UNIVERSITY OF CALIFORNIA,
IRVINE

The Tragedy of Climate Change

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

In Political Science

by

Christopher Stephen Stoughton

Dissertation Committee:
Professor Richard Matthew, Chair
Associate Professor Matthew Beckmann
Associate Professor Steven Davis

2020

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

I would like to express my deepest appreciation to the members of my committee, Dr. Steven Davis, Dr. Matthew Beckmann, and Dr. Richard Matthew for their willingness to serve and their valuable contributions. I am especially grateful to the Chair of my committee, Dr. Matthew, for his guidance and feedback which have been instrumental in the formation and completion of this project. I also want to thank my parents for their encouragement and inspiration without which this would not have been possible. I want to thank my wife, Carolina Alban-Stoughton, for her support throughout this long journey. Lastly, I want to thank my three year old son, Kai Andrew, for the daily reminder of the miracle of life and the joy found in the present moment.

VITA

Christopher Stephen Stoughton

2000	B.A. in Political Science, University of California, San Diego
2004	M.A. in Political Science, American University
2005-09	Policy Analyst, Pacific Institute for Research and Evaluation
2011-2012	Lecturer, Montgomery College, Takoma Park
2014-2020	Teaching Assistant, University of California, Irvine
2017-2020	Lecturer, California State Polytechnic University, Pomona
2018	Teaching Associate, University of California, Irvine
2020	Ph.D. in Political Science, University of California, Irvine

PRESENTATIONS

2004	"Corporate Liberal Ideology", Hawaii International Conference on Social Sciences.
2017	"Paris Agreement: Turning Point or Business as Usual?", International Studies Association West.
2018	"Paris Agreement:Turning Point or Business as Usual?", Annual Meeting of the International Studies Association.
2018	"Quality of Democracy and Climate Policy Outcomes among Established Democracies", Association for Environmental Studies and Sciences Annual Conference.
2018	"Interest Group Explanation of the Republican Party's Policies on Climate Change", American Political Science Association Annual Conference.

2020 “The Elephant in the Room: Fossil Fuel Interests and Climate Policy Performance”, International Studies Association Annual Conference.

PUBLICATIONS

Review of Malin, Stephanie A., The Price of Nuclear Power: Uranium Communities and Environmental Justice. H-War, H-Net Reviews. July, 2016.

ABSTRACT OF THE DISSERTATION

The Tragedy of Climate Change
by
Christopher Stephen Stoughton
Doctor of Philosophy in Political Science
University of California, Irvine, 2020
Professor Richard Matthew, Chair

This Dissertation develops a Neorealism theory of climate change to provide a deeper, power-based, explanation for why global efforts have largely failed to limit climate change over the last thirty years. Nearly all of the literature on climate change is based within a Neoliberalism framework. No published study to date has provided a comprehensive examination of climate change from a Neorealism perspective. This Dissertation begins to fill this gap in the literature by examining efforts to limit climate change from a number of different angles while using both quantitative and qualitative methods. The analysis finds that the interaction of the underlying structural dynamic at both the global and state levels largely explains why efforts have failed to limit climate change. The interaction of the global anarchic political structure, dominant Liberalism ideology, and fossil fuel dependence among leading state and nonstate actors has led to a business-as-usual pathway to persist. The findings imply that it is highly unlikely global efforts will be able to limit climate change to under two degrees Celsius above pre-industrial levels, the stated target of the latest international agreement, the 2015 Paris Agreement. Achieving such a target would require a transformation of the global structural dynamic which is unlikely in the foreseeable future. The Dissertation concludes by offering a few recommendations for scholars and policymakers.

INTRODUCTION

> This is all wrong. I shouldn't be up here. I should be back in school on the other side of the ocean. Yet you all come to us young people for hope? How dare you! You have stolen my dreams and my childhood with your empty words. And yet I'm one of the lucky ones. People are suffering. People are dying. Entire ecosystems are collapsing. We are in the beginning of a mass extinction. And all you can talk about is money and fairy tales of eternal economic growth. How dare you! (Sixteen year old climate activist Greta Thunberg speaking at the 2019 UN Climate Action Summit).

How did we get here? Why have global efforts failed to limit climate change? What are the deeper, underlying dynamics that explain this failure? Is the latest international agreement on climate change, the Paris Agreement, a step in the right direction or just a smokescreen that enables business-as-usual to persist? Looking forward, what, if anything, can be done to correct the path we are currently following? These are the questions that inspired this research project and which this Dissertation seeks to answer.

Global efforts to limit climate change began over thirty years ago. In 1988 the Intergovernmental Panel on Climate Change (IPCC) was formed to disseminate the latest scientific knowledge about climate change and to motivate global leaders to take urgent action. Then, in 1992 world leaders formed the United Nations Framework Convention on Climate Change (UNFCCC). Within the UNFCCC two international treaties have been signed, the 1997 Kyoto Protocol and the 2015 Paris Agreement. Over this same time period a global movement has formed to focus the world's attention on climate change. Climate activists, environmental organizations, human rights organizations, scientists and groups of scientists, state leaders at the national and subnational levels, and diplomats have all worked tirelessly over these last few decades to limit climate change. A growing number of global networks have formed comprised of subnational governments and businesses committed to reducing greenhouse gas (GHG)

emissions. Over this time period evidence presented by scientists has become increasingly clear that climate change poses an imminent threat.

And yet, the world continues to follow a business-as-usual pathway. Global emissions continue to rise. Production of fossil fuels has increased substantially to meet growing demand and has consistently comprised approximately 80% of the global energy supply.[1] The concentration of GHG emissions in the atmosphere continues to increase which has already led to global average temperatures to increase one degree Celsius above pre-industrial levels.[2] Even more damming of global efforts to limit climate change is the fact that the rate of growth in carbon dioxide (CO2) concentration levels in the atmosphere has accelerated over these last three decades. The last three decades have witnessed the highest growth rates, increasing each decade. Atmospheric CO2 growth rate was 1.50 ppm per year from 1990-1999; 1.97 ppm per year from 2000-2009; and 2.40 ppm per year from 2010-2019. Four out of the five largest single annual growth rates in CO2 atmospheric concentration levels in history have occurred since 2010.[3]

Reports are issued regularly by scientists that highlight the dire impacts climate change has already had and how these impacts will only grow as global temperatures continue to rise over time. It is important to note from the outset that climate change is just one of many global environmental changes that are occurring as a result of human activity. The interaction of these global environmental changes is leading to devastating outcomes for an increasing portion of the world's ecosystem and human populations. According to a 2019 U.N. Report on species extinction:

[1] The World Bank, 'Fossil fuel energy consumption', 1960-2015, DataBank, <https://data.worldbank.org/indicator/eg.use.comm.fo.zs> (17 March 2020).
[2] The National Aeronautics and Space Administration, 'Global climate change: The evidence', <https://climate.nasa.gov/evidence/> (17 March 2020).
[3] CO2.Earth, 'CO2 acceleration', 8 January 2020, <https://www.co2.earth/co2-acceleration> (17 March 2020).

> Nature is declining globally at rates unprecedented in human history – and the rate of species extinctions is accelerating, with grave impacts on people around the world… The health of ecosystems on which we and all other species depend is deteriorating more rapidly than ever. We are eroding the very foundations of our economies, livelihoods, food security, health and quality of life worldwide.[4]

This UN report provides evidence that we are potentially in the beginning stages of what scientists have labelled a "sixth extinction" in which the effects of human activity including global warming is leading to a sixth mass extinction of species in world history (Kolbert 2014).

It is at least a legitimate question whether this process will eventually imperil life on Earth for humans as well. A recent report projects that parts of the world will be unfit for human habitation within this century due to global warming (Pal and Eltahir 2016). Scientists have warned that unchecked climate change could lead to the crossing of so called "tipping points" which then could lead to abrupt and irreversible changes in the global ecosystem with devastating consequences for all of life on Earth including for humans (Lenton et al. 2019; Steffen et al. 2018).

Jared Diamond provides a number of examples from the historical record of many societies that have collapsed and not survived due in part to their unwillingness to heed warnings of impending natural catastrophes (Diamond 2005). However, this time we are facing a global dynamic of an unprecedented scale and reach which imperils all life on Earth. Earth scientists have found that the last time carbon dioxide levels were this high was fifteen million years ago. At that time Earth temperatures were five to ten degrees Fahrenheit warmer than today's

[4] United Nations, 'UN Report: Nature's dangerous decline unprecedented; species extinction rates accelerating', 6 May 2019, < https://www.un.org/sustainabledevelopment/blog/2019/05/nature-decline-unprecedented-report/> (3 March 2020).

temperatures; sea level was approximately 75-120 feet higher than they are today; and there was no permanent sea ice cap in the Arctic.[5]

Scientists began studying climate change in the early nineteenth century when the greenhouse effect was identified. They learned that throughout Earth's history GHG emissions have risen and fallen due to natural causes and these GHG emissions get trapped in Earth's atmosphere for a period of time. This variation in concentration levels of GHG emissions in the atmosphere was then found to be directly correlated with the historical variation in Earth's average temperature. By studying fossil records scientists have discovered that higher CO2 levels in the atmosphere are associated with higher global temperatures. These global temperature variations are primarily responsible for the many life cycles throughout Earth's history.

In 1958 scientists began measuring CO2 concentration levels in the atmosphere in real time when the Mauna Loa Observatory on the island of Hawaii was constructed. These annual measurements showed that CO2 concentration levels were rising much faster than historical records. It became clear that the industrial revolution that led to exponential global economic and population growth that began in the middle of the twentieth century and continues to this day is responsible for this dramatic increase in CO2 concentration levels in the atmosphere over the last century. This latter type of climate change is termed anthropogenic climate change. In essence human activity is amplifying the underlying natural global warming cycle that the Earth has been experiencing since the last ice age ended around 12,000 years ago. For the rest of this Dissertation anthropogenic climate change will be referred to simply as global warming or climate change.

[5] Stuart Wolpert, 'Last time carbon dioxide levels were this high: 15 million years ago, scientists report', Science Daily, 9 October 2009, < https://www.sciencedaily.com/releases/2009/10/091008152242.htm>(23 February 2020).

Increasing concern about global warming led climate scientists from around the world to form the IPCC. The World Meteorological Organization and United Nations created the IPCC "to provide governments at all levels with scientific information that they can use to develop climate policies".[6] The growing concern over global warming is succinctly stated in the 1988 UN Resolution that created the IPCC: "Certain human activities could change global climate patterns, threatening present and future generations with potentially severe economic and social consequences…Continued growth in atmospheric concentrations of 'greenhouse' gases could produce global warming with an eventual rise in sea levels, the effects of which could be disastrous for mankind if timely steps are not taken at all levels".[7] The IPCC does not conduct original research but rather brings together the leading climate scientists in the world to issue regular assessment reports that are intended to "provide a comprehensive summary of what is known about the drivers of climate change, its impacts and future risks, and how adaptation and mitigation can reduce those risks".[8] The first assessment report was issued in 1990 and the latest and fifth assessment report (at the time of this Dissertation being published) was issued in 2014. These efforts by scientists to motivate global leaders to take action concerning climate change then led to the creation in 1992 of the UNFCCC and within this framework the signing of two international agreements on climate change – the 1997 Kyoto Protocol and the 2015 Paris Agreement.

As stated in the 1992 founding document that created the UNFCCC, the objective of these international efforts is "stabilization of greenhouse gas concentrations in the atmosphere at a

[6] Intergovernmental Panel on Climate Change, <https://www.ipcc.ch/about/> (18 February 2020).
[7] United Nations, 'UN Resolution 4353', <http://research.un.org/en/docs/ga/quick/regular/43>(18 February 2020).
[8] Intergovernmental Panel on Climate Change, <https://www.ipcc.ch/about/> (18 February 2020).

level that would prevent dangerous anthropogenic interference with the climate system".[9] The 2015 Paris Agreement is more specific as it states that the goal of international efforts is to limit "the global average temperature to well below 2°C above pre-industrial levels" and 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". This is turn would require "the widest possible cooperation by all countries, and their participation in an effective and appropriate international response, with a view to accelerating the reduction of global greenhouse gas emissions".[10]

It is important to emphasize that the explicit temperature targets stated in the Paris Agreement are the result of a political rather than a scientific consensus (Knutti et al. 2016). Climate scientists are reluctant to define exactly what constitutes "dangerous anthropogenic interference with the climate system". Instead they speak in terms of increasing probabilities of risks and impacts associated with increasing concentrations of GHG emissions in the atmosphere. In fact, as will be shown, there is a large degree of uncertainty and complexity involved with this question that have contributed to the failure of global efforts to limit climate change. However, the two degree target is used throughout this Dissertation as the threshold since it is the primary target of political efforts to limit climate change and it is the most cited target in the literature. Throughout the rest of this Dissertation this target is called the two degree pathway.

Before previewing each chapter two additional notes are in order to set the stage. First, this Dissertation is about climate change mitigation not about climate change adaptation. Climate change adaptation is a whole separate issue that is beyond the scope of this research project.

[9] United Nations, 'United Nations Framework Convention on Climate Change', <https://unfccc.int/resource/docs/convkp/conveng.pdf> (18 February 2020).
[10] United Nations, UNFCCC, 'Adoption of the Paris Agreement', Conference of the Parties, 15 December 2015, <https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf> (18 February 2020).

Climate change adaptation refers to policies designed to adapt to the impacts of climate change. Climate change mitigation refers to policies designed to reduce the concentration of GHG emissions in the atmosphere that is causing climate change.

Second, climate change is an extremely complex phenomenon. It is most certainly one of if not the most difficult and complex challenges humanity faces in the twenty first century. There are no easy or simple explanations, answers, or solutions. This research project attempts to make some sense out of this complexity by examining it from six different angles as presented in the six main chapters. In many ways this Dissertation tries to apply one possible meaning of the *blind men and an elephant* ancient Indian parable. The traditional meaning of this parable is a warning of the limitations of subjective experience. However it can also be read as an admonition to scientists to examine a phenomenon, especially if it is a complex phenomenon, from many different angles or perspectives. That being said not every aspect of climate change is examined in this Dissertation. For example, the individual aspect of global warming is not examined which would focus on individual psychology and behavior concerning climate change. This is of course a very important aspect of climate change to consider but it is beyond the scope of this project.

This Dissertation presents a Neorealism theory of climate change. In so doing it critiques the Neoliberalism framework in which global efforts to limit climate change and the literature that surrounds these efforts are based. Within the field of international relations (IR) there has not been an effort to comprehensively examine global efforts to limit climate change from a Neorealism perspective. This Dissertation is an attempt to begin to fill this gap in the literature and provide a deeper, power-centered explanation of the behavior and interaction of the most important global actors concerning climate change.

The First Chapter examines one of the core assumptions of the Liberalism framework that guides international efforts to limit global warming which is, as the stated purpose of the IPCC shows, that climate science motivates leading state actors to coordinate efforts to limit global warming. This core assumption is examined by analyzing three areas of climate change research: climate pathway models, the literature on the economic costs and benefits of climate change impacts, and the literature on the economic costs and benefits of climate change mitigation. According to Liberalism this information is critical in order for state actors to make well-informed decisions concerning climate change. This information should motivate state actors to take strong collective action to accelerate the reduction of GHG emissions consistent with a two degree pathway. This chapter examines this central assumption of the Liberalism paradigm and whether it accurately explains the interaction of climate science and state actors concerning climate change.

Chapter Two then presents a Neorealism theory of climate change that builds on the Neorealism foundation in order to explain state behavior, international relations, and outcomes concerning climate change. In the academic field of IR there are two dominant theories, Liberalism and Realism, that have in recent decades evolved into Neoliberalism and Neorealism. With few exceptions the literature on climate change within the field of IR is dominated by Neoliberalism.

As will be shown Neorealism enables a deeper understanding and explanation of global efforts to limit climate change than does Neoliberalism. In other words Neorealism has more explanatory power in explaining state behavior and international relations concerning climate change than does Neoliberalism. The analysis presented in this chapter builds upon Neorealism

to explain how the interaction of state level and global level structural dynamics explains state behavior and international relations concerning climate change.

Chapter Three then presents the findings of a quantitative analysis that examines the role fossil fuel interests play in explaining the relative capabilities of states in terms of both state power and addressing climate change. The first series of tests seeks to address whether domestic fossil fuel production levels have an impact on state power more generally. The second series of tests then examine whether fossil fuel production has a direct impact on a state's overall climate change policy performance. The findings are then discussed within a Neorealism framework.

Chapter Four and Five then examine the efforts of subnational governments and their networks to address climate change. IR scholars from a Neoliberalism perspective have raised the prospect that so called nonstate actors (actors other than countries) can either lead or at least supplement global efforts to limit climate change. Perhaps nonstate actors can fill the leadership void left by state actors and build an alternative pathway to limiting global warming.

Chapter Four explores this prospect by presenting the findings of an analysis of a case study of a prominent transnational coalition of subnational states and regions which is committed to accelerating the reduction of GHG emissions consistent with a two degree pathway. This research focuses on the role fossil fuel production levels play in explaining which subnational governments have joined the Coalition. It first looks at the Coalition as a whole to see if subnational states and regions are joining the Coalition from countries that have high levels of dependence on the fossil fuel industry. It then takes a closer look at members that have joined from eight countries: The U.S., Canada, Germany, Australia, South Africa, India, Brazil, and Mexico to see how these states and regions compare with the other states and regions in their countries in terms of dependence on the fossil fuel industry.

Chapter Five then presents the findings of a quantitative comparative analysis of states' climate change mitigation policies in the U.S. It is has been speculated that climate mitigation actions by nonstate actors in the U.S. including the private sector, states, and cities could possibly achieve the U.S. pledge for the Paris Agreement even without the leadership or even cooperation of the U.S. federal government. For the purpose of the analysis a first of its kind comprehensive quantitative comparative measurement is created to measure each state's commitment to reducing GHG emissions. These scores measure and compare states' commitment to reduce GHG emissions and then are used in a quantitative analysis to examine the roles a number of variables play in explaining their variation. These variables include gross state product, vulnerability to climate change, fossil fuel dependence, and ideology.

Chapter Six then explains U.S. behavior concerning climate change through the Neorealism theory of climate change developed in earlier chapters. The focus of this chapter is on how the interaction of internal structural dynamics explains the behavior of the U.S. concerning climate change. The analysis focuses on the roles that the Constitution, ideology, and geography of the U.S. have played in inhibiting its ability to enact a domestic climate mitigation policy or cooperate with other countries to accelerate the reduction of GHG emissions consistent with a two degree pathway.

1

Climate Science and the Failure of the Liberalism Paradigm

Introduction

International relations concerning climate change operate within a Liberalism paradigm which includes three core assumptions. The first core assumption is countries (states or state actors) are rational agents that pursue their self-interest. In order for this rationality principle to be met state actors need sufficient information to make optimal decisions concerning climate change. This leads to the second core assumption which is climate science is critical in motivating state actors that it is in their self-interest to cooperate via international institutions to limit global warming. From this perspective, information about the costs and benefits associated with both the impacts of climate change and the mitigation of climate change is extremely important in informing and motivating state behavior and international diplomacy. This then leads to the third core assumption which is that over time the improving state of knowledge concerning climate change leads to more effective international cooperation to mitigate climate change (for examples of one or more of these core assumptions found in the literature see Bodansky and Rajamani 2018; Falkner 2016; Feldman 1992; Haas 1992; Kennel et al. 2016; Keohane and Victor 2011; Keohane and Victor 2016; Kinley 2016; Klein et al. 2017; Victor 2011; Victor 2016).

This paper examines these core assumptions of the Liberalism paradigm by analyzing three areas of climate research. First, it analyzes the Representative Concentration Pathways (RCP) developed for the Intergovernmental Panel on Climate Change Fifth Assessment Report published in 2014. The Fifth Assessment Report informs the latest international agreement on climate change, the 2015 Paris Agreement on Climate Change. Special emphasis is placed on the

RCP that leads to a likely chance that global warming will not exceed two degrees Celsius above pre-industrial levels since this is the stated target of the Paris Agreement. Second, it examines research which estimates the economic costs and benefits of the impacts of climate change. Third, it assesses research which estimates the economic costs and benefits of climate mitigation.

Representative Concentration Pathways

The latest assessment report (AR5) by the Intergovernmental Panel on Climate Change (IPCC) issued in 2014 presents four mitigation scenarios called Representative Concentration Pathways (RCPs). "*Representative*" refers to the fact that each RCP is representative of a larger set of scenarios in the literature produced by teams of scientists who develop scenarios through integrated assessment models. Each RCP represents most of the different scenarios in the published literature. "*Concentration Pathways*" then refer to the global carbon dioxide emissions concentrations as the primary output of the RCPs. The four RCPs (RCP 8.5, RCP 6, RCP 4.5, and RCP 2.6) refer to the radiative forcing levels each scenario leads to by the end of this century which are then aligned with particular likelihoods of leading to certain global warming ranges (Van Vuuren et al. 2011).

The RCPs result in different pathways based on a different set of assumptions including population and economic growth, climate mitigation policy implementation, energy use, land use, and technology development. These different assumptions then lead to different concentrations of global emissions which then lead to different estimates of the range of temperature outcomes that are likely to result from such concentration levels. The AR5 does not state which pathway is most likely and the pathways are not intended to reflect real world conditions. Rather, they are hypothetical models that show what would be the most likely outcome if the world actually followed the various assumptions made in the models.

RCP 8.5 is considered the worst case scenario which assumes there will be no major climate mitigation policy implementation that makes any discernable difference and a relatively slow pace for innovation and diffusion of non-carbon based energy sources. Compared to the other pathways RCP 8.5 also assumes higher population growth and lower levels of growth in per capita income especially in developing countries. These higher population growth and lower economic development assumptions lead to much higher energy use and energy intensity/efficiency rates half of historical rates. Concerning energy use, RCP 8.5 assumes increasing levels of primary use at the higher end of projections in the literature and higher than the other pathways. In order to satisfy this increasing global energy demand RCP 8.5 assumes increasing use of all primary energy supplies including nuclear, fossil fuels, bio-energy, and solar/wind/geothermal. However, most of the energy mix in 2100 in RCP 8.5 is still dominated by fossil fuels as it is now. Coal use increases almost tenfold by the end of the century and there is continued reliance on oil in the transportation sector. As is the case with the other RCPs, RCP 8.5 assumes increasing deployment of carbon capture and storage (CCS) in conjunction with burning fossil fuels which is discussed in detail later in this chapter. Under RCP 8.5 global emissions would continue to increase steadily at recent historic rates until the 2060-2080 timeframe when they begin to level off as a result of extensive deployment of CCS (Van Vuuren et al. 2011). If the world follows this pathway then according to RCP 8.5 the most likely temperature change by 2100 will be 4.1-4.8 degrees Celsius above pre-industrial levels (IPCC 2014).

Both RCP 6 and RCP 4.5 are low emissions models that represent middle of the road scenarios between the more pessimistic world imagined by RCP 8.5 and the more optimistic world imagined by RCP 2.6. Both RCP 6 and RCP 4.5 assume the world will implement climate

policies via increasing carbon prices. RCP 4.5 assumes a more immediate and higher trend of global carbon pricing than RCP 6. Another critical difference between these two pathways and RCP 8.5 is these two pathways assume a much lower population growth. Both RCP 6 and RCP 4.5 assume global population will reach around nine billion in the year 2100 whereas RCP 8.5 assumes there will be around twelve billion. The latest (2019) median estimates from the United Nations is eleven billion and thus closer to the RCP 8.5 assumption (United Nations 2019). Both RCP 6 and RCP 4.5 envision an overall increase in fossil fuel use, especially coal and natural gas. RCP 4.5 predicts higher overall primary energy use and assumes a lot more nuclear and bio-energy will meet this demand whereas RCP 6 assumes small increases in nuclear and bio-energy. Both scenarios assume increases in solar/wind/geothermal but not to the degree assumed in RCP 8.5 which requires extensive development of all energy sources to meet the needs of higher population growth. The biggest difference between RCP 6 and RCP 4.5 is RCP 4.5 assumes more extensive deployment of CCP in conjunction with the burning of fossil fuels and bio-energy production (Van Vuuren et al. 2011).

These two middle of the road pathways lead to global emissions concentrations and global temperatures in 2100 between those of RCP 8.5 and RCP 2.6. RCP 6 leads to CO2 concentrations in 2100 of 720-1000 ppm and therefore an unlikely chance of limiting global warming below three degrees Celsius and a likely chance of limiting global warming below four degrees Celsius above pre-industrial levels. RCP 4.5 leads to CO2 concentration of 580-720 ppm CO equivalent which then has a likely chance of limiting global warming below 4 degrees, and about a fifty-fifty chance of limiting global warming below three degrees depending on where in the range concentrations end up by 2100 (IPCC 2014).

