-Usual (BAU)" level, essentially meaning if South Korea were to continue their emissions at their current level. Interestingly they commit to reducing their emissions by 37% below the BAU level.[132] Later, when explaining that their target is fair and ambitious, they indicate another commitment of reducing their total global GHG emissions by 40-70% from 2010 levels by 2050.[133] Interestingly South Korea suggests that they are not able to set more stringent goals because of their industrial structure with roughly a 32% share of manufacturing.[134] Comparing this to China, with roughly a 39.8% share of manufacturing[135], it seems a bit dull of an excuse. However South Korea's current emissions only amounts to 1.4% of global GHG emissions.[136] Their cumulative emissions were 62994.79 Ktons CO_2 in 2015.[137]

South Korea, being a developing country, is not required to submit reductions goals to the UN, but did so at the 2015 UNCCC. This may have a bearing on the slackening of their targets. However, it is still significant to compare with China's INDC as it provides an indication of

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[132] Republic of Korea. 2015. *Intended Nationally Determined Contribution.* United Nations Framework Convention on Climate Change. http://www4.unfccc.int/submissions/INDC/Published%20Documents/Republic%20of%20Korea/1/INDC%20Submission%20by%20the%20Republic%20of%20Korea%20on%20June%2030.pdf
[133] (Republic of Korea 2015)Ibid. at 4
[134] (Republic of Korea 2015)Ibid. at 4
[135] United States CIA. 2016. *The World Factbook.* https://www.cia.gov/library/publications/the-world-factbook/fields/2012.html?countryName=China&countryCode=CH&regionCode=eas&#CH
[136] (Republic of Korea 2015) Supra. Note 126 at 4
[137] (European Comission 2016) Supra. Note 71

China's INDC ambition. South Korea's INDC is obviously far less ambitious than all other INDCs examined in this comparative analysis but it supplies the notion that China's INDC could be much less developed and thus much less ambitious, given that it is also a developing country that does not need to submit goals to the UN.

The chosen comparatives all maintained various differences and similarities to China and, as expected, they provide a varying degree of value to the understanding of the feasibility and the ambitiousness of China's INDC. Each of these comparatives have submitted INDCs to the Paris UNCCC in 2015, whether required to or not, and all have ratified into the Paris Agreement. They are at various levels of enforcement of their proposed targets and ambitions, likewise. Therefore, the wide range of information available helped to provide a greater understanding of what China may be capable of achieving in its own regard.

Feasibility Study

In conducting this feasibility study, the four main overhead goals were examined for their ability to be integrated into policy as well as executed realistically. The feasibility study is based on the extensive research, in the critical policy analysis, comparative analysis and literature review, on both the current practices, policies and strategies employed by the Chinese government and the proposed INDC changes and their impact. The feasibility study will contain extensive data related to political, environmental, economic, and technical impact and will include advantages and disadvantages of both the current situation and the proposed policy changes. Lastly a brief commentary on the likelihood of achieving the proposed INDC timeline of 2030 will be discussed in a schedule feasibility study. Since the paper is framed under the SWOT framework, the various feasibilities will be categorized as whether they are a strength, weakness, opportunity or threat to achieving China's INDC goals.

Political Feasibility

The political feasibility of China's INDC initiated changes is based largely on whether the national, provincial and local level governments and officials can support each other and come to an agreement on the implementation of the policies in place and the proposed policy changes presented. As discussed in previous sections of this report, the three levels of government each hold a significant extent of power to enforce the policies and thus their individual interests are of importance in terms of whether they are willing to enforce it. To reiterate, it is obvious that the national level government interests in implementation of the INDC policies, as well as current national policies, is the highest. They are the level of government that is introducing the policies and proposed INDC changes, after all. They are also the level of government with an international responsibility to the United Nations and are paying considerable attention to their international reputation. The provincial level of government has been expressing their interest in aligning with the national level government through their production and implementation of provincial polices and pilot programs, likewise. However, where it gets disorganized and uncertain is at the local level of government. In terms of their interest in perpetuation, implementation and support for national and provincial level policies and the proposed INDC changes, the appearance from the local level governments has been supportive. However, in terms of their history of implementation of this support it has been less satisfactory and much of the environmental strides at national and provincial level have been given less consideration at local level.

Not only is the local level of government varied in type but their administrative capabilities are varied as well. Below provincial level government the local level government is essentially made up of four other administrative levels, these are: Prefectural, County, Township and Village levels.[138] Furthermore, these four levels break down into various levels of administration which have even greater variation in their capabilities.[139] A very significant challenge for China and implementation of national policy is the alignment of all these levels of government to a shared goal. Likewise, uncovering what the interests of each individual

[138] The Central People's Government. 2013. *Administrative Division of the People's Republic of China.* http://www.gov.cn/test/2005-06/15/content_18253.htm
[139] (The Central People's Government 2013) Ibid.

prefecture, county, township or village level government are poses difficulties. However, it can be reiterated, from the literature review, that the most likely interest for local level governments is that of GDP and economic growth for their constituency. This leaves climate change policies as a secondary, or even perhaps less significant, interest. It should be noted though, that national level government, and the provincial level government, can forcefully impose the policies and policy actions on the local level government. It is just understood that the higher-level governments afford the curtesy of allowing the local level governments to make their own decisions for their communities.

As reiterated from the methodology and framework section of this paper, current national level policies, such as the 12th and 13th 5-year plans and the NCCP are advantageous because they outline specifics of how to begin the implementation of successful policy actions. They also contain the explanations of the necessary framework for the implementation of the various policy mechanisms for achieving similar goals to the INDC overhead goals, those of which can easily be changed to reflect the new INDC goals. However, the national policies have their disadvantages as well. One such disadvantage is that there is not a clear legislative system for implementation of these policies. As demonstrated in the critical policy analysis, all the national policies outline mechanisms to achieve their goals, but there is not a clear policy currently in China that says exactly how they are to be executed at ground level and much of the wording in the current policies are simply suggestive. The policies, likewise, do not stipulate penalties or repercussions for not implementing them and they are written more as policy guiding principles, for policy making, rather than policy actions.

Similarly, the changes proposed in the INDC document are advantageous because they increase the percentages of emissions reduction and specify many specific mechanisms additional to those in the current policies. The INDC document has also been ratified into the Paris Agreement in 2016 at the international level, which carries with it a certain amount of accountability. The overhead goals are easily transferable to current policies in China and are aligned with the current national interests which makes it easy to adopt into national policy. However, there is still the disadvantage of these policy changes not carrying any repercussions

and being more like guiding principles than policy actions. Because they are more ambitious with their overhead goals, the INDC could also be considered a disadvantage because it would require much more work at all levels of government.

The ability to change the current national policy, or adopting the INDC goals and mechanisms into national policy is, in fact, feasible. Likewise, adopting the INDC goals and mechanisms is already taking place at national level in the 13th 5-year plan. When the goals and mechanisms are adopted into current national policy, it is politically feasible to assume that the provincial level of government will include the new goals and mechanisms into their own current policy, considering their alignment with the national level government. The only area in which these goals and mechanisms are potentially not politically feasible are at the local level for reasons specified prior in this section.

In terms of the implementation of these policies, politically, at least in terms of reputation, there is no issue at national or provincial level. Both national and provincial governments have a reputation for and have been recognized by the public as being supportive towards and promoting environmental sustainability and climate change mitigation for the country. Therefore, if the national government were to begin ratifying national policies that included strict measures and repercussions of inaction, it does not seem likely that there would be disagreement. Reiterated from the critical analysis, the targets and goals as they pertain to emissions reduction, forest cover and non-fossil fuel energy source increase of the 12th 5-year plan were achieved. This indicates that perhaps it is feasible to implement the necessary policy actions needed to achieve the INDC policy changes and mechanisms.

Political feasibility is considered an area of strength in terms of reaching the INDC goals, regardless of the disconnect between local and national government. This is largely due to the fact that China maintains a very strong communist national government. This power at national level can allow for the implementation of the INDC mechanisms if the policy forums are changed and subsequently enforced by the governing bodies.

Environmental Feasibility

China has set some very ambitious overhead goals in terms of their environmental impacts, and their feasibility is questionable. However, given that China has seen success with somewhat lower goals set, it is not incredibly unlikely that they could reach these goals, and achieve environmental feasibility, likewise.

