

THE UNITED STATES VERSUS CHINA: A COMPARISON OF CLIMATE
COMMITMENTS AND RELATIVE SUCCESS UNDER THE PARIS AGREEMENT

by

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ABSTRACT

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China and the United States are respectively the largest emitters of carbon dioxide in the world. The human production of carbon dioxide along with other greenhouse gases, mainly associated with the burning of fossil fuels, has led to an increase in the average global surface temperature. To combat climate change, both the United States and China entered the Paris Agreement in late 2015 and made commitments aimed at reducing their greenhouse gas emissions. While the United States is working towards reducing emissions per capita, China's current goal is to peak emissions with all best efforts by the year 2030. Pre-existing policies in both countries suggest that they should be able to reach their goals, but China's rising emissions per capita will likely eclipse the levels in Europe and possibly reach the same very high level as the United States

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I. Introduction

China and the United States are respectively the largest emitters of carbon dioxide, a greenhouse gas which is the primary driver of climate change. In 2015, both countries took major steps in rectifying anthropogenic climate change by entering the Paris Agreement, the most recent and significant step in a decades-long United Nations effort. The Paris Agreement was the first time in history that nearly every nation came together and agreed that action needed to be taken in order to combat climate change. Ratification of the Agreement by both the U.S. and China was a massive influence on other countries, which led many to ratify the Paris Agreement in the following year. With the agreement in place, both countries are committed to their respective self-determined goals declared in their Nationally Determined Contributions, the technical label for their commitments.

Due to varying levels of development, urbanization, industrialization and existing environmental policy, the United States and China have opted to pursue important but distinct goals from one another. The United States will focus its efforts on reducing total carbon emissions, while China will attempt to peak their emissions in the coming decades with a shorter-term focus on reducing carbon intensity. The latter metric refers to a country's carbon emissions divided by its gross domestic product, and represents carbon efficiency in an economy. The lower the carbon intensity, the more GDP that is being produced using a smaller output of carbon dioxide.

These goals are extremely important given the current trends in each country's emissions patterns. While the United States has been experiencing a modest decline in carbon dioxide emissions since 2005, China's emissions eclipsed the U.S. during late 2005 to early 2006, and have continued to grow at a rapid pace (World Bank 2016). Many estimates place China's total carbon emissions 58% higher than 2005 levels despite its pledges in the Paris Agreement (Du Reitz and Chatterton 2015, 8). Likewise, the U.S. is facing a variety of issues that place its ability to achieve continued carbon emission reductions in doubt (Du Rietz and Chatterton 2015, 13).

The aim of this study is to analyze whether the United States or China will be more successful in meeting their respective commitments under the Paris Agreement, as well as their relative success in meeting the larger goal of the Agreement, which is to reduce carbon emissions by 80% by the year 2050. In addition, this study will compare climate policies of the U.S. and China that are pertinent to the Paris Agreement, as well as trends in emissions leading up to the Agreement.

II. The United Nations Framework Convention on Climate Change History

The ratification of the Paris Agreement marked a historic moment in the global fight against climate change. As a part of the United Nations Framework Convention on Climate Change, or UNFCCC, the 2015 Paris Agreement was an accord that united nearly every nation in an effort to mitigate climate change and its effects on human activities and ecosystems (UNFCCC 2016). Almost 200 countries met in Paris from November 30th to December 11th as a part of the UNFCCC's twenty-first Conference of

the Parties (COPs) (UNFCCC 2016). The Agreement itself set some ambitious goals, such as keeping average global surface temperature increases below 2 degrees Celsius. This target is important because the general consensus among the scientific community is that two degrees Celsius is the threshold for possibly irreversible repercussions (Mastroianni 2015). Additionally, two degrees Celsius is the upper limit set by the Paris Agreement, and under Article Two it is stated that keeping the warming to 1.5 degrees Celsius would be beneficial in reducing the negative repercussions of climate change (Paris Agreement 2015, 2). Countries are able to help achieve this goal through their own means using “self-determined contributions,” which helped the Paris Agreement reach ratification quickly, in less than a year after the Paris Climate Change Conference took place (UNFCCC 2016). This so-called “bottom-up” approach, which allowed for the intricate development of climate change mitigation and adaptation plans, attracted nations that abstained from previous COPs contained stricter demands (C2ES 2015). The agreement entered force near the end of 2016 on November 4th -- 30 days after at least 55 countries representing 55% of global emissions had ratified the agreement on October 5th of the same year (UNFCCC 2016).

The Paris Agreement is not the first global accord to tackle climate change, and it is in fact a part of a history of action that has taken place on the world stage since the early 1970s. The first global environmental conference took place in Stockholm, Sweden, in June of 1972 (UNEP 1972). This was the United Nations Conference on the Human Environment, a first step forward in setting goals and guidelines in order to protect and preserve the environment for humans around the world (UNEP 1972). Ultimately the

conference culminated in the “Declaration of the United Nations Conference on the Human Environment,” which laid down basic principles for human rights regarding the environment and compelled governments to protect and preserve those environments. It was remarkable because for the first time in history some of the most powerful nations of the world banded together in a united front and recognized that the environment required governmental care for the sake of protecting it from human-induced destruction (UNEP 1972).

Two decades later, when the UN met again in Rio de Janeiro, Brazil, as a part of the United Nations Conference on Environment and Development, the world banded together to address the growing concerns of climate change and other global environmental issues (Earth Summit 1997, 1). The conference was unprecedented in both the number of participating parties and scope of the issues being discussed. At the conference 108 governments were represented as well as over 2,400 non-governmental organizations (Earth Summit 1997, 1). From the discussions that took place, two major agreements were established concerning the environment: the UNFCCC and the Convention on Biological Diversity (Earth Summit 1997, 1).

Most relevant to this study was the formation of the UNFCCC during the 1992 Rio Earth Summit, because it is from the UNFCCC that the recent Paris Agreement arose. The participating nations at the Rio Earth Summit formed the UNFCCC as a legally binding convention to aid in global accountability for environmental protection, and the UNFCCC entered into force in March of 1994 (UNFCCC 2017, 1). The UNFCCC was established so that governments could exchange information regarding

their greenhouse gas emissions, their policies for dealing with these emissions, and the most effective practices for doing so (UNFCCC 2017, 1).

As a part of the UNFCCC, yearly formal meetings known as the Conference of the Parties (COPs) are to be held unless the member parties decide to not convene (UNFCCC 2017). The first COP, or COP 1st session, took place in Berlin, Germany in March of 1995, one year after the UNFCCC first entered into force (UNFCCC 2017). The purpose of the COPs in a framework convention is to develop the details of the agreement as it unfolds over time, since full agreement on a complex and difficult issue like global warming would be nearly impossible to achieve in a one-time event. The COPs also review the development of the UNFCCC and the implementation of legal measures adopted by the COP in previous sessions (UNFCCC 2017). The President of the COP, as well as several Vice Presidents and Chairmen/women are elected for each session, and the location of the COP is hosted by different member nations as well (UNFCCC 2017).

While the UNFCCC was responsible for many of the discussions that led to the Paris Agreement in 2015, it is also known for the Agreement's renowned predecessor, the Kyoto Protocol. The Kyoto Protocol was the focus of the COP 3rd session which took place from the 1st-10th of December in 1997 (UNFCCC 2017). Much like the Paris Agreement, the Kyoto protocol was aimed at reducing greenhouse gas emissions, especially in developed countries that are responsible for the majority of GHG emissions already emitted (UNFCCC 2017). The protocol entered into force on February 16th, 2005 with 37 participating countries committing to reducing greenhouse gas emissions by five

percent of what they were in 1990 (UNFCCC 2017). By design, the Kyoto Protocol emphasized emissions reductions by the developed nations of the world, which had been responsible for most of the global greenhouse gas emissions. Emissions reductions by developing countries, such as China and India, were not mandated at this COP.