The most optimistic pathway is RCP 2.6 which leads to a likely chance of limiting global warming below two degrees Celsius above pre-industrial levels (two degrees pathway). More attention is spent on this model since it forms the basis of the current international target as stated in the Paris Agreement. The two degree pathway is an arbitrary target that is the result of a political rather than a scientific consensus. For their part climate scientists emphasize the increasing risks involved with global warming and the multitude of complexities and uncertainties involved. This is especially true when projecting decades into the future.

RCP 2.6 is truly a best case scenario in which a large number of unproven and optimistic assumptions are completely met. There are many such optimistic assumptions in the model however this paper highlights three which deserve more attention than they have generally received in the literature. First, it assumes low population growth. Second, it assumes a global carbon price beginning in 2010 and increasing every decade thereafter which leads to immediate, significant, and increasing declines in global emissions. Third, it assumes extensive and increasing deployment of carbon capture and storage (CCS) in conjunction with the burning of fossil fuels and the burning of bio-energy. Each assumption is considered in order.

Low Population Growth Assumption

First, as is the case with RCP 6 and RCP 4.5, RCP 2.6 assumes a low population growth reaching around nine billion by 2100. The most recent UN median estimates have the world reaching 9.7 billion people by 2050 and then reaching 10.9 billion by 2100 (United Nations 2019). If the world follows the UN median estimates then there is no possible way to limit global warming below two degrees according to RCP 2.6. This much higher population growth would lead to major changes in energy use inputs in the model which then would lead to very different global emissions concentrations in 2100 all else being equal. If the UN median estimates turns out to be

correct then energy demand will be much higher than RCPs 6, 4.5, and 2.6 assume which then would require much higher levels of energy production, energy efficiency, and/or deployment of CCS than are assumed in the three low emissions models. This is a bigger problem for RCP 2.6 since it requires the lowest emissions in 2100 in order to limit global warming below two degrees above pre-industrial levels. (Van Vuuren et al. 2011).

Carbon Pricing Assumption

The second major assumption in RCP 2.6 that enables a two degree pathway is the implementation of an immediate and increasing global price on carbon beginning in 2010 which drives down global emissions below baseline scenarios beginning in 2010. In the model the carbon price is set at twenty five USD/tC (or seven USD/tCO2) in 2010, 200 USD/tC (or sixty USD/tCO2) by 2020, 300 USD/tC (or eighty USD/tCO2) by 2030, and around 600 USD/tC (or 160 USD/tCO2) by 2050 (Van Vuuren et al. 2011a). According to the model the implementation of an immediate and increasing global price on carbon spurs immediate and significant developments in energy efficiency, carbon capture and storage, renewable energy, and nuclear energy which then lead to immediate, significant, and dramatic reductions in global emissions beginning in 2010 with rates of reductions increasing every decade thereafter.

In reality the world has not yet by the time of this paper (2020) implemented anything close to a global price on carbon. A growing number of subnational and national jurisdictions are implementing some type of carbon price (including carbon taxes and cap-and-trade programs). As of 2019 some forty five countries and twenty five subnational jurisdictions have enacted or are planning on implementing a carbon price of some sort. Together, these jurisdictions cover about twenty percent of global emissions. However, only Sweden, Switzerland, Finland, and Norway have carbon prices at the 2020 level assumed in the RCP 2.6 model (World Bank 2018).

These are rare exceptions to the general rule throughout the world of no carbon pricing at the present moment. According to a study by Rogelj et al. published in 2013, the authors conclude that in order for there to be a sixty six percent chance of not exceeding two degrees Celsius above pre-industrial levels the world would need to immediately (in 2013) implement a global carbon price of more than US$40 tCO2e. According to the study delaying such a global carbon price by even ten to twenty years would lead to only a ten to thirty five percent probability of not exceeding two degrees (Rogelj et al. 2013).

There are major questions concerning carbon pricing which lie at the heart of most low emissions scenarios. Two are highlighted here. The first question is whether the level of carbon pricing assumed in the models is politically feasible in many parts of the world. Barry Rabe discusses the volatile political nature of pricing carbon throughout the world in his 2018 book *Can We Price Carbon?* Rabe documents the history of the unpopularity of carbon pricing throughout the world, especially for carbon taxes, along with the powerful economic and political forces which have prevented carbon pricing from being implemented in many parts of the world. When they are enacted these forces then work to get rid of these carbon pricing mechanisms, efforts which in many cases have been successful. Few jurisdictions throughout the world have been able to successfully implement and sustain a carbon tax over a long period of time. Most jurisdictions are forced to implement some sort of cap-and-trade program which is more politically feasible but is much less effective than pure carbon taxes as they are more open to manipulation, distortion, and corruption (Rabe 2018).

Many political forces align to prevent and/or overturn carbon pricing but one often overlooked group is lower income populations in both developing and developed countries which would be hit harder by the large and increasing levels of carbon pricing envisioned in the

low emissions scenarios. Carbon pricing is a type of regressive "tax" (used loosely here not in its technical sense since it is an open question whether cap-and-trade-programs, one type of carbon pricing, are "taxes") in that the costs are passed along to the consumer and so this tax takes a larger proportion of lower income groups' incomes than higher income groups. This is a serious and potentially fatal problem with this fundamental assumption in these low emissions models. A tax and dividend program has been proposed to solve this problem but then the tax revenue is not used to help pay for the costs associated with transitioning away from fossil fuels which some say is necessary but instead would be distributed back to citizens to use however they choose.

The 2018 so called "yellow vest" protests in France in response to the implementation of a gas tax in the name of climate change is perhaps a foreshadowing of the type of response from certain populations throughout the world as jurisdictions enact various forms of carbon pricing to address climate change. French President Macron proposed a gas tax increase as part of the country's action plan to address climate change. The proposed gas tax increase sparked nationwide protests among the working class which grew to the largest and most violent protests in France in decades. In response to the protests President Macron withdrew the proposal. According to protestors, they are not against taking action concerning climate change per se but rather are against having working class people pay the costs of taking action to reduce emissions. One communication from the protestors proposes a tax on fuel and kerosene for ships and airplanes instead.[11] This back and forth has had a significant symbolic significance since Paris was the site of the 2015 Paris Climate Agreement and the protests received extensive global media coverage. For example, after President Macron withdrew the gas tax, U.S. President

[11] Emily Atkin, 'France's yellow vest protestors want to fight climate change', The New Republic, 10 December 2018, <https://newrepublic.com/article/152585/frances-yellow-vest-protesters-want-fight-climate-change> (22 February 2020).

Trump stated that the withdrawal shows that France does not believe in the 2015 Paris Agreement.[12]

The major increases in carbon pricing assumed in the low emissions scenarios will no doubt have a major impact on lower income populations throughout the world. The question is how these populations and their governments will react to each other. If the recent example in France and many other historical cases documented in Rabe's analysis is any indication, then this central assumption of a global, immediate, and increasing carbon pricing in the low emissions models is a highly optimistic and unlikely scenario. Certainly it has not happened yet and has virtually no chance of happening any time soon (e.g. next five to ten years).

The second major question concerning the carbon pricing assumption in these low emissions models is whether it would be sufficient to drive the degree of emissions reductions necessary to achieve the two degree pathway. In other words, even if the world is somehow able to muster the political will to implement the degree of carbon pricing in the near future as envisioned in the low emissions models, which as just explained is extremely doubtful, it is unclear whether it would be the driver of emissions reductions as assumed in low emissions models. Carbon pricing, and more specifically carbon taxes, is the preferred policy mechanism by most economists as the most efficient and effective means to achieve emissions reductions and thus carbon pricing plays a central role in low emissions models. However, there is little evidence carbon pricing leads to the degree of emissions reductions assumed in the low emissions models. Few published studies have evaluated the effectiveness of carbon pricing. Most of these are case studies of the few jurisdictions that have been able to implement and sustain carbon pricing over an extended period of time.

[12] Tom Embury-Dennis, 'Macron scraps French fuel tax amid nationwide protests and rioting in Paris', The Independent, 6 December 2018, <https://www.independent.co.uk/news/world/europe/france-protests-fuel-tax-rise-scrapped-macron-yellow-vests-gilet-jaunes-a8669621.html> (22 February 2020).

One of the few quantitative studies on carbon pricing that has been conducted to date is an analysis of carbon taxes implemented in 16 countries, two Canadian provinces, and a city. As carbon taxes are assumed by economists to be the most effective and efficient mechanism to drive down emissions, these should be viewed as best case scenarios compared to other jurisdictions that implement some sort of cap-and-trade program which is generally perceived by economists to be less effective. The author of the study, Steven Nadel, finds that the median reduction per year in these jurisdictions that can be attributed to the carbon taxes is 1.3% (Nadel 2016). RCP 2.6 assumes the entire world will experience four percent emissions reductions per year as a result of a global carbon tax. Nadel's analysis suggests it is highly optimistic to expect global emissions to decline by four percent a year, at least in the beginning years when the carbon price is still relatively low as it is in most jurisdictions that currently have it..

There is even less evidence cap-and-trade programs drive down emissions to levels that are assumed in low emissions models. Europe's Emissions Trading System (ETS) is the world's largest and longest running cap-and-trade program. According to one comprehensive review of the literature on the ETS, the program "has led to some small levels of abatement" (Laing et al. 2013). In another analysis of the longest running carbon cap-and-trade program in the United States, the Regional Greenhouse Gas Initiative (RGGI), the authors conclude "the direct impact of the RGGI program on power sector CO2 emissions has been small, at best" (Schmalensee and Stavins 2017). Meanwhile two recent reports have concluded that the other most prominent carbon cap-and-trade program in the U.S., the state of California's cap-and-trade program, has major flaws which are likely to prevent it from driving down emissions consistent with its targets (Cullenward et al. 2018; Haya 2018).

These findings indicate that even if somehow a global cap-and-trade program emerges it is very unlikely to have the degree of effect required to drive down emissions as assumed in RCP 2.6 and other low emissions models. These prominent examples show that even under the best socio-economic and political conditions, cap-and-trade programs are complex and open to manipulation, distortion, and corruption. The fact that there is little evidence that cap-and-trade programs have driven down emissions in optimal conditions indicates such programs are likely to have even less success in less ideal conditions prevalent in most of the world.

The bottom line is a global carbon pricing mechanism as envisioned in low emissions models is very unlikely in the foreseeable future. Much more likely is a continuation of the present situation which is a sporadic carbon pricing global market. Such a sporadic carbon pricing global market is open to leakage in which high emissions industries and regions are not covered and high emissions industries can move to regions that do not have carbon pricing. High pollution countries and industries thus are able today and in the foreseeable future to not be subject to carbon pricing mechanisms. If high emissions jurisdictions do enact the sort of aggressive carbon pricing mechanism envisioned in low emissions models then their industries are able to move to other jurisdictions which do not have such regulations. The overall effect then is a likely continuation of the historical and global trends in terms GHG emissions.

Carbon Capture and Storage Assumption

The third major assumption made in low emissions models is the extensive and increasing deployment of carbon capture and storage (CCS) in conjunction with the burning of fossil fuels and bioenergy. According to low emissions models even in the unlikely scenario in which the world's population grows at rates below what most expect and the world implements a global carbon pricing mechanism immediately that actually drives down emissions immediately and

significantly, there still would be the need for extensive and increasing deployment of CCS in order to limit global warming to below two degrees. CCS in conjunction with the burning of fossil fuels is a major component of RCP 2.6. According to one report, in order to achieve the two degree pathway more than 2,500 CCS facilities need to be in operation by 2040 each capturing some 1.5 million tonnes per annum (Mtpa) (Global CCS Institute 2018).

The problem with this assumption is that large scale, commercial deployment of CCS in conjunction with the burning of fossil fuels is nearly non-existent at this point in time and there are major questions as to whether it will ever be feasible at the scale imagined under these low emissions scenarios In the year 2019 there are eighteen large scale CCS facilities capturing some forty MTpa (Global CCS Institute 2018). Historically the CCS industry has barely progressed due to major economic, environmental, and political obstacles revolving around cost and CO2 storage. It is widely acknowledged that in order for CCS to be economically competitive in the energy marketplace there needs to be significant government assistance in the form of carbon taxes, subsidies, and/or other means to make CCS competitive in the market place (Watson et al. 2014).

However, hard as it is to believe, the major questions and concerns of CCS in conjunction with the burning of fossil fuels pale in comparison with the assumption in RCP 2.6 and the other low emissions models which envision extensive deployment of CCS in conjunction with bioenergy (BECCS). BECCS refers to growing biomass such as plants and trees; burning the biomass for energy; capturing the emissions that result from burning the biomass; and then storing the emissions underground. In theory this process leads to so called “negative emissions” since it takes more emissions out of the atmosphere than it produces while generating energy. The widespread deployment of BECCS is a critical assumption in most low emissions models

due to the now inevitable overshoot in which the world will most definitely overshoot the global carbon budget associated with low emissions models (Anderson and Peters 2016).

First, before addressing the major questions associated with BECCS, it is important to note how this central assumption in low emissions models is scarcely mentioned outside of the climate modelling literature. A few climate scientists have made efforts in recent years to raise awareness among the general public but the vast majority of public discussion concerning low emissions targets barely mentions it. The Paris Agreement document does not mention BECCS or negative emissions. Only a few of the national pledges for the Paris Agreement mentions BECCS as part of their plans to reduce emissions. Climate Action Tracker, one of the most prominent organizations of climate experts that monitors, analyzes, and reports on country pledges for the Paris Agreement, does not mention negative emissions in any of its website, analyses, or reports. Organizations such as the Climate Action Tracker that monitor progress towards achieving the stated goal of the Paris Agreement do not state that the climate model that achieves the two degree pathway everyone is relying on is largely dependent on extensive deployment of BECCS beginning in 2030. If this central assumption is taken out of the two degree pathway model then the analyses of organizations such as the Climate Action Tracker would be completely altered. In fact, if this central assumption is taken out of the model then the entire discussion surrounding the two degree pathway, which has become a sort of Holy Grail, would be completely transformed.

The fundamental problem with this critical underlying assumption that is central to the low emissions models relied on by the international community is that at the present time it is science fiction. In other words, the climate modelling community has imagined a massive global deployment of a technology that has not been proven at anywhere near the scale imagined in

these scenarios. There are serious questions as to whether this massive deployment of BECCS is feasible due to the major technological, political, economic, and social risks, tradeoffs, and uncertainties involved (Anderson and Peters 2016). Then, this major, critical assumption is buried in the model (and the literature) largely ignored by the UNFCCC, international leaders, and observers. This would seem to be the definition of madness especially when considering the stakes involved. It is critically important this underlying assumption be brought to light outside of the climate expert community and seriously examined and questioned. It should be a central focus of any discussion surrounding the goal to limit climate change to two degrees Celsius above pre-industrial levels not on the periphery where it is scarcely mentioned as is the situation now.

BECCS is included in RCP 2.6 because it is necessary to make up for global emissions overshooting the global carbon budget in RCP 2.6. Thus in the extremely unlikely scenario in which all of the other optimistic assumptions in the model are met including the population, carbon pricing, and CCS in conjunction with the burning of fossil fuels, global emissions still do not decline rapidly enough in the model for there to be a likely chance of not exceeding two degrees Celsius above pre-industrial levels. According to RCP 2.6, global emissions begin to gradually decline in 2010 (which has not happened) and dramatically declines beginning in 2020 (which is not happening). However, even if all of the previously mentioned unrealistic assumptions are completely met in the model, beginning in 2030 global emissions still do not decline at rates consistent with a two degree pathway. In order to make up for this gap, which increases over time even assuming all other assumptions are completely met, the model includes substantial deployment of BECCS beginning in 2030 which then dramatically increases

thereafter to make up for the increasing gap between predicted emissions levels and the amount of emissions consistent with a two degree pathway (Van Vuuren et al. 2011a).

The scale of this deployment of an unproven technology is extraordinary and would undoubtedly have major impacts and tradeoffs which are largely unknown and thus are not accounted for in the models. One of the major impacts will be on land use. In one estimate, land one to two times the entire country of India is required to grow the amount of bioenergy for BECCS envisioned under RCP 2.6 (Anderson and Peters 2016). Planting biomass on an area larger than the size of India raises serious concerns when considering the world is expected to increase some three billion people by 2100 and consumption of natural resources continues to increase exponentially. According to many estimates we are already overshooting the world's biocapacity to regenerate itself and thus are operating an ecological deficit at current population levels (McBain et al. 2017). Adding another three billion or so people will further overstretch the world's natural resources and capacity to absorb humanity's growing ecological footprint. Seen within this reality setting aside arable land one to two times the size of India is extremely improbable. This global population and economic growth will require increasing consumption of natural resources which will place greater demand on land use. Thus, the amount of land required for BECCS under RCP 2.6 will compete with other needs for this land for a growing global population and economy (Van Vuuren et al. 2010).

There is widespread skepticism among experts that this core assumption of RCP 2.6 and other low emissions climate models is feasible. According to the IPCC "there is only limited evidence on the potential for large-scale deployment of large-scale afforestation, and other CO2 removal technologies and methods" (IPCC 2014). A recent 2018 assessment of the negative emissions assumption in the two degree models by the European Academies Science Advisory Council

concludes that these assumptions are “seriously over-optimistic” and therefor policymakers should not expect technology will come to the rescue. According to the report the negative emissions technologies including BECCS “offer only limited realistic potential to remove carbon from the atmosphere and not at the scale” envisioned in the two degrees scenarios. The report further notes if the world does deploy such extensive use of negative emissions technologies there are significant uncertainties and social and economic costs which are not included in the climate models and have just begun to be explored by experts (EASAC 2018).

This central assumption in low emissions models leads to a perverse logic or what some have called a “moral hazard” in rationalizing the continuation and expansion of the fossil fuel industry (Anderson and Peters 2016). Due to the assumption of extensive deployment of CCS in conjunction with the burning of fossil fuels and bioenergy, RCP 2.6 expects by 2100 the world will use substantially more natural gas and coal than today’s levels. Coal use would double while natural gas use would more than triple. In the next lowest emissions model RCP 4.5 it is expected oil use will also substantially increase between now and 2100 (Van Vuuren et al. 2011). These increases in fossil fuel use are only possible in low emissions models with the assumption of widespread deployment of negative emissions technologies. This assumption in RCP 2.6 and other low emissions models give the fossil fuel industry and those who depend on the fossil fuel industry a green light to continue fossil fuel development while increasingly focusing everyone’s attention on developing negative emissions technologies which as just now explained is an unrealistic expectation.

Climate Change Impacts

One of the central assumptions in the Liberalism paradigm that guides international relations concerning climate change is that the worsening impacts of climate change will motivate state

and nonstate actors alike to cooperate to reduce global emissions. There are several problems with this core assumption. First, there is limited information concerning the long term impacts of climate change. Second, this information is filled with complexities and uncertainties. Third, and perhaps most problematic is the little information we do have indicates that these impacts will vary widely across both populations and regions throughout the world.

The most sophisticated climate models so far developed barely tap into the complexity of the multiple interactions involved with climate change impacts. These forecasts are improving and becoming more precise but they still have a long way to go before we can predict with any degree of accuracy the costs associated with climate change. William Nordhaus is one of the leading climate modelers in the world. In a 2017 review of studies on the global impacts of climate change Nordhaus and Andrew Moffat conclude that impact estimates in climate models are not comprehensive and are limited in nature. According to Nordhaus and Moffat "comprehensive impact studies are almost an afterthought in the study of climate change" (Nordhaus and Moffat 2017). This is due to the extraordinary complexity involved with attempting to estimate future impacts of climate change. Climate change will have numerous impacts on nearly all aspects of human existence. Attempting to accurately predict how these impacts and interactions will actually play out in the real world decades into the future and then to somehow place a financial value on these impacts is perhaps an impossible task.

However, the little information we do have concerning estimated impacts from climate change at the state and regional levels suggest that these impacts are and will continue to be highly asymmetrical. In other words, some countries and regions will face wide variation in how climate change will impact them in the coming decades. This variation runs from an existential threat at one extreme to a possible net positive effect on the other extreme. Some states very

survival is at risk due to climate change such as states in low lying islands and desert environments. Other states, in the higher and lower latitudes for example, will likely benefit at least in some economic and political ways due to a warming climate. Furthermore, even within regions various populations and industries will be impacted differently depending on their relative socio-economic circumstances, how they make their money, and the particular natural environments in which they live. Thus, some states, regions, populations, and industries are better able to adapt to climate change and some will even benefit in various ways.

A prominent study by Burke et al. models the effect climate change will have on countries' economic production in a business-as-usual scenario. This study is not comprehensive and focuses on only one aspect of the estimated future costs associated with climate change, in this case economic production. However, it does provide some indication how the impacts of climate change will vary widely depending on the region of the world and even different regions within countries in the coming decades. According to the authors' estimates, countries in the northern latitudes such as Canada, Northern Europe, and Russia will actually have increased economic production as a result of climate change increasing agricultural yields and thus will benefit from climate change. The United States, Argentina, Peru, southern Europe, East Asia, Australia and New Zealand will suffer moderate losses on the whole with varying effects within regions. On the other hand most of Africa, Eastern and Northern South America, Central America, the Middle East, and South Asia will suffer the greatest losses in economic productivity (Burke et al. 2015). Again, this impact analysis is not comprehensive and so it should not be considered an accurate projection of the overall economic impact climate change will have on countries. But it is an indication that whatever the future impact will be it will not be equal across regions and populations. Some countries will no doubt suffer much worse than other countries in terms of

both the impact of climate change and the ability to adapt to climate change. The same is true within countries and various populations both within and across countries.

Another line of research attempts to estimate the social cost of carbon at the country level. As explained by Ricke et al. "the social cost of carbon represents the economic cost associated with climate damage (or benefit) that results from the emission of an additional tonne of carbon dioxide" (Ricke et al. 2018). These studies attempt to assess and compare the damages of climate change at the country level. Ricke et al. estimate the amount of marginal damage and/or benefit "expected to occur in an individual country as a consequence of additional CO2 emission" (Ricke et al. 2018). The authors find wide variation in the estimated damages and benefits associated with increasing CO2 levels. Russia, Canada, and many European countries are expected to benefit from increasing CO2 levels while India, the United States, Saudi Arabia, Brazil, and China are expected to receive the most damages from climate change. Other countries throughout the world experience varying levels of harm associated with rising levels of global concentration of CO emissions. Once again, this analysis does not model all of the various impacts of climate change but rather specific elements. And as a comparison of these two models exemplifies different models will come to different conclusions.

Countries will be affected in different ways and degrees from the impact of climate change but wealthy countries will be more able to adapt to this changing climate and absorb the costs imposed by the impact of climate change. One of the most respected measurements of a country's overall vulnerability to climate change is the Notre Dame GAIN index. This index, as are most vulnerability indices, is highly correlated with wealth. This makes sense and is as true within countries as across countries. Wealthier individuals, families, communities, states, regions, and countries will be better able to adapt to climate change and absorb the costs imposed

by climate change than poorer areas, individuals, and populations. As a result, the cost-benefit analysis by state actors when deciding what to do about climate change will come to different conclusions depending in part how they believe climate change might affect them in the future. This calculation among state actors may become more clear as impact studies improve and provide more precise estimates at the country and regional levels, both the negative and positive impacts, which as the initial studies indicate will most likely show the asymmetry of climate impacts across populations and geographic regions.

Climate Change Mitigation Costs and Benefits

Economists attempt to estimate the global costs of climate mitigation efforts which would lead to global warming not exceeding two degrees Celsius above pre-industrial levels. These models typically assume the least-cost path in which the world collectively takes the most cost-effective action to achieve the two degree pathway. In these scenarios the world institutes an immediate, significant, and global price on carbon which then increases substantially every decade thereafter. This rising cost of carbon spurs a rapid transition away from fossil fuels and policy implementation which then lowers energy demand. Additionally, the two degree pathway assumes technology development resulting in large scale and extensive deployment of carbon capture and storage (CCS) in conjunction with the burning of fossil fuels and bioenergy as described earlier. Such models assume the "utopian ideal of 100 percent efficient policies with 100 percent participation of countries" in which there are no exemptions anywhere in the world for anyone (Nordhaus 2013, 177-8). Under this ideal scenario the estimated mitigation costs would be between one and two percent of total world income on an annual basis which according to William Nordhaus is substantial yet manageable.