Two main INDC overhead goals will be the defining factors in whether, or not, this policy is environmentally feasible; increasing the share of non-fossil fuels in the energy mix by 20%, and increasing the forest stock volume by 4.5 billion cubic meters. Increasing forest carbon stocks by this amount infers an increase in forest cover of 50-100 million hectares of forest.[140] This increase would create a nearly 1-gigaton carbon sink, equivalent to stopping tropical deforestation for almost a full year, or taking 770 million cars off the road.[141] This alone could see that the overhead goal of reducing emissions by 60-65% does indeed happen, if not increase that percentage. However, planting these many trees will take up a lot of land, and additionally the trees will take time to grow to maturity and maintain the ability to fully sequester the CO_2 it needs to. Another main thing to consider in terms of the feasibility of this endeavor is that China was only able to increase its tree cover by 49 million hectares over 20 years, from 1990 to 2010.[142]

However, the potential for CO_2 reduction is significantly increased when forest cover increase is coupled with the proposed INDC overhead goal of increasing the share of non-fossil fuel energy, and consequently a significant reduction in coal use. To reach the overhead goal of 20% increase in non-fossil fuel energy will require China to deploy 800 to 1,000 gigawatts in non-fossil capacity.[143] According to studies done by the National center for Climate Change Strategy in China, the share of all renewables in total power generation is expected to rise to 30% in 2030.[144] Likewise, China's installed capacity of non-fossil power is expected to increase by

[140] Taryn Fransen, Ranping Song, Fred Stolle and Geoffrey Henderson. 2015. *A Closer Look at China's New Climate Plan (INDC).* Washington, DC: World Resources Institute.
[141] (Taryn Fransen 2015) Ibid.
[142] (Taryn Fransen 2015) Ibid.
[143] (Taryn Fransen 2015) Ibid.
[144] National Center for Climate Change Strategy and International Cooperation. 2016. *Pursuing an Innovative Development Pathwa: Understanding China's NDC.* Partnership for Market Readiness.

over 900 gigawatts from 2014 levels.[145] Demonstrated in Figure 10, in the appendices, average annual installation of non- fossil capacity should, and could, increase from around 42 gigawatts per year in the period from 2005- 2020 to 66 gigawatts during 2020 - 2030, and to potentially 87 gigawatts in the 2030- 2050 period.[146] The share of non-fossil fuels is projected to increase from 7.9% in 2010 to 22% by 2030.[147] Due to the increase in non-fossil fuels, the share of coal use is projected to decrease from 71% in 2010 to 50% in 2030.[148] Additionally, the mix of mitigation efforts across different areas proposes a carbon-mitigation potential of 850000 Ktons CO_2 in 2020, 2300000 Ktons CO_2 in 2030, and 5400000 Ktons CO_2 in 2050.[149]

In deciding the environmental feasibility, the overall UN Paris Agreement target of limiting the global temperature rise to below 1.5°C must also be taken into consideration. China's INDC overhead goals were, in fact, created to contribute environmentally to this target. Even if China can meet their INDC goals and make significant reductions, their efforts alone will not be sufficient to limit the global temperature from rising below 1.5°C. However, with combined efforts of the other parties signed to the Paris Agreement, China's goals are ambitious and accommodating. In terms of overall environmental feasibility, it seems feasible that China can reach their INDC goals. It is not environmentally feasible for the Paris Agreement target, alone.

Environmental feasibility is considered an area of weakness in terms of achieving the INDC goals, as well as the Paris Agreement goals, because it is reliant on all the INDC goals being achieved all at once to be significant. Environmental achievement for China is weak unless many mechanisms are enforced and many outlying factors are achieved.

Technological Feasibility

https://openknowledge.worldbank.org/bitstream/handle/10986/25749/110555-WP-FINAL-PMR-China-Country-Paper-Digital-v1-PUBLIC-ABSTRACT-SENT.pdf?sequence=1&isAllowed=y

[145] (National Center for Climate Change Strategy and International Cooperation 2016)Supra. Note 144 at 23
[146] (National Center for Climate Change Strategy and International Cooperation 2016)Supra. Note 144 at 25
[147] (National Center for Climate Change Strategy and International Cooperation 2016)Supra. Note 144 at 23
[148] (National Center for Climate Change Strategy and International Cooperation 2016)Supra. Note 144 at 23
[149] (National Center for Climate Change Strategy and International Cooperation 2016)Supra. Note 144 at 20

First discussed briefly in the literature review, China is participating in various international technology transfer programs. These programs include, but are not limited to the implementation of supercritical and ultra- supercritical coal fired power plants, Natural gas combined cycle power plants, Photovoltaic power generation, Wind power, and waste heat recovery for steel and cement plants.[150] The two main methods for the transfer of these technologies are technology licencing and joint ventures.[151]

Current policies such as the 12th 5-year plan, and the NCCP do make mention to the need for research and development in regard to technological advancement of wind, solar, and other forms of renewable or non-fossil fuel energies but do not specify any methods or means in which to undertake these efforts. The 12th 5-year plan speaks briefly also of the national government's ambition to construct high-speed rail and make improvements in subway and light rail coverage but again is unspecific of whether or not it will be part of a technology transfer or researched and developed locally.[152]

China's INDC discusses technology in a specific policy mechanism, suggesting that there is a need to enhance support for science and technology through research and development, assumingly locally. The mechanism emphasizes the need for strengthening commercialization of low-carbon technologies, renewable energies, advanced nuclear power technologies and carbon capture and storage.[153] It also suggests the promotion of technologies that utilize carbon dioxide to enhance oil recovery and coal-bed methane recovery.[154] Lastly the INDC mechanism highlights the need to improve the technical support system for addressing climate change, by establishing a mechanism that effectively integrates government, industries, academic and

[150] (Ueno 2009) Supra. Note 57 at 8
[151] (Ueno 2009) Supra. Note 57 at 3
[152] (Lewis 2011)Supra. Note 83 at 3
[153] (Department of Climate Change, National Development and Reform Commision of China 2015) Supra. Note 70 at 13
[154] (Department of Climate Change, National Development and Reform Commision of China 2015) Supra. Note 70 at 13

research institutes, as well as, strengthening professional and personnel training for addressing climate change.[155]

Additionally, stipulated in the INDC document is a section regarding the Paris Agreement's commitment to the continuation and enhancement of these programs. The agreement stipulates that developed countries must continue the transfer of technologies to developing countries, as well as provide support to their research and development of technologies based on need.[156] It also stipulates that existing technology mechanisms are to be strengthened to address performance and financial mechanisms are to be enhanced to include an additional window for technology development and transfer.[157] What this means is that the ratification of the Paris Agreement by China, and all other countries, and China's contribution to it allow China access to the enhanced technology transfer programs.

Current national policy has had the advantage of seeing major advances in developing efficient coal-burning power generation technologies, and clean coal power generation technologies.[158] Additionally, energy efficient and saving technologies have been widely executed as to be used in building materials and chemicals, and in sectors such as construction, transportation, and mining..[159] The current policies have seen the advancement of research and development in areas such as renewable and new energies like wind, bio-energy, solar, hydro, and thermal power technologies.[160]

In terms of feasibility, therefore, it can be assumed that with current technology transfer programs, the additional availability of support and programs through the Paris Agreement, current national policy and INDC policy changes, the technological ability to mitigate climate change is feasible. Furthermore, the implementation of the INDC mechanism is also feasible.

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[155] (Department of Climate Change, National Development and Reform Commision of China 2015) Supra. Note 70 at 13
[156] (Department of Climate Change, National Development and Reform Commision of China 2015) Supra. Note 70 at 18
[157] (Department of Climate Change, National Development and Reform Commision of China 2015) Supra. Note 70 at 18
[158] (Ministry of Science and Technology : China 2007) Supra. Note 55 at 3
[159] (Ministry of Science and Technology : China 2007) Supra. Note 55 at 3
[160] (Ministry of Science and Technology : China 2007) Supra. Note 55 at 3

The impact of implementing the INDC policy changes is positive and only adds to the current situation for research and development. Implementing the use of the technology advancements through these policy changes can aid in reaching the INDC overhead goals, likewise.

Technological feasibility is considered an area of opportunity for achieving the INDC goals, as advancement in technology has the potential to greatly enhance mechanisms for achievement and reducing the difficulty in obtaining emissions reduction. Technological advances also provide opportunity to the goal of increasing non-fossil fuel energy.