One of the mechanisms for achieving this goal is the trading of assigned amount units or AAUs, which represent the allowed amounts of greenhouse gas emissions each country can produce (UNFCCC 2017). This cap-and-trade system is beneficial because some countries may be able to adapt and reduce emissions more quickly than others. The excess credits these countries will have left over can be sold to countries that are not able to keep up with emission reduction targets. According to the UNFCCC this approach makes carbon dioxide emissions a commodity that can be bought, traded, and tracked through an international transaction log to ensure countries are dealing with each other honestly.

Additionally, in 2012 an amendment to the Kyoto Protocol, known as the Doha Amendment, was added, and committed 17 countries to further emission reductions, as a part of the COP 18th session (UNFCCC 2017). Currently 75 countries have ratified the amendment, including China but not the United States. The commitment period ratified by the Doha Amendment extends from 2013-2020, which is ten years before China is set to meet its goals established by the Paris Agreement (UNFCCC 2017, 1).

Since 1997, 192 parties have signed onto the Kyoto Protocol, but the United States remains absent from the agreement (CNN 2017). The Protocol would have bound the United States to the highest emissions reduction for a single nation (7%) from 1990

levels, while a few other developed nations would still be permitted to grow their emissions (UNFCCC 2017). Furthermore, the Kyoto Protocol exempted over 100 developing countries from the emissions reduction targets of the treaty, including China (CNN 2017). Negotiated during the Clinton presidency, subsequently President George W. Bush was opposed to this measure of the Kyoto Protocol as it was, in his opinion, unfair to the United States (Reynolds 2001). He also argued that the United States would face higher energy costs and undue economic burdens if it had signed the agreement (Reynolds 2001). For these reasons the United States did not participate in COP 6-2 in Bonn, Germany, where the Kyoto Protocol was adopted by 178 nations (CNN 2017).

Events took a turn for the worse in 2009 at the 15th COP in Copenhagen, Denmark, which was intended to mark the end of the period covered by the Kyoto Protocol and the beginning of its successor agreement. At the Copenhagen Summit, there was a staunch difference in the attitudes of post-industrial or developed countries, and developing countries that are still in the process of industrialization (Diringer 2009). Between the 7th and the 18th of December in 2009, multiple drafts of what eventually became the Copenhagen Accord were rejected by developing nations (Diringer 2009). During discussions at the Conference, some of the smaller developing nations were lumped into groups, and agreements regarding significant aspects of the Accord were made on their behalf without members of each nation being present (Diringer 2009). This resulted in harsh words from leaders of several countries such as Sudan, Venezuela, Bolivia and others (Diringer 2009).

The result of the Summit, the Copenhagen Accord, was a major disappointment. Much like the Paris Agreement, the Copenhagen Accord set an overarching goal of keeping global temperature increase below 2 degrees Celsius (Rogelj and Meinshausen 2010, 1126). While early drafts of the Accord had included long term emissions goals to 2050, the final draft left out these sections to gain the support of participating parties (Rogelj and Meinshausen 2010, 1126). Instead, some countries opted to pledge shorter term goals for 2020, but these were not made legally binding (Rogelj and Meinshausen 2010, 1126). The United States promised to reduce emissions by 17% below 2005 levels, and China agreed to reduce carbon intensity by 40-45% (Rogelj and Meinshausen 2010, 1126).

Unfortunately, neither of these goals were ambitious enough to prevent a 2 degrees Celsius increase in global temperatures (Rogelj and Meinshausen 2010, 1128). Some analyses determined that even if the non-legally binding pledges were fulfilled in all participating countries, global temperatures would have a 50% chance to exceed a 3 degrees Celsius increase (Rogelj and Meinshausen 2010, 1128).

III. Climate Change and its Impacts

The limited success and slow progress of the UNFCCC thus far suggests that combating climate change is an extraordinary undertaking, as it is a global issue with no straightforward solutions. The term, climate change itself encompasses a wide range of issues that will have varying effects on both human activities and ecosystems worldwide. A large part of climate change includes the warming of the earth's atmosphere and

oceans (IPCC 2014, 2). During the last one hundred years, global temperatures have risen by 0.8 degrees Celsius (EPA 2017). At the end of the twenty first century there could easily be a further increase in global temperatures of up to 4 degrees Celsius (EPA 2017). Most atmospheric warming is occurring at earth's surface where humans, plants, animals, and a variety of other organisms reside. Moreover, the warming of the oceans is mostly limited to surface waters, which contain fragile marine ecosystems such as coral reefs (IPCC 2014, 4). The warming of the atmosphere and oceans has also resulted in the decreased amount of ice at the poles. Since 1979, the mean extent of Arctic sea ice has decreased for each successive decade (IPCC 2014, 4). Likewise, land ice found in massive sheets on Greenland and Antarctica has lost significant mass since 1992 (IPCC 2014, 4), with implications for significant sea level rise. These are some of the most common side effects of climate change that receive a large portion of public attention.

Another lesser known aspect of climate change is that carbon dioxide is being deposited from the atmosphere into the ocean, which in turn raises the ocean's acidity (IPCC 2014, 4). Since the preindustrial era to 2010, the ocean's pH level has dropped by .1 (IPCC 2014, 4). While this may seem like a small difference, the pH scale is logarithmic meaning that this is equal to a 26% increase in acidity. This acidity increase negatively affects species that depend on calcium carbonate to form supporting structures such as corals and pteropods (NOAA 2017). Corals and other calciferous organisms may be at risk for extinction because of rising energy demands for survival or just from being outcompeted by organisms that are better suited to more acidic waters (NOAA 2017).

Compounding the issue of rising acidity is the fact that sea levels are also rising. The Intergovernmental Panel on Climate Change 2014 Synthesis Report stated that from 1901 to 2010 sea level rose an estimated .19m, and at an increased rate in the past couple of decades. Sinking land masses, because of tectonic plate movement, can further increase the impacts of sea level rise. The Environmental Protection Agency has gathered data showing that in the United States, the Gulf Coast experiences the fastest rates of sea level rise because of sinking land masses. This equates to an eight-inch increase in sea level rise in the last fifty years alone (EPA 2017). According to current data, global sea level rise will only accelerate during the twenty first century due to increasing temperatures. Estimates place the overall rise somewhere between one and three feet by the year 2100 (EPA 2017).

It is also believed that estimates coming from the EPA are too modest, and the full-blown effects of climate change may be much worse than the EPA is reporting. Former NASA employee and scientist James Hansen's research indicates that sea level rise could be up to ten times higher than previously predicted due to new feedback mechanisms his team has discovered (Holthaus 2015). Furthermore, as our ocean's temperatures increase, the water undergoes thermal expansion, which is the driving force behind sea level rise. The IPCC predicts that over 95 percent of the ocean will experience rising sea levels by the end of the 21st century (IPCC 2014, 62). This not only puts human developments like homes and businesses at risk, but entire landmasses such as the Florida peninsula may no longer be viable habitat for the flora and fauna currently living there.

Climate change also encompasses the occurrence of more frequent and extreme weather patterns. These weather patterns include droughts in farming regions, heavier precipitation in others and heat waves that will increase in intensity as global temperatures climb higher (IPCC 2014, 7). The rising sea levels mentioned before have already synergized with storms, which has resulted in recorded record storm surges since the 1970s (IPCC 2014, 8). Since the 1970s in the United States, record low temperatures have become less common during winters while record highs have increased in frequency (EPA 2017). Precipitation has also been more concentrated into what the EPA calls “single-day events,” where instead of higher rainfall spread out over a series of days, a location will experience record breaking rainfall in a single day. Nine of the top ten single-day events have occurred since 1990, suggesting an increased frequency of these events in more recent years (EPA 2017). It is likely that is linked to the increased global temperatures affecting the hydrologic cycle.

The root of climate change and its various impacts is the anthropogenic production of greenhouse gases, the most prominent of which is carbon dioxide (IPCC 2014, 2). Through the analysis of ice cores, tree cores and other data, carbon dioxide levels for the past several hundred thousand years have been shown to fluctuate in a positive correlation with average global temperatures (EPA 2016). Since the pre-industrial era, humans have emitted approximately 2040 Gt of carbon dioxide into the atmosphere (IPCC 2014, 4). This amount of carbon dioxide far outweighs any non-human sources and almost half of this was emitted in the past four decades alone. Carbon

dioxide, methane, and nitrous oxide levels are now at higher concentrations in our atmosphere than at any time within the last 800,000 years (IPCC 2014, 4).