However, under more realistic scenarios in which much of the world does not follow the least-cost path, as is currently the case in the real world, the mitigation costs rise exponentially over time. A full participation model estimates the cost of reaching 3.25 degrees at .5% of global annual income, whereas for fifty percent participation the cost of reaching 3.25 degrees is four percent. It is also very likely the world as a whole will not implement the most efficient and cost-effective policies as described earlier. Models that assume less efficient and cost-effective policies lead to a rough doubling of the global mitigation costs. So for example, if half the world implements a more realistic climate mitigation policy scenario then the global costs would rise to around eight percent of total world income on an annual basis (Nordhaus 2013). According to one analysis, out of twenty two models that assume partial participation in global efforts to accelerate GHG emissions reductions, twenty found the two degree pathway was "infeasible" which is defined as "causing a horrible economic depression" (Nordhaus 2013, 180).

Although there are plenty of studies which assess the costs of climate mitigation at the global level, to date there are not any published studies of cross-national analyses of climate mitigation costs at the country level. There are case studies which estimate the costs of climate mitigation for certain countries but there aren't any studies which allow us to compare climate mitigation costs across countries. As is the case with climate impacts, climate mitigation costs undoubtedly vary significantly both across and within countries. The particular socio-economic, political, and geographic circumstances of countries affect the costs they would incur from implementing the degree of climate mitigation assumed in two degree pathway scenarios. Such a study would be extremely difficult if not impossible to carry out which is why it hasn't been done. It would need to consider not only the variation in costs across countries but also the relative nature of these costs. As discussed earlier carbon prices are by nature regressive as they disproportionately

affect lower income populations. In addition, a country's level of dependence on fossil fuels would no doubt alter the relative cost of climate mitigation across countries.

In addition to the long term benefits associated with climate mitigation in terms of lowering climate change impact costs, climate mitigation also leads to a number of more immediate co-benefits which should be included in any cost-benefit analysis of climate mitigation. These co-benefits include the health benefits of improving air quality and the economic activity generated associated with efforts to reduce GHG emissions. Actions to reduce GHG emissions oftentimes (though not necessarily or always) include co-benefits that lead to reductions in local air pollution which then leads to reductions in illnesses, diseases, and deaths from local air pollution. Additionally, actions to reduce GHG emissions lead to jobs, businesses, and industries in energy efficiency, renewable energy, and infrastructure development. However, to date, there has not been a comprehensive published study which quantifies the overall economic benefit of climate mitigation at the global level or at the country level in a cross-national analysis. This is an under researched area of climate change that deserves more attention. Such knowledge is extremely important to provide policymakers with information to make informed decisions when considering the costs and benefits associated with climate mitigation. However, as it stands right now, this information is not available to policymakers.

Integrated climate models typically include assumptions concerning the costs of climate mitigation in the aggregate at the global level as a percentage of GDP. However if the assumption is that countries are rational actors that conduct cost-benefit analysis when considering policies to address climate change, then these models do not provide useful information. The very different socio-economic and geographic conditions of countries lead to very different cost-benefit calculations. Research that suggests certain global level costs under

certain assumptions, which as this paper attests are not very reliable, is not going to be taken very seriously by leaders of countries when considering what to do about climate change.

Conclusion

The Liberalism paradigm guides both scholars and diplomats concerning international efforts to limit global warming. This Liberalism paradigm includes three core assumptions. First, states are rational actors that rationally pursue their self-interest. Second, climate science is critical in providing political leaders to make informed decisions and also in persuading state actors that it is in their self-interest to cooperate via international institutions to limit global warming. Third, the improving state of knowledge concerning climate change leads to more international cooperation to mitigate climate change.

The findings presented in this chapter indicate these core assumptions of Liberalism are not being met in the real world and are unlikely to be met in the foreseeable future for two main reasons. First, the climate models policymakers and observers rely on are based on unrealistic assumptions. Second, the many complexities and uncertainties involved with estimating the costs and benefits are not conducive to the sort of increasing cooperation which is necessary to achieve a low emissions pathway. These are discussed in order.

First, low emissions models relied on by policymakers are filled with a number of unrealistic assumptions that are not currently being met and are very unlikely to be met in the coming decades. One of these central assumptions, the extensive deployment of carbon capture and storage (CCS), leads to the perverse incentive and moral hazard for the expansion of fossil fuel development through the rest of this century. Another unrealistic assumption concerns population growth. Low emissions models assume much lower population growth than the most recent median United Nations estimates. If these models included the most recent U.N. estimates

they would not come close to achieving the emissions reductions necessary to reduce global emissions in line with a two degree pathway. A third unrealistic assumption is the implementation of carbon pricing on a global basis which increases over time. This is not happening and is very unlikely to happen in the foreseeable future. It is also doubtful whether even if this were to occur that it would actually lead to the degree of global emissions reductions assumed in these models.

Second, the Liberalism assumption that improvements in knowledge and information leads to improvements in cooperation runs directly into the obstacles of complexity and uncertainty which are inherent in climate science. As documented in this chapter there is little information concerning the costs and benefits associated with the mitigation and impacts of climate change at the country level. What little information there is concerning these costs and benefits associated with both climate change impacts and climate change mitigation efforts suggest wide variation. This asymmetry makes cooperation less not more likely. There are large degrees of uncertainty and complexity involved with all research pertaining to climate change and this uncertainty and complexity is not going to change any time soon.

One important manifestation of this central dilemma is the 1.5 and 2 degree temperature targets stated in the Paris Agreement. As mentioned in the Introduction of this Dissertation these targets are the result of a political rather than a scientific consensus. With few exceptions, climate scientists are highly reluctant to define exactly what constitutes “dangerous anthropogenic interference with the climate system”. This is due to the considerable uncertainties and complexities involved with trying to make such a determination as just discussed. The few climate scientists who have been willing to address this question have come to different conclusions concerning the appropriate target. In a 2016 published paper James Hansen and

colleagues conclude that the two degree target is too high and presents unacceptably high dangers and risks (Hansen et al. 2016). Other scientists have argued the two degree target is the most appropriate target (Schellnhuber et al. 2016; Steffen et al. 2018). While other scientists have argued there is too much uncertainty and complexity at the present time to determine any target as representing the threshold (Knutti et al. 2015). These confusing signals by climate scientists are not conducive to motivating increasing cooperation among state actors to accelerate the reduction of global GHG emissions. Even worse, growing knowledge of the asymmetry of climate impacts is more likely to lead to less cooperation as state actors come to different conclusions based on their particular cost-benefit analyses.

The findings of this chapter show what little information we do have concerning the impacts of climate change indicate these impacts will be spread unevenly across regions and populations within regions. These asymmetrical climate impacts will have major implications in terms of global efforts to limit climate change. A core assumption of Liberalism is that state actors are rational agents that pursue what they believe to be in their best self-interest. However, for those states such as Russia which may actually benefit over the next few decades in terms of the impacts of climate change then according to Liberalism it is perhaps irrational for Russia to participate in international efforts to accelerate the reduction of GHG emissions. This is especially true for a country like Russia when considering these efforts to accelerate the reduction of GHG emissions threaten its geostrategic interests since it is one of the leading fossil fuel producers in the world. This fossil fuel production is a central source of its geostrategic power.

As shown throughout this chapter climate change is an extremely complex phenomenon and so increasing knowledge and information about this phenomenon does not lend itself to clarity

and action but rather to a lack of clarity and less action. The exponential profusion of climate change science and research in recent years has in many ways led to too much information that is too technical, complex, and specialized to have any real impact on public policy. This explosion of knowledge and information about climate change will no doubt continue which will only make this picture more complex and less user-friendly to inform and motivate policymaking and cooperation.

An important example of this growing problem is the new emissions scenarios which will replace the Representative Concentration Pathways (RCPs) for the next IPCC Assessment Report (AR6). The AR6 is due in 2021 and these new emissions scenarios will form the foundation of global efforts concerning climate change and the literature surrounding these efforts for the foreseeable future. These "Shared Socioeconomic Pathways" (SSPs) include five narratives or pathways that include a more complex array of assumptions than are included in the RCPs. As described in this paper the RCPs are already extremely complex which are not well understood by most observers including policymakers. The SSPs are much more complex and will undoubtedly be even more confusing and less understood by policymakers, scholars, the media, and the general public. This increasing complexity and fragmentation of the science of climate change is not conducive to informing and motivating states to take action on climate change.

This example also points to a growing disconnect between climate science and public policy. The leading climate scientists who have created the SSPs argue they are an improvement from the RCPs and earlier climate models as they better represent the complexities and uncertainties inherent in projecting climate scenarios decades into the future (Riahi et al. 2017). However, the problem is these models that increasingly reflect the uncertainties and complexities involved

with climate change are becoming less user-friendly for policymakers in making decisions concerning climate change thus undercutting the core Liberalism assumption. This becomes clear when trying to make any sense out of the SSPs and what they mean in terms of what policymakers should do concerning climate change based on the information provided by the SSPs. Progress in science does not necessarily translate into progress for policy when it comes to climate change as assumed by Liberalism. In fact, the opposite is occurring. This inverse relationship runs counter to the Liberalism paradigm which assumes progress in climate science leads to progress in global cooperation to limit climate change.

2

A Neorealism Theory of Climate Change

Introduction

It is widely acknowledged global warming poses one of the most difficult global collective action challenges in the twenty-first century. The World Economic Forum publishes an annual Global Risks Report which presents the findings of a survey of world experts and decision-makers. For the 2019 report, failure of climate change mitigation and adaptation was rated the second biggest global risk in terms of likelihood and second biggest risk in terms of impact. Extreme weather events and natural disasters, two climate change related phenomena, are also in the top five list for both categories.[13]

As a result of this growing awareness of the perils of climate change and the urgent need to reduce atmospheric concentrations of greenhouse gas (GHG) emissions, there have been attempts at the international level to coordinate efforts to reduce GHG emissions consistent with a climate pathway that limits global warming within what scientists consider sustainable limits. These efforts led to the formation of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 and two subsequent climate treaties: the Kyoto Protocol signed in 1997 and the Paris Agreement signed in 2015. As is well known and will be reviewed in this chapter, these efforts, at least up to the present time, have largely failed to reduce global emissions by any discernable amount (Keohane and Victor 2016).

These international efforts, as well as the literature that describes these efforts, are based within the Neoliberalism paradigm. There are several consequences of this monopoly of

[13] World Economic Forum, 'The Global Risks Report 2019 14th Edition', <http://www3.weforum.org/docs/WEF_Global_Risks_Report_2019.pdf> (1 November 2019).

Neoliberalism over climate change. One is these international efforts and the literature concerning these efforts tend to be highly idealistic and optimistic. A second consequence is these international efforts and the literature concerning these efforts do not focus on the competition for power which is a central aspect that explains state behavior and international relations. Thus there is a need to critique this Neoliberalism framework which dominates the issue of climate change and for a more power-centered framework to explain both state behavior and international relations concerning climate change. This chapter is an attempt to achieve these two objectives.

The rest of this chapter proceeds as follows. First, the core principles of Neoliberalism and Neorealism, the two main theories in the field of international relations, are analyzed and compared. The second section then examines international efforts to limit global warming. The third section analyzes the literature on climate change in the field of international relations. Last, a Neorealism theory of climate change is developed.

Comparison of Neorealism and Neoliberalism

Before analyzing international relations concerning climate change from a Neorealism perspective it is important to define exactly what is meant by Neorealism, how it differs from the other main theory in the field of international relations (IR), Neoliberalism, and how it can be applied to examining climate change. There is no universally agreed upon definition of Neorealism. Today there are various strains of Neorealism including offensive and defensive Neorealism. Neorealism itself is an offshoot of the Realism tradition which goes back centuries to Hobbes, Machiavelli, and Thucydides, among others. Hans Morgenthau and Kenneth Waltz are most responsible for developing the theory of Realism in the modern field of IR and so it is appropriate to begin with their work.

Hans Morgenthau's classic *Politics among Nations: The Struggle for Power and Peace* is one of the founding texts in the academic field of IR and is widely considered as the beginning of what we now call Realism in the field of IR. According to Morgenthau there are six principles that form the foundation of Realism as a theory. Most relevant for this paper are the first three principles. The first principle is society is governed by objective laws that have their roots in human nature. The second principle is interest is defined in terms of power. Thus, "international politics, like all politics, is a struggle for power". Power is the central concept that defines the fields of political science and international relations and the central explanatory variable in trying to understand politics and political behavior. Third, the key concept of Realism, "interest defined as power", is "an objective category which is universally valid, but it does not endow that concept with a meaning that is fixed once and for all" (Morgenthau 1993). In other words, individuals and collections of individuals pursue power, defined in terms of interest, and this interest is defined differently for different people at different times.

Following Morgenthau, Kenneth Waltz then builds on *Politics among Nations* and other foundational realist texts to construct what he later called "structural realism" (Neorealism). Waltz agrees with the basic premises stated by Morgenthau and other leading Realism scholars. However, he builds on the Realism foundation by stressing the importance of the global political structure as a powerful force which affects state behavior and international relations. The current global structure is anarchy with no centralized overarching political government. This anarchic global structure differentiates international relations from domestic politics which is hierarchical by nature with the state government as sovereign. The other main aspects of Neorealism as constructed by Waltz are: (1) States are the most powerful units; (2) States are unitary actors "who, at a minimum, seek their own preservation and, at a maximum, drive for universal

domination"; (3) States do not trust each other and thus must rely on themselves which Waltz defines as a self-help system "in which those who do not help themselves, or who do so less effectively than others, will fail to prosper, will lay themselves open to dangers, will suffer"; (4) This self-help system then leads towards the creation of balances of power; (5) A state's position within the global balance of power is determined by the global political structure and the distribution of capabilities (Waltz 2010).

Both Morgenthau and Waltz have been criticized for not defining power more precisely (Keohane 1986). However, for both scholars, the concept of power cannot be defined in exactly one way that applies universally and historically. Both claim power is a means towards an end. For Morgenthau both the means of power and the objective of what a state wants to achieve through power differs across states and time. For Waltz, the objective can be as minimal as survival to the maximum of world domination. States use power in different ways to achieve different objectives at different times. However, both are clear that power is the central explanatory variable to understand politics and political behavior including international relations between state actors.

Neoliberalism arrived later in the scene in the field of IR. It accepts a few basic assumptions of Realism and Neorealism but then differs markedly from the Realism tradition in a number of ways. Neoliberalism is also rooted in a long tradition, in its case the Liberalism tradition which can be traced back to Immanuel Kant, John Locke, Adam Smith and others. These historic figures generally have a more positive view of human nature, the future, and the prospect of human cooperation to achieve common objectives. The core principle of Liberalism in terms of international relations is the idea that the world is becoming more interdependent primarily through the processes involved with economic development, liberalization, and globalization.

The leading figure who is most responsible for developing Liberalism as a theory in the field of international relations is Robert Keohane.

As Keohane describes it in *After Hegemony*, liberal institutionalism (Neoliberalism) sees "cooperation as essential in a world of economic interdependence" in which "shared economic interests create a demand for international institutions and rules". Neoliberalism accepts the premises of Realism that there is a global anarchic structure and states are rational, unitary actors that pursue their self-interest. However, in contrast to Realism, Neoliberalism as conceived by Keohane believes "states build international regimes to promote mutually beneficial cooperation". This is accomplished as "international regimes…reduce transaction costs for states, alleviate problems of asymmetrical information, and limit the degree of uncertainty that members of the regime face in evaluating each other's' policies" (Keohane 2005).

For the purpose of this chapter, two key differences separate Neorealism and Neoliberalism. The first concerns relative vs. absolute gains. From a Neoliberalism perspective international institutions are both an effect and a cause of increasing economic interdependence between states. These institutions help facilitate cooperation and coordination to achieve increasingly shared interests as the global economic system becomes more integrated. These shared interests are referred to as absolute gains in which states are willing to pursue longer term absolute gains even if it means a loss in short-term relative gains on the basis that all will be better off in the long term via cooperation even it means short-term losses (Keohane and Martin 1995).

From a Neorealism perspective this doesn't make any logical sense. In an anarchic world states see themselves first and foremost as competitors for power. As articulated by Mearsheimer in a recent paper states "have little choice but to act according to realist dictates and engage in security competition with each other. Their aim is to gain power at the expense of their

adversaries" (Mearsheimer 2019). Thus states should not be willing to construct and abide by institutions if they lead to a loss of near-term relative gains compared to their competitors. States do not trust other states and do not believe they will offer credible commitments. States are expected to renege on any international agreement whenever it is convenient or their political (geo-strategic) interests change. This should lead states as rational actors to pursue a self-help strategy in navigating a competitive world.

The second main difference between Neoliberalism and Neorealism for the purpose of this chapter concerns the effects of international institutions. From a Neorealism perspective international institutions should have no independent effect as they are basically a reflection of the distribution of global power (Mearsheimer 1994). As described by Stephen Krasner "the nature of international arrangements is better explained by the distribution of national power capabilities than by efforts to solve problems of market failure" (Krasner 1991). States are willing to join international institutions only if they believe it will not harm their relative degree of short-term power and will either have no effect or a positive effect on their power. In other words international institutions "cannot get states to stop behaving as short-term power maximizers" (Mearsheimer 1995).

From a Neoliberalism perspective, international institutions do have independent effects through reducing transaction costs and uncertainty along with developing a legal structure which facilitates cooperation and reciprocity. International regimes help correct so called global market failures through providing a forum for bargaining in relation to the cost of externalities. These international regimes alter the incentive structure which then leads to altering states' perception of self-interest and ultimately their behavior (Keohane 2005).

International Efforts to Limit Climate Change

International efforts to limit global warming officially began in 1992 when the United Nations Framework Convention on Climate Change (UNFCCC) was formed. The stated goal of the UNFCCC was "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system".[14] Every country in the world became party to the UNFCCC. Within the UNFCCC two international agreements have been adopted, the 1997 Kyoto Protocol and the 2015 Paris Agreement.

One of the most important principles of the UNFCCC which has been a core obstacle to international cooperation is the common but differentiated responsibilities clause which separated developed and developing countries in terms of responsibility in limiting global warming. The idea at the time (1992) was that since developed countries were responsible for most of historical GHG emissions then they are responsible for taking the lead and doing more to limit future emissions. In practice this clause doomed international efforts from the start as it was used by developed and developed countries alike to not participate in such efforts.

The Kyoto Protocol embodies this fundamental flaw as it exempted the entire developing world, including rapidly developing China and India, from any binding emissions reductions. It called for developed countries to agree to binding emissions reductions beginning in 2008 (eleven years after the Kyoto Protocol was signed). The United States signed the agreement but then later decided to not participate. A U.S. Senate Resolution passed unanimously on the eve of the signing of the Kyoto Protocol foreshadowed this later decision. The Resolution advised the President of the U.S. (then president Bill Clinton) to not sign the Protocol since it did not include

[14] United Nations, 'United Nations Framework Convention on Climate Change', 9 May 1992, <https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf,> (22 February 2020).

developing countries such as China and India.[15] Canada signed and began participating in the Protocol before later withdrawing. Japan, New Zealand, and Russia participated in the first commitment period that lasted from 2008-2012 but then decided to not participate in the second commitment period which runs from 2012-2020.

The evidence of whether the Kyoto Protocol has led to reduced GHG emissions among participating countries is mixed. Thirty six developed countries participated in the first commitment period which ran from 2008-2012. These countries agreed to reduce their emissions by 5% below 1990 levels. All thirty six countries met and in some cases exceeded these targets. However these targets were met due in large part to three variables that call into question the effectiveness of the Protocol. First, many of the countries that joined the Protocol are former Soviet states which experienced rapid emissions reductions in the 1990s due to deindustrialization before the first commitment period began. Second, the first commitment period coincided with the global recession which began in 2008 and led to a decline in emissions in participating countries for a number of years. Third, the Protocol includes a flexibility mechanism which enables participating countries to buy credits instead of reduce their emissions to meet their commitments. If these three variables are taken out of the equation then very few if any of the countries would have met the 5% target.[16]

The bottom line is global GHG emissions actually accelerated from 1990 to 2012 thus following a business-as-usual pathway (Rosen 2015). The Protocol gave a free pass to developing countries China and India which by the time of the second commitment period had

[15] United States Senate, 'S.Res.98 - A resolution Expressing the Sense of the Senate Regarding the Conditions for the United States Becoming a Signatory to any International Agreement on Greenhouse Gas Emissions under the United Nations Framework Convention on Climate Change', 25 July 1997, <https://www.congress.gov/bill/105th_congress/senate-resolution/98> (22 November 2019).

[16] Michael Le Page, 'Was Kyoto Climate Deal a Success? Figures Reveal Mixed Results', New Scientist, 14 June 2016, <https://www.newscientist.com/article/2093579-was-kyoto-climate-deal-a-success-figures-reveal-mixed results/> (22 November 2019).

become the first and third leading emitters in the world. The exponential growth in China's emissions alone has dwarfed any possible reductions among participating countries. The world's other leading emitter, the United States, did not participate in the Kyoto Protocol. Other leading emitting countries such as Japan, Russia, and Canada withdrew from the Protocol. When everything is taken into consideration it is clear the Kyoto Protocol largely failed to seriously address climate change.

Years of international negotiations to enact a new treaty to replace the Kyoto Protocol when it expires in 2020 led to the 2015 signing of the Paris Agreement. By signing the Agreement, states agreed to limit global warming to "well below 2 °C above preindustrial levels" (hereafter referred to as the two degree pathway). This in turn would require "the widest possible cooperation by all countries, and their participation in an effective and appropriate international response, with a view to accelerating the reduction of global greenhouse gas emissions".[17]

The heart of the Agreement is the pledge and review mechanism. By becoming parties to the Agreement states agree to submit what are called nationally determined contributions (NDCs). Each country determines its own contribution to limiting global warming by submitting five year pledges which include a GHG emissions reduction target and a plan on how it will achieve the target. These pledges are voluntary and there are no compliance or enforcement mechanisms. Every five years there is a so called global stocktake in which the previous pledges are reviewed and countries then offer pledges for the next five year period. These stocktakes are intended to enable more ambitious actions and deeper cooperation over time. One hundred and ninety five

[17] United Nations, UNFCCC, 'Adoption of the Paris Agreement', 15 December 2015, <https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf> (22 November 2019).

countries signed the Agreement and offered pledges. One hundred and eighty nine countries have ratified the Agreement and become official parties.[18]

The Paris Agreement marks a turning point in international efforts to limit global warming in at least two ways. First, it largely sidesteps the common but differentiated responsibilities principle. Nearly every country in the world signed the Agreement and submitted pledges. Second, it represents a more bottom-up approach. The Kyoto Protocol included binding emissions cuts which included compliance and enforcement mechanisms. It also included specific mechanisms on ways in which participating states could comply with the binding commitments. In contrast the Paris Agreement includes no such provisions. Each country offers voluntary pledges which it believes it can realistically attain. It then can attain these pledges however it so chooses as long as it outlines a plan, states a target, and measures its progress. It includes no compliance or enforcement mechanisms and no penalties for states that do not meet their targets. As a result, the Paris Agreement can be described as a broad, shallow international institution in which it exhibits broad participation and weak incentives to alter behavior.

The early signals indicate the Paris Agreement is not having any impact on state behavior and it is highly unlikely it will achieve its stated goal of achieving the two degree pathway. The United Nations' annual assessments have consistently shown that the initial pledges by countries are grossly insufficient to coming even close in reducing emissions consistent with the two degree pathway. The 2018 Report concludes that this emissions gap "has increased significantly in comparison with previous estimates".[19] One independent study shows that all industrialized states are not on track to meet even their insufficient pledges (Victor et al. 2017). Global

[18] United Nations Framework Convention on Climate Change, 'Paris Agreement – status of ratification', <https://unfccc.int/process/the-paris-agreement/status-of-ratification> (19 March 2020).

[19] United Nations Environment Programme, 'Emissions Gap Report 2018', November 2018, <http://wedocs.unep.org/bitstream/handle/20.500.11822/26895/EGR2018_FullReport_EN.pdf> (22 November 2019).

emissions have actually increased since the signing of the Paris Agreement following several years of stabilization of global emissions leading up the signing of the Agreement (partly as a result of the recent global recession). Global emissions increased at a rate not seen in over seven years in 2018. Emissions are expected to continue to increase in 2019 as the global economy continues to expand following the recession that began in 2008 (Le Quéré et al. 2018).