Economic Feasibility

As highlighted in the literature review, the annual growth (GDP) target in the 12th Five-Year Plan was 7% and the growth (GDP) target in the 13th Five-Year Plan is 6.5%.[161] Therefore, China clearly has specific interests in continuing their growth in GDP. However, the implementation of China's INDC could promote economic decoupling from carbon emissions, in general.[162] This means that China's GDP will be less dependent on carbon, as it is now, and it will create a more positive condition for a potential transition toward a low-carbon path of development.[163] The most significant reason for decoupling will be the decrease in energy intensity per unit of GDP, as specified in the INDC, and the increase of non-fossil fuels in China's energy mix.[164]

Whether, or not, GDP will take precedent over the efforts of climate change mitigation and emissions reduction will largely depend on how China plans to fund their proposed policy efforts. In 2013 China's was funding their climate efforts through both domestic and foreign sources, 1. Public finance which came from both international and domestic sources, 2. Carbon market finance through the Kyoto Protocol Clean Development Mechanism (CDM); an international source, 3. Mainstream private sector finance; such as foreign and domestic bank

[161] (World Bank Group 2017) Supra. Note 7
[162] Fu Sha, Zou Ji, Liu Linwei. 2015. *An Analysis of China's INDC.* Translated by China Carbon Forum: China National Center for Climate Change Strategy and International Cooperation. http://www.chinacarbon.info/wp-content/uploads/2015/07/Comments-on-Chinas-INDC.pdf
[163] (Fu Sha 2015)Ibid. at 4
[164] (Fu Sha 2015)Ibid. at 4

loans, 4. Direct investment; again, both foreign and domestic and Charitable and NGO financing.[165] For a detailed illustration of how these sources stream their distribution of funds to China, see Figure 9 in the Appendices.

Data available for 2011 suggests that while China does receive much of its climate change mitigation and emissions reduction financing from international sources, their domestic financing is the most dominant source of funding.[166] The most significant source of financing in 2011 was through private State Banks; totaling US$294 billion[167] (See Figure 8 in Appendices). In comparison, the total amount of foreign financing in 2011 was US$70.5 billion.[168] The UN led Clean Development Mechanism (CDM) has, however, been a significant source of low carbon financing, with an estimated US$9.3 billion being sourced to China by 2012.[169] It is important to note that since these numbers were made available, many things have changed in terms of economic relationships in China. First, China has begun to fund climate financing for poorer developing countries.[170] Furthermore, China's relationships, with the developed countries who have been funding them, have shifted toward a more strategic partnership than a relationship between donor and recipient and international banks are also increasing their funding.[171]

Interestingly, most climate financing in China is focused on mitigation activities. This is in alignment with the policies, since none of the policies make any direct mention to adaptation strategies. The 12th 5-year plan highlights the need for financial investment toward clean technology, energy efficiency, environmental protection and renewable energy.[172] This could be in a large part because investment from private and public financial sources has been places where the returns will be the greatest. Though transportation and building energy conservation

[165] The Climate Group. 2013. *Shaping China's Climate Finance Policy:.* London, UK: The Climate Group. https://www.theclimategroup.org/sites/default/files/archive/files/Shaping-Chinas-Climate-Finance-Policy.pdf
[166] (The Climate Group 2013) Ibid. at 2
[167] (The Climate Group 2013) Ibid. at 2
[168] (The Climate Group 2013) Ibid. at 2
[169] (The Climate Group 2013) Ibid. at 2
[170] (The Climate Group 2013) Ibid. at 4
[171] (The Climate Group 2013) Ibid. at 4
[172] (The Climate Group 2013) Ibid. at 4

are key issues for all the current and INDC policies, there has been less investment into these areas because they simply have higher upfront costs.[173]

China's climate financing is still rather under-developed. This is largely due to the fact that administration between government departments is blurred and often duplications and ineffective uses of funding results.[174] Additionally, there is a deficiency in the regulatory standards for financial institutions, as well as a deficiency in statistical information as it pertains to climate finance streams, which makes it difficult to manage, account for, or distribute international climate funds.[175] Additionally, as mentioned previously in political feasibility, China's policies are deficient in legal standing and force. This is necessary to guarantee financial institutions are putting their money into feasible endeavors.

International funding is also changing, which could affect the way and costs in which China will have the capability to finance their climate change policy. Revenue from the UN's CDM is declining due to a collapse in the price of CDM credits and increasing restrictions in the EU on where credits can be sourced from.[176] Regardless of this however, China's INDC contains a specific mention toward the Paris Agreement. It stipulates that developed countries will be responsible for new, additional, adequate, sustained and predictable financial support to developed countries for their actions against climate change.[177] It further outlines that the scale of financing will increase yearly from 2020 and will primarily come from public funds.[178] The INDC speaks specifically about the role of the Green Climate Fund (GCF) as an important operating entity and that it should be strengthened, as well as guided by the parties of the convention.[179] This means that using the GCF as a negotiation point, China may be able to secure additional funding in the future to fuel its policy needs.

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[173] (The Climate Group 2013) Supra. Note 159 at 4
[174] (The Climate Group 2013) Supra. Note 159 at 9
[175] (The Climate Group 2013) Supra. Note 159 at 9
[176] (The Climate Group 2013) Supra. Note 159 at 10
[177] (Department of Climate Change, National Development and Reform Commision of China 2015)Supra. Note 70 at 18
[178] (Department of Climate Change, National Development and Reform Commision of China 2015)Supra. Note 70 at 18
[179] (Department of Climate Change, National Development and Reform Commision of China 2015)Supra. Note 70 at 18

In terms of the feasibility, therefore, of the current and new policy, there seems to be a lot of funding going into the projects resulting from them. Theoretically, yes, it is economically feasible to implement policies and policy actions of the INDC because of this. It is especially true if the financing from international sources is increased because of the Paris Agreement.

Economic feasibility is considered an area of threat to the achievement of INDC goals because of its hindering ability. Being that GDP growth is such a significant factor at play in terms of enforcement of environmental policy by local governments and other actors, it can be said that economics threatens that enforcement if conditions are not favorable. With the beginning of an economic downturn for China overall, it can be assumed that this treat may become very significant in the hindrance of achieving goals set out in the INDC.

Schedule Feasibility

The schedule for the four INDC overhead goals to be achieved is by 2030. The first thing to consider, when deciding if this is feasible, is that of previous overhead goals. The 11th 5-year plan specified a timeline from 2005 to 2010, and seen a reduction in emission of 19.1%, just shy of their 20% goal in five years.[180]This also means that the NCCP goal of 20% reductions by 2010 was also met. The 12th 5-year plan set a timeline from 2011- 2015, and a goal of 16% reduction in energy intensity or energy consumption per unit of GDP and 17% reduction in carbon intensity or carbon emissions per GDP are cited[181], and China was able to achieve an 18.2% reduction in energy intensity and 20% reduction in carbon intensity by 2015.[182] These are much shorter time frames than the INDC goal of 60-65% reduction by 2030, however they are also much smaller amounts.

Given, though, that China has realistically reached around a 20% reduction in five-year periods without intense goals and international pressure through the ratification of the INDCs into the Paris Agreement, it does not seem to be too farfetched a possibility. Additionally, as

[180] (Moarif and Rastogi 2012) Supra. Note 17 at 10
[181] (Lewis 2011) Supra. Note 83 at 1
[182] (Davide 2016) Supra. Note 85 at 5

demonstrated in the Environmental Feasibility study, the other two targets seem to also be achievable, if not even earlier than the INDC proposes. Therefore, considering all other feasibility data, the critical policy analysis and the literature review information, it can be assumed that, yes, the schedule for the INDC overhead goals is feasible.

Schedule feasibility is considered an area of threat to achieving the INDC goals because it is a challenge to maintain the trajectory needed to achieve the goals in the set time frame. It is not a significant threat, however, as it has been found to be feasible if China adheres to strict enforcement of their mechanisms for achieving the INDC goals.

Enforceability Study

Regardless of whether any of the INDC goals are feasible, the defining factor in the goals achievement is whether they are enforced. As previously mentioned in this paper, none of the policies, current or proposed by the INDC changes, are subject to repercussions and they are not part of any defined legislative system. It is, largely, this reason that enforcement of these INDC goals, and even current policy, is sparse and uneven across the various levels of government, as well as across the various sectors of business. Information about the implementation mechanisms and enforcement of any of the policies discussed in this paper have proven to be nearly impossible to uncover, since there is currently very little accountability attached to them.

However, a journalist, with interest into the enforcement of environmental policy, was able to shed light on the fact that, at ground level, a lot of blind eyes are turned toward the situation of enforcement. In the documentary *'Under the Dome,'* by Chai Jing, examples of where policy simply did not matter are abundant. There are two examples; industrial manufacturing and transportation, that are relevant to the likelihood of enforcement of the current policy and the INDC proposed changes in this documentary that will be discussed here. Both are largely relevant to the overhead goal of 60-65% reduction in CO_2.