Rising surface temperatures on land, and in the sea, have a variety of negative effects on both human activities and the ecosystems that occur there. There have been an increasing number of heatwaves in recent years which have resulted in the deaths of humans unable to cope with their intensity and duration (IPCC 2014, 6). Infrequent precipitation and the loss of glacial ice melt have caused many regions to experience both lower quality and quantity of water (IPCC 2014, 6). Additionally, droughts and irregular weather have reduced crop yields across the globe which puts food security at risk. Due to the overwhelming evidence, the Intergovernmental Panel on Climate Change has labeled human impact as having a greater than 95% probability of causing more than one half of the increases recorded in global average surface temperatures since 1951 (IPCC 2014, 5).

Due to the overwhelming problems represented by climate change, the nations of the world could no longer afford indulge in inaction. It was the international pressure caused by the over looming threat of climate change that instigated the necessity for the success of the Paris Agreement.

IV. Structure of the Paris Agreement

The Paris Agreement contains 29 Articles that comprise its framework. They contain a variety of goals, methods and concerns that each of the ratifying parties has agreed to (Paris Agreement 2015, 1). Article 1 is fairly simple and contains a few terms such as

Party, Convention and Conference of the Parties, which are described so that their meanings are understood during their further use in the remaining Articles. Article 2 is the backbone of the Agreement, as it contains the three main goals established by the Paris Agreement (Paris Agreement 2015, 22). These include:

- “Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;
- Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production;
- Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate resilient development” (Paris Agreement 2015, 22).

Article 3 then requires participating Parties to communicate their efforts to meet not only the goals established under Article 2, but also to meet the more specific actions established under the remaining Articles (Paris Agreement 2015, 22). For instance, Article 8 stresses the necessity of cooperation among the Parties in creating systems that can warn and deal with some of the adverse impacts of climate change such as severe weather events (Paris Agreement 2015, 26).

Moreover, there is a strong emphasis in the Paris Agreement on the differences in abilities that each Party will have in meeting the goals set forth by the Agreement, with particular focus on the differences of developed and developing nations. Under Article 9,

it is specifically mentioned that developed countries, due to their larger financial resources, will aid in the funding of climate adaptation strategies in developing countries (Paris Agreement 2015, 26&27).

The Agreement also establishes a future “facilitative dialogue” that will take place in November of 2018 (Paris Agreement 2015, 4), the purpose of which is to take an account of the efforts each party intends to make towards the goals outlined in Article 2. These country specific goals are to be submitted to the Secretariat of the UNFCCC and published on the UNFCCC website for transparency (Paris Agreement 2015, 3). Furthermore, Article 14 creates a system of “global stocktakes,” which requires that ratifying parties of the Paris Agreement shall communicate the progress that has been made toward achieving the goals set out by each Party (Paris Agreement 2015, 29). The first stocktake will occur in 2023 with additional stocktakes taking place every subsequent five years.

It is evident that the Paris Agreement is a comprehensive accord that will require time, money, and collaborative efforts, from both developed and developing nations. Unsurprisingly, there is a large push for world leaders in pollution to make large contributions towards reducing carbon dioxide and other greenhouse gases.

The largest offenders, China and the United States respectively, made a joint declaration on September 3rd, 2016 about their intent to ratify the agreement (Reuters 2016). U.S. President Barack Obama and Chinese President Xi Jinping met before the G20 Summit, an annual meeting of 20 of the world’s largest economies, founded in 1999, which was hosted in 2016 for the first time in China (Landler and Perlez 2016). While

matters other than climate change were discussed by the two leaders, they made it clear that it remained a massively important issue that deserved the commitment of the largest polluters (Landler and Perlez 2016). The decision to ratify the Paris Agreement had already passed through China's National People's Congress, and the Agreement's lack of legally binding emissions targets allowed President Obama to act without congressional approval (Phillips 2016).

This joint action was an important step in ratifying the Paris Agreement so that it could reach the threshold for entry into force about a month later. Because the United States and China are the largest emitters of greenhouse gas, their joint declaration validated the legitimacy of the Paris Agreement as a solution to fighting climate change (UNFCCC 2016). Currently it is estimated that China produces slightly more than one fifth of global emissions and the United States is not far behind at about 17.9 percent (Reuters 2016).

V. Nationally Determined Contributions

Under the framework of the Paris Agreement, countries were able to self-determine their contributions toward combating climate change (UNFCCC 2016). The intended contributions for each country were submitted to the Secretariat and published on the UNFCCC website for transparency (UNFCCC 2017). Parties were encouraged to submit their intended Nationally Determined Contributions, or NDCs, before COP 22, which occurred shortly after the Paris Agreement entered into force (UNFCCC 2017). While allowing nations to determine their own more specific goals, the NDCs are non-

binding (Page 2015). Outside of pressure from other parties that have signed onto the Paris Agreement, at this stage there are no legal repercussions or fines for not achieving the targets established under a country's NDC (Page 2015).

The United States and China have both released their plans for Nationally Determined Contributions. Their contributions are especially important because China and the United States are the largest emitters of greenhouse gases respectively. As a part of *China's Intended Nationally Determined Contributions*, the document submitted by China to the UNFCCC as a record of its goals, the Chinese government makes note of the importance of climate change and its effects, such as temperature increases, sea level rise and extreme weather (CINDC 2016, 1). Likewise, the United States explains in the beginning pages of its own NDC that drastic emission reductions are required to keep global temperature rise below 2 degrees Celsius (U.S. INDC 2016, 1). Both nations have decided to use 2005 as their baseline year for the goals they determined for themselves in the aforementioned NDCs.

Due to the differences in these countries levels of development and other factors, however, they will be pursuing different goals in the years leading up to 2030, the year by which both countries hope to achieve significant progress towards their goals. China, according to its NDC, is a "developing country with a population of more than 1.3 billion... in the process of rapid industrialization" (CINDC 2016, 2). Due to its continuing industrialization, China has decided to attempt peaking its carbon emission around the year 2030, with "all best efforts to peak early," and focus on reducing carbon intensity in the meantime (CINDC 2016, 3). China wishes to lower its carbon intensity

by 60-65% of 2005 levels (CINDC 2016, 5). Carbon intensity is a measure of the carbon dioxide emissions of a country divided by its gross domestic product (GDP). The measure emphasizes efficiency gains in energy use rather than an overall reduction in greenhouse gas emissions. Aiming for this goal allows China to grow its carbon emissions over the next few decades, which is beneficial to China's interests because placing a hard cap on its emissions today could put a large burden on its steadily growing economy. Moreover, as long as China's GDP continues to increase at a rate higher than its carbon emissions growth, it can continue to make progress towards a 60-65% carbon intensity reduction. China also explicitly states that its goal is to have renewable energy sources comprise at least 20% of primary energy consumption (CINDC 2016, 5). This is a 5% higher share than business as usual, which means a possible 5% fewer carbon dioxide emissions could be emitted by China in the coming decades (Carbon Tracker 2017).

The United States, on the other hand, is a post-industrial nation that has already passed its peak emissions. In other words, the total emissions of the United States are not likely to ever reach a higher point than they did in 2005. For this reason, the United States has thus marked 2005 as the reference year for its NDC goals when it comes to emissions (U.S. INDC 2016, 1). Unlike China, the United States is looking to make immediate reductions in its greenhouse gas emissions, and its NDCs reflect that. According to the cover note of the *U.S. Intended Nationally Determined Contributions*, the United States has proposed a goal of reducing greenhouse gas emissions by as much as 28% of 2005 levels by the year 2025 (U.S. INDC 2016, 1). Even more ambitiously, the

United States declared its intent to have “economy-wide emission reductions of 80% or more by 2050” (U.S. INDC 2016, 2).