Perhaps most damning for the Paris Agreement is the behavior of the United States. The U.S. is responsible for more cumulative GHG emissions than any other country in the world. It is currently the second leading emitter and one of the two most powerful countries in the world. As is the case with nearly every country, the U.S. submitted an insufficient pledge to achieve the stated goal of the Agreement. Then, following the election of president Trump, the U.S. officially signaled its intent to withdraw from the Agreement. Under the provisions of the Agreement it cannot do so until November 2020 which is coincidentally the same time as the next U.S. presidential election. Therefore it is not clear whether the U.S. will end up participating or not beginning in 2021 which will depend on the results of the November 2020 U.S. presidential elections. However, it is a clear example of the severe limitations of the power of international institutions to alter the behavior of leading state actors.

As this brief overview of the history of international relations concerning climate change up to the present time makes clear, international cooperation has been weak and has had no discernable impact in altering state behavior or on limiting global warming. State actors have been unwilling to create an international institution which would lead to real behavior change and major reductions in atmospheric concentrations of greenhouse gas emissions consistent with a two degree pathway. The major international institution concerning climate change, the UNFCCC, has been weak and ineffectual. According to one common criteria for regime

effectiveness “a regime is considered to be effective insofar as it solves or alleviates the problem it has been established to cope with” (Jovi and Underdal 2018). Under this definition international efforts in general and the UNFCCC more specifically, have been extremely ineffective.

Literature on Climate Change in the Field of International Relations

With few exceptions the literature on climate change within the field of international relations (IR) is implicitly based within a Neoliberalism framework. Rarely does an IR scholar writing on climate change explicitly claim that she/he is basing her/his study on Neoliberalism assumptions or using any theoretical framework for that matter. In fact, the literature on climate change in the field of IR is nearly devoid of theoretical discussion. Many of these scholars would no doubt deny that their work is based within a Neoliberal framework. However, the literature review conducted for this chapter shows that in fact nearly all of the literature on climate change within the field of IR is implicitly based on the core assumptions and logic of Neoliberalism as described earlier in this chapter. As a result, most of this work focuses on regime design (for examples in the literature see Barrett 2003; Esty and Moffa 2012; Falkner 2016; Keohane and Victor 2011; Keohane and Victor 2016; Luterbacher et al. 2018; Rosen 2015; Victor 2011). Following is a brief summary of a few of the most influential examples in this literature.

One of the most comprehensive assessments of international environmental agreements and their implications for efforts to limit climate change is presented by Scott Barrett in *Environment and Statecraft,* published in 2003. In analyzing some three hundred environmental treaties Barrett concludes that “the principal task of a treaty is to restructure incentives” (Barrett 2003, 355). Applying this insight to international efforts to limit global warming Barrett concludes that the Kyoto Protocol failed in part because it has design flaws including lacking an enforcement

mechanism which would alter the incentive structure. He then proceeds to recommend a technology-based approach in which international efforts would focus on spurring a transition away from fossil fuels via cooperation on research and development, technology standards, and a multilateral fund to spread the technology.

In *Global Warming Gridlock*, published in 2011, David Victor provides his own reasons why the Kyoto Protocol failed and offers his recommendations on how to design a more effective regime. He argues that the Kyoto Protocol failed because it took a top-down, rigid approach, with a focus on targets and compliance. According to Victor, a better regime design would be more bottom-up, flexible, and realistic. He proposes a "carbon club" modelled after the WTO which he believes would be much more effective. This club would be comprised of the leading developed countries (Victor 2011). These countries would lead the way in terms of agreeing to reduce GHG emissions.

In a more recent analysis in 2016 following the signing of the Paris Agreement Victor along with Robert Keohane argue that the Paris Agreement is a significant step in the right direction. Although they see it currently as a weak institution that represents shallow cooperation, they believe that over time it will facilitate deeper and more effective cooperation. An important aspect of the Paris Agreement according to Keohane and Victor, is that the pledge and review system enables a more realistic appraisal of state preferences and enables states to ratchet up their ambition and cooperation over time. According to the authors the range of interests reflected in the national pledges include: (1) creating the global public good of reduced climate change; (2) the domestic public good co-benefits associated with reducing domestic greenhouse gas emissions such as public health benefits; (3) the economic co-benefits associated with promoting alternative energy industries; (4) side-payments to help pay the cost of climate

mitigation and adaptation; (5) the reputational benefits of being leaders in global efforts to limit climate change (Keohane and Victor 2016).

In one of the few articles on climate change published in a top tier international relations journal in recent years, Robert Falkner largely agrees with Keohane and Victor's conclusions. In his analysis of the Paris Agreement he concludes that "the Paris climate summit heralds the beginning of a new era in international climate politics, one that offers the chance of more durable international cooperation" (Falkner 2016). Like Keohane and Victor, Falkner sees the Paris Agreement as a more realistic, bottom-up, and flexible framework which has the potential to lead to more effective cooperation. He praises the fact that it moves away from the Kyoto Protocol's mandatory emissions reductions and instead enables state actors to participate by offering what they can realistically achieve in terms of reducing its domestic emissions.

These few examples, which represent most of the literature on climate change in the field of IR, largely ignore power-centered variables that have inhibited international efforts to limit climate change and very likely could inhibit these efforts going forward. They do not offer deeper explanations for why these international efforts have failed up to the present time. In fact, they are not able to do so precisely because they are based within a Neoliberalism framework which does not allow for such an explanation. As noted in the previous section, the Paris Agreement has not led to any discernable reduction in global emissions below a business-as-usual scenario. States offered weak pledges which are not expected to come anywhere close to achieving the stated objective of the Paris Agreement and most states are not on track to even meet these insufficient pledges. The U.S. has signaled its intent to withdraw and meanwhile global emissions have been increasing at record levels since the signing of the Paris Agreement.

The annual emissions gap between what is required to achieve the two degree pathway and the current pathway is growing every year.

A perfect example of this lack of power-centered analysis is the fact that Keohane and Victor's list does not include the variables which have inhibited both state ambition and international efforts up the present time. This assessment of state interests reflected in national pledges for the Paris Agreement ignores the power-based interests that are also no doubt reflected in national pledges for the Paris Agreement. Fossil fuel, geostrategic, and other power-based interests are missing from this list which certainly plays some role in explaining state behavior and international cooperation to limit climate change.

Although nearly all literature on climate change within the field of IR is from a Neoliberalism perspective there are a few exceptions which at least point in the direction of examining climate change from a Neorealism perspective. One such example is a 2006 paper by Frank Grundig which provides a central insight that lays the foundation for why international efforts to limit global warming are best understood within a structural realism framework. Grundig utilizes a game theoretical model and comparative statics to analyze and compare international cooperation concerning climate change, ozone depletion, and international trade. His model predicts that international cooperation concerning climate change should be more difficult compared to ozone depletion and international trade because in the case of climate change the relative gains of climate mitigation are significant (the costs of solving the problem are significant for state actors) and it involves nonexcludable goods (everyone benefits from actions taken by individual states). This differs from ozone depletion which involves nonexcludable goods but does not include significant relative gains considerations (the economic costs of solving the ozone depletion problem are insignificant in terms of a proportion of country GDP).

It also differs from international trade which includes significant relative gains concerns but involves excludable goods. The combination of nonexcludable goods and relative gains considerations is what makes international cooperation concerning climate change so difficult. Grundig concludes his analysis by stating that "the case of global warming falls within the empirical domain of neorealism and that power-based explanations cannot be ignored" (Grundig 2006).

The dominant Neoliberalism analyses in the field of IR laments how states have not designed effective institutions to seriously address climate change but they fail to explain why states have been unwilling to do so up to the present time and why this will change in the future. This lack of deep explanation is due to the core assumptions and logic of the Neoliberalism paradigm on which this literature is grounded. In his analysis of over three hundred environmental treaties presented in *Environment and Statecraft* Barrett finds that nearly all have been ineffective. He finds only a few notable exceptions such as the Montreal Protocol (Barrett 2003). In a 2012 evaluation of the three environmental treaties adopted at the 1992 Rio Summit - the UN Framework Convention on Climate Change; the Convention on Biological Diversity; and the UN Convention to Combat Desertification, all three conventions are given an "F" in terms of effectiveness (Tollefson and Gilbert 2012). International environmental institutions that threaten the core interests of state actors have by and large failed to achieve their stated objectives.

Of course these international regimes have "design flaws" but only Neorealism is able to provide a deeper explanation for *why* these regimes have design flaws. If we examine state behavior and international relations concerning climate change from a Neorealism perspective then the discussion around regime design becomes less relevant and even misguided. For if states act according to the logic of Neorealism then it becomes clear why they have not constructed and

are very unlikely in the future to construct an international institution that would accelerate the reduction of GHG emissions in line with a two degree pathway. From a Neorealism perspective there is no regime design which can alter the underlying structural dynamics that have prevented international efforts to limit climate change from being more successful.

A Neorealism Theory of Climate Change

Conventional Neorealism as constructed by Waltz is better able to explain state behavior and international relations concerning climate change over the last few decades than Neoliberalism. As Neorealism would expect and predict state actors have behaved as short-term utility maximizers who have been more concerned about short-term relative gains over long-term absolute gains. States have been unwilling to commit to an international institution that would mandate and enforce the acceleration of global GHG emissions consistent with a two degree pathway. The UNFCCC has had no independent effect on state behavior but instead has acted to protect and perpetuate the status quo. The most powerful state actors such as the U.S., China, and Russia have treated climate change as a second order issue as they prioritize other issues. States have consistently reneged on past agreements exemplified most glaringly in recent times by the decision of the U.S. to withdraw from the Paris Agreement. Over time international efforts have not improved to address climate change even as both the impacts of climate change have increased and our knowledge of climate change has improved. Neorealism is a much better theoretical framework in analyzing state behavior and interaction concerning climate change than Neoliberalism. A power-centered interpretation of state behavior and interaction concerning climate change is both severely lacking in the field of IR and much needed. As presented in the previous section there has yet to be published a comprehensive explanation of state behavior and international relations concerning climate change from a Neorealism perspective.

However, conventional structural Realism as constructed by Kenneth Waltz is not able to provide a full account of state behavior and interaction concerning climate change. Conventional Neorealism is not able to explain the variation of state behavior and interaction either across units or over time more generally or more specifically as it relates to climate change. It provides an adequate macro explanation of state behavior and outcomes over the last few decades concerning climate change, better than Neoliberalism or any other theory is able to provide. However, it is not able to explain the wide variation of behavior that exists between states and over a longer period of time concerning the issue of climate change for the simple reason that it focuses nearly exclusively on the global political structure as the primary driver that explains international relations. This narrow focus has little explanatory value when trying to explain the variation that exists with state behavior and interaction concerning climate change.

This section thus proposes two developments to conventional Neorealism in order to provide a comprehensive power-centered and structural account of state action and interaction concerning climate change. The first is to place greater emphasis on the relative capabilities of states in explaining state behavior and international relations between state actors. Second, ideology and the natural environment are added to the political structure as the most fundamental structural forces which operate at both the state and global levels. This updated version of Neorealism accepts the core tenants of Realism as developed by Hans Morgenthau and of Neorealism as developed by Kenneth Waltz summarized earlier in this paper. It then adds these new developments. Taken together this updated version of Neorealism is able to provide a dynamic and comprehensive analysis of state behavior and international relations between state actors concerning climate change. These developments of Neorealism are explained in order.

First, it is necessary to place greater emphasis on the relative capabilities of state actors. As noted by many scholars over the years, Waltz's theory places too much emphasis on the global structure and not enough emphasis on the differences between states in explaining state behavior and interaction. Waltz intentionally tried to steer clear of reductionism and so he downplayed the internal characteristics of states which he admitted play some role in how states behave and interact. However, by doing so he constructed a theory which does not explain variation well either across units or over time. The anarchic global political structure has remained static throughout human history and will not change unless a global, sovereign government is formed, which is extremely unlikely in the foreseeable future. Consequently, this constant is not able to explain the wide variation in state behavior across units or over time, especially over longer periods of time. Concerning the issue of climate change there is wide variation in how states have reacted. Furthermore, as climate change becomes a more important issue this variation in state behavior and interaction is increasing over time. The question then becomes what determines the relative capabilities across states? In other words, what explains the variation of power among state actors? This question leads to the second development to Neorealism proposed here. In order to understand and explain the variation in capabilities across states it is necessary to add ideology and the natural environment to the political structure as the most fundamental structural forces that shape state behavior and interaction.

The proposal here is to explain state behavior and international relations through three primary structural forces: the political structure, ideology, and the natural environment. State behavior and international relations is then the result of an interaction of these structural forces which operate at both the unit (state actors) level and global level. Such a model is especially useful when analyzing the issue of climate change. The phenomenon of climate change and state

behavior and interaction concerning this phenomenon can only be understood and explained within this theoretical framework in which the natural and social systems interact at the state and global levels.

The political structure is one of the fundamental structural forces which explain state behavior and international relations. At the global level the political structure is essentially anarchic as is generally recognized and which is emphasized by Neorealism as the driving force behind international relations. This anarchic political structure at the global level no doubt at least partly explains the tragedy of the commons phenomenon that besets so many environmental and other global public good dilemmas including the issue of climate change. In lieu of a global governing authority, sovereignty and thus ultimate power, lies with state actors. As explained by conventional Neorealism this "state of nature" that exists at the global level leads states to see themselves first and foremost as competitors. States then do not trust each other; they are expected to renege on any agreements; and actors focus on relative gains. This dynamic leads to the tragedy of the commons as explained by Garrett Hardin and the Prisoner's Dilemma as explained by game theory.

However, this one variable cannot account for the wide variation that exists concerning state behavior and interaction. There have been many cases in which cooperation has developed within conditions of an anarchic system whether it be at the global level among state actors or local and regional levels (Barrett 2003; Ostrom 1990). Conventional Collective Action Theory also cannot adequately explain why actors behave differently within these anarchic conditions (Ostrom 2010). There must be other variables involved which help explain this variation that exists concerning unit level behavior and interaction between units in a system.

For example, at the state level variations in political structure help explain the relative capabilities between states. This political structure in the form of a political constitution (or lack thereof), laws, norms, and political institutions plays an important role in interacting with the other structural forces which explain state behavior and international relations. Whether a political system is an authoritarian regime, democracy, theocracy, or some other regime in part determines its behavior and interaction with the rest of the world. Ditto for whether it is a strong, failing, or failed state. Many other aspects of a state's political system impact its behavior, ability, and willingness to cooperate with other state actors concerning such issues as climate change.

Ideology also plays a fundamental role in explaining state behavior and international relations. For the purpose of this paper ideology is defined as encompassing "all relatively coherent sets of cultural symbols-ideas, beliefs, and attitudes that are action oriented and whose function it is to interpret the political system and to direct and justify public policy". In this way ideology "shapes understandings or misconceptions of the social and political world" (Freeden 1998). Ideology plays a number of political and social functions in a society including integration, distortion, and legitimation (Ricoeur 1986). In any given society political ideologies compete for the right to govern. Ideology has been a fundamental defining force since the dawn of human civilization and the struggle for power that defines politics in general and world politics in particular is in many ways a struggle between competing ideologies.

Since the end of World War II the Liberalism ideology has increasingly dominated world affairs. For the purpose of this Dissertation Liberalism refers to the philosophical tradition as originally constructed by John Locke, Adam Smith, and other predominately British and American philosophers and intellectuals in the 17th through 19th centuries. The core values of

Liberalism include an emphasis on individual rights and liberties, secularism, private property, limited government, laissez-faire/free-market capitalism, and economic growth. Liberalism and Capitalism have co-evolved as they feed off of each other and share many of the same fundamental values. The global economic and political systems reflect core Liberalism/Capitalism values represented by international institutions such as the World Trade Organization, World Bank, International Monetary Fund, Organization for Economic Cooperation and Development, and the United Nations. There are of course other major ideologies that are dominant in various regions and states throughout the world including communism, socialism, and Islam. But at the end of the day the global economic and political systems are largely governed by the Liberalism/Capitalism ideology.

There are many moral, social, economic, and political facets to this Liberalism/Capitalism ideology, a few of which were just mentioned. However two core principles of this ideology are most important concerning the issue of climate change and so are highlighted here. The first is the economic growth/development imperative that lies at the center of Capitalism. One of the core principles of Capitalism is the necessity of growth. For Capitalism to survive it has to grow. If it does not then it begins to self-destruct via recessions and depressions. As a result of this growth imperative within the global economic system one of the top priorities for most state actors is to maximize economic growth. This growth imperative is critical for state survival at one end of the spectrum and the global balance of power at the other end of the spectrum. The more a state grows the more wealth and power it attains and the better it is able to improve its position of power and influence on the world stage.

This economic growth imperative has so far had a co-dependent relationship with population growth. Both population and economic growth have grown in tandem since the onset of the

industrial revolution as they feed off of each other in a symbiotic relationship. Since the onset of the industrial revolution, which was facilitated and has been sustained by the Liberalism/Capitalism ideology, the world has experienced exponential growth in both population and industrial output. This exponential growth in global population and industrial output are the two main causes of the global warming crisis. It is telling that international efforts to limit global warming do not even mention these two principle causes of global warming as a serious reckoning of this fact would then lead to a fundamental questioning of the Capitalism/Liberalism world order.

The second core principle of the Liberalism/Capitalism ideology most relevant to the issue of climate change is the idea of the "invisible hand" proposed by Adam Smith in the Wealth of Nations. As described by Garrett Hardin in his classic essay *Tragedy of the Commons* Adam Smith "popularized the 'invisible hand,' the idea that an individual who 'intends only his own gain,' is, as it were, 'led by an invisible hand to promote…the public interest'" (Hardin 1968). According to Hardin this core idea of liberalism "has ever since interfered with positive action based on rational analysis, namely the tendency to assume that decisions reached individually will, in fact, be the best decisions for an entire society". Hardin goes on to explain how this core idea of Liberalism has led to a justification for the expansion of laissez-faire capitalism throughout the world.

Hardin then illustrates how this core idea of Liberalism/Capitalism contributes to the tragedy of the commons. As he famously puts it:

> Each man is locked into a system that compels him to increase his herd without limit – in a world that is limited. Ruin is the destination toward which all mean rush, each pursuing

> his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all (Hardin 1968).

As this quote suggests, international institutions guided by these core principles of Liberalism are powerless to prevent the tragedy of the commons outcome precisely because they are unable to correct the fundamental causes of this tragedy which are exponential growth of population and economic development, both of which are fundamental values of the Liberalism/Capitalism paradigm. This dynamic forms the foundation of the Paris Agreement. The Agreement does not mention population or economic growth. The idea of the invisible hand then finds its expression in the pledge and review mechanism that is at the heart of the Paris Agreement and is now the official logic of global efforts to limit climate change. Hardin's quote about the invisible hand accurately describes the logic of the pledge and review mechanism.

The other fundamental structural force that largely determines state behavior and interaction besides the political structure and ideology structure is the natural environment. All natural and human systems operate within this global natural environment. Any purported systems theory must include the natural environment as a defining structural characteristic. By leaving this critical structural aspect of human behavior and relations out, Waltz's structural realism theory is not a true systems theory (Tang 2013). The competition over and exploitation of natural resources has been one of the driving forces throughout human history. Empires and civilizations throughout the world have risen and fallen in part due to their control or loss of control over natural resources. Geography has both enabled and constrained world powers throughout history. Without understanding the fundamental role the natural environment plays one cannot begin to explain state behavior and international politics at the systemic level.

At the state level the natural environment includes a state's overall geography and climate including its size, natural resources, and location. These relative characteristics play critical roles in determining the relative capabilities of state actors across units and over time. Jared Diamond is most responsible for improving our understanding of the critical role geography has played in explaining the variation of human development throughout history (Diamond 1998). Concerning the issue of climate change the relative degree of fossil fuel reserves and a state's relative degree of dependence on such fossil fuel reserves could potentially play important roles in explaining the variation of state behavior. This link is examined at length throughout the rest of this Dissertation.

At the global level the natural environment plays a fundamental role as it relates to everything including state behavior and interaction concerning climate change. The global natural environment includes renewable and non-renewable natural resources; positive and negative feedback loops; and natural laws and limits. Within this global natural environment all natural and human systems interact in a complex web of a global ecosystem. The phenomenon of climate change and state behavior and interaction concerning climate change must be understood within this global environmental structural context. The dynamic of climate change and human behavior and interaction concerning climate change are the result of these feedback mechanisms and interactions within this global natural environment.

In 1972 *Limits to Growth* (LTG) was published which presents the findings from research conducted by a team of scientists at MIT. The scientists use systems dynamics theory and computer modeling to analyze the long-term causes and consequences of growth in the world's population and material economy (Meadows et al. 2004). The team model twelve different scenarios based on different assumptions about how growth in population and natural resource

use interacts with a variety of ecological limits. The baseline model depicts a business-as-usual (BAU) scenario in which the historical trends up to that time continue with no major changes in course direction. This scenario predicts that at some point in the middle of the twenty first century natural resource constraints will lead to a collapse as a result of "humanity having to divert more and more capital to cope with the problems arising from a combination of constraints" (Meadows et al. 2004). Such a collapse would then lead to "failing health, conflict, ecological devastation and gross inequalities" as well as a prolonged decline in global population and economic production.

Recent analysis has found that we are largely following the LTG BAU scenario. A thirty year update published in 2002 by the original authors show that the world has largely followed the LTG baseline scenario up to that time. According to a more recent analysis conducted in 2014 "data from the forty years or so since the LTG study was completed indicates that the world is closely tracking the BAU scenario (Turner 2014). Another analysis published in 2012 concurs, finding that "the real world has followed the business-as-usual scenario in LTG" (Randers 2012).

If we continue to follow this baseline LTG scenario and such a collapse of the global economic system occurs at some point during this century as predicted by the LTG baseline scenario which we have so far followed then this would have profound implications on all human and natural systems throughout the world. Such a scenario would most certainly have major effects on the other two global structural dynamics – ideology and global political structure. It could conceivably lead to a collapse of the Liberalism/Capitalism world order. It could also lead to a fundamental transformation of the global political structure. Or then again it could do neither or one or the other. It is impossible to predict how such a scenario would play out in the real world. Such a collapse would also no doubt have a major direct impact on global

emissions. However, even if such a dramatic collapse of the global economic system does not occur, if the world continues to follow a BAU pathway then there will certainly be major ecological effects that will undoubtedly have major repercussions for the world's economic and political systems. We are just beginning to see this process play out at the present time.

Taken together, these three developments of conventional structural Realism enable a more comprehensive explanation of state behavior and interaction both across units and over time. The three fundamental structural forces: the political structure, natural environment, and ideology operate and interact at both the global and state levels in determining state behavior, their relations, and the outcomes of these relations. Concerning the issue of climate change it enables a more comprehensive explanation of the variation of state behavior and interaction both across units and over time. This Neorealism framework also enables an analysis of the geostrategic aspects of climate change. Such geostrategic considerations of climate change have been largely ignored within the field of international relations which is at least in part due to Liberalism's monopoly over climate change diplomacy and scholarship.

Few works have explored the geostrategic aspects of climate change. Anthony Giddens, a prominent sociologist, provides one of the only extensive discussions of the geopolitics of climate change in his 2009 book *The Politics of Climate Change* (Giddens 2009). While Giddens provides a general discussion of the different geopolitical considerations involved with climate change, he does not provide an in depth and detailed analysis of the relationship between fossil fuel interests, state behavior, and the effectiveness of international institutions that address climate change since it is primarily a work of sociology rather than political science or international relations. Michael Klare, an IR scholar who has written extensively on the geopolitics of energy more generally, focuses on the geopolitics of climate change in his new

book *All Hell Breaking Loose:The Pentagon's Perspective on Climate Change* (Klare 2019). However Klare's book focuses on the national security implications of the impacts of climate change and other environmental change which have been more widely covered in the literature (Matthew 2011).

The Neorealism theory of climate change developed in this chapter enables a more comprehensive and deeper geopolitical analysis of climate change. Here, two such geopolitical aspects of climate change are highlighted which thus far have received scant attention in the IR literature. First, international efforts to limit global warming threaten the core geopolitical interests of many states throughout the world. Second, climate change will likely have some power enhancing effects for some key state actors such as Russia. These two considerations are discussed in order.

No IR scholar to date has provided an extensive study of the geopolitical implications of global efforts to drastically reduce and eventually eliminate the use of fossil fuels within this century. If international efforts to drastically reduce fossil fuels are successful, how would this reduction and eventual elimination of fossil fuels in such a short period of time affect various states' power and the global balance of power? In the language of Neorealism, how would achieving or even coming close to achieving this objective, impact different states' relative capabilities, state power, and by extension the global balance of power? Such a transformation of the existing global economic system would no doubt have major effects on state power and the global balance of power. Fossil fuel production is a major component of many states' geostrategic power.