The first area that Chai Jing uncovers blatant disregard for current policy is related to industrial manufacturing. This is particularly related to the first mechanism in the INDC;

Building Energy Efficient and Low-Carbon Industrial System, under the overhead goal of CO_2 reduction. Chai discovers that many regulations are simply not followed in this sector. Upon visiting a steel production factory in Hebei province in October 2014, Chai discovers that there are completely unsafe working conditions, no ventilation inside of open pit coal burning, and no discipline to the factories that operate this way.[183] Since they are so poorly managed inside it is not hard to believe that steel factories are not managing their emissions. Steel production in China requires 600kg of coal and 3-6tons of water to produce 1 ton of steel. This production process emits 1.53kg of sulfur dioxide, a significant GHG, and 1kg of soot per 1 ton of steel.[184] The numbers are not given for how much carbon is emitted per 600kg of coal, but it is likely a significant amount. It would cost China 100 yuan per ton of steel to bring factories up to MEP standards.[185] However, when Chai questions the Ministry of Environmental Protection (MEP) about why factories remain unregulated in their emissions, she is simply told that "factories are too big to fail".[186] What this means is that the economy is reliant on them, people's livelihoods depend on the jobs in this sector, and the MEP would rather turn a blind eye than risk disrupting this system.

The second area that blatant disregard for policy is uncovered is in the transportation sector. The number one pollutant and emitter of CO_2 in Beijing, the country's capital, are vehicles. It can, therefore, be assumed that this is also true for the rest of the country. Not only has the country seen a massive spike in the number of vehicles sold and on the road since 1990, but the current public transportation system and alternative means of transportation are severely lacking.[187] The roadway and highway structure is also unsuitable for emission reduction capabilities, due to the high idle time for running vehicles as they sit in traffic waiting to move in the congestion.[188] This situation might be why China thought it necessary to include

[183] 2015. *穹顶之下 (Under the Dome).* Directed by Chai Jing. Performed by Chai Jing. http://www.upworthy.com/see-it-here-exclusive-english-translation-of-powerful-viral-chinese-documentary-under-the-dome
[184] (Chai 2015)Ibid.
[185] (Chai 2015)Ibid.
[186] (Chai 2015)Ibid.
[187] (Chai 2015)Ibid.
[188] (Chai 2015)Ibid.

transportation as an INDC mechanism for the reduction of CO; Controlling Emissions from Building and Transportation Sectors.[189]

However, even if the government can improve road structure and limit the number of cars on the road, a huge problem remains in the enforcement of regulations for vehicle emissions. Chai uncovered that the regulation for filters on 18 wheelers to prevent 500 times more carbon emissions, has been completely disregarded. As an investigative journalist, Chai accompanied police as they inspected 18 wheelers heading into the city in the middle of the night carrying various goods. The trucks had the stickers that proved certified for approved emissions filtering but an alarming number of the trucks with these stickers did not actually have the filter on the vehicle.[190] When Chai inquired further to the manufacturer who is in control of issuing the stickers, they dismiss her complaint as simply a mistake in placing stickers and that if the order is there for the trucks they will sell them.[191] She also questions the ministries for not enforcing this rule and she does not ever get an answer.[192] In the process of uncovering this, Chai also criticizes PetroChina and Sinopec for distributing poor quality oil to vehicles in China, which results in increased GHG emissions. These companies set their own production standards and the MEP is again claiming powerless to respond.[193] What seemed to be happening, therefore, is that no one wants to take responsibility for changing the rules. The Ministry of Environmental Protection is a newer ministry who, at the time, seemed fearful to begin enforcement and disrupt the current system.

In recent years, as the Chinese Government has become increasingly more aware of the ever-accumulating environmental problems facing China, they have also become more aware of the fact that enforcement of environmental laws and regulations has been slack. In April 2014, the National Government imposed changes to the country's Environmental Protection Law

[189] (Department of Climate Change, National Development and Reform Commision of China 2015)Supra. Note 70 at 9
[190] (Chai 2015)Supra. Note 177
[191] (Chai 2015)Supra. Note 177
[192] (Chai 2015)Supra. Note 177
[193] (Chai 2015)Supra. Note 177

(EPL), and have begun the attempt implementation of it as of January 2015[194]. These changes are the first changes to the EPL since its inception in the 1980s[195]. It is being touted as the strictest piece of legislation regarding the environment in China in the Ministry of Environment's history[196]. The new EPL has an expressed focus on correcting the issue of weak enforcement, particularly in the areas of imposing greater liability on enterprise, providing repercussions for violations of regulations and policy, and establishing a forum for environmental public-interest litigation[197]. Accordingly, the national government has proposed intensification of supervision as a means to monitor the enforcement of this new legislation.

Regarding the imposition of greater liability on enterprises, Section 1 of Article 19 in the EPL extends the scope of projects required to conduct Environmental Impact Assessments (EIA).[198] Additionally, a stipulation in Article 56 specifies that the enterprise in charge of conducting an EIA must also engage in public consultation[199]. This requires them to explain the project to the public and fully solicit their opinions. The department responsible for approving the EIA report must publish the full text of such report[200]. Additionally, Article 45 stipulates that all enterprises that may emit GHG or CO_2, must apply for a license to do so, and must observe the requirements of the license[201]. Currently, the Ministry is establishing the integrated Pollution Administrative Permit System (PAPS), and has recommended that the State Council formulate implementation regulations[202]. Additionally, Article 64 states that those who have caused environmental damages from pollution shall be subject to tort liability in accordance with the provisions of the Tort Liability Law of the People's Republic of China[203].

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[194] King & Wood Mallesons. 2014. *Environmental Protection Law: Big Changes in 2014.* May 20. Accessed July 2017. http://www.chinalawinsight.com/2014/05/articles/compliance/environmental-protection-law-big-changes-in-2014-2/.
[195] (King & Wood Mallesons 2014) Ibid.
[196] (King & Wood Mallesons 2014) Ibid.
[197] (King & Wood Mallesons 2014) Ibid.
[198] 2014. "EU-China Environmental Governance Programme." *Environmental Protection Law of The People's Republic of China- unofficial translation.* EU-China Environmental Governance Programme, April 24. https://www.chinadialogue.net/Environmental-Protection-Law-2014-eversion.pdf.
[199] (EU-China Environmental Governance Programme 2014) Ibid. at 12
[200] (EU-China Environmental Governance Programme 2014) Ibid. at 12
[201] (EU-China Environmental Governance Programme 2014) Supra. Note 198 at 9
[202] (EU-China Environmental Governance Programme 2014) Supra. Note 198 at 9
[203] (EU-China Environmental Governance Programme 2014) Supra. Note 198 at 14

The identified repercussions for violations are significant in the revised EPL. Section 2 of Article 19 has imposed strict repercussions on projects that do not provide the necessary EIA to the extent of disallowing the project to commence[204]. Article 61 further identifies repercussions for failure to produce an EIA if the project is already underway, such as being ordered to be suspended the project, having to pay a fine, or in extreme cases, being ordered to restore the site to its original condition[205].

Moreover, Article 55 provides that with respect to the enterprises whom illegally discharged pollutants, the Ministry may seize and detain facilities and equipment that discharge said pollutants[206]. Article 59 Section 1 stipulates that where an enterprise is subject to a fine, for violations, and is ordered to rectify the situations that contribute to illegal emissions, but refuses to do so, the Ministry may impose consecutive daily fines based on the original penalty amount, starting from the day following the order of rectification[207]. Section 2 further orders that the amount for the penalty shall be determined in accordance with the operational costs of pollution prevention, direct losses caused by the illegal act, illegal gains and other similar factors[208]. This fining scheme is unlimited and could result in crippling the project financially, consequently.