Both countries also reference several key policies that have helped them to reach certain milestones in fighting climate change. For China, this includes the *National Plan on Climate Change (2014-2020)*, the *National Program on Climate Change*, and the *Work Plan for Controlling Greenhouse Gas Emissions during the 12th Five Year Plan Period* (CINDC 2016, 3). China’s NDC also recognizes the progress the country had made by the year 2014 under these policies. Its carbon intensity is self-reported to be 33.8% lower than 2005 levels, with non-fossil fuels comprising approximately 11.2% of the primary energy consumption mix (CINDC 2016, 3). From the numbers reported in its NDC, it would seem that China had already made significant progress in reaching its 2030 goals by the year 2014. It has stated that from 2005 to 2014, installed hydro power has grown 2.57 times, on-grid wind power has increased by over 90 times, and solar capacity is about 400 times larger than in 2005 (CINDC 2016, 3-4).

The United States was humbler reporting its own achievements in combating climate change leading up to the Paris Agreement. The U.S. NDC lacks hard figures, aside from the goal of a 26-28% reduction in emissions from 2005 levels by the year 2025 (U.S. INDC 2016, 1). Instead, the document mentions that under the Clean Air Act, the United States Environmental Protection Agency has put in place regulations that will reduce carbon emissions from new and existing power plants, improve vehicle fuel economy standards, and bolstered energy conservation standards in building codes and home appliances (U.S. INDC 2016, 4-5). The NDC does mention that since 2008 the

Federal Government has been successful in reducing its own operations' greenhouse gas emissions by 17%, and under the Paris Agreement it has committed to reducing these emissions even further by up to 40% of 2005 levels by the year 2025 (U.S. INDC 2016, 5).

VI. Policy Comparisons

The United States and China both referenced a number of important laws and regulatory powers within their NDCs that will be instrumental in making progress in the years following the Paris Agreement. For the United States, these include the Clean Air Act, the Clean Power Plan and the Energy Independence and Security Act (U.S. INDC 2016, 4-5). China's regulations regarding climate policy include the *National Plan on Climate Change*, the *Nation Program on Climate Change*, the *Work Plan for Controlling Greenhouse Gas Emissions During the 12th Five Year Plan Period*, and the *Work Plan for Climate Change (2014-2020)* (CINDC 2016, 3-8). Each of these policies has a range of methods and strategies for keeping their respective countries on track to meet their Nationally Determined Contributions under the Paris Agreement.

For the United States, the Clean Power Plan (CPP) was planned as one of the cornerstone policies for reducing carbon emissions. Under the Clean Power Plan, the EPA would be responsible for setting pollution standards for newly constructed, modified, or reconstructed power plants. These regulatory powers would come from existing powers established under the Clean Air Act (CPP 2015, 1-23). The plan was announced in 2015 by President Obama and the Environmental Protection Agency,

before being halted in its enforcement by a U.S. Supreme Court ruling in early 2016 (EPA 2017). Twenty-four states filed lawsuits against the EPA, stating that not only was the federal government attacking the coal industry, but that it was also overstepping its powers under the Clean Air Act by regulating state carbon emissions (Magill 2016). This hold was placed so that a lower court could decide whether the EPA actually had overstepped its regulatory powers.

The CPP's goal was to reduce carbon pollution sourced from power plants because electricity generation is responsible for nearly a third of the nation's carbon dioxide emissions (CPP 2015, 1). The plan made it clear that fossil fuels were not going to be eliminated under its regulations, but that great efforts would be made to ensure that fossil fuels were being used efficiently and cleanly by new and existing power plants (CPP 2015, 1-2). This effort would include improving the "heat rate" of coal-fired plants that already exist by improving the design of older plants (CPP 2015, 4). Another avenue outlined by the CPP for increasing fossil fuel efficiency in electricity generations is switching to natural gas plants and phasing out coal-fired plants due to the higher carbon efficiency of the former source (CPP 2015, 4). At the same time, the CPP calls for additional zero-carbon sources of energy, mainly renewables like wind and solar, although nuclear energy is another possibility (CPP 2015, 1).

As a part of the varied methods states could employ to meet both interim and final goals set by the EPA, the CPP was going to establish a system for assigning states' carbon credits, and producing a market to buy and sell these credits, which is otherwise known as the cap-and-trade method (CPP 2015, 6). This would offer states flexibility and

a market based solution for reducing carbon dioxide emissions (CPP 2015, 6). States that are more prepared to adapt and reduce carbon dioxide levels could sell excess carbon credits for a fiscal benefit. Other states that are not able to reduce emissions as quickly would have the opportunity to spend money on purchasing these credits from carbon-reducing states. With the EPA only allocating enough credits for the nation as a whole to meet carbon emission goals for power plants, the market would work out how the U.S. achieves that goal (CPP 2015, 6-7). While it is unfortunate that this plan has been blocked in court rulings, some states have continued to comply as if the plan was still in effect (EPA 2016). States such as California, Louisiana, New York, and 17 others have continued with planning to meet the goals set out by the EPA, as a precaution for the possibility that the CPP does survive in federal court (Harball and Holden 2016).

The Clean Air Act (CAA), which was the source of the regulatory power the EPA used for the CPP, is another piece of important legislation for reducing carbon emissions. Established in 1963, at first it gave the federal government only the power to research methods of monitoring and controlling air pollution in the United States (EPA 2013, 1). In 1970, 1977, and 1990, the CAA underwent major revisions with the addition of amendments that expanded its scope and power (EPA 2013, 1). This change allowed the EPA to set national regulations for air quality, while also enabling states to implement their own plans in a joint effort with the EPA (EPA 2013, 1-3). The EPA was also given oversight powers, and if states did not formulate or place plans into action, enable the EPA to place sanctions on those states (EPA 2013, 7). The standards set by the EPA are known as “national ambient air quality standards,” and a large portion of these standards

dealt with stationary sources of high pollution (EPA 2013, 3&9). Stationary sources included power plants, which are addressed further under the CPP, and industrial sites used for manufacturing goods (EPA 2013, 9).

From these two pieces of legislation a pattern starts to emerge. In the U.S. it would seem that dealing with carbon dioxide follows a specific formula. First, the federal government's Environmental Protection Agency is granted authority to establish standards and goals for the nation and individual states. States are then given the freedom to decide how they will individually meet these goals, by either coming up with their own plans or using guidance and research from the EPA to form a joint effort with the agency.

China, while following some of this pattern in its own implementation of environmental plans, also differs from the United States in a few key ways. As a part of China's Policies and Actions for Addressing Climate Change, national agencies, such as the General Administration of Quality Supervision, are given the power to set regulations and standards for the nation's climate goals (NDRC 2012, 5). For instance, this agency along with the National development and Reform Commission have set national standards for energy consumption of high energy products, and this action is similar to that of the EPA (NDRC 2012, 5-6). The difference is that China's government takes a more hands-on approach than the U.S. federal government, going as far as to set price floors and ceilings for various energy sources (KPMG 2016, 80). This is a more direct way of affecting the usage of different energy sources because it directly sets the price of various sources such as oil or natural gas.

China also use tax incentives to persuade some consumers to make more energy efficient decisions. According to China's Policies and Actions for Addressing Climate Change, the Ministry of Industry and Information Technology formed a catalogue of vehicles that met or exceeded energy consumption quotas (NDRC 2012, 7). Citizens who purchase and use these vehicles are then eligible for either tax breaks or complete exemptions depending on the vehicle. While this method of reducing carbon, emissions is not unique to China, the U.S. policies mentioned in its NDC did not include any programs that offered tax incentives to individual consumers (U.S. INDC 2016, 1-5). Both the U.S. and China have goals set to increase renewable energies in the share of primary energy consumption. For China, the goal is for renewables to comprise about 15% of primary energy consumption by the year 2020 (NDRC 2012, 8).