When considering these implications it becomes clear why any comparison to international efforts to address the hole in the ozone layer is not useful. International efforts to address the

ozone layer are oftentimes held up as a model of international cooperation which has largely been successful. However, as pointed out earlier these two issues are fundamentally different. International efforts to address the hole in the ozone layer involved an insignificant component of the global economic system whereas global warming strikes at the heart of the global economic system. Reducing GHG emissions in line with a two degree pathway threatens the core strategic interests of many of the most powerful states in the world. Many countries throughout the world depend on the extraction and sale of fossil fuels for their economic well-being and geostrategic power. The development of fossil fuels has literally fueled the rise to power of many states throughout the world. The fossil fuel industry is one of the largest and most powerful industries in the world. Global efforts to reduce and eventually eliminate fossil fuels threaten some of the most powerful state and nonstate interests in the world.

Leading up to the September 2019 UN Climate Summit in New York City United Nations Secretary-General Antonio Guterres called on world leaders to offer plans to reduce their state's GHG emissions by forty five percent over the next decade, and to near zero emissions by 2050. According to the Secretary-General such immediate and drastic reductions are necessary in order to achieve the two degree pathway world leaders agreed to when signing the 2015 Paris Agreement.[20] Achieving such an incredible feat would lead to major reductions in the production and sale of fossil fuels throughout the world over the next few decades. This would then have a major impact on countries that have significant dependence on the fossil fuel industry or that have been captured by the fossil fuel industry politically and/or economically.

This central obstacle to limiting global warming becomes clear when considering the three most powerful countries in the world that comprise the current global balance of power: the U.S.,

[20] Antonio Guterres, UN Secretary General, press release for the Climate Action Summit 2019, 23 September 2019, <https://www.un.org/en/climatechange/assets/pdf/CAS_main_release.pdf> (9 January 2020).

China, and Russia. These three states are collectively responsible for 50% of global GHG emissions. They are also the top producers of coal, natural gas, and oil.[21] This domestic fossil fuel production has been an important source of each state's rise to power and ability to sustain their power. All three states have shown little to no interest in leading international efforts to accelerate the reduction of GHG emissions consistent with a two degrees pathway. Instead, all three have prioritized the domestic development of fossil fuels as part of their core geostrategic interests.

The second geopolitical aspect of climate change which has received little attention in the IR literature is the potential power enhancing effects of climate change. Climate change is widely depicted as a negative development that is bad for everyone. However, recent research indicates the future effects of climate change are likely to be highly asymmetrical which is having and will have very different effects on various regions and populations throughout the world (Burke et al. 2015; Ricke et al. 2018). These recent reports indicate that some countries in the northern latitudes for example may experience net benefits in terms of economic production over the next few decades. As stressed in the previous chapter of this Dissertation there is much uncertainty and complexity surrounding any projections of the impacts of climate change decades into the future. Nonetheless there is no doubt there will be some benefits of climate change for some state and nonstate actors in the coming years and decades which have received little to no attention and which could have major consequences concerning global efforts to limit climate change.

For example, it is quite possible the warming of the Arctic could actually enhance the power of Arctic states such as Russia, the U.S., Norway, and Canada as thawing ice will expose valuable minerals and open the fabled Northwest Passage both of which have major implications

[21] British Petroleum, 'Statistical Review of World Energy 2019', June 2019, <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html> (18 February 2020).

in terms of geopolitics, wealth, and power. Russia has done the most to position itself for possible benefits of a warming Arctic. It is in the process of building a massive infrastructure in the Arctic to explore and export fossil fuel deposits that are being exposed as a result of climate change.[22] It now maintains twenty seven operational military bases above the Arctic Circle. It lays claim, much of it disputed, to the most territory in the Arctic compared to other states. Some are warning of a potential new Cold War over the Arctic. In a 2019 speech at a meeting of the Arctic Council U.S. Secretary of State Mike Pompeo stated "the Arctic is at the forefront of opportunity and abundance". He then asked rhetorically "Do we want the Arctic Ocean to transform into a new South China Sea, fraught with militarization and competing territorial claims?"[23] Such remarks by global leaders highlight the competitive nature of international relations among superpowers much of which revolves around geostrategic considerations. The impacts of climate change will no doubt have major geostrategic implications in the coming decades which once again have received little attention in the IR literature.

Conclusion

This paper has shown how state actors have been unwilling to seriously address climate change up to the present time. The United Nations Framework Convention on Climate Change (UNFCCC) has been impotent in altering the fundamental structure that underlies the global warming collective action dilemma. The Kyoto Protocol has had no significant impact on global emissions. The latest international agreement on climate change, the 2015 Paris Agreement, is a weak institution that has so far not fared any better. It does not include any serious incentives

[22] Joel Bourne, 'See Russia's massive new gas plant on the Arctic coast', National Geographic, 22 March 2019, <https://www.nationalgeographic.com/environment/2019/03/sabetta-yamal-largest-gas-field/#close> (9 January 2020).
[23] Neil Shea, 'Scenes from the new Cold War unfolding at the top of the world', National Geographic, 8 May 2019, <https://www.nationalgeographic.com/environment/2018/10/new-cold-war-brews-as-arctic-ice-melts/> (9 January 2020).

that would lead to behavior change by the most important state actors. Leading states continue to pursue what they perceive to be in their best short-term interest in terms of national security and geopolitics which has not included prioritizing climate change over other more pressing national security concerns. These states have clearly prioritized short-term relative gains over long-term absolute gains.

As the theoretical foundation on which both diplomacy and scholarship on climate change have been built, Neoliberalism has clearly failed to lead to an adequate response to climate change and explain the reasons for this failure. The core assumptions of Neoliberalism fail to address the strategic and power calculus of state actors throughout the world which has been the primary obstacle to seriously reducing global concentrations of emissions in line with what climate scientists say is necessary to avoid the worse effects of climate change. The expectations and logic of Neoliberalism have not been met in the real world of state actors who are primarily concerned about their short-term, relative power and security which at least so far has not included climate change as a first order national security priority.

This chapter builds on the Neorealism framework to develop a Neorealism theory of climate change. This theory adds ideology and the natural environment as fundamental structural forces that along with political structure enable and/or constrain the behavior of actors. It then places greater emphasis on the distribution of capabilities part of the Neorealism equation in explaining the behavior and interaction of state actors. This revised theory of Neorealism is better able to explain state behavior and international relations concerning climate change. These structural dynamics at both the state and global levels have consistently inhibited international efforts to limit climate change. Using this framework to analyze international relations concerning climate

change makes clear that in order for real and enduring cooperation to occur, there would need to be a major change in the underlying structural dynamic.

Due to Neoliberalism's monopoly over the climate change discussion in terms of both diplomacy and scholarship, the geostrategic implications of climate change and efforts to limit climate change have barely been considered in the international relations literature. This chapter has sketched a brief outline of what such an analysis would consider. The next chapter of this Dissertation continues this line of inquiry by examining the role fossil fuel dependence plays in explaining state behavior and interaction concerning efforts to limit climate change.

3

The Elephant in the Room

Fossil fuel interests and climate change policy performance within a Neorealism framework

Introduction

It is widely acknowledged that international efforts to limit global warming have up to the present time had little real impact on global emissions (Keohane and Victor 2016). At the same time countries throughout the world have taken varying levels of action both domestically and internationally to reduce greenhouse gas emissions. These two realities lead to two basic questions which this chapter seeks to answer through a Neorealism framework. First, why have international efforts to limit climate change failed? Second, what explains the variation of climate mitigation action between countries? This chapter presents the findings from a cross-national quantitative analysis which attempts to answer these two questions. The analysis tests the hypothesis that fossil fuel interests play an important role in explaining why international efforts to limit climate change have failed and the variation of climate mitigation efforts between countries.

The global economic system as a whole still largely depends on fossil fuels. Eighty percent of the world's energy demand is met by fossil fuels, a number which has held steady for the last thirty years.[24] Thus, the entire world has some degree of "fossil fuel interest". The world continues to largely depend on a cheap supply of fossil fuels for economic growth. Maintaining relatively low fossil fuel prices is a national priority for many if not all countries throughout the world. However, these interests do vary throughout the world. Even within the fossil fuel industry itself and between the various fossil fuel producers, interests vary widely. In terms of

[24] The World Bank, Data Bank, <https://data.worldbank.org/indicator/eg.use.comm.fo.zs> (18 February 2020).

state actors, fossil fuel interests can take several different forms. First, states may depend on a cheap supply of fossil fuels for national GDP growth. Second, states may depend on the income derived from the domestic production of fossil fuels. Third, states may derive global power if it supplies a substantial amount of fossil fuels to other countries and parts of the world which then become dependent on them. Fourth, in free-market liberal countries the fossil fuel industry may influence the political system to pursue a course that is in its interests and in some cases "capture" the state so that it protects and promotes its agenda even at the expense of other interests within the state.

This chapter focuses on a country's degree of fossil fuel production and how this degree of production impacts its relative capabilities in terms of both state power and climate change mitigation policies. Two primary hypotheses are tested here: First, that fossil fuel production levels are correlated with state power. Second, that fossil fuel production levels are correlated with climate mitigation policy performance. Furthermore, it is argued that these two relationships are linked and largely explain why international efforts have failed to limit climate change.

Presumably, states which have the strongest fossil fuel interests along these lines are likely to be the least ambitious in terms of pursuing climate mitigation both domestically and globally. From the standpoint of short-term self-interest these states have every incentive to maintain the status quo for as long as possible. For many countries throughout the world the economic and political benefits they receive from the fossil fuel industry is considerable and in some cases even critical to their degree of economic and political power. States which have the strongest fossil fuel interests should display worse climate policy performance.

Although it is widely understood that this fossil fuel interest is a major obstacle to achieving global cooperation to limit climate change, it has not received the attention it deserves by

scholars within the field of international relations (IR). Many studies mention fossil fuel interests or use it as a control variable, but it has not received the degree of sustained, comprehensive examination which it should receive. This lack of focus on fossil fuel interests is in part due to the fact that nearly all climate scholarship is conducted within a Neoliberalism framework. Realism scholars have mostly stayed on the sideline in scholarly discussions concerning climate change. One consequence of this is a lack of focus on the power-based considerations of state actors which inhibits climate mitigation at both the domestic and international levels.

Literature Review

Scholars in various fields have offered a number of theories to explain the variation in environmental and climate change policies among state actors. Theories include the Environmental Kuznets Curve (EKC); the democracy effect; modernization theory; the vulnerability hypothesis; and the co-benefits thesis. Less attention has been paid to power-based explanations such as the role fossil fuel interests and geostrategic interests play. Each of these explanations in the literature is considered in order.

One of the most common explanations for variation in environmental policies more generally among states is the Environmental Kuznets Curve (EKC). The EKC is derived from the original Kuznets Curve hypothesis proposed by economist Simon Kuznets which posited that economic inequality increases when an economy goes through the beginning stages of economic development but then decreases during latter stages of development (Kuznets 1955). Economists Gene Grossman and Alan Krueger then applied the logic of the Kuznets Curve to hypothesize a similar relationship between economic development and environmental effects (Grossman and Krueger 1991).

According to the Environmental Kuznets Curve (EKC) hypothesis there is an inverted U shape relationship between economic growth and pollution. The rise in emissions is due to an increase in economic activity as the state begins to develop. At some point in the developmental process emissions then begin to decrease. This is presumably due to a number of factors including increasing efficiency and greater public demand for stricter controls on emissions which occur along the developmental process (Cole et al. 1997). This theory posits that "at some stage of development citizens demand and government is able to deliver pollution control and conservation" (Fiorino 2011). The EKC theory is essentially an optimistic view of economic development in that it assumes environmental awareness and protection is an inevitable outcome of economic development. Developed countries should be more concerned about the environment and demand that their government protect the environment. The EKC hypothesis has been proposed within the Neoliberalism paradigm in which economic liberalization should lead to both democratization and improvement in environmental outcomes (Arrow et al. 1995)

The empirical record of the EKC hypothesis is mixed at best (Fiorino 2011). There is evidence of the expected inverted U relationship between increasing income per capita and certain local air pollutants. According to some studies air and water pollution tend to increase until it reaches a particular threshold at which point local air and water pollution begins to decline (Dasgupta et al. 2002). However, the evidence does not support the EKC for many other environmental impacts including CO2 which is invisible and does not have an immediate direct impact (Cole et al. 1997). Others have criticized the EKC hypothesis for not taking into consideration other factors which may explain the apparent inverted U curve. For one, it is possible that as countries develop they are merely outsourcing their pollution to less developed countries. Second, most developed countries overall environmental impact is much higher than

less developed countries. The most developed countries in the world have the highest per capita ecological footprint. Even if these developed countries do enact local environmental regulations to reduce local air and water pollution, the overall global environmental impact of these developed countries is much worse than less developed countries (Arrow et al. 1995).

Another line of research to explain differences in climate mitigation efforts across countries is the democracy hypothesis. According to this theory more democratic countries tend to be more responsive to environmental concerns; better constrain powerful interest groups including the fossil fuel industry; and are more effective and accountable in carrying out climate change policies. The argument that democracy improves national environmental performance rests primarily on two basic assumptions. First, in well-functioning democracies there is both a strong civil society along with civil freedoms and a free flow of information which enables citizens to be well informed and provides plenty of opportunities for citizens to demand government action to address environmental problems and concerns (Frederiksson and Wollscheid 2007; Neumayer 2002; Payne 1995). Second, democracies are assumed to produce more effective governance, including a strong and professional civil service, a strong and independent legal system, and more accountability (Esty and Porter 2005; Pellegrini and Gerlagh 2006). These assumptions lead to the expectation that more democratic countries exhibit stronger environmental policies including policies to address climate change.

Cross-national quantitative studies have produced mixed results in terms of the effect democracy has on climate change policies and greenhouse gas emissions (Fiorino 2011). For the dependent variable, these studies use various indicators such as commitments to international climate change agreements, policy commitments to reduce or limit greenhouse gas emissions, and greenhouse gas emissions levels and trends. For example, Michelle Battig and Thomas

Bernauer conduct a comparative analysis of 185 countries in which they examine the effect of democracy on both climate change policy output and policy outcomes. They define policy output as commitments to reduce greenhouse gas emissions and policy outcome as actual emission reductions. They find the effect of democracy on policy output is significantly positive and the effect of democracy on climate change outcomes is ambiguous. The authors conclude more research is needed to explore this difference between policy output and policy outcome when assessing the relationship between democracy and climate change as most studies only analyze one or the other (Battig and Bernauer 2009).

Another theory which combines elements of the economic development and democracy theories in attempting to explain the variation of environmental policies across countries is modernization theory. Based on the work of Max Weber and Talcott Parsons, modernization theory attempts to explain the developmental process societies undergo from agrarianism to industrialization to post-industrialization. Political Scientist Ronald Inglehart then developed a version of this theory beginning in the 1970s which has influenced much of the modernization literature in the field of social science ever since. Inglehart argues increasing levels of economic and physical security lead to increasing levels of what he terms post-materialist values which emphasize among other values environmental protection (Inglehart and Norris 2017). According to this theory, societies that exhibit higher levels of values associated with Liberalism tend to exhibit sustainable development (Welzel 2013). This theory developed by Inglehart and others is based on the World Values Survey which attempts to assess and compare the values of individuals and societies across countries.

This particular theory is not tested in the analyses presented in this chapter due to two reasons. First, it is questionable whether the World Values Survey is able to truly compare these

values across countries (Sokolov 2018). Values such as freedom and democracy are defined differently throughout the world. What democracy or freedom mean in one culture does not have the same meaning in other cultures. The subjective and relative aspects of the results of the survey calls into question their explanatory value. Second, measurements for democracy and economic development capture the core of the modernization theory. The analysis conducted for this study uses economic development and democracy variables as proxies to measure any potential modernization effects on the variation of climate change policy performance across countries.

Another possible explanation for the variation in GHG emissions levels and climate policies between countries is the degree of vulnerability a country faces. Presumably, countries that are more vulnerable to climate change would be more motivated to help lead global efforts to limit climate change. These countries have a clear self-interest to be part of the solution to global warming. Indeed, there are some low-lying nations whose very survival is at risk due to rising sea levels which is one of the effects of global warming. Other reports indicate some parts of the world may become too hot for human habitat by the end of this century (Pal et al. 2016). Many other countries face extreme threats from the various impacts of climate change. At the same time, new reports indicate some parts of the world may actually benefit in some respects from climate change. One prominent study finds wide variation in the effects of global warming on economic production. According to the authors, Canada, much of Europe, and Russia will actually benefit from global warming while the United States, China, Australia, and Argentina will suffer less economic damages from climate change than Africa, India, the rest of Latin America, and the Middle East which are projected to suffer the worst economic damage as a result of climate change (Burke et al. 2015).

Empirical studies have generally not provided evidence to support the vulnerability hypothesis. For example, a 2012 study by Tubi et al. which examines over 90 countries between 1990 and 2011 finds there is not a link between vulnerability and climate change mitigation policies. The authors examine both the impacts of climate change and adaptive capacity on climate mitigation policies. The impacts of climate change are found to have no effect on climate mitigation policies. Adaptive capacity is found to have a positive impact on the level of declared policy but this impact disappears when policy implementation is taken into consideration. The authors suggest part of the explanation for this lack of a link between vulnerability and climate mitigation policies is the high level of uncertainty involved with the assessment of vulnerability (Tubi et al. 2012). If true, this would mean the vulnerability hypothesis fails for much the same reason why the EKC hypothesis fails – the lack of a local, clear, direct, and immediate impact of increasing concentrations of GHG emissions in the atmosphere.

In addition to the Environmental Kuznets Curve, vulnerability, and democracy hypotheses, scholars have also suggested other motivations that may lead some countries to take more ambitious climate mitigation action. A 2016 article in Nature Climate Change by leading IR scholars Robert Koehane and David Victor list five interests which they argue are reflected to some degree in the national pledges to the 2015 Paris Climate Agreement: (1) Willingness to pursue the global public good; (2) the co-benefits of reducing pollutants such as black carbon which cause both local health problems and global warming; (3) the economic benefits of creating new low-carbon industries; (4) side-payments among developing countries to help pay for adaptation and mitigation efforts; (5) reputational benefits associated with being a global leader in providing a global public good and on the flip side the negative stigma associated with not cooperating on an important global issue. Such “soft power” is thought by some scholars to

be an important consideration for some countries which help explain their behavior (Keohane and Victor 2016).

While the Environmental Kuznets Curve, democracy, vulnerability, and co-benefits hypotheses are all plausible variables that may impact the variation of climate mitigation between countries, it would seem reasonable to expect that fossil fuel dependence is another variable that would explain at least some of the variation of climate policy performance between countries and lack of international cooperation to mitigate climate change. If states are assumed to be rational actors then those states which are more dependent on fossil fuel production would be expected to be less likely to participate in global efforts to reduce and eliminate the fossil fuel industry since this would result in a loss of wealth and power for these countries. If this is true than any efforts to mitigate climate change that does not address this central obstacle would seem to be doomed for failure since it would be impossible to seriously address global warming without the cooperation of the states that have the biggest stake in maintaining the status quo. This is the definition of the tragedy of the commons phenomenon Hardin articulated in 1968 as it relates to environmental issues more broadly (Hardin 1968).

Another way of thinking about this relationship is the so called "resource curse", a well-documented phenomenon in the fields of economics and political science (Auty 1994; Sachs and Warner 2001). In his 2012 book *The Oil Curse: How Petroleum Wealth Shapes the Development of Nations,* Michael Ross presents an extensive analysis of how petroleum wealth negatively affects a country's economic, social, and political development. In a later review of the hundreds of studies that have been conducted on the resource curse Ross concludes there is strong evidence that petroleum "has at least three important effects: It tends to make authoritarian regimes more durable; it leads to heightened corruption; and it helps trigger violent conflict in

low-and middle-income countries" (Ross 2015). In yet another study, Ross along with Erik Voeten finds "the more a country depends on oil exports, the less engaged it is in institutionalized cooperation (Ross and Voeten 2016).

The "carbon lock-in" complex is another way of examining this phenomenon. Gregory Unruh developed the concept of carbon lock-in to describe industrial economies that "have become locked into fossil fuel-based technological systems through a path-dependent process driven by technological and institutional increasing returns to scale…arises through a combination of systematic forces that perpetuate fossil fuel-based infrastructures" (Unruh 2000). This condition leads to inertia and ultimately a "techno-institutional complex" in which the status quo prevails and prevents transitions to other less environmentally destructive energy systems. Numerous scholars have written about path-dependency in different contexts and how such path dependency leads to inertia (Pierson 2000). In the context of climate change scholars have identified a number of factors that contribute to carbon lock-in which include infrastructural and technological, institutional, and behavioral (Seto et al. 2016). These forces interact to ensure the continuation of the status quo and delay change to the energy system.

Considering efforts to limit global warming are fundamentally about reducing GHG emissions that primarily come from the burning of fossil fuels, one would expect the literature to be filled with numerous studies that focus on the role fossil fuel dependence plays in explaining variation of climate mitigation across countries and the lack of international cooperation to limit global warming. So it is surprising that, much like the common phenomenon of the elephant in the room, in much of the literature the issue of fossil fuel interests is normally acknowledged as a central issue but rarely directly addressed at least in any focused, comprehensive, or sustained way. The previously cited paper by Keohane and Victor barely mentions fossil fuel interests as a

major obstacle for global cooperation to limit global warming. Both Keohane and Victor are leading scholars in the field of international relations on the issue of climate change. Their 2016 paper represents much of their research on climate change. Neither has focused their attention in their research on the role played by fossil fuel interests in inhibiting global cooperation. Victor's influential 2011 book *Global Warming Gridlock* barely mentions fossil fuel interests (Victor 2011). Similarly, Keohane and Victor's influential 2011 paper *The Regime Complex for Climate Change* scarcely mentions this central obstacle to solving climate change (Keohane and Victor 2011). Perhaps it is obvious that fossil fuel interests are the primary obstacle to achieving international success in limiting global warming but this only means that focus should be directed to this central obstacle, not that it should be largely ignored as is the case in much of the literature.

Cross-national quantitative analyses similarly tend to downplay the role fossil fuel interests play in effecting climate policies and implementation. No cross-national quantitative study found for this literature review focuses on the role fossil fuel interests play in the variation of climate mitigation across countries. A number of studies include a variable for fossil fuel interests in the analysis either as a control variable when focusing on some other variable or as a single variable in a multivariate analysis that looks at a number of variables together. In nearly every case the relationship between fossil fuel interest and climate mitigation is positive and significant as would be expected. However, in most studies this relationship is normally mentioned in passing or not at all as the author(s) focus on other findings from the studies. The authors then usually conclude their studies by largely ignoring the relationship between fossil fuel interest and climate mitigation.

A case in point is a 2013 article titled *Drivers of National Climate Policy*. The authors attempt to explain variation of national climate policy performance across countries. They group possible explanations into four categories: (1) variation in institutional form of country-level governance regimes; (2) patterns of dependence on fossil fuel energy; (3) broad systemic differences among states; (4) variations in the traditions of economic intervention by states. The authors then analyze the effects of these variables on climate policy performance before and after the adoption of the Kyoto Protocol. They find that compared to the other factors, fossil-fuel dependence has the largest impact on climate change policies. However, the authors then proceed to spend only a single, short paragraph acknowledging this fact in the analysis section and then barely mention it in their conclusion. The authors continuously refer to the "geopolitics of climate change" but they do not focus on the role fossil fuel interests play in this geopolitics of climate change (Lachapelle and Paterson 2013). Much like the rest of the literature, the authors acknowledge the elephant in the room before proceeding to largely ignoring it in both their analysis and conclusion. This same phenomenon is found over and over in cross-national analyses on climate change.

Theory and Hypotheses

The rest of this chapter examines state behavior and international relations concerning climate change from a Neorealism perspective. Neorealism is based on three basic principles. First, the primary concern of states is power. This objective of power ranges from mere survival to global dominance. Second, the global anarchic structure is of primary importance in explaining state behavior and interaction. Third, the anarchic structure along with the relative capabilities of states determines the global balance of power. These three basic principles of Neorealism then lead to the logic of a self-help system in which every state can (and should) only rely on itself

(Waltz 2010). In this "state of nature" state actors do not trust each other; see each other primarily as competitors; and are more concerned about relative and short-term gains than absolute and long-term gains. International institutions should have no independent effect and any impact it does have only reinforces and reflects the current balance of power. If states do make commitments as part of international institutions, they are expected to renege whenever it is politically or economically convenient. According to Neorealism conflict and competition are the defining characteristics of the international system (Mearsheimer 1994).