Perhaps the most substantial change in terms of repercussions is the fact that those in charge of the enterprise can be held accountable and serve detention for a period between 5 days and 15 days for severe violations[209]. Article 63 lays out the groundwork in which this can happen. Expressly, Section 1 to 4 detail that violations in which a penalty has been applied, but is refused to have been carried out are subject to this more severe penalty.[210]

With respect to intensification of supervision and monitoring, Article 42, Section 2 requires that any institution or enterprise that has potential to emit pollution must establish an Environmental Protection Accountability System (EPAS) which also specifies the

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[204] (EU-China Environmental Governance Programme 2014) Supra. Note 198 at 5
[205] (EU-China Environmental Governance Programme 2014) Supra. Note 198 at 13
[206] (EU-China Environmental Governance Programme 2014) Supra. Note 198 at 12
[207] (EU-China Environmental Governance Programme 2014) Supra. Note 198 at 13
[208] (EU-China Environmental Governance Programme 2014) Supra. Note 198 at 13
[209] (EU-China Environmental Governance Programme 2014) Supra. Note 198 at 14
[210] (EU-China Environmental Governance Programme 2014) Supra. Note 198 at 14

responsibilities of any person(s) in charge of this endeavor[211]. Substantially emitting enterprises shall install monitoring equipment which must be operated at a normal rate, and usage must be ensured. Additionally, the person(s) responsible for maintaining this equipment must keep the original records of said monitoring[212]. Having a permit system, as defined in Article 45, also allows for the Ministry to monitor who has the legal right to emit GHG and CO_2 and provides room to crack down on violations. Article 54, Section 2 creates accountability to the public. It states that when a violation has happened, the Ministry shall record the list of the enterprise's violations into the public record in a timely fashion.[213] Any respectful enterprise that is concerned with their reputation would be hard pressed to want this information to be made public.

Furthermore, by creating a forum for environmental public-interest litigation, accountability is greatly increased. As with many sections of China's INDC, an emphasis on public involvement is stressed in the new Environmental Protection Law. Article 57 Section 1 explains that the public is encouraged to carry out supervision on environmental violations. Specifically, citizens, legal persons and other organizations that discover environmental pollution and ecological destruction by any organization or individual are entitled to report such violations to the Ministry[214]. Article 57 Section 2 increases the accountability to, and power of, the public further by stipulating that where the Ministry fails to perform its responsibilities, citizens, legal persons and other organizations are entitled to report such non-performance to their superior authorities or the supervision authorities, respectively.[215]

The most meaningful change pertaining to public-interest litigation is that found in Article 58, which establishes the conditions for public-interest lawsuits. With respect to actions that pollute the environment and harm the public interest, competent social organization may bring a lawsuit to the court[216]. It is important to note, however, that it is specified in Article 58

[211] (EU-China Environmental Governance Programme 2014) Supra. Note 198 at 9
[212] (EU-China Environmental Governance Programme 2014) Supra. Note 198 at 9
[213] (EU-China Environmental Governance Programme 2014) Supra. Note 198 at 9
[214] (EU-China Environmental Governance Programme 2014) Supra. Note 198 at 12
[215] (EU-China Environmental Governance Programme 2014) Supra. Note 198 at 12
[216] (EU-China Environmental Governance Programme 2014) Supra. Note 198 at 12

that not just any publicly interested organization can bring a lawsuit. Only social organizations that meet the following conditions, as stipulated in the EPL, consecutive years or more, and have no law violation records. may file litigation to the people's courts; Those organizations who have been registered at the civil affair departments of people's governments at or above municipal level with sub-districts in accordance with the law and those organizations who have specialized in environmental protection public interest activities for five consecutive years or more, and have not violated the law themselves.[217]. Regardless of the tight constraints on who can bring the lawsuit, it is significant to note that public interest groups are able to make a legal claim to the violations by enterprise if they see it is needed, allowing for much greater public involvement.

The government in China and its Ministries hold the most significant power for the ability to enforce its legislations, policies and regulations. The Environmental Protection Law is significant in providing the Ministry of Environment with the enforcement power it needs and evidently the Ministry has subsequently begun the steps needed in the implementation of the policies and regulations it champions. However, it is important to consider that enforcement of the policies, regulations and legislation available to China will require Ministry accountability and intense monitoring to be successful. The local bodies responsible for monitoring and enforcement have followed varying methods of achieving this, thus far, and as mentioned in other sections of this paper the degree in which environmental monitoring and enforcement have been understood as significant also varies.

While the laws have been made stricter, they did in fact exist before these changes and as shown by Chai in her investigations, it is easy enough for the Ministry to pass on the responsibility by ignoring the violation as it sees fit. Therefore, it will also require ground level participation and consistency, something that has a proven track record of being slack. Perhaps the rise of, and promotion of, public participation is right to be so greatly indicated. Unless the enforcement at ground level improves drastically from these legislative changes, nothing will truly change for China's emissions, and no significant reductions will take place. All the

[217] (EU-China Environmental Governance Programme 2014) Supra. Note 198 at 13

companies and people Chai interviewed and spoke with during her documentary indicated that they would, indeed, follow the rules if the rules were being enforced. Chai also cites that if China could properly enforce existing standards in the industrial manufacturing and transportation sectors alone, there would be a roughly 60% reduction in GHG emissions[218], but business as usual conditions will simply not see this through.[219]

Discussion and Conclusion

The actuality that climate change is such a significant and pressing issue, and the fact that China is a leading contributor to the issue, indicates that it is significantly important that China's contribution to the global effort of climate change mitigation be investigated and evaluated for its merit. Therefore, the most recent contributions to the United Nations Climate Change Conference (UNCCC) in December 2015, by means of China's Intended Nationally Determined Contributions (INDC), are vital to the understanding of the future impact China may have on the problem. In other words, it is important to the understanding of the global issue to know if China's INDC will have a significant impact on lowering emissions domestically, which will subsequently lower the emissions globally. And since China has Ratified their INDC into the UN Paris Agreement in 2016 it is significant to determine if the INDC holds water to the greater effort.

China's INDC has been subjected, herein, to a critical policy analysis, a brief comparison analysis, and a feasibility study, in an attempt to answer the question of whether the targets set out in China's INDCs at the UNCCC in 2015 feasible within their proposed timeframe goal of 2030. These three examinations have revealed whether the INDC will have any effect on both policy making in China and on the reduction of emissions. Additionally, they have revealed an existing paradigm surrounding China's enforceability of their environmental policies. All the

[218] (Chai 2015)Supra. Note 177
[219] (Chai 2015)Supra. Note 177

examinations, and their findings, were based on extensive research into topic matter; such as current and past climate change or environmental policies, strategies, practices, technologies and economics, and through numerous sources; such as governmental data, UN and World Bank data, academic journals and reports, books, and a video documentary.

Findings

China has made themselves globally accountable by outlining, in their INDC, four specific goals that they would like to achieve through a number of mechanisms, also detailed therein. Their INDC goals are ambitious but not unlike those of the four comparison countries. They are more detailed and ambitious than South Korea and the American INDCs, but potential even or maybe slightly less ambitious than the INDC goals of the European Union and India.

China has several national and provincial policy pieces in place that facilitate their global climate change goals and can be adapted to include the INDC policy changes. They also have many strategies and practices that are outlined in their current policies for achieving climate change mitigation actions. Politically, however, there is a disconnect from national and provincial to local implementation of these policies due to the local need to invest in economic growth.

Economically China is growing but is beginning to see a slight decline in GDP, the funding for environmental policy enactment comes largely from domestic sources, which are tied, therefore, to GDP and in order to maintain the funding needed, let alone increase it, international sources may need to be increasingly relied on. Additionally, there is funding for technological initiatives from the global level.

Technologically, China has a structure in place that allows them to participate in research and development in new technologies for climate change emissions mitigation. They are active participants in the global effort of technology transfers which benefits them and helps make technological advancement in this area affluent.

Environmentally China is already on track to see their INDC goal of peaking carbon emissions early, and given their recent achievements in their 12th 5-year plan it is likely that they could achieve their carbon emissions reduction targets if they are able to increase the forest cover and the percentage of non-fossil fuel energy sources. This, however does not mean that China's contributions alone will achieve the Paris Agreement goal of limiting the global temperature rise by 1.5 degree.

In examining the schedule, all four of the goals are easily obtained within their set target timeframe if their specific mechanisms are achieved. China has been achieving their previously set goals in the 12th 5-year plan so the timeframe, though a little steeper in comparison, is not unrealistic.

While theoretically all the examined facets are feasible for China's INDC goals, it was significant to the likelihood of achievement to consider domestic enforcement. Enforcement records of environmental policies, regulations and legislation are spotty, at best, and it proved rather difficult to find data on them. This could be partly due to the fact that the regulations, policies and legislation are vast, expand across too many sectors, and are governed by varying ministries, or governmental bodies at local level and, because of unstable methods for monitoring, they are hard to keep track of.

It was found that, at the local level in various capacities, regulations are absolutely ignored or easily avoided. This constitutes a real issue in the ability of the national government to realize its goals for emissions reduction. This alongside the political agenda that sees local level governments not implementing environmental policies indicates that there is a significant disconnect between feasibility and enforcement.