VII. Base Load CO₂ and Trends Before Paris

For the purpose of this study, I'll be comparing the carbon intensity and carbon emission per capita of the United States and China in 2005, the reference year for their respective goals, and predictions for those measurements for the ending years of their commitments under the Paris Agreement. This year is important for the United States because 2005 was the year the country had the highest recorded carbon dioxide emission in history and while 2007 was another year of high carbon emissions, the United States has not yet surpassed carbon emission levels from 2005 (World Bank 2016). A large part of this trend is due to energy production shifting away from coal fired power plants, and

towards natural gas plants, which run more efficiently and emit less carbon dioxide per unit of energy (Adams 2013).

U.S. Carbon Dioxide Emissions in Kilotons (1960-2013)

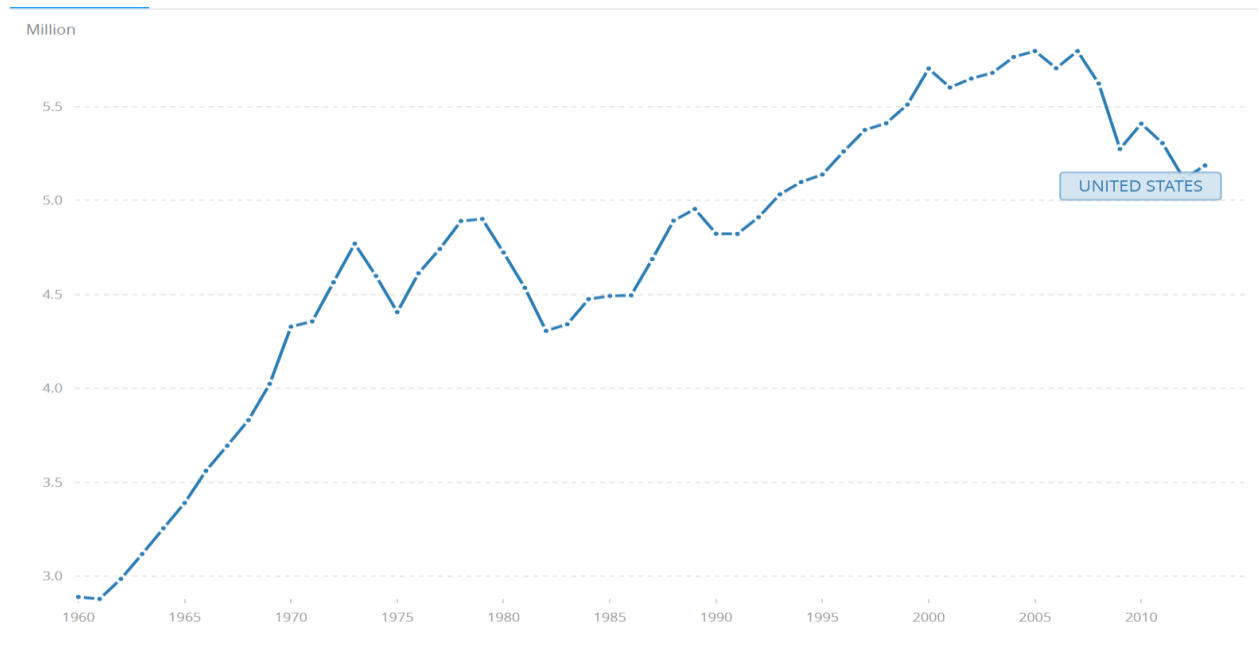


Figure 1. U.S.'s total carbon dioxide emissions trends 1960-2013 (World Bank 2016).

Referencing the graph above from the World Bank 2016 data archives, the United States' peak carbon dioxide emissions equaled 5,795,161.785kt in 2005 (World Bank 2016). The latest year for which the World Bank has carbon emissions data was 2013; at that time, the United States measured 5,186,168.427kt of carbon dioxide emissions (World Bank 2016). Even though this second figure still represents an overwhelmingly large amount of carbon dioxide emissions coming from the United States, it also shows that carbon dioxide emissions have declined for the U.S. during that eight year period. Furthermore, this is a decrease of approximately 10.51%. Therefore, the United States must only decrease carbon dioxide emission by another 15.5-17.5% over the next 12

years in order to meet the goals established in its NDC (U.S. INDC 2016, 1).

Unfortunately, there are a number of roadblocks in enacting sufficient policy to maintain the U.S. momentum, and there may be a slowing or even reversal in progress towards the 26-28% reduction

China Carbon Dioxide Emission in Kilotons (1960-2013)

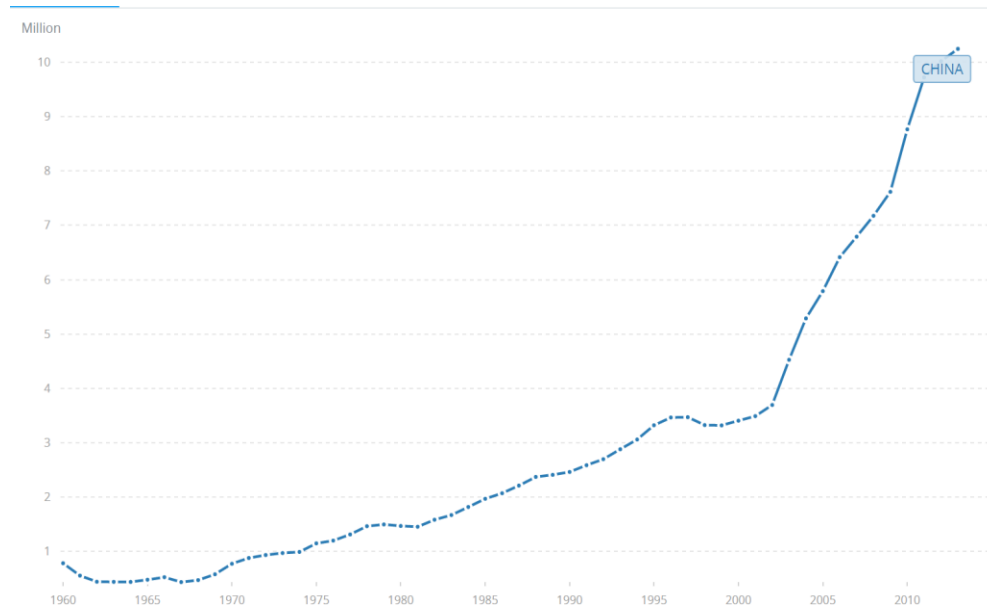


Figure 2. China's total carbon dioxide emissions trends 1960-2013 (World Bank 2016).

Like the United States, China had carbon dioxide emission levels of about 5,790,016.984kt in 2005 (World Bank 2016). Unlike the United States, China did not experience a decline in emission levels over the eight years that followed. Instead the opposite occurred, and carbon emissions rose to over 10,249,463.018kt (World Bank 2016). This trend means that in an eight-year time period China's carbon dioxide emissions increased by just over 77%. The disparity in these trends is again likely due to the differences in levels of development between the U.S. and China, along with China's

economic growth outpacing that of the United States' (World Bank 2016). According to the CIA's World Factbook, China's economy is the 13th fastest growing in the world (CIA 2016). China is the largest manufacturing nation in the world, and its rapid industrialization and urbanization requires an ample supply of energy, which today is mostly supplied by fossil fuels (Mapi 2015).

By 2013 China's carbon dioxide emissions more than eclipsed the United States, and were close to being equal to the emissions of both countries' 2005 levels combined (World Bank 2016). However, it is important to consider the population sizes of these countries because there is a vast difference in the number of people living in the United States compared with China. Raw carbon emission levels are important, but looking at the population of each country can help determine how much carbon is emitted per person. This gives a better picture of how carbon intensive the average lifestyle is in each country.

According to the World Bank, China's population in 2005 was an estimated 1,303,720,000 people (World Bank 2016). At that time, the United States only had a population of 295,516,599. Despite having nearly 1 billion more citizens than the United States, China was still emitting slightly less carbon dioxide overall. By dividing total carbon emission by the estimated population of each country, a carbon emission per capita figure can be produced. This metric viewed as a fairer comparison for trends in carbon emissions in each country because it shows the average amount of carbon dioxide each person is responsible for producing over the course of a year.