As noted, one of the core principles of Neorealism is the global balance of power is determined by the anarchic global structure and the relative capabilities of states. The anarchic global structure is a constant (unless there is a fundamental transformation of the global structure such as the formation of a sovereign world government). This leaves the relative capabilities of states as the fluctuating variable that determines the balance of power in the world. The question then becomes what determines the distribution of capabilities between states? Conventional Neorealism is largely silent in this question. Waltz intentionally left this part of the equation as abstract as possible which then had the effect of minimizing this variable thereby emphasizing the role played by the anarchic global structure.

The previous chapter of this Dissertation proposes a Neorealism theory of climate change that builds on the Neorealism foundation constructed by Waltz. While accepting the basic tenants of Neorealism, it proposes two developments. First, ideology and the natural environment are added to the political structure as the most fundamental structural forces that shape state behavior and international relations. These fundamental structural forces operate and interact at both the state and global levels. Second, more emphasis is placed on the relative capabilities of states in explaining state behavior and international relations. These relative capabilities among state

actors are then largely shaped by an interaction of the three structural forces at both the state and global levels. This framework is then best able to explain state behavior and international relations concerning climate change. It is a dynamic systems theory in that it assumes the fundamental structural forces are forever evolving as they interact.

The rest of this chapter focuses on one aspect of this framework, namely the role fossil fuel interests play in determining both the relative capabilities between states and the behavior and interaction of states concerning climate change. Two hypotheses are tested to examine these relationships. The first hypothesis tested is that fossil fuel production levels should be correlated with state power. Higher levels of fossil fuel production should be correlated with higher levels of state power. This should especially be the case among the most powerful states in the world. Second, fossil fuel production levels should be correlated with climate policy performance. This should be true both for fossil fuel production levels and in terms of how dependent a state is on the fossil fuel industry as a percentage of its GDP.

Global efforts to limit climate change threaten the interests of the fossil fuel industry and the states that depend on this industry. These policies aim to reduce the burning of fossil fuels with the goal of eventually eliminating the use of fossil fuels entirely. Therefore we would expect that those states which depend on the production of fossil fuels for a significant percentage of their economies and/or are in some sense "captured" by a powerful domestic fossil fuel industry would exhibit relatively weak climate policies. These states would then be expected to inhibit global efforts to limit global warming as they prioritize fossil fuel interests over taking action on climate change. The short-term separate economic interests related to fossil fuel production should trump any possible long-term shared interests that may result from taking action to reduce emissions.

If this is true then fossil fuel production levels should be the strongest variable that explains both the lack of overall ambition to address climate change and the variation of climate policy performance between states. Those states that have the highest levels of fossil fuel production should have the weakest climate policy performance while those states that exhibit the best climate policy performance should have low fossil fuel production levels. This should hold true even when controlling for other variables. Other variables may appear to have some effect on the variation of climate policy performance between states but when combined together with fossil fuel interests, these effects should disappear.

From a Neorealism perspective, vulnerability to the impacts of climate change should have no significant effect on the variation of climate policy performance between states. As referenced in the literature review cited earlier and covered in depth in the first chapter of this Dissertation, the science of climate vulnerability is filled with uncertainty and complexity. It is unclear how the myriad of impacts from climate change will impact states over time. Consequently, up to this point in time the information on future climate impacts is not clear enough to have any real impact on state behavior. According to Neorealism, climate change is a second order concern of states for the foreseeable future as they prioritize the pursuit of relative, strategic power and economic growth in the near term which for many states are tied to the continued development of fossil fuels. As a result, the tragedy of the commons/prisoner's dilemma phenomenon should prevail as states seek their short-term economic self-interest in an anarchic global structure.

Methodology

A cross-national quantitative analysis is conducted to understand why climate policy performance varies across countries and the main factors which are inhibiting more ambitious policies to limit global warming. The analysis consists of bivariate and multivariate linear

regressions which includes constant variables during the 2017-2019 time period. Two separate analyses are conducted. The first analysis examines the effect fossil fuel production has on state power. The second analysis measures the impact a number of different variables, including fossil fuel production levels, has on climate change policy performance.

For the first analysis the dependent variable is state power as measured by the 2019 U.S. News and World Report Power Rankings. The independent variables include fossil fuel production data from the 2017 EIA International Energy Statistics and GDP data from the 2017 International Monetary Fund World Economic Report is used for the economic development control variable.

For the analysis on climate change policy performance, the 2019 Climate Change Performance Index is used for the dependent variable.[25] The Index, which is a collaborative effort by Germanwatch, the NewClimate Institute, and the Climate Action Network, evaluates and compares the climate protection performance of fifty six countries which are responsible for more than ninety percent of global greenhouse gas (GHG) emissions It is the most current and comprehensive assessment of countries' climate policy performance. The Index combines climate policy output (climate policies) and climate policy outcomes (policy implementation and GHG emissions trends). It also combines quantitative and qualitative assessments. The qualitative component includes the assessment of around 350 energy and climate experts from around the world. Countries are assessed and compared in terms of their overall climate policy performance which includes climate policy (20%); GHG emissions (40%); renewable energy development (20%); and energy use statistics (20%).

[25] The Climate Change Performance Index 2019, Germanwatch, <https://www.climate-change-performance-index.org/the-climate-change-performance-index-2019> (20 February 2020).

Three different indicators are used to measure fossil fuel interests. The first is total natural resource rents as measured by the World Bank (Lange et al. 2018). Total natural resource rents are the sum of oil, natural gas, coal, mineral, and forest rents. The World Bank calculates the total natural rents as the difference between the price of a commodity and the average cost of producing it. The rents are then calculated as a share of GDP. This indicator is perhaps the best measurement of a country's relative level of dependence on the fossil fuel and timber industries which are the primary industries associated with global warming. The second indicator is petroleum production which uses the 2017 petroleum data from the IEA International Energy Statistics database.[26] The third indicator used is petroleum production as a percent of GDP. This indicator is created by the author using 2017 petroleum production data from the IEA, the average West Texas Intermediate price of oil for 2017[27], and GDP for 2017 taken from the World Bank.[28] The petroleum industry is the most powerful fossil fuel sector in the world which constitutes a significant source of revenue for many countries. As described in the first chapter of this dissertation, the petroleum industry is the most threatened fossil fuel industry in low emissions models since it is not as able to take advantage of carbon capture and storage as much as the other fossil fuels. As a result, we would expect this sector of the fossil fuel industry to have the most effect on climate policy performance.

To assess whether a country's level of vulnerability to climate change has any effect on its climate policy performance, the Notre Dame Global Adaptation Initiative (ND-GAIN) Country

[26] EIA International Energy Statistics database, U.S. Energy Information Administration, <https://www.eia.gov/beta/international/rankings/#?prodact=53-1&cy=2017 > (20 February 2020).
[27] M. Garside, 'Average annual West Texas Intermediate (WTI) crude oil price from 1976 to 2019', Statista, 20 January 2020, <https://www.statista.com/statistics/266659/west-texas-intermediate-oil-prices/> (20 February 2020).
[28] 2017 Country GDP, World Bank, <https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?view=map> (20 February 2020).

Index is utilized.[29] Assessing and comparing vulnerability across countries is difficult and involves trade-offs and subjective judgements. There is no consensus on how to measure climate vulnerability or even on a definition of climate vulnerability. However, it is the judgement of this author that the ND-GAIN Country Vulnerability Index is the best and most current and comprehensive climate vulnerability measurement available. ND-GAIN measures vulnerability using 35 indicators in five areas – food, water, health, ecosystems, human habitat, and infrastructure. The Index was published in 2017 thus providing an up to date vulnerability assessment. Some vulnerability assessments attempt to project how climate change will affect countries in the future and usually focus on one aspect of climate change impact as a proxy. Future projections are fraught with uncertainty and focusing on a single aspect of climate change does not give an accurate overall vulnerability to climate change whereas ND-GAIN provides a comprehensive and near term assessment of vulnerability to climate change.

The model also includes variables for democracy and economic development. For the democracy variable, the 2019 Freedom House country score is utilized.[30] The Freedom House democracy index is the most comprehensive assessment and comparison of countries' level of democracy. For the economic development variable, GDP (at purchasing power parity) per capita for 2017 from the IMF is used.[31]

Analysis

Table 3.1 shows the results of bivariate and multivariate analyses that examine the relationship between petroleum production levels and global power among the top sixty most powerful

[29] 2017 ND-GAIN Country Index Vulnerability Ranking, Notre Dame Global Adaptation Initiative, <https://gain.nd.edu/our-work/country-index/rankings/> (20 February 2020).
[30] Freedom in the World 2019 Report, Freedom House, <https://freedomhouse.org/report/countries-world-freedom-2019?order=title&sort=asc> (20 February 2020).
[31] 2017 GDP (at purchasing power parity) per capita, 2017 World Economic Outlook Database, International Monetary Fund, <https://www.imf.org/external/pubs/ft/weo/2017/02/weodata/index.aspx> (20 February 2020).

nations as measured by 2018 US News and World Report. The US News and World Report ranking is based on an equally weighted average scores from five country attributes that relate to a country's power: a leader, economically influential, politically influential, strong international alliances, and strong military.[32]

Table 3.1
Predictors of state power

Variables	Model 1	Model 2	Model 3
Petroleum Production	.006*** (.001)		.003** (001)
GDP	.006*** (.001)		.004*** (.001)
Observations	65	66	64
Adjusted R Square	.36	.44	.50

*** Statistically significant at the .1 percent level
** Statistically significant at the 1 percent level
Sources: Country Power (2018 US News and World Report Power Ranking); Petroleum Production (2017 EIA International Energy Statistics); GDP (2017 International Monetary Fund World Economic Report)

The results confirm the hypothesis that there is a significant correlation between state power and the production of petroleum even when controlling for GDP. The bivariate analysis shows that by itself petroleum production levels explain thirty six percent of the variation when comparing country power. This is a significant explanation for the variation of power between states by just one variable. GDP also explains a large percentage of the variation of power between countries as would be expected. When both variables are combined into a single multivariate regression both variables maintain their strength and significance. These two variables, GDP and petroleum production, are correlated but not so much that there is a risk of a multicollinearity problem. Further, it is more likely petroleum production has more of an effect on GDP than the other way around since it is well established that large petroleum production is

[32] Power Rankings 2019, US News and World Report, <https://www.usnews.com/news/best-countries/power-rankings> (20 November, 2019).

a source of national wealth as is the case with states such as Saudi Arabia and the UAE. It makes less sense that a higher GDP leads to more petroleum production which depends on whether a state has large deposits of fossil fuels which is not the case for many wealthy countries throughout the world.

Next, an analysis is conducted to examine the impact a number of different variables have on the variation of climate change mitigation policies between states. Table 3.2 shows the results of a series of bivariate regressions which analyzes the effects each independent variable has on the dependent variable climate change policy performance. All three fossil fuel production variables have strong and significant effects on climate policy performance. Out of the three variables, petroleum production, explains the most variance at thirty four percent while natural resource rents and petroleum production as a percentage of GDP both explain twenty eight percent of the variance (in separate tests). In each case states that have high levels of fossil fuel production levels tend to have low climate policy performance.

The other independent variables, when measured separately, have mixed effects. A state's level of democracy also is strongly and significantly correlated with climate policy performance. States that have higher levels of democracy tend to have stronger climate policy performance as expected. However, this variable does not explain as much of the variance as the fossil fuel interests variables suggesting it is not as strong of a predictor as fossil fuel interests. On the other hand both GDP per capita and vulnerability have no effect on climate policy performance.

Table 3.2
Predictors of climate policy performance (bivariate regressions)

Variables	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
Natural Resource Rent	-1.445*** (.318)					
Petroleum Production		-.003*** (.000)				
Petroleum Production (as percentage of GDP)			-1.166*** (.257)			
Democracy				.179** (.065)		
Economic Development					-.042 (.099)	
Vulnerability						-.184 (.429)
Observations	49	49	45	48	49	49
Adjusted R Square	.282	.344	.284	.119	-.017	-.017

*** Statistically significant at the .1 percent level
** Statistically significant at the 1 percent level
Sources: Climate Policy Performance (2019 Climate Change Performance Index); Natural Resource Rent (World Bank 2018 data); Petroleum Production (EIA International Energy Statistics; 2017 Total Petroleum Production); Petroleum Production as a Percentage of GDP (EIA International Energy Statistics; 2017 Petroleum Production and World Bank GDP data for 2017); Democracy (2019 Freedom House country score); Economic Development (GDP PPP Per Capita; IMF 2017); Vulnerability (ND-GAIN Country Vulnerability Index 2017).

Figures 3.1 and 3.2 then exhibit the correlation that both fossil fuel production and fossil fuel production as a percentage of GDP have with climate policy performance. As seen in Figure 3.1 countries that exhibit high levels of dependence on petroleum production tend to exhibit low climate policy performance levels whereas countries which have low levels of dependence on the fossil fuel industry exhibit more variation in their climate policy performance. The same phenomenon exists in Figure 3.2. In both cases countries that exhibit strong fossil fuel interests exhibit weak climate policy performance.

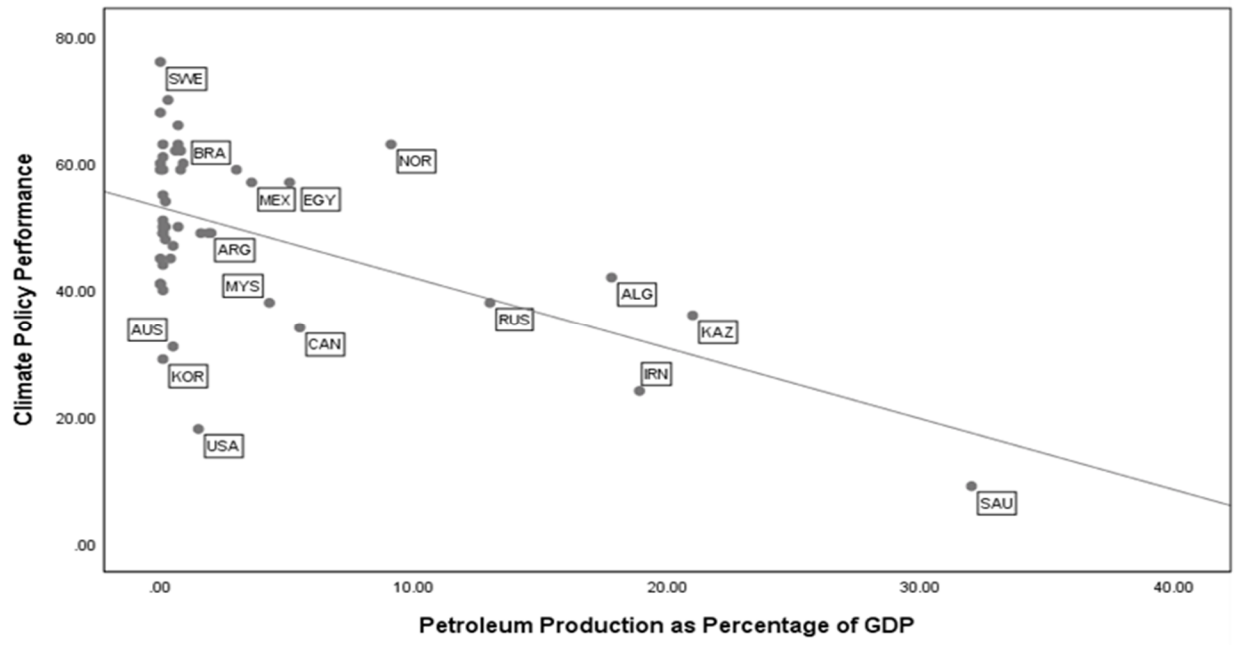

Fig. 3.1
The relationship between petroleum production (as a percentage of GDP) and climate policy performance

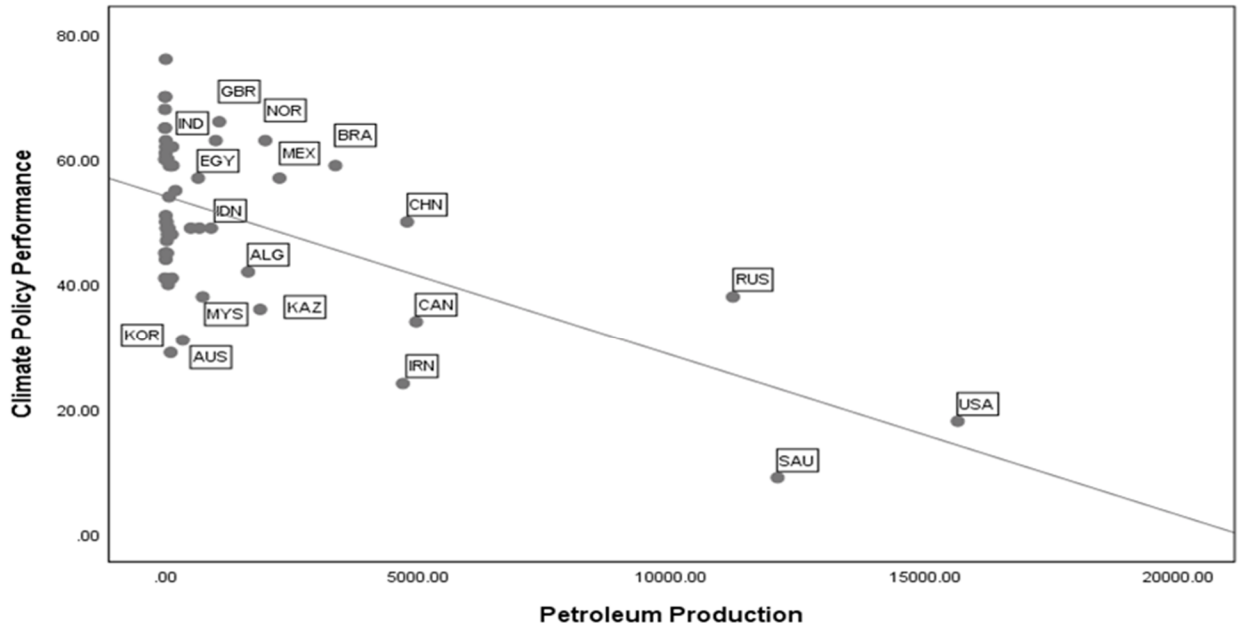

Fig. 3.2
The relationship between petroleum production and climate policy performance

Next, a series of multivariate regressions are performed to analyze the effect the independent variables have on climate policy performance when controlling for each other. Table 3.3 shows the results from these series of tests. The first multivariate regression includes natural resource rent, democracy, economic development, and vulnerability. When controlling for the other variables natural resource rent maintains its significance as a strong driver of climate policy performance. Level of democracy loses its predictive power when controlling for the other variables. The other two variables, economic development and vulnerability continue to show no effect. The second multivariate regression replaces natural resource rent with petroleum production. The same pattern occurs for this test. When controlling for the other variables petroleum production continues to be a strong and significant predictor of climate policy performance. Level of democracy loses its significance and both economic development and climate vulnerability have no correlation with climate policy performance. The third test continues the same pattern with petroleum production as a percentage of GDP maintaining its strong and significant effect while the other variables have no effect.

Table 3.3
Predictors of climate policy performance (multivariate regressions)

Variables	Test 1	Test 2	Test 3
Natural Resource Rent	-1.135* (.458)		
Petroleum Production		-.002** (.001)	
Petroleum Production (as percentage of GDP)			-.766* (.378)
Democracy	.102 (.099)	.134 (.079)	.138 (.103)
Economic Development	-.206 (.124)	-.141 (.123)	-.187 (.127)
Vulnerability	-.151 (.502)	-.034 (.480)	-.107 (.506)
Observations	45	45	42
Adjusted R Square	.281	.343	.277

** Statistically significant at the 1 percent level
* Statistically significant at the 5 percent level

As noted in the literature review section, previous research has found evidence of a so called "resource curse" which negatively affects levels of democracy in countries. It is possible that in addition to the direct effect fossil fuel levels have on climate policy performance, this dependence could also have an indirect effect through its effect on levels of democracy which as this analysis confirms does have an independent impact on climate policy performance. To see if this could be true a series of bivariate and multivariate regressions are conducted. Table 3.4 shows that the three fossil fuel interest variables do have strong and significant effects on level of democracy even when controlling for economic development. Both petroleum production as a percentage of GDP and natural resource rent by themselves explain forty four percent of the

variance. When combined with GDP per capita the two variables explain nearly two thirds of the variance. The correlation in both cases is highly significant at the .1% level.

Table 3.4
Predictors of level of democracy (bivariate and multivariate regressions)

Variables	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
Natural Resource Rent	-3.670***					-3.339***
	(.582)					(.481)
Petroleum Production		-.004**			-.004***	
		(.001)			(.001)	
Petroleum Production			-2.910***	-2.693***		
(as percentage of GDP)			(.477)	(.385)		
Economic Development				.666***	.825***	.628***
				(.131)	(.152)	(.128)
Observations	48	48	45	44	47	47
Adjusted R Square	.441	.156	.440	.640	.470	.626

*** Statistically significant at the .1 percent level
** Statistically significant at the 1 percent level

Discussion

This analysis provides strong evidence that fossil fuel interests in the form of production levels and dependence on the fossil fuel industry have played a significant role both in terms of explaining the variation of climate change policy performance across states and in hindering overall international efforts to limit global warming. First it was shown that there is a significant correlation between fossil fuel production levels and state power even when controlling for GDP. Those countries that have higher levels of petroleum production tend to have higher levels of state power. This finding indicates that fossil fuel interests play an important role in explaining the relative capabilities among state actors.

This relationship becomes clear when examining the three most powerful countries in the world: the United States, China, and Russia. These three countries have a disproportionate impact on climate change and international efforts to limit climate change. Between them they

account for approximately fifty percent of global CO2 emissions. They are also the leading producers of fossil fuels. Between them they produce thirty two percent of the world's supply of oil, sixty percent of the world's supply of coal, and forty three percent of the world's supply of natural gas.[33] Moreover all three states exhibit low climate policy performance. The analysis presented in this paper indicates that this is not a coincidence; that in fact it is very likely that domestic production of fossil fuels plays an important role in explaining these states' low climate policy performance. International efforts to limit climate change have failed in part because these three countries have prioritized the domestic production of fossil fuels over all other considerations including those concerning climate change.

As will be explained in more depth and detail in a later chapter of this Dissertation, the United States has consistently prioritized domestic fossil fuel production over addressing climate change throughout the twenty eight years of international efforts to limit global warming. Both Democratic and Republican led presidential administrations and congresses have consistently led efforts to increase domestic fossil fuel production for energy security, energy independence, and geostrategic purposes. These efforts have resulted in the United States now becoming the leading producer of fossil fuels in the world. The United States is now the number one producer of petroleum and natural gas and the third leading producer of coal in the world.[34] The rise in domestic production of petroleum and natural gas is due in large part to the fracking revolution which has been enabled by public policies by the U.S. federal government. This increase in

[33] Statistical Review of World Energy 2019 Report, British Petroleum, June 2019, <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html> (20 February 2020).
[34] Jeff Desjardins, 'Mapped: fossil fuel production by country', World Economic Forum, 19 June 2019, <https://www.weforum.org/agenda/2019/06/mapped-fossil-fuel-production-by-country/> (22 February 2020).

domestic fossil fuel production is projected to continue well into the future and threatens to drown out international efforts to limit climate change.[35]

China has similarly prioritized fossil fuel interests over efforts to limit climate change. The dramatic development of China over the last few decades cannot be overstated. It now emits approximately twenty eight percent of the world's CO2 which is more than all of Europe, Africa, the Middle East, and South America combined. This development has been enabled in large part by the massive domestic production of fossil fuels, especially coal. China now produces forty six percent of the world's coal as it continues to prioritize domestic economic development.[36] China's long term plan to continue this development well into the future is the so called Belt and Road Initiative(BRI) modelled after the ancient Silk Road which linked much of Eurasia. This decades long, multi-trillion, global infrastructure project is developing trade routes throughout the world. This massive project dwarfs any efforts to limit climate change China is taking and also threatens international efforts to limit climate change. One recent analysis published in the journal *Nature Sustainability* found that large investments by China in pipeline infrastructure associated with the BRI "will increase the rate at which oil and gas reserves are exploited, further locking the world into fossil-fuel dependency and high greenhouse gas emissions" (Ascensao et al. 2018). These concerns have not deterred China as it sees the BRI as a means to increase its global power.