The recent changes made to one legislative piece, the Environmental Protection Law, were intended to increase the enforceability and monitoring power of the Ministry of Environment, as well as afford greater public involvement capabilities, in an attempt to satisfy the problems in this area. However, ground level investigations into enforcement have revealed a paradigm that indicates how easy it is for the Ministry to simply not take responsibility for enforcing the laws, even when they have the power to. This leaves a reasonable doubt for the

ability of the national government to achieve the INDC goals and questions feasibility overall, therefore.

Limitations

This paper does not have the capacity to give complete and comprehensive consideration to all aspects pertaining to China's INDC, and therefore is prepared to accept its limitations. The paper is limited to the resources it has included in its consideration, and additional information could elaborate further in the feasibility studies. These limitations, furthermore, include the need for future research to be done on the implementation of China's INDC policy changes and additionally, revisiting the outcome of the newly instituted legislative changes to the Environmental Protection Law as this paper cannot predict the future, and can only be accepted that its findings are assumed based on China's past practices, strategies and policy actions. Therefore, the achievements by China on their INDC policy changes will need to be monitored. Additionally, enforcement of the regulations and policies that result from INDC changes plays the most significant role. However, this area of research was only limitedly covered in this paper and so there is a need for deeper consideration of this and future research should be done regarding this paradigm.

Appendix

	EASE	SCOPE	ENVIRONMENTAL CERTAINTY	COST CERTAINTY	ECONOMIC CONSIDERATIONS	POLITICAL CONSIDERATIONS
Subsidy	(-) Can be complex to design and implement (+) Can be included as part of existing program (-) Difficult to remove, though should be temporary, as vested interests develop	(+) Flexible: can be very targeted or broad	(-) Many factors influence uptake and use of subsidy; final environmental result can be estimated but will remain unknown beforehand	(+) Budget for subsidies generally known and allocated	(-) Difficult to get price of subsidy "right" (-) Can have distortionary effects, as firms get used to lowered cost of certain activities/technologies (+) Can be used for industrial development policy (+) Can spur innovation, incentivize activity not otherwise possible (-) May have international trade implications	(+) More politically popular than taxes (-) Net financial outflow from government
Tax	(+) Can be easily applied and understood (-) Can be complex to design and implement (+) Can be included as part of existing program	(+) Flexible: can be very targeted or broad	(-) Environmental outcome uncertain – difficult to determine the "right" tax level to achieve a given outcome	(+) Cost per unit of pollution known (-) Interaction with existing taxes may make it less effective	(+) Source of revenue (+) Provides clear signal for investment decisions (-) Cost of tax fixed and is thus not easily changed if macroeconomic conditions of the country change (e.g. recession or boom). (-) May have international trade implications	(-) Often politically unpopular (-) Potential for loopholes (+) Source of revenue; can be used to offset tax reductions elsewhere
Trading	(-) Can be complex to design and implement (+) Once in place, can be less costly to administer than a regulatory regime (-) Requires robust and complete data	(+) Broad; most efficient when cost differences are available within the program (+) (-) Can be applied to a specific sector, though will be less economically efficient overall	(+) Based on a cap or quantified pollution limitation (-) More difficult to ensure in baseline and credit systems (-) Design should account for carbon leakage where needed, i.e. displacement of emissions from the trading program to outside the program	(-) Difficult to foresee price of allowances (+) Various cost control measures can be included in program design to mitigate price fluctuations	(+) More economically efficient, as least cost abatement options will be found first (+) With gradual increasing stringency, can incentivize innovation (-) Cost containment features can reduce near-term incentive for innovation (+) Market price adapts to changing macroeconomic conditions	(-) Can be difficult to determine cap (-) (+) Concessions to specific interest groups can be provided – reduces economic efficiency, but can make implementation more politically feasible (+) Can be source of revenue, depending on design (-) Complexity can result in reduced political acceptance

Figure 1: Relative Pros and Cons of Different Market-Based Policies. [Source: (Moarif and Rastogi 2012)pp. 3]

A. All the Cities Included										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Median	12.53%	13.97%	14.79%	13.39%	12.47%	13.29%	14.79%	15.17%	18.68%	18.14%
Average	18.29%	21.22%	21.13%	20.07%	19.15%	18.14%	18.97%	20.88%	23.54%	23.27%
Std. Dev.	20.81%	23.11%	21.46%	21.42%	19.28%	18.02%	17.46%	18.19%	18.98%	17.17%
Observations	37	47	47	47	84	86	86	86	86	86
B. The 37 Cities Appeared in All Years										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Median	12.53%	13.97%	14.79%	10.38%	14.79%	15.89%	14.79%	16.39%	18.68%	20.33%
Average	18.29%	20.18%	20.10%	19.04%	21.50%	21.63%	21.62%	23.98%	27.55%	28.30%
Std. Dev.	20.81%	21.49%	20.39%	20.48%	20.26%	19.60%	18.97%	20.57%	22.87%	21.09%
Observations	37	37	37	37	37	37	37	37	37	37

Note: A city is included in the analysis only if all the days in that year were monitored.

Source: Ministry of Environmental Protection of China.

Figure 2: Average Ratio of Days Reaching Decent quality air conditions. [Source: (Wu, et al. 2013) pp. 36]

(Dependent Variable: Change in Ratio of Days Reaching "Grade I" in Air Quality)

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Environmental Amenity Investment	0.0201	0.0222	0.0247	0.0336	0.0336	0.0363
(normalized by GDP)	(1.87)*	(1.99)**	(2.22)**	(2.55)**	(2.52)**	(2.74)***
Transportation Infrastructure Investment	-0.0010	-0.0010	-0.0004	0.0001	0.0004	0.0013
(normalized by GDP)	(-0.36)	(-0.33)	(-0.14)	(0.03)	(0.11)	(0.35)
Lagged Environmental Amenity Investment		-0.0085	-0.0174		0.0028	-0.0062
(normalized by GDP)		(-0.71)	(-1.40)		(0.19)	(-0.42)
Lagged Transportation Infrastructure Investment		-0.0002	-0.0013		-0.0017	-0.0035
(normalized by GDP)		(-0.05)	(-0.34)		(-0.37)	(-0.74)
Two Year Lagged Environmental Amenity			0.0286			0.0328
Investment (normalized by GDP)			(2.35)**			(2.37)**
Two Year Lagged Transportation Infrastructure			0.0012			0.0038
Investment (normalized by GDP)			(0.32)			(0.87)
Lagged Air Quality Level	-0.7070	-0.7078	-0.7075	0.2607	0.2582	0.2690
	(-13.50)***	(-13.37)***	(-13.43)***	(4.04)***	(3.95)***	(4.15)***
Per Real Capita GDP Growth	-3.6434	-3.6257	-3.3039	-3.0852	-3.1389	-3.2256
	(-2.82)***	(-2.78)***	(-2.50)**	(-1.71)*	(-1.72)*	(-1.78)*
Per Real Capita GDP Growth * Lagged Real Per	0.3100	0.3094	0.2768	0.2515	0.2570	0.2640
Capita GDP Level	(2.42)**	(2.38)**	(2.10)**	(1.40)	(1.42)	(1.47)
Weighted Change of Air Quality in Other Cities	0.9833	0.9542	0.9681	1.2946	1.2876	1.2546
	(1.41)	(1.37)	(1.38)	(1.52)	(1.50)	(1.47)
Lagged Foreign Direct Investment	-0.0014	-0.0013	-0.0014	-0.0007	-0.0007	-0.0019
(normalized by GDP)	(-0.64)	(-0.57)	(-0.61)	(-0.19)	(-0.19)	(-0.50)
City Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.407	0.408	0.418	0.912	0.912	0.914
Number of observations	486	486	486	369	369	369

Note: (1) t statistics in parentheses

(2) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 3: Comparing days of good air quality and the influence of environmental infrastructure improvements. [Source: (Wu, et al. 2013)pp. 37]