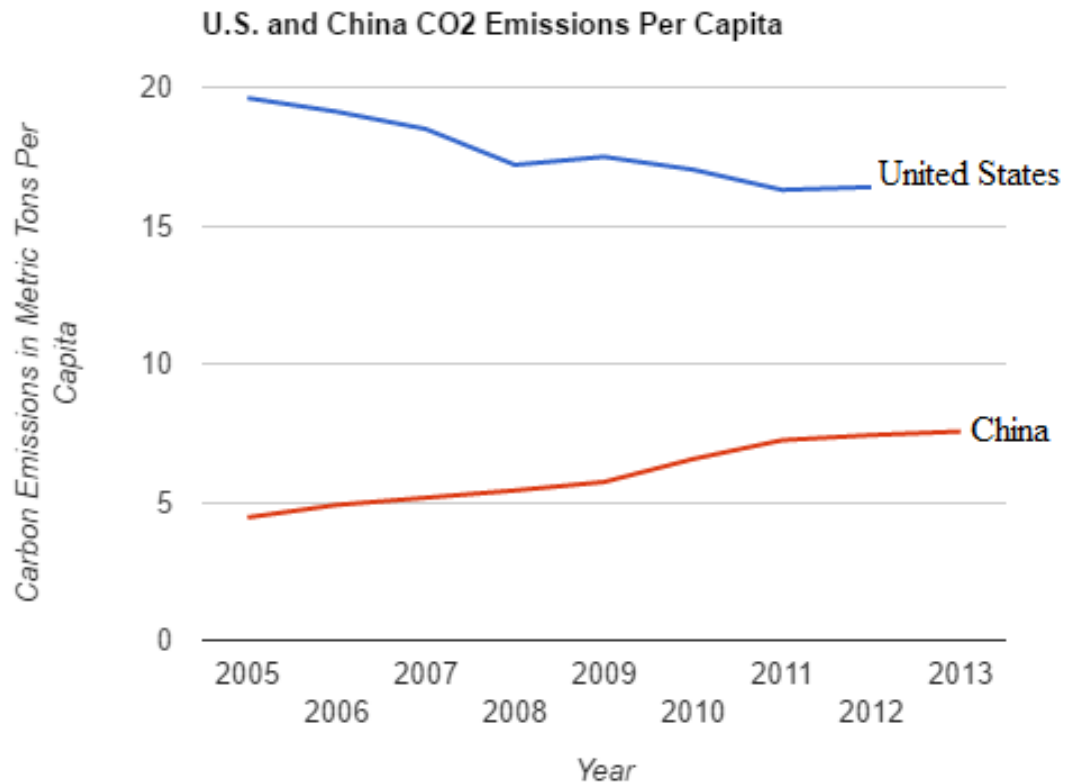


Figure 3. Comparison of U.S. and China's CO2 emissions per capita (World Bank 2016).

In the years leading up to the Paris Agreement, the United States showed a steady decline in carbon dioxide emissions per capita, while China experienced a steady increase (World Bank 2016). Over this period, the gap in emissions per capita between the United States and China has decreased. Given China's immense population, it may be impossible to reach the overarching goal of reducing carbon dioxide emissions by 80% by 2050 if this trend continues. If China's emissions per capita reached the same level as the United States'

Additionally, tracking the trends in the gross domestic product of each country is pertinent to the accuracy of comparing China and the United States. After all, China has set itself a goal to reduce carbon intensity, or total carbon emission divided by GDP, by a

rate of over 60% by the year 2030 (CINDC 2016, 5). This metric may seem like a lackluster approach to dealing with climate change, since overall emissions continue to increase, but decreases in carbon intensity due indicate a trend toward a more carbon efficient economy.

According to the U.S. Bureau of Economic Analysis, the GDP for the United States in 2005 equaled US\$13.094 trillion. By 2013, the GDP had increased to US\$16.692 trillion, despite experiencing a decline from 2007-2008 due to the Great Recession (USBEA 2016). This means that in 2005, the reference year for both the U.S. and China's NDCs, the United States had a carbon intensity of 0.443kg CO₂ per 1 USD gross domestic product. In 2013, the United States' carbon intensity had shifted to 0.311kg CO₂ per 1 USD gross domestic product. This means that during those eight years the United States already experienced a hefty decrease in carbon intensity of around 30%, nearly half of what China wishes to accomplish by 2030.

The World Bank's data shows that in 2005 China's gross domestic product was equal to US\$2.286 trillion, but this drastically increased and by 2013 China had a GDP equal to US\$9.607 trillion (World Bank 2016). This growth in its economy is much larger than the growth the U.S. experienced over the same time span. It must be noted, though, that China's carbon dioxide emissions also nearly doubled during this time-span and are continuing to grow, unlike the U.S., which has seen an emissions decline (World Bank 2016). The result is that in 2005 China's carbon intensity was much higher than the United States, at 2.533kg CO₂ per 1 USD in gross domestic product. By the year 2013, this number had lessened to 1.067kg CO₂ per 1 USD in GDP. This means that since

2005, China had already experienced a 57.88% decrease in carbon intensity. It seems that little additional effort will be required for China to achieve its goal of reducing its carbon intensity by 60-65% as this goal has largely been met already. So, while it is groundbreaking that China was willing to commit to any action regarding carbon emissions, it has not set forth goals that go beyond what it was already on track to achieve.

VIII. Critical Evaluation of U.S. and China's Goals

It was important for China and the United States to make strong commitments to the Paris Agreement in 2015. They are respectively the largest emitters of carbon dioxide, the primary greenhouse gas responsible for global warming and climate change. Their efforts should serve as an example to the other nations of the world on how to address and mitigate the impacts of climate change, as well as to show that zero carbon economies are not a dream, but a potential reality that is just beyond the horizon.

Following the Paris Agreement, it would seem that both countries have met some stumbling blocks, suggesting that they may not serve as the shining examples that they should be. The United States has recently experienced a change in leadership and President Donald Trump has stated intentions that could reduce or even reverse some of the progress the United States has already made in reducing carbon dioxide levels. He appointed Scott Pruitt as head of the EPA, who claims that carbon dioxide is not the primary cause of global warming, despite scientific evidence (Daly 2017). He also disagrees with the conclusions of the climate research done by both NASA and the

National Oceanic and Atmospheric Administration, which has shown that carbon dioxide and other human emissions have already driven up global temperatures since the industrial revolution (Daly 2017). President Trump and his administration have also blocked the EPA from issuing any more grants, and placed a temporary block on their social media communications with the public (Riddell 2017).

Furthermore, President Trump has signed an executive order to undo President Obama's Clean Power Plan, as a part of his campaign promise to bring back coal jobs (Pengelly 2017). This act goes hand in hand with a cancelation of a 14-month prohibition of new coal leases on federal lands (Fox News 2017). Both measures are counterproductive to achieving the goals of the Paris Agreement. These factors combined the President's vow withdraw America from the Paris Climate Agreement are all possible setbacks in the previous efforts to mitigate global warming due to anthropogenic forces (Reuters 2017).

Moreover, reports are emerging that show that U.S. current commitments under the Paris Agreement cannot be met even if existing and proposed policies remain intact. According to the analyses of Jeffery B. Greenblatt and Max Wei, published in *Nature Climate Change*, the policies contained within the U.S. NDC are not enough to reduce carbon emissions by 26-28% of 2005 levels by 2025 (Greenblatt and Wei 2016, 1090). In fact, their worst-case scenario places GHG emission reductions at only 4.8% lower than 2005, with a margin of error that could place the United States emissions even higher than their 2005 peak (Greenblatt and Wei 2016, 1091). This worst-case scenario assumes that the Clean Power Plan is thrown out along with other key existing and planned

climate policies. However, even their analysis of the best-case scenario, in which the Clean Power Plan is enhanced beyond its current emissions targets, places the United States approximately 500,000kt short of the goals set up under the Paris Agreement (Greenblatt and Wei 2016, 1092).