Perhaps no other state actor exhibits the clear link between fossil fuel interests and state power than Russia. Under the leadership of Vladimir Putin, Russia has increased its geostrategic

[35] Kelly Trout and Lorne Stockman, 'Drilling towards disaster: Why U.S. oil and gas expansion is incompatible with climate limits', Oil Change International, January 2019, <http://priceofoil.org/content/uploads/2019/01/Drilling-Towards-Disaster-Web-v3.pdf> (22 February 2020).
[36] Statistical Review of World Energy 2019, British Petroleum, June 2019, <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html> (22 February 2020).

power through the production and export of fossil fuels. Putin has adroitly taken control over the fossil fuel industry in Russia and developed the domestic fossil fuel industry to make Russia one of the leading fossil fuel producers and exporters in the world. He has consistently increased natural gas, petroleum, and coal exports so that much of Europe and Asia are dependent on fossil fuels from Russia. More than one third of European oil imports and seventy percent of European natural gas imports come from Russia. Forty seven percent of Russian coal exports go to Asia. A large percentage of the Russian government revenue is dependent on the fossil fuel industry. In 2016 oil and gas revenues accounted for 36% of Russia's federal budget revenues.[37] This control, development, and export of Russia's extensive fossil fuel resources have enabled Putin to amass considerable regional and global power. Much of Eurasia is now dependent on Russia's fossil fuels and will be so for years and perhaps decades to come.

The evidence presented in this paper shows that domestic production of fossil fuels is not only correlated with state power, but is also correlated with state climate mitigation policies. The first test shows that fossil fuel production levels are strongly and significantly correlated with state power. The second series of tests which examines the effects that different variables have on states' climate change policy performance shows that all three variables that measure a country's level of fossil fuel production have strong and significant effects. These effects hold true even when controlling for the other variables cited in the literature as possibly having an impact on climate policy performance. Furthermore, the other variables are shown to have no independent effect when controlling for fossil fuel variables. Only democracy has an effect when measured by itself. However, when combined in a multivariate regression with the fossil fuel variables the democracy effect disappears. It was further found that petroleum production has an effect on

[37] Country Overview for Russia, U.S. Energy Information Administraton, 31 October 2017, <https://www.eia.gov/beta/international/analysis.php?iso=RUS> (20 February 2020).

democracy levels which suggests that petroleum production has an additional indirect impact on climate policy performance via its effects on democracy levels.

A small number of countries are responsible for much of the correlation found in these tests which could be seen as a weakness. However, the results properly reflect the core challenge that confronts international efforts to limit climate change. A small number of countries in the world produce the vast majority of fossil fuels and are responsible for most of the world's GHG emissions. China, Russia, the United States, and Australia produce two thirds of the world's supply of coal. The United States, Russia, Canada, and the fifteen countries that belong to OPEC supply seventy six percent of the world's supply of petroleum. China, the United States, India, Russia, Japan, Germany, South Korea, Brazil, Iran, Saudi Arabia, and Canada are responsible for two thirds of the world's carbon dioxide emissions.[38] Any serious international effort to limit global warming would need to include most if not all of these high fossil fuel producing countries. To think we can "solve" global warming without the willing participation of these states that produce the vast majority of the world's fossil fuels is foolhardy at best and delusional at worst.

The core problem is that while there is more variation of climate policy performance among states that score low on fossil fuel production and resource rent as a percentage of GDP there is much less variation among countries that have high levels of fossil fuel production and resource rent as a percentage of GDP. Again these are the countries that really matter when it comes to climate change since they are responsible for the vast majority of global GHG emissions. All countries in the world that score relatively high on the production of fossil fuels and other natural

[38]Statistical Review of World Energy 2019 Report, British Petroleum, June 2019, <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html> (20 February 2020).

resource rents as a percentage of GDP have low to very low climate policy performance. Many of these countries are also the most powerful countries in the world, in part because of their strategic exploitation of fossil fuels. These findings indicate that any notion that these countries would be willing to form some sort of a "club" modelled after the WTO as suggested by David Victor and others is not realistic. Instead, in reality, these countries have been and most likely will continue to be the primary obstacles to limiting climate change for the reasons outlined in this and the previous chapter.

This analysis provides strong evidence that Neorealism is the most appropriate theoretical framework to analyze state behavior and international relations concerning climate change. As Neorealism would predict, state actors have proven that they are more concerned about short term relative gains in terms of power and wealth than they are in long term absolute gains via international cooperation. For many countries around the world their relative capabilities are tied to the continued development of fossil fuels. As this analysis indicates, for many of these countries one of these primary concerns has been the continuation of the status quo in terms of fossil fuel development. This status quo is fundamentally opposed to mitigating climate change. Many countries throughout the world, including many of the most powerful countries, have prioritized the domestic production of fossil fuels for a variety of reasons relating to wealth, power, and geopolitics.

As this analysis shows fossil fuel production is a source of state power and at least partly explains the relative capabilities of states and the global balance of power. It is not in the self-interest of these states, at least in the short term, to reduce and eventually eliminate the production of fossil fuels. This is especially true when considering the findings of the first chapter of this Dissertation which shows that the two degree pathway is based on a model that

assumes widespread deployment of carbon capture and storage which would enable an expansion of fossil fuel consumption the rest of this century even in low emissions climate models.

Conclusion

This analysis provides strong evidence that fossil fuel production interest is the central obstacle to seriously addressing climate change. Undoubtedly both diplomats and scholars would acknowledge this to be the case which makes it all the more astounding that both groups have largely ignored this central obstacle in their proposed solutions and analyses. Unless this central problem is addressed directly and seriously, by diplomats, scientists, and scholars alike, then any proposed solutions will certainly fail as they have thus far. The most glaring example of this is the recently adopted Paris Climate Agreement which largely ignores this central obstacle as does much of the literature on the Paris Agreement.

This analysis also reveals the limitations of the Neoliberalism approach in addressing climate change and the superiority of Neorealism to explain the lack of international cooperation to limit global warming. The time period covered in this analysis is 2017-2019, two to four years after the signing of the latest international agreement on climate change and twenty six years after the signing of the United Nations Framework Convention on Climate Change (UNFCCC). As Neorealism would predict most countries continue to act as short-term utility maximizers and pursue relative and short-term gains over absolute and long-term gains. And just as Neorealism predicts international institutions have had no independent effect on the behavior of state actors and no real impact on global warming. Neoliberalism's expectations concerning both the effect of international institutions and the behavior of state actors have not been met in the case of the twenty eight year history of international efforts to limit global warming.

However Neoliberalism continues to dominate the discussion surrounding climate change among scholars in the field of international relations. These scholars hold out belief that eventually a tipping point will occur and states will one day get serious about addressing climate change and they will then utilize international institutions to coordinate global efforts to limit global warming. These international institutions will then have the type of independent effect long predicted by Neoliberalism as they facilitate this coordination in ways that would not be possible without such institutions. The belief is that this tipping point will occur due to some combination of democratization, economic development, impacts from climate change, and/or more accurate and complete information about the costs of climate change impacts.

The evidence from this study, along with the findings from the two previous chapters of this Dissertation, indicates that this is highly optimistic thinking and highly unlikely to happen in the foreseeable future. Since the adoption of the UNFCCC in 1992 the world has become more developed and interconnected. Our knowledge of climate change and its impacts have vastly improved. The actual impacts of climate change have become more apparent, widespread, and costly. And yet we have not seen any improvement in international cooperation which has led to any improvement in outcomes. According to Neoliberalism this doesn't make any sense.

On the other hand, as seen through a Neorealism framework this makes perfect sense. According to Neorealism, states are primarily concerned about power. A state's relative degree of power is explained by the anarchic global structure and the relative capabilities of states. This chapter has shown how domestic production of fossil fuels plays a role in determining the relative capabilities of some states both in terms of overall power and the capability to participate in global efforts to accelerate the reduction of GHG emissions. This is especially true among the most powerful states which have the most impact on climate change and international efforts to

address climate change. According to Neorealism we should expect the same pattern to continue into the foreseeable future in which strong actors undermine international efforts to limit climate change.

4

Nonstate Actors to the Rescue?

Analysis of a transnational network of subnational states and regions committed to limiting climate change

Introduction

As explained in earlier chapters Neoliberalism has guided both international efforts to address climate change and the literature that surrounds these efforts. This Neoliberalism framework includes the view that nonstate actors, such as private corporations, NGOs, international institutions, subnational governments, play a robust role in global affairs. According to this view these nonstate actors have power and influence in their own right that in many cases can rival or even exceed the power and influence of some countries (states or state actors). For example, some of the largest private corporations earn more revenue than many states' GDP. Within this Neoliberalism framework increasing attention has focused on the role that subnational governments are playing concerning global efforts to limit climate change. A number of global coalitions have been formed by these subnational governments including cities, subnational states, and regions with the sole intent to reduce greenhouse gas (GHG) emissions. Some scholars have suggested that these networks could lead, supplement, or even possibly supplant international efforts by state actors to limit climate change.

From a Neorealism perspective these subnational governments would be expected to have little to no impact on climate change. According to Neorealism states are by far the most important actors on the world stage. This is especially true when considering the most powerful states such as the United States, China, and Russia which as explained in the previous chapters of this Dissertation have an outsized influence over everything including climate change. Nonstate

actors should then play secondary or periphery roles in international affairs including issues as climate change.

Additionally, the Neorealism theory of climate change developed in Chapters Two and Three of this Dissertation suggests that when it comes to climate change, fossil fuel interests should play an outsized role in explaining why these global efforts by subnational jurisdictions are unlikely to make any real difference and why subnational jurisdictions do or do not join these global coalitions. It would be expected that the subnational jurisdictions that comprise these global networks would not come from parts of the world that are most dependent on the fossil fuel industry. These jurisdictions would be expected to prioritize their relative power which in the case of subnational jurisdictions would be defined as a strong economy. As is the case with countries, it would be expected that any subnational jurisdictions that are dependent on the fossil fuel industry would similarly not participate in global efforts to limit climate change.

This chapter tests this hypothesis by analyzing one of the most prominent global networks of nonstate actors committed to reducing GHG emissions, the Under 2 Coalition. The Under 2 Coalition is comprised of subnational states and regions which sign an MOU to reduce GHG emissions within their jurisdictions to levels that are consistent with a pathway to limit global warming well below two degrees Celsius above pre-industrial levels. The Coalition includes some 220 subnational jurisdictions from six continents, representing 1.2 billion people, and 43% of the global economy.[39]

The Under 2 Coalition is an interesting case to study due to the fact that it is primarily composed of subnational states and regions. All of the other major transnational networks of nonstate actors committed to reducing GHG emissions are composed of cities or businesses. The most prominent and oldest of these networks are made up of cities. As a result, most of the

[39] Under 2 Coalition, <https://www.under2coalition.org/about> (20 February 2020).

literature on these transnational networks focuses on transnational city networks. Consequently there is a dearth of knowledge of transnational networks comprised of subnational states and regions. This is an important gap since subnational states and regions throughout the world are critical actors in global efforts to reduce GHG emissions. Additionally, subnational states and regions resemble countries more so than cities so they are also important testing grounds for the types of policies and coordination that could potentially work at the international level between countries.

The primary hypothesis of this paper is the Under 2 Coalition should consist of subnational states and regions which are not heavily dependent on the production or distribution of fossil fuels compared to other subnational states and regions in their respective countries. In order to test this hypothesis an analysis is conducted of the Coalition with a closer look at fifty four subnational members from eight countries – the United States, Canada, Germany, Australia, Mexico, India, Brazil, and South Africa.

Literature Review

Beginning in the 1960s Neoliberalism scholars in the field of international relations (IR) began to question and even challenge the state-centric approach to studying world affairs which had been the focus of the IR field up to that time. One book in particular set the stage for much of the Neoliberalism literature on the role nonstate actors and their networks play in global affairs. Joseph Nye and Robert Keohane co-edited *Transnational Relations and World Politics* in 1970 in which they and other scholars analyzed transnational relations among nonstate actors across a wide range of issue areas and subject matters. Nye and Keohane conclude their edited volume by arguing that a new paradigm is needed in the field of international relations to better reflect the increasingly complex reality of global relations. According to Nye and Keohane multinational

corporations and nongovernment organizations are increasingly playing key roles in global economic and social affairs which in many cases transcend or perhaps even supersede the power of national governments. They believe the development of technology is enabling this shift in power and influence away from the state and towards nonstate actors in some aspects of economic and social global affairs (Nye and Keohane 1970).

In recent years there has been a proliferation of literature on transnational relations between nonstate actors focused on the issue of climate change. Once again, Robert Keohane has played a key role in this literature. In a highly influential 2011 essay Keohane and David Victor argue that global efforts to address climate change reflect what they call a "regime complex" in which state actors and conventional international relations between state actors through international institutions are just one part of a complex web of global efforts to address climate change which includes many nonstate actors and networks. The authors further argue that this is the optimal approach. They argue that the United Nations Framework Convention on Climate Change (UNFCCC), the primary instrument of state actors to address climate change, is not able on its own to adequately solve the global collective action problem climate change presents. According to the authors, a more flexible, adaptable approach which is exemplified by the climate regime complex is more effective in dealing with climate change since there is so much uncertainty involved with climate change and there is always new emerging information. This regime complex includes nonstate actors, such as non-governmental organizations, multinational corporations, financial institutions, and subnational governments, along with their networks (Keohane and Victor 2011).

Another paper by Elinor Ostrom published at around the same time as the Keohane and Victor paper also forms the foundation on which much of this literature on nonstate actors and

climate change rests. In a 2010 working paper for the World Bank Ostrom analyzes global warming through the polycentric perspective which she and her colleagues developed. Ostrom argues that the conventional view that a single governmental unit at the global scale is needed to solve the climate change problem is flawed and instead it would be more effective to take a polycentric approach. A polycentric approach to solving global warming would operate at the local, regional, national, and international levels with multiple stakeholders and governing authorities in many cases overlapping (Ostrom 2009).

Ostrom's recommendation is based on her and her colleagues' research on common pool resources which earned Ostrom a Nobel Prize in Economics. This research documents the many cases throughout the world in which at the local and regional levels actors are able to overcome the collective action dilemma of managing common natural resources and avoid the tragedy of the commons outcome as depicted by Garrett Hardin through the building of trust and reciprocity and the sharing of information. Applied to the problem of global warming, Ostrom recommends that the most effective strategy is to build such local and regional networks throughout the world in a more bottom-up, lateral approach. Local, regional, and global networks can then build trust and reciprocity, and share information, technology, resources, and best practices.

In the published form of this paper Ostrom discusses the multiple benefits of reducing GHG emissions including economic, political, social, and health benefits (Ostrom 2010). These multiple benefits no doubt at least partly explain why so many actors throughout the world have been willing to reduce their GHG emissions in lieu of a global level, central governing authority which incentivizes such action. According to conventional collective action theory actors should not be willing to take such action for the sole benefit of reducing the impacts of climate change without an external authority which would ensure such cooperation through some combination of

negative and/or positive incentives. The fact that so many actors, both state and nonstate, are taking significant and in many cases costly action to voluntarily reduce their GHG emissions in lieu of an effective international treaty points to other benefits these actors are deriving from taking such action besides the potential benefit of reducing the negative impacts of climate change. This in turn suggests networks are most effective when they generate and enhance these benefits for those who join and participate in such networks.

Other research challenges the dominant view that climate change should be characterized as a collective action dilemma. A recent paper by Aklin and Mildenberger argues that scholars wrongly characterize global warming as a collective action dilemma with a focus on the free-rider problem. The free-rider problem refers to a dynamic in which members of a group do not pay the costs of membership while receiving the same benefits. Aklin and Mildenberger conduct an extensive empirical analysis which provides convincing evidence that countries climate policies are not dependent on whether other states take actions or based upon any international treaty. Aklin and Mildenberger's research indicates that climate action is instead driven by what they term "domestic distributive conflicts" between political and economic forces that are for and against taking such action (Aklin and Mildenberger 2018). This research focuses on state actors however the same logic should prevail among nonstate actors such as subnational governments.

Aklin and Mildenberger's paper points to an important murky area in the theoretical analysis on climate change which deserves clarification. Aklin and Mildenberger correctly note that much of the literature on climate change, including Ostrom's analysis, depict it as a collective action dilemma based on the central free-rider problem. The free-rider problem is highlighted by Mancur Olson in his classic *The Logic of Collective Action* (Olson 1965). Olson's book forms

the basis of most discussions concerning collective action dilemmas. However, collective action theory and the collective action dilemma predates Olson's book and finds its foundation in the Prisoner's Dilemma which then formed the foundation of Hardin's classic *Tragedy of the Commons* essay. In both the Prisoner's Dilemma and Hardin's *Tragedy of the Commons* essay, the fundamental problem of the collective action dilemma is not the free-rider problem per say but rather the fundamental problem is that in cases in which common resources are shared and there is no external authority the rational course of action for the individual is to not cooperate and instead pursue what he/she perceives to be in his/her best short-term economic self-interest (Hardin 1968). This rational calculation leads the individual to pursue a course of action that maximizes his/her short-term economic utility. This rational course taken at the individual level then leads to the tragedy of the commons as depicted by Hardin or a sub-optimal outcome as depicted by the Prisoner's Dilemma.

Scholars have published a wide range of views concerning the role nonstate actors and their networks are playing concerning efforts to limit global warming. At one end of the spectrum scholars have expressed the prospect that these networks could potentially "supplant the need for national action to address climate change" (Feldman 2012). In this view, these networks' "soft power characteristics" such as being flexible, decentralized, and adaptable are more effective in addressing climate change than a single, global institution. Echoing Ostrom, Daniel Cole argues that a polycentric approach best enables the building of trust and communication at multiple levels which will be necessary to accelerate the reduction of GHG emissions beyond business as usual scenarios (Cole 2015).

At the other end of the spectrum, scholars have expressed skepticism towards the prospect that nonstate actors and their networks can have any significant effect on limiting global

warming. In a scathing critique published in 2007 Jonathan Wiener argues that "subnational state-level action is not the best way to combat global climate change…local action is not well suited to regulating mobile global conduct yielding a global externality…subnational state-level action, by itself, is of limited value, and may even yield perverse results". Wiener gives several reasons for why these efforts are likely to be ineffective but his main argument is that these efforts suffer from the problem of "leakage". This is the same fundamental problem that has hindered international efforts, namely that if parts of the world do not participate in any global effort to reduce GHG emissions then industries that produce GHG emissions can move from regulated to unregulated regions. Unregulated regions also enjoy a competitive advantage in the global market place that will undeniably continue to exist for fossil fuels and other industries that result in GHG emissions for decades to come (Wiener 2007). According to Wiener the only way to truly limit global warming would be a comprehensive international agreement which includes all countries in the world and includes enforcement mechanisms to ensure GHG emissions reductions consistent with a two degree pathway.

A more widespread view concerning these efforts by nonstate actors falls between these two extremes. In this view nonstate actors and their networks serve to supplement international efforts and potentially fill the gap between national commitments for the Paris Agreement and the amount of GHG emissions reductions needed to limit global warming below two degrees above pre-industrial levels. According to this view an "all hands on deck" approach is needed to limit global warming including state and nonstate actors (Hale 2016). Although this more common view falls between the two more extreme views it is still a positive view which claims these efforts by nonstate actors can fill the so called "emissions gap" that exists between national commitments to the Paris Agreement and the needed GHG emissions reductions to achieve the

international targets. From this perspective the Paris Agreement represents a positive step in the right direction in acknowledging the key role nonstate actors must play to limit global warming. In the words of Thomas Hale, the Paris Agreement marks the transition in international efforts from a "regulatory" to a "catalytic and facilitative" framework which embraces nonstate actors and their networks as part of the solution (Hale 2016).

Few empirical studies have examined these efforts by nonstate actors in any depth or detail. The few studies which have been conducted tend to provide a broad descriptive overview of these efforts (Bulkeley et al. 2014). In one of the few empirical analyses of transnational networks comprised of cities, Jennifer Bansard and colleagues find that transnational municipal networks are comprised mostly of cities from Europe and North America; that their emission reduction goals are no more ambitious than the ambitions of countries; and that they lack monitoring provisions to track whether they are making progress to achieving their targets (Bansard et al. 2016). This study provides empirical support for Wiener's argument that these efforts by subnational governments are likely to fail due to the problem of leakage. These findings suggest these networks are best understood as a sort of a coalition of the willing in which for whatever reasons state and nonstate actors find it in their best interest to form and join them. If this is the case then it is unlikely they will have any significant impact on global warming which would require more broad global participation.

A small subset of the empirical literature attempts to explain why subnational governments join these global networks committed to reducing GHG emissions. Most of these studies focus on city networks within the United States. For example Zahrain et al. find that US cities that are highly vulnerable to climate change, vote Democratic, and host environmental NGOs are more likely to join the Cities for Climate Protection campaign (Zahrain et al. 2008). Rachel Krause

finds that policy entrepreneurs play an important role in explaining why some cities join these networks (Krause 2010). In one of the few empirical studies that attempts to explain why subnational governments join transnational networks committed to reducing GHG emissions, Taedong Lee finds that a city's level of globalization, defined as cultural, economic, and political ties to the international system, explains part of the variation of local governments' participation in transnational climate change networks (Lee 2014).

An extensive empirical study conducted by Andonova et al. published in 2017 finds that national policies and institutions strongly influence whether subnational governments join transnational networks committed to reducing GHG emissions. The authors' findings largely confirm their initial expectations that participation in these global networks are in part due to those societies having a strong commitment to environmental values and having the capacity and resources to engage in collective action. Participation rates are relatively high in countries that have strong national climate policies and open institutions. On the other hand, participation rates tend to be low in countries that have weak national climate policies and restrictive institutions. According to the authors these findings provide supporting evidence for the claim that transnational networks are likely to be more complementary rather than substitutes for international efforts (Andonova et al. 2017).

This literature review reveals three main findings most relevant for this study: First, few empirical studies have been conducted that attempt to explain why subnational governments join transnational networks committed to reducing GHG emissions. Second, of these few studies, not one examines whether fossil fuel interests may play some role in helping to explain this variation of participation in these networks both across and within countries. Third, this omission is partly due to the fact that the empirical research in this area focuses on cities and city networks. Cities

inherently have less variation in fossil fuel interests especially in terms of fossil fuel production and distribution. No study to date has focused on transnational networks comprised primarily of subnational states and regions committed to reducing GHG emissions. This is an important omission since states and regions do have more variation in terms of fossil fuel interests and they provide a better comparison to countries as they must confront many of the same jurisdictional and urban-rural issues that cities do not face.

Theory

Global efforts to limit climate change aim to drastically reduce and eventually eliminate the use of fossil fuels. These efforts present an existential threat to the fossil fuel industry, one of the most powerful and prevalent industries in the world. Furthermore, these efforts to reduce the use of fossil fuels threaten the livelihoods of any connected industries and jurisdictions which are dependent on the fossil fuel industry. These "fossil fuel interests" vary greatly throughout the world. Some areas are more dependent on the production and distribution of fossil fuels and related industries than others. It would stand to reason that those regions of the world that are more dependent on the production and distribution of fossil fuels and related industries would be less likely to take significant actions to reduce GHG emissions, including joining and participating in any global efforts.

As shown in the previous chapter of this Dissertation this turns out to be the case when it comes to the behavior of state actors. Countries that have high levels of dependence on the fossil fuel industry tend to have weak climate policy performance including participation in global efforts to reduce GHG emissions. The countries that have the strongest climate policy performance tend to be less dependent on the production and distribution of fossil fuels. The question this paper seeks to answer is whether this same pattern exists at the subnational level.

This question has not been addressed in the literature which is an important omission since if this is the case then it raises serious questions as to how effective these nonstate actors and their networks can be in global efforts to limit climate change. The primary hypothesis of this chapter is that participation of subnational governments in transnational networks committed to reducing GHG emissions should be strongly and significantly influenced by the degree of dependence on the production and/or distribution of fossil fuels. If found true then this would call into serious question how effective these efforts among nonstate actors can be in helping to limit climate change.

To test this hypothesis an examination of the Under 2 Coalition is conducted. The Under 2 Coalition is one of the most prominent transnational networks comprised of subnational governments that are solely committed to reducing GHG emissions. The Coalition includes some 220 governments from six continents, representing 1.2 billion people, and forty three percent of the global economy. It provides a unique opportunity to analyze the role fossil fuel dependence may play in terms of understanding why some subnational governments would decide to voluntarily join a global network designed to reduce GHG emissions both across and within countries.