Methods	Purpose	Preparation	Type of boundaries	Scope	Agency
IPCC Guidelines for National GHG Inventories	GHG inventories in different countries and regions to provide accounting framework and approach	Countries and regions	Geographical boundaries	Production	IPCC
ICLEL City GHG Inventories	To find major sources of GHG emissions in urban areas	Cities	Geographical boundaries	Production + consumption	ICLEL
GHG Regional Inventory Protocol, (GRIP)	Statistical monitoring of GHG emissions in order to compare to the potential emissions reductions between the cities	Cities	Geographical boundaries	Production + consumption	University of Manchester
China Provincial GHG Inventory Protocol	To find out the status of provincial GHG emissions in order to implement long-term plan to control GHG emissions	Provinces	Geographical boundaries	Production	China's NDRC
The GHG Protocol: A Corporate Accounting and Reporting Standard	Accounting corporate GHG emissions and GHG action plan on the basis of business enterprises, trade	Enterprises	Organizations operating boundaries	Production + consumption	WRI/WBCSD
Series of ISO 14064 standards	To emphasize on ISO standards	Corporate, business projects,	Organizations operating boundaries	Production + consumption	ISO standards
Guide PAS2050	Accounting of full life cycle of a product or service consumer	Products, services	Organizations operating boundaries	Production + consumption	British Standards Institute
Standard PAS2060	Reducing compensation to implement a carbon neutral	Countries, communities, companies, individ	Organizations operating boundaries	Production + consumption	British Standards Institute

Figure 4: Types of GHG Inventory Methods. [Source: (Gu, Li and Cook 2014)pp. 2]

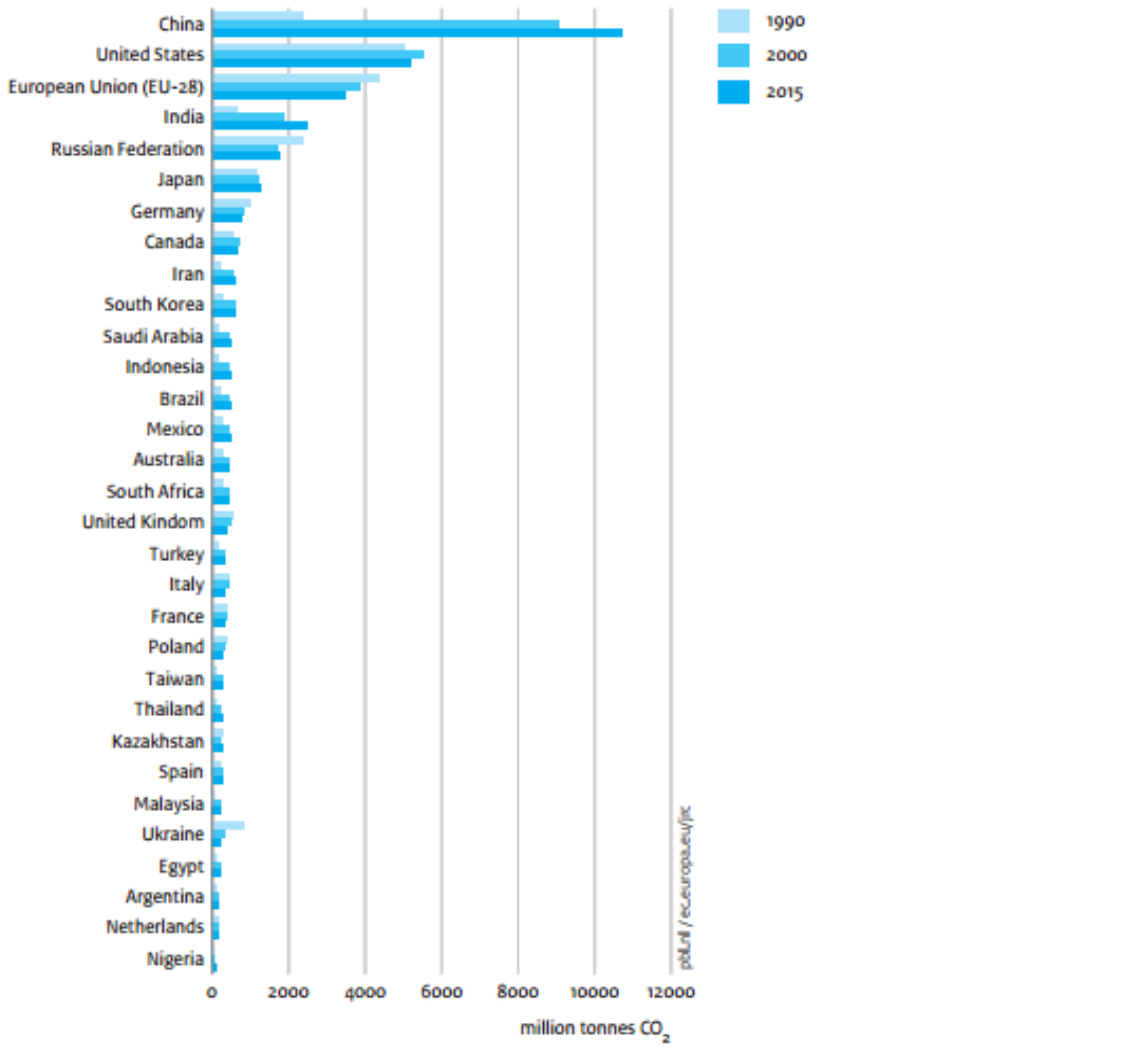

Figure 5: CO2 Emissions per Country from Fossil-fuel use and cement production. [Source: (Olivier 2016) pp. 38]

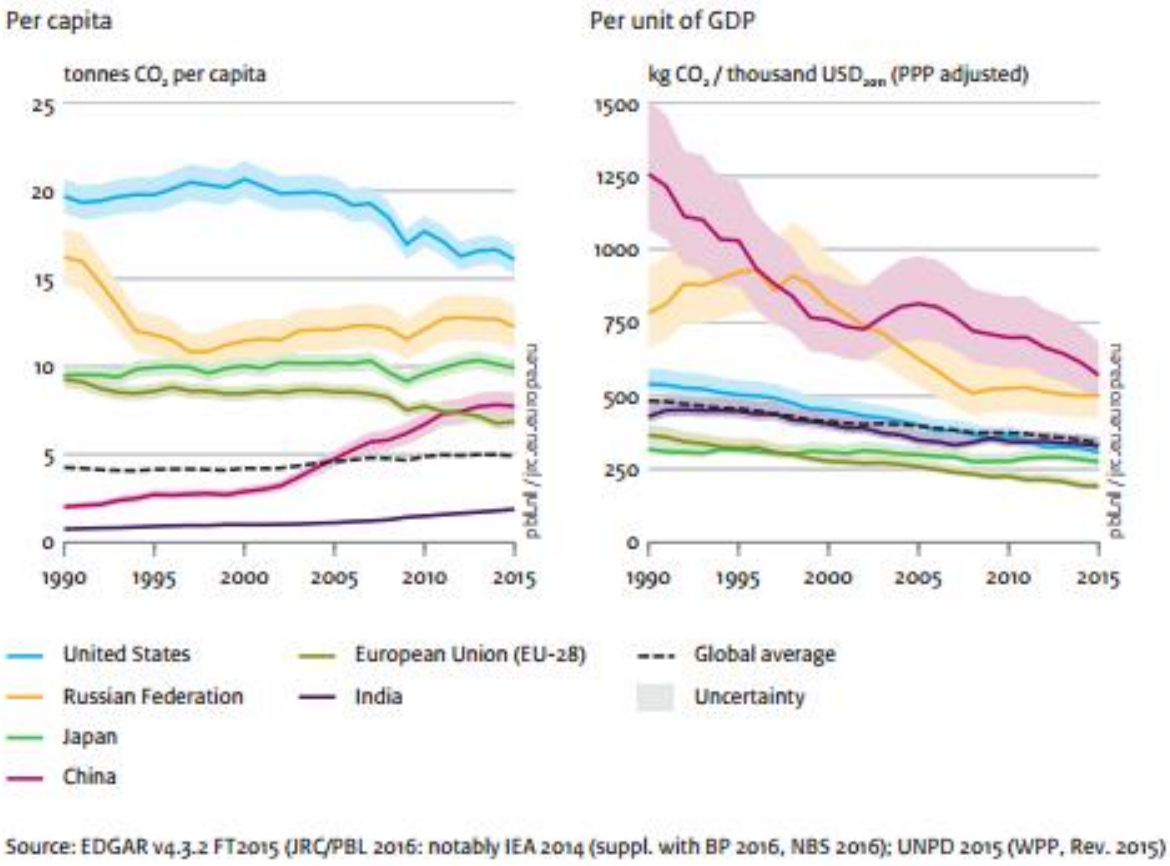

Figure 6: CO2 emissions from fossil-fuel use and cement production in the top 5 emitting countries and the EU. [Source: (Olivier 2016) pp. 44]