It is evident then, that the United States will not meet its goals outlined in the U.S. NDC if only current policies are implemented. Some of the least optimistic projections place carbon emissions for the U.S. at the same or even higher levels than our 2005 peak (Du Rietz and Chatterton 2015, 13). Again, this potential is caused by the possible repeal of the Clean Power Plan and Republican control of the House and Senate, which has typically meant fewer environmental regulations (Du Rietz and Chatterton 2015, 13). Additionally, if the United States' 2025 goals are not met or exceeded, then the 2050 goal of an 80% reduction in emissions is entirely unrealistic (Du Rietz and Chatterton 2015, 13).

For China, its initial Paris Agreement goals may not have been ambitious enough to make the impact that is required to keep global temperature increases below 2 degrees Celsius. According to my own calculations using figures from the World Bank's data archives, China had already reduced its carbon intensity by 57.88% from 2005 levels by the year 2013. Only committing to reduce that intensity by 60-65% by the year 2030 seems lackluster in comparison (CINDC 2016, 3). What is more concerning is that China's NDC is not promising anything beyond what China had already planned to implement before the Paris Agreement, using previously instituted policies (Zhou et. al 2011, viii). In fact, China's estimated carbon intensity reductions ranged between 82-

88.3% lower than 2005 levels by 2050, which is even more ambitious than what was stated within their NDC (Zhou et al. 2011, 33). This reduction in carbon intensity was expected from the work plans set forth by China's previous five year domestic plans (Zhou et al. 2011, 33). The same study from which these estimates were derived also predicted that given China's climate and energy consumption policies in 2011, emissions would peak by 2030 (Zhou et al. 2011, 36). Therefore, China did not make any groundbreaking commitments under the Paris Agreement.

Meanwhile, the country's carbon dioxide emissions are expected to grow at a startling pace, given that China is already the largest single emitter of carbon in the world. A study published by Bloomberg New Energy Finance estimates China's carbon emissions to grow by another 58% from 2010 levels by the year 2030 (Du Reitz and Chatterton 2015, 8). This places China's carbon emissions at nearly 13.9 million kt in the year 2030. The 5 million kilotons increase in carbon dioxide emissions from China is roughly equal to what the United States would be emitting in its entirety by 2025, given that it meets its own goals.

U.S. Versus China: Existing Trends and Projections

U.S./ China	2005	2013	2025 (U.S.) & 2030 (China) Projections
Total CO2 Emissions	5,795,161.785kt/ 5,790,016.984kt	5,186,168.427kt/ 10,249,463.018kt	5,143,206.084kt/ 13,853,246.725kt
Per Capita CO2 Emissions	19.610 metric tons/ 4.441 metric tons	16.390 metric tons/ 7.553 metric tons	14.904 metric tons/ 9.787 metric tons
Carbon Intensity	0.443kg per 1USD/ 2.533kg per 1USD	0.311kg per 1USD/ 1.067kg per 1USD	0.257kg per 1USD/ 0.527kg per 1USD

Table 1. U.S. versus China summarization of trends before Paris and projections afterwards. (Sources: World Bank 2016, Populationpyramind.net 2017, OECD Data 2017.)

Given the uncertainty of the future of environmental policy in the United States, the aforementioned analyses suggest a wide range of possible reductions in U.S. carbon dioxide emissions at the goal year of 2025. The average of the carbon dioxide reduction estimates found in Greenblatt's and Wei's study indicate a 12.25% reduction from 2005 levels by the year 2025 (Greenblatt and Wei 2016, 1090-1095). This results in the U.S. total carbon dioxide emissions being 5,143,206kt and this is the number that was used in conjunction with population and GDP estimates for 2025 to calculate per capita emissions and carbon intensity. Looking at Table 1., China's emissions continue to increase to 2030, approaching levels that are almost 3 times of what the U.S.'s will be in each country's goal year. Moreover, much like before the Paris Agreement, per capita carbon emissions in each country should continue to come closer together, with the U.S. experiencing a steady decline, and China experiencing an increase. As China's emissions

peak near 2030, it is possible that China could surpass the U.S. in lowering carbon intensity and keep per capita emissions from ever eclipsing U.S. levels.

IX. Conclusion

Overall, China will be more successful than the United States in achieving its goals under the Paris Agreement. The United States will most likely not meet the goals it set under its NDC to reduce carbon dioxide emissions by 26-28% of 2005 levels by 2025. This is due to systematic opposition of new climate policy and existing policy lacking the rigor to enable the U.S. to meet emission targets. On the other hand, China will certainly achieve its carbon intensity reduction of 60-65% of 2005 levels by 2030. What China promised to do under its NDC in the Paris Agreement was less ambitious than what was planned for in their domestic five year plans. The downside is that China's rising carbon dioxide emissions will only further push the world closer to and possibly beyond a 2 degrees Celsius increase in global temperatures. Therefore, I think that by default the U.S. paltry emissions reduction will be more beneficial toward staying in line with the Paris Agreement's overarching goals than will China's contributions.

X. Bibliography

- Adams, Emily E. "Data." Data Highlights - 41: U.S. Carbon Dioxide Emissions Down 11 Percent Since 2007 | EPI. October 2, 2013. Accessed January 1, 2017. http://www.earth-policy.org/data_highlights/2013/highlights41.
- C2ES. "Outcomes of the U.N. Climate Change Conference in Paris." December 2015. Accessed April 2017. <https://www.c2es.org/docUploads/cop-21-paris-summary-02-2016-final.pdf>.
- Carbon Tracker. "What Does the US-China Climate Change Agreement Mean in Practice? Analytical Insights." Carbon Tracker Initiative. Financial specialists making carbon investment risk real today in the capital market. Accessed February 26, 2017. <http://www.carbontracker.org/what-does-the-us-china-climate-change-agreement-mean-in-practice-analytical-insights/>.
- "Causes of Climate Change." EPA. December 27, 2016. Accessed January 08, 2017. <https://www.epa.gov/climate-change-science/causes-climate-change>.
- CIA. "Country Comparison: GDP - Real Growth Rate." Central Intelligence Agency. Accessed April 26, 2017. <https://www.cia.gov/library/publications/resources/the-world-factbook/rankorder/2003rank.html>.
- "Climate Impacts on Coastal Areas." EPA. October 06, 2016. Accessed January 08, 2017. <https://www.epa.gov/climate-impacts/climate-impacts-coastal-areas>.
- Daly, Matthew. "Scott Pruitt, EPA Chief: Carbon Dioxide Not Primary Cause of Warming." The Washington Times. March 09, 2017. Accessed April 26, 2017. <http://www.washingtontimes.com/news/2017/mar/9/scott-pruitt-epa-chief-carbon-dioxide-not-primary-/>.
- Diringer, Elliot. "Summary: Copenhagen Climate Summit." Summary: Copenhagen Climate Summit | Center for Climate and Energy Solutions. Accessed April 26, 2017. <https://www.c2es.org/international/negotiations/cop-15/summary>.
- "Domestic Product - GDP Long-term Forecast - OECD Data." The OECD. Accessed April 26, 2017. <https://data.oecd.org/gdp/gdp-long-term-forecast.htm>.
- Du Rietz, Adnrea, and Richerd Chatterton. "How Ambitious Are the Post-2020 Targets?" Bloomberg GLP. August 13, 2015. Accessed December 12, 2016. <https://data.bloomberglp.com/bnef/sites/4/2015/07/2015-07-03-How-ambitious-are-the-post-2020-targets.pdf>.

- Eilperin, Juliet. "Obama Hails 'Historic' Ratification of Paris Climate Agreement." The Washington Post. October 05, 2016. Accessed January 08, 2017. <https://www.washingtonpost.com/news/energy-environment/wp/2016/10/05/obama-hails-historic-ratification-of-paris-climate-agreement/>.
- EPA. "Overview of the Clean Power Plan: Cutting Carbon Pollution from Power Plants." Environmental Protection Agency. Accessed December 14, 2016. <https://www.epa.gov/sites/production/files/2015-08/documents/fs-cpp-overview.pdf>.
- EPA. "The Clean Air Act in a Nutshell: How It Works." Environmental Protection Agency. Accessed January 1, 2017. https://www.epa.gov/sites/production/files/2015-05/documents/caa_nutshell.pdf.
- "Find Out More About COP21." Sustainable Innovation Forum 2015, December 2015, Paris, France. Accessed April 26, 2017. <http://www.cop21paris.org/about/cop21>.
- Greenblatt, Jeffrey B., and Max Wei. "Assessment of the Climate Commitments and Additional Mitigation Policies of the United States." Nature Climate Change. September 26, 2016. Accessed March 2, 2017. <http://www.nature.com/nclimate/journal/v6/n12/abs/nclimate3125.html#supplementary-information>.
- Harball, Elizabeth, and Emily Holden. "Clean Power Plan: After the stay: Where All 50 States Stand." Clean Power Plan: After the Stay: Where All 50 States Stand -- Monday, February 22, 2016. February 22, 2016. Accessed March 15, 2017. <http://www.eenews.net/stories/1060032728>.
- Holthaus, Eric. "The Point of No Return: Climate Change Nightmares Are Here." Rolling Stone. August 05, 2015. Accessed February 12, 2017. <http://www.rollingstone.com/politics/news/the-point-of-no-return-climate-change-nightmares-are-already-here-20150805>.
- 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 [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp
- Landler, Mark, and Jane Perlez. "Rare Harmony as China and U.S. Commit to Climate Deal." The New York Times. September 03, 2016. Accessed April 26, 2017. https://www.nytimes.com/2016/09/04/world/asia/obama-xi-jinping-china-climate-accord.html?_r=0.

- Magill, Bobby. "The Suit Against the Clean Power Plan, Explained." Climate Central. April 12, 2016. Accessed February 12, 2017. <http://www.climatecentral.org/news/the-suit-against-the-clean-power-plan-explained-20234>.
- "MAPI." China Solidifies Its Position as the World's Largest Manufacturer | MAPI. Accessed April 26, 2017. <https://www.mapi.net/blog/2015/09/china-solidifies-its-position-world%E2%80%99s-largest-manufacturer>.
- Mastroianni, Brian. "Why 2 Degrees Are So Important to the Climate." CBS News. November 30, 2015. Accessed December 15, 2016. <http://www.cbsnews.com/news/paris-un-climate-talks-why-2-degrees-are-so-important/>.
- Page, Samantha. "No, The Paris Climate Agreement Isn't Binding. Here's Why That Doesn't Matter." ThinkProgress. December 14, 2015. Accessed April 26, 2017. <https://thinkprogress.org/no-the-paris-climate-agreement-isnt-binding-here-s-why-that-doesn-t-matter-62827c72bb04>.
- "Paris Agreement." Climate Action - European Commission. November 23, 2016. Accessed January 08, 2017. http://ec.europa.eu/clima/policies/international/negotiations/paris_en.
- Pengelly, Martin. "Trump to Sign Executive Order Undoing Obama's Clean Power Plan." The Guardian. March 26, 2017. Accessed April 30, 2017. <https://www.theguardian.com/environment/2017/mar/26/trump-executive-order-clean-power-plan-coal-plants>.
- Phillips, Tom. "China Ratifies Paris Climate Change Agreement Ahead of G20." The Guardian. September 03, 2016. Accessed April 26, 2017. <https://www.theguardian.com/world/2016/sep/03/china-ratifies-paris-climate-change-agreement>
- "Population Pyramids of the World from 1950 to 2100." PopulationPyramid.net. Accessed April 26, 2017. <https://www.populationpyramid.net/united-states-of-america/2030/>.
- Reuters. "President Trump Prepares to Withdraw from Groundbreaking Climate Change Agreement, Transition Official Says." Donald Trump to Withdraw from Paris Agreement on Climate Change | Fortune.com. January 30, 2017. Accessed February 17, 2017. <http://fortune.com/2017/01/30/donald-trump-paris-agreement-climate-change-withdraw/>.
- Reynolds, Paul. "Kyoto: Why Did the US Pull Out?" BBC News. March 30, 2001.

Accessed April 12, 2017. <http://news.bbc.co.uk/2/hi/americas/1248757.stm>.

Riddell, Kelly. "Donald Trump Shut the EPA Down — Thank Goodness." The Washington Times. January 24, 2017. Accessed March 23, 2017. <http://www.washingtontimes.com/news/2017/jan/24/donald-trump-shut-epa-down-thank-goodness/>.

Rogelj, Joeri, and Malte Meinshausen. "Analysis of the Copenhagen Accord Pledges and Its Global Climatic Impacts— A Snapshot of Dissonant Ambitions." IOP Science. September 29, 2010. Accessed April 2, 2017. <http://iopscience.iop.org.ezproxy.fau.edu/article/10.1088/1748-9326/5/3/034013/pdf>.

"Trump Signs Executive Order Rolling Back Obama-Era Energy Regs." Fox News. March 28, 2017. Accessed April 30, 2017. <http://www.foxnews.com/politics/2017/03/28/trump-signs-executive-order-rolling-back-obama-era-energy-regs.html>.

United Nations Framework Convention on Climate Change. "Status of ratification." The Paris Agreement - main page. Accessed January 08, 2017. http://unfccc.int/paris_agreement/items/9485.php.

United Nations Framework Convention on Climate Change. "Introduction to the Convention." Introduction to the Convention. Accessed January 08, 2017. http://unfccc.int/essential_background/convention/items/6036.php.

United Nations. United Nations. *UN Conference on Environment and Development*. Department of Public Information, 1997. Unep. "United Nations Environment Programme." Stockholm 1972 - Declaration of the United Nations Conference on the Human Environment - United Nations Environment Programme (UNEP). Accessed January 08, 2017. <http://www.unep.org/documents.multilingual/default.asp?documentid=97&articleid=1503>.

United Nations Framework Convention on Climate Change. "The United Nations Framework Convention on Climate Change." The United Nations Framework Convention on Climate Change. Accessed January 08, 2017. http://unfccc.int/essential_background/convention/items/2627.php.

United Nations Framework Convention on Climate Change. "Kyoto Protocol." Kyoto Protocol. Accessed January 08, 2017. http://unfccc.int/kyoto_protocol/items/2830.php.

Paris Agreement. Proceedings of Paris Agreement, France, Paris. Accessed January 08, 2017.

http://unfccc.int/files/home/application/pdf/paris_agreement.pdf.

United Nations Framework Convention on Climate Change. "Paris Agreement." United Nations Framework Convention on Climate Change. 2015. Accessed December 3, 2016.

http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf.

US Department of Commerce, BEA, Bureau of Economic Analysis. "Bureau of Economic Analysis." BEA International Economics Accounts. Accessed April 26, 2017. <https://www.bea.gov/international/index.htm>

U.S. "U.S. Cover Note INDC and Accompanying Information." United Nations Framework Convention on Climate Change. 2016. Accessed December 14, 2016. <http://www4.unfccc.int/Submissions/INDC/Published%20Documents/United%20States%20of%20America/1/U.S.%20Cover%20Note%20INDC%20and%20Accompanying%20Information.pdf>.

"What is Ocean Acidification?" What is Ocean Acidification? Accessed January 08, 2017. [http://www.pmel.noaa.gov/co2/story/What is Ocean Acidification%3F](http://www.pmel.noaa.gov/co2/story/What%20is%20Ocean%20Acidification%3F).

Zhou, Nan, David Fridley, Michael McNeil, Nina Zheng, Jing Ke, and Mark Levine. "China's Energy and Carbon Emissions Outlook to 2050." Lawrence Berkeley Laboratory. April 2011. Accessed January 2017. ERNEST ORLANDO LAWRENCE BERKELEY NATIONAL LABORATORY <https://china.lbl.gov/sites/all/files/lbl-4472e-energy-2050april-2011.pdf>.