China	Total	Coal	Oil	Gas	Other	Total	Coal	Oil	Gas	Other
Total sectors (Mt CO_2)	**8,909**	**7,433**	**1,145**	**299**	**32**	**100%**	**83%**	**13%**	**3%**	**0%**
Power and heat generation *	4,353	4,251	15	56	32	49%	48%	0%	1%	0%
Other energy industry own use	389	279	61	48		4%	3%	1%	1%	
Manufacturing industry **	2,743	2,484	175	85		31%	28%	2%	1%	
Road transport	610		581	29		7%		7%	0%	
Other transport ***	143	12	131	0		2%	0%	1%	0%	
Residential sector	330	191	75	63		4%	2%	1%	1%	
Other buildings ****	340	215	107	17		4%	2%	1%	0%	

United States	Total	Coal	Oil	Gas	Other	Total	Coal	Oil	Gas	Other
Total sectors (Mt CO_2)	**5,120**	**1,702**	**1,990**	**1,399**	**26**	**100%**	**33%**	**39%**	**27%**	**1%**
Power and heat generation *	2,128	1,596	29	486	18	42%	31%	1%	9%	0%
Other energy industry own use	282	10	109	164		6%	0%	2%	3%	
Manufacturing industry **	422	96	66	252	8	8%	2%	1%	5%	0%
Road transport	1,445		1,443	2		28%		28%	0%	
Other transport ***	256		209	47		5%		4%	1%	
Residential sector	323		54	269		6%		1%	5%	
Other buildings ****	263		80	179		5%		2%	3%	

European Union (EU-28)	Total	Coal	Oil	Gas	Other	Total	Coal	Oil	Gas	Other
Total sectors (Mt CO_2)	**3,340**	**1,128**	**1,290**	**867**	**54**	**100%**	**34%**	**39%**	**26%**	**2%**
Power and heat generation *	1,254	927	50	239	38	38%	28%	1%	7%	1%
Other energy industry own use	156	32	87	36	0	5%	1%	3%	1%	0%
Manufacturing industry **	414	118	85	195	15	12%	4%	3%	6%	0%
Road transport	819		815	3		25%		24%	0%	
Other transport ***	42		38	4		1%		1%	0%	
Residential sector	416	41	115	259	0	12%	1%	3%	8%	0%
Other buildings ****	239	10	99	130	1	7%	0%	3%	4%	0%

India	Total	Coal	Oil	Gas	Other	Total	Coal	Oil	Gas	Other
Total sectors (Mt CO_2)	**1,869**	**1,348**	**447**	**72**	**1**	**100%**	**72%**	**24%**	**4%**	**0%**
Power and heat generation *	945	886	25	32	1	51%	47%	1%	2%	0%
Other energy industry own use	43	3	31	10		2%	0%	2%	1%	
Manufacturing industry **	493	410	66	17		26%	22%	4%	1%	
Road transport	206		203	4		11%		11%	0%	
Other transport ***	16		16			1%		1%		
Residential sector	87	14	66	8		5%	1%	4%	0%	
Other buildings ****	78	36	40	2		4%	2%	2%	0%	

* Includes public power and heat production

** Excludes emissions from non-energy use and feedstock use of fuels

*** Excludes international marine and aviation bunkers

**** Service sector; includes agriculture and forestry

Figure 7: CO2 emissions from fossil fuel combustion in 2013, by sector and fuel, in China, the United States, the European Union and India [Source: (IEA, 2015c) in (Olivier 2016) pp. 36]

SOURCE		AMOUNT (US$)**	PERIOD
Public	Domestic	$41 billion	2011
	Foreign	$2 billion (min)	2006-12
Carbon market	CDM	$9.3 billion[2]	Up to 2012
Private	State banks	$294 billion	2011
	Domestic green bonds	$6 billion	2011
	Domestic PE/VC	$1.72 billion	2011
	Domestic IPOs	$3.68 billion	2011
	Foreign IPOs	$1.4 billion	2011
	Foreign banks	Unknown	2011
Direct investment	Domestic and foreign	$45.5 billion	2011
Charitable & NGO	Domestic and foreign	$0.6 billion	2011

Figure 8: sources and Scales of Climate Financing in China [Source: (The Climate Group 2013) pp. 2]

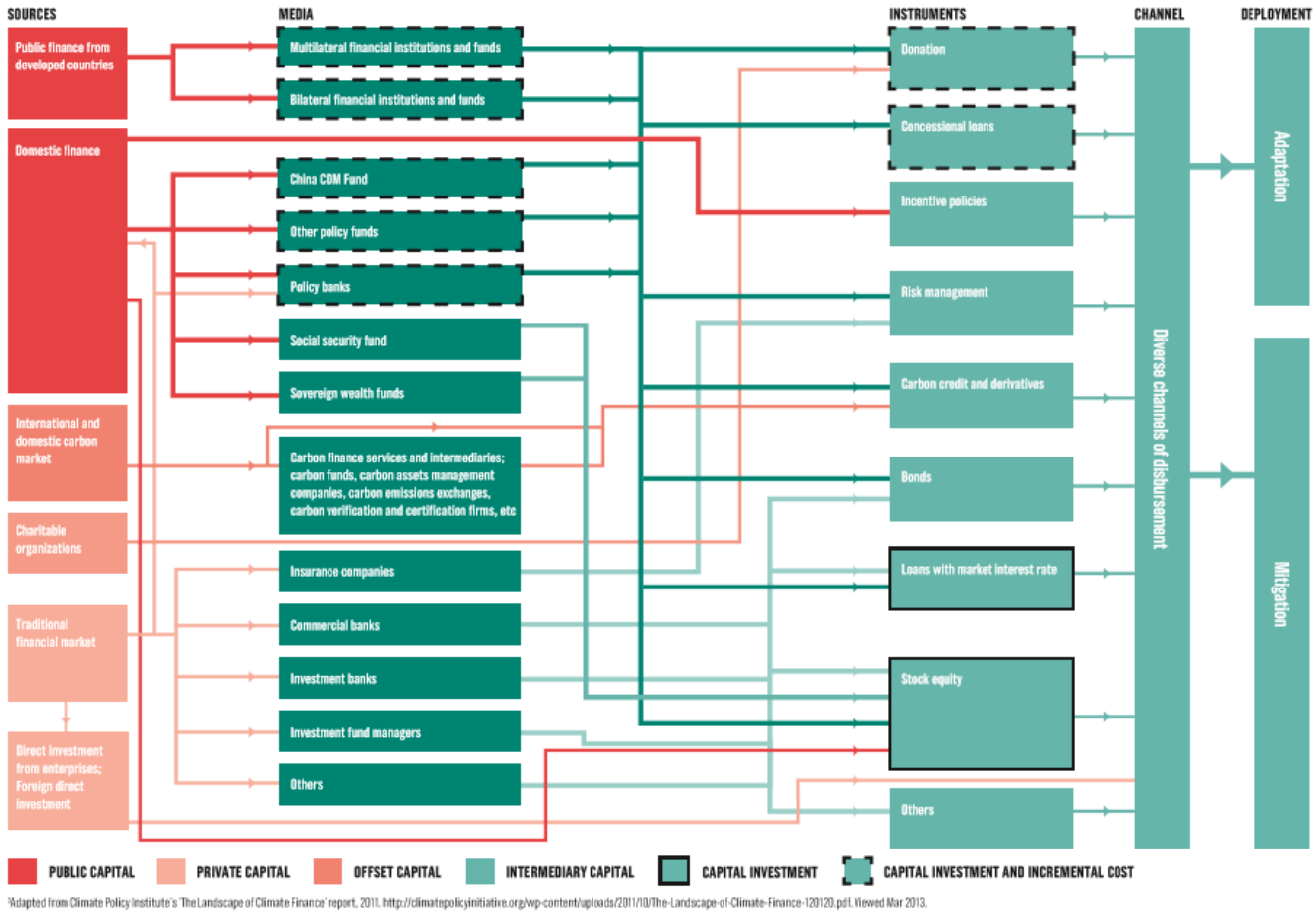

Figure 9: Climate Finance Sources and Flows in China. [Source: (The Climate Group 2013) pp. 3]

	2005-20	2020-30	2030-50
Annual average new installed capacity of non-fossil power generation (GW) (breakdown below)	41.8	65.6	87.1
Wind power (GW)	14.2	23.8	35.6
Solar power (GW)	7.0	25.0	36.4
Nuclear power (GW)	3.4	9.2	10.6

Source: From an NDC scenario from PECE model developed by NCSC and Renmin University of China

Figure 10:The Deployment of Non-Fossil Fuel Energy 2005-2050. [Source: (National Center for Climate Change Strategy and International Cooperation 2016) pp. 25]

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