The contention of this chapter is that economic considerations are the primary motivations that explain why any government, in this case subnational governments, would decide to join or not join any global effort to reduce GHG emissions. If true, then this would mean that the Under 2 Coalition should be comprised of subnational governments that are not heavily dependent on the production and/or distribution of fossil fuels. This paper focuses on whether fossil fuel dependence may play a significant role in explaining why subnational governments decide to join or not join these global networks designed to reduce GHG emissions.

Methods and Data

This research project includes two parts. First, an analysis is conducted of the Under 2 Coalition as a whole to determine whether there is any correlation between membership in the Coalition and fossil fuel production at the national level. This part of the analysis includes looking at whether subnational governments are joining from countries which have high levels of fossil fuel production. Second, a more in depth and detailed analysis is conducted on the members of the Coalition from eight countries: The United States, Canada, Germany, Australia, Mexico, India, Brazil, and South Africa. This second part of the study examines which states/regions in the eight countries are most reliant on the fossil fuel industry.

These eight countries were chosen for three main reasons. First, they are important countries in terms of the roles they are playing concerning the issue of global warming either because of their high levels of carbon emissions or their high levels of fossil fuel production. Second, they provide a diverse sample representing different parts of the world and both developing and developed countries. Third, these countries exhibit wide variation in terms of fossil fuel production levels at both the national and subnational levels. Therefore they provide a good sample to analyze the role fossil fuel production levels may play in explaining why subnational governments throughout the world in varying circumstances do or do not join global networks committed to reducing GHG emissions.

Both primary and secondary sources are utilized for the analysis including the Under 2 Coalition website; government databases and reports; energy companies' databases and reports; energy organizations' articles, websites, and reports; and news articles. Country level fossil fuel and carbon emissions data is taken from British Petroleum's 2019 Statistical Review of World

Energy.[40] Data for total natural resource rents as a percentage of a country's GDP is taken from the World Bank's database.[41] Information pertaining to a country's climate policy performance is taken from the 2019 Climate Change Performance Index produced by Germanwatch.[42] For each individual country a separate analysis is conducted utilizing various government and non-government sources to determine the degree of fossil fuel dependence for the subnational states and/or regions.

Analysis

The Under 2 Coalition is primarily comprised of subnational states and regions. It is the largest and most important transnational network comprised of subnational states and regions committed to reducing GHG emissions in the world. The Coalition was formed in 2015 by ten subnational states and regions. As of July 2019 the Coalition has grown to include 198 regions, states, and cities signatories. Most of the members are regions and states. Every continent is represented and includes members from all parts of the world and every phase of development.

The stated purpose of the Under 2 Coalition is to limit "global warming to below 2°C, which is needed to avert catastrophic climate change". The Coalition gives several reasons why the Coalition is needed. First, it notes that international efforts have been inadequate to achieving a two degree pathway. The Coalition functions to help fill this void in global leadership. Second, states and regions are in many cases primarily responsible "for the development and implementation of policies that have the most impact on climate change". Third, "state and

[40] Statistical Review of World Energy 2019 Report, British Petroleum, June 2019, <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html> (20 February 2020).
[41] 'Total Natural Resource Rents', The World Bank Database, <https://data.worldbank.org/indicator/NY.GDP.TOTL.RT.ZS> (20 February 2020).
[42] Climate Change Performance Index 2019, Germanwatch, <https://www.climate-change-performance-index.org/the-climate-change-performance-index-2019> (20 February 2020).

regional governments often serve as the laboratories for policy innovations which are then adopted at the national and even international level".[43]

In order to join the Under 2 Coalition states and regions must sign the Under 2 MOU. By signing the MOU the region or state agrees to pursue emission reductions consistent with a trajectory of 80 to 95 percent below 1990 levels by 2050 and/or achieving a per capita annual emission goal of less than two metric tons by 2050. These ambitious emissions reduction targets are consistent with a climate pathway that would limit global warming below two degrees Celsius above Pre-industrial levels. This goal is more ambitious than just about every country level goal in the world. According to an independent report published in 2018 if the members of the Coalition achieve their stated targets then it would reduce global emissions 4.9-5.2 GtCO2e per year by 2030 which is more than any other transnational network comprised of nonstate actors in the world.[44] To achieve this ultimate goal these subnational jurisdictions must submit an appendix to the Under 2 Coalition that lays out how they plan on achieving the 2050 goal. The jurisdictions agree to collaborate and share information to help each other attain their targets. This collaboration and sharing of information includes annual meetings, technical assistance, and reports. Reports include case studies, annual evaluations, and monitoring.

An analysis of all of the members of the Coalition shows that not one subnational state or region has joined the Coalition from the top fifty countries that are the most dependent on natural resource rents. The World Bank maintains a database that quantifies total resource rents as a percentage of GDP. Total resource rents is defined as "the sum of oil rents, natural gas rents, coal

[43] Under 2 Coalition, The Climate Group, <https://www.under2coalition.org/frequently-asked-questions> (20 February 2020).
[44] Global Climate Action from Cities, Regions, and Businesses, Data Driven Yale, NewClimate Institute, <https://datadrivenlab.org/wp-content/uploads/2018/08/YALE-NCI-PBL_Global_climate_action.pdf>(20 February 2020).

rents (hard and soft), mineral rents, and forest rents".[45] This finding shows that among those countries in which this dependence is greatest, subnational states and regions are no more willing to take action to limit global warming than their national governments.

This finding leads to the question of whether this same trend is found within countries. In other words, is it the case that the subnational jurisdictions that have joined the Under 2 Coalition are less dependent on the fossil fuel industry than the other subnational jurisdictions in their countries that have not joined the Coalition? To answer this question an analysis is conducted to compare states and regions that have joined the Under 2 Coalition with states and regions that have not joined the Coalition in eight countries: The United States, Canada, Germany, Australia, Mexico, India, Brazil, and South Africa. Each of these countries are examined in order.

The United States

Perhaps no country in the world is more important concerning global warming than the United States. It emits the 2nd most amount of carbon dioxide emissions, second only behind China. The U.S. now produces more overall fossil fuels than any other country in the world. It produces the third most amount of coal, the most amount of petroleum, and the most amount of natural gas. However, due to the size and diversity of the total U.S. economy, total natural resource rents only equals 0.5% of the country's GDP. As a whole the U.S. has low levels of dependence on the fossil fuel industry compared to other countries. Yet the United States has always been and continues to be a major obstacle for international efforts to limit global warming. According to the Climate Change Performance Index which measures and compares countries in terms of their climate policy performance including international efforts, the United

[45] 'Total Natural Resource Rents', The World Bank Database, <https://data.worldbank.org/indicator/NY.GDP.TOTL.RT.ZS> (20 February 2020).

States exhibits very low climate policy performance. Twelve of the fifty states in the United States have joined the Under 2 Coalition: California, Connecticut, Hawaii, Massachusetts, Minnesota, New Hampshire, New York, Oregon, Rhode Island, Vermont, Washington, Virginia.

To determine the level of fossil fuel dependence for each U.S. state a data analysis was conducted. Data was collected for gross state product (GSP) from the 2019 Bureau of Labor of Economic Analysis[46] and state-by-state fossil fuel production and sales price from the U.S. Energy Information Administration.[47] This data was utilized to determine the percentage of each state's GSP derived from the combined sale of petroleum, natural gas, and coal.

The analysis finds that in 2017 the production and sale of fossil fuels including petroleum, natural gas, ,and coal did not represent more than 0.5% of the gross state product (GSP) for any of the twelve states in the U.S. that have joined the Under 2 Coalition. Eighteen states within the United States derive more than one percent of their GSP from the fossil fuel industry. Ten of these states derive more than five percent of their GSP from the fossil fuel industry and of these five states derive at least twenty five percent of their GSP from the fossil fuel industry. None of the eighteen states with significant fossil fuel dependence have joined the Under 2 Coalition.

Canada

Canada is another important and interesting case concerning global warming. It emits the seventh most carbon dioxide in the world and is a global leader in fossil fuel production as it produces the fourth most amount of petroleum, the thirteenth most amount of coal, and the fourth most amount of natural gas. However, due to its large and diverse economy it exhibits low to medium levels of fossil fuel dependence. It's total natural resource rents amount to 1.7% of its

[46] Gross Domestic Product by State 2018, Bureau of Economic Analysis, U.S. Department of Commerce, <https://www.bea.gov/system/files/2019-04/qgdpstate0519_4.pdf> (20 February 2020).
[47] U.S. Energy Overview, U.S. States: State Profiles and Energy Estimates, U.S. Energy Information Administration, <https://www.eia.gov/state/> (20 February 2020).

total GDP which is on the medium to low end compared to other countries. Like the United States Canada rates very low compared to other countries concerning its climate policy performance. Four of Canada's thirteen provinces and territories have joined the Under 2 Coalition: British Columbia, Northwest Territories, Ontario, and Québec.

An analysis of the Canadian provinces and territories and the fossil fuel industry reveals that the provinces and territories that have joined the Under 2 Coalition are the least dependent on the fossil fuel industry compared to the other provinces and territories in Canada. The fossil fuel industry contributes about ten percent to the Canadian national GDP. The vast majority of this revenue is generated by the oil and natural gas industry which is located almost entirely in three provinces, Alberta, Saskatchewan, and Newfoundland and Labrador. The petroleum and natural gas industry in these three provinces provides over twenty five percent of their economies. These provinces have not joined the Under 2 Coalition. The four provinces and territories which have joined the Coalition (British Colombia, Northwest Territories, Ontario, and Quebec) exhibit low levels of reliance on the fossil fuel industry for their economies.[48]

Germany

Germany is one of the most important countries in the world when it comes to global warming. It is the fifth leading emitter of carbon dioxide in the world. In terms of fossil fuel production, it produces low levels of petroleum and natural gas but it is the eighth leading producer of coal in the world. Overall, as a country it has a low level of dependence on the fossil fuel industry as total natural resource rents make up only 0.1% of the country's GDP. The Climate Change Performance Index rates Germany as exhibiting medium climate policy performance. Eight of the sixteen states in Germany have joined the Under 2 Coalition: Baden-

[48] Provincial and Territorial Energy Profiles, Canada Energy Regulator, Government of Canada, <https://www.neb-one.gc.ca/nrg/ntgrtd/mrkt/nrgsstmprfls/index-eng.html> (20 February 2020).

Württemberg, Bavaria, Hesse, Lower Saxony, North Rhine-Westphalia, Rhineland-Palatinate, Schleswig-Holstein, Thuringia.

The eight German states that have joined the Under 2 Coalition have no significant fossil fuel industry located within their territories. The coal industry is located in East Germany, primarily in the states of Brandenburg, Saxony Anhalt, and Saxony.[49] None of these states are members of the Under 2 Coalition. The German states that have joined the Under 2 Coalition are located outside of the coal region and thus have no significant levels of reliance on the fossil fuel industry for their economies.

Australia

Australia is another important state actor concerning the issue of global warming. It emits the fifteenth most amount of CO2 emissions in the world and is a significant producer of fossil fuels as it produces the eighth most amount of natural gas and the fourth most amount of coal in the world. Natural resource rents make up seven percent of the country's GDP which is a medium level compared to other countries. According to the Climate Change Performance Index Australia exhibits very low climate change policy performance. Four of Australia's nine states and territories have joined the Under 2 Coalition: Australian Capital Territory, Queensland, South Australia, and Victoria.

An analysis of Australia's fossil fuel industry reveals that two of the four states that have joined the Under 2 Coalition have significant coal industries that significantly contribute to their gross state product. One member, Queensland, produces more coal than any other state in

[49] Kerstine Appunn, 'Coal in Germany' by Kerstine Appunn, Clean Energy Wire, 7 February 2019, <https://www.cleanenergywire.org/factsheets/coal-germany> (20 February 2020).

Australia. Victoria, another Coalition member, also produces a significant amount of coal.[50] An examination of the appendices of the two states submitted to the Under 2 Coalition shows that they plan on significant action to reduce emissions within their borders.

However neither appendix mentions their coal industries and whether they plan on reducing and eventually eliminating these industries within their borders which would include significant economic loss in terms of productivity, jobs, and state revenue. Their plans indicate that at least in the short term they plan on continuing their coal production while at the same time reducing emissions in other aspects of their economic systems as well as developing renewable energy. It is unclear whether these states foresee a time when they would need to reduce and eventually get rid of this industry which significantly contributes to their economies.

South Africa

South Africa is perhaps the most important country on the continent of Africa concerning climate change. It is the fourteenth leading emitter of CO2 in the world and number one in Africa. It produces an insignificant amount of petroleum and natural gas but produces the seventh most amount of coal in the world, more than any other country in Africa. Coal is a significant part of the South Africa economy. This extensive coal production is partly responsible for total natural resource rents being five percent of the country's GDP which is in the medium range compared to other countries around the world. It also may have something to do with the country's poor climate change policy performance. According to the Climate Change Performance Index the country as a whole has a low rating in terms of climate change policy performance.

[50] Australian Energy Update 2018, Department of the Environment and Energy, Department of Industry, Science, Energy, and Resources, Australian Government, <https://www.energy.gov.au/publications/australian-energy-update-2018> (20 February 2020).

The two provinces that have joined the Under 2 Coalition, KwaZulu-Natal and Western Cape, do not have significant coal industries located within their jurisdictions. The vast majority of coal production in South Africa is located in the provinces of Limpopo and Mpumalanga, neither of which has joined the Under 2 Coalition.[51] The coal industry is a significant economic and political force in these provinces as well as the country as a whole. KwaZulu-Natal and Western Cape do not have this powerful industry located within their jurisdictions. This fact could partly explain why they are trying to diversify their economies and be part of the global transition away from fossil fuels including joining sub-national global networks such as the Under 2 Coalition.

India

India is certainly one of the most important countries that is playing an increasingly significant role concerning global warming. It is the third highest emitter of CO2 in the world behind only China and the United States. Although it produces minimal amounts of petroleum and natural gas only China produces more coal than India. This coal production is largely responsible for total natural resource rents being two percent of the country's GDP which is in the medium to low range compared to other countries. However, India is rated as having a high climate change policy performance by the Climate Change Performance Index. This high rating is due to its ambitious national GHG emissions reduction targets and considerable plans for renewable energy development. However, the most recent 2019 CCPI ratings notes that India could very well backslide as it has announced plans to build new coal-fired power plants that would undermine their ambitious GHG emissions reduction targets. Two of India's twenty nine states have joined the Under 2 Coalition: Chhattisgarh and Telangana.

[51] 'Our Operations and Projects', Universal Coal PLC, <http://www.universalcoal.com/our-operations-and-projects/overview> (20 February 2020).

An analysis of the coal industry in India reveals that coal is a significant part of the Chhattisgarh economy but not a significant part of the Telangana economy. Chhattisgarh is actually the number one producer of coal in India.[52] However an examination of Chhattisgarh indicates that it joined the Coalition not to seriously reduce its own carbon emissions but rather to focus on addressing the impacts of climate change. The appendix that Chhattisgarh submitted to the Under 2 Coalition that is supposed to detail how it plans on reducing its own emissions does not mention anything of the sort. Rather, it only discusses how the state is especially vulnerable to climate change and how it needs to protect itself from the impacts of climate change. The state has created the Chhattisgarh State Centre for Climate Change.[53] The Centre's website contains numerous reports and information none of which mentions the coal industry or any plans to reduce emissions within the state. Rather it focuses exclusively on the impacts of climate change and efforts to address these impacts through adaptation measures. Since joining the Under 2 Coalition in 2017 there is no evidence that the State has taken any action to reduce emissions within its borders such as reducing coal production.

Mexico

Mexico is another important country concerning global warming. It is the twelfth leading CO2 emitter in the world and along with Brazil is the leading emitter of CO2 in Latin America. It is the eleventh leading producer of petroleum in the world. Largely as a result of this significant petroleum production Mexico's total natural resource rent equals 3% of its total GDP which is in the medium to low range compared to other countries. According to the Climate Change Performance Index Mexico scores in the medium range of climate policy performance.

[52] Energy Statistics 2019, Central Statistics Office, Ministry of Statistics and Programme Implementation, Government of India, <http://www.mospi.gov.in/sites/default/files/publication_reports/Energy%20Statistics%202019-finall.pdf> (20 February 2020).
[53] Chattisgarh State Centre for Climate Change,< http://cgclimatechange.com/> (20 February 2020).

Fifteen of Mexico's thirty one states have joined the Under 2 Coalition: Aguascalientes, Baja California, Baja California Sur, Chiapas, Colima, Hidalgo, Jalisco, Mexico State, Michoacán, Oaxaca, Querétaro, Quintana Roo, Sonora, Tabasco, Yucatán.

Most of the oil industry in Mexico is located in both onshore and offshore oil fields in the Gulf of Mexico and thus plays a significant role in the economies of the Gulf states.[54] The states that are most dependent on the oil and gas industry in Mexico are Veracruz, Chiapas, Tabasco, Campeche, and Tamaulipas. Of these states only Chiapas has joined the Under 2 Coalition. The other thirteen states that have joined the Coalition have insignificant fossil fuel industries as a portion of their GSP.[55] As of August 2019 Chiapas has not submitted an Appendix outlining its plans to achieve the Under 2 Coalition goal even though it signed the Under 2 MOU in June 2015. This indicates it is not serious about doing anything of significance in terms of trying to achieve the ambitious Under 2 Coalition goal.

Brazil

The last country analyzed for this chapter is Brazil which is yet another extremely important country concerning global warming. It has the same amount of CO2 emissions as Mexico and so it also is the twelfth leading CO2 emitter in the world. It produces the tenth most amount of petroleum in the world. However, most importantly, much of the Amazon rainforest resides in Brazil which is one of the most critical CO2 sinks in the world. For decades deforestation for timber, cattle ranching, and settlement throughout the Amazon has endangered this critical carbon sink. Natural resource rents account for approximately 3.5% of Brazil's GDP which is in the mid to low range. According to the latest Climate Change Performance Index, Brazil's

[54] Overview of Oil and Gas Industry in Mexico, International Trade Administration, <https://www.trade.gov/knowledge-product/mexico-n-oil-and-gas> (20 February 2020).
[55] Ron Patterson, 'Why Mexico's oil production could fall even further', Oil Price, 20 August 2018, <https://oilprice.com/Energy/Energy-General/Why-Mexicos-Oil-Production-Could-Fall-Even-Further.html> (20 February 2020).

climate policy performance ranks as medium compared to other countries throughout the world. Seven of Brazil's twenty six states have joined the Under 2 Coalition: Acre, Amazonas, Mato Grosso, Pernambuco, Rondônia, São Paulo State, Tocantins.

In all seven of the Brazilian states that have joined the Under 2 Coalition, the petroleum industry does not play a significant role in any of their state economies. Some 90% of Brazil's oil industry is located off-shore in the Southeastern part of the country. Much of this production lies off the coast of the Brazilian states Rio de Janeiro and Espirito Santo and so the fossil fuel industry represents a significant share of these states' economies. Neither of these states have joined the Under 2 Coalition. Enormous oil reserves have been discovered in recent years along the coast of Brazil attracting global investment especially from China.[56] These recent discoveries have the potential of making Brazil one of the top oil exporters in the world. Nonetheless, the Brazilian states that have joined the Under 2 Coalition are not located along the coast where this development would have a significant impact on their state economies.

Conclusion

This analysis finds that the Under 2 Coalition is almost completely void of regions of the world where fossil fuel production comprises a significant portion of their economies. First, in an analysis of the overall Coalition it is found that not one subnational state or region has joined the Coalition from any of the top fifty countries that are the most dependent on natural resource rents including the fossil fuel industry. Second, in an analysis of fifty four states and regions from eight countries it is found that in only four cases is fossil fuel production a significant portion of the state or regional economy. Thus ninety two percent of the states and regions examined as part of this analysis exhibit low levels of dependence on the fossil fuel industry. In two of the

[56] Bruno Braga, 'Brazil's Oil, Gas Industry Expects to Create 500,000 Jobs by 2020', Hart Energy, 23 July 2018, <https://www.hartenergy.com/exclusives/brazils-oil-gas-industry-expects-create-500000-jobs-2020-31247> (20 February 2020).

states/regions in which fossil fuel production does represent a significant share of their economies it is found that in one case the state has not submitted a plan to reduce emissions and in another the state's plan focuses exclusively on adaptation rather than reducing emissions. So really, only two out of fifty four states and regions are the exceptions to the overall trend and further analysis reveals that even in these two exceptional cases the two jurisdictions do not pledge to make any real effort to reduce their fossil fuel production.

These findings provide evidence to support the primary hypothesis of this paper: that participation of subnational governments in transnational networks committed to reducing GHG emissions should be strongly and significantly influenced by the degree of fossil fuel production. The pattern found at the international level, that fossil fuel production levels play a significant role in explaining why countries do or do not participate in international efforts to reduce GHG emissions, is found at the subnational level as well. Those regions of the world, at both the national and subnational levels, in which fossil fuel production comprises a significant share of their economies, are extremely unlikely to participate in any global efforts to seriously reduce GHG emissions.

There are no doubt a number of reasons why a subnational state or region would or would not join the Under 2 Coalition or any other global network committed to reducing GHG emissions. This study does not take a comprehensive look at trying to determine these various reasons. Such an examination is beyond the scope of this paper. There are many subnational states and regions throughout the world that have low levels of dependence on the fossil fuel industry and have not joined the Under 2 Coalition. So there are obviously other reasons besides low dependence on the fossil fuel industry that explain why some subnational states and regions have not joined the Coalition. Further, as the four cases in this study exemplify there are a few cases

in which states and regions that do have some significant degree of dependence on the fossil fuel industry have joined the coalition. Again, a more comprehensive examination is needed to determine the other variables that come into play in explaining these outliers. However, this study has demonstrated that with few exceptions states and regions that have joined the Coalition exhibit low levels of dependence on the fossil fuel industry. This finding has important implications for the prospect of transnational networks of nonstate actors to have any significant effect on global warming.

Overall, the findings from this chapter indicate that these transnational efforts among nonstate actors are unlikely to have any significant impact on global emissions in the foreseeable future. Certainly the evidence collected here indicates that any suggestion these efforts could somehow "supplant" or "substitute" international efforts between countries is extremely unlikely. Perhaps these networks may supplement international efforts but based on this analysis it seems very unlikely these actions have been or will be significant in terms of having any measurable impact on global GHG emissions. Much more likely is that these efforts have marginal effects.

At both the national and subnational level, global efforts to reduce GHG emissions do not include jurisdictions that are significantly dependent on the production of fossil fuels. As a result these efforts almost completely ignore the supply side of the global warming problem. Those regions that are significantly dependent on the production of fossil fuels continue to pursue production of these fossil fuels. This increase in supply then leads to lower prices that then slows down the transition to renewable energy that is underway but which needs to accelerate in order to reduce emissions consistent with a two degree pathway. Global efforts at both the national and subnational levels are not addressing this central supply-side obstacle to limiting global warming below business as usual levels.

These findings also indicate that global efforts to reduce GHG emissions are not hindered so much by the often cited free-rider problem but rather the central obstacle is the continued dependence on the fossil fuel industry that besets so many jurisdictions throughout the world at both the national and subnational levels. This central dilemma is exemplified in both the Prisoner's Dilemma and the tragedy of the commons metaphor formulated by Garrett Hardin. Jurisdictions throughout the world at all levels are pursuing what they perceive to be in their best near term economic self-interest. For those jurisdictions that significantly rely on fossil fuel production for their economic well-being this means that they most likely will resist, or at least not participate, in efforts to reduce GHG emissions. Or, as a couple of cases examined here indicate, they may join any such efforts for a variety of reasons and then largely ignore their own contribution to the problem. This study provides some preliminary evidence to support this assertion. Until this central obstacle is seriously and directly addressed, any global efforts, whether they be at the national or subnational levels, are unlikely to have success in limiting global warming below business-as-usual scenarios.

5

Drivers of State Level Climate Change Mitigation Policies in the U.S.

Introduction

As discussed in the previous chapter scholars within the dominant Neoliberalism framework have considered the prospect that nonstate actors such as subnational governments can supplement or even supplant conventional international relations among state actors to limit global warming. The findings presented in the previous chapter provide evidence against this prospect. In examining one of the most prominent global networks of subnational states and regions committed to reducing greenhouse gas (GHG) emissions it finds not one subnational state or region has joined the Coalition from any of the top fifty countries that are the most dependent on natural resource rents including fossil fuels. It further finds that ninety two percent of a sample of members across eight countries exhibits no significant fossil fuel production levels. These findings indicate that global efforts to limit climate change among nonstate actors run into the same primary obstacle that has inhibited international efforts among state actors, namely fossil fuel dependence. This chapter takes a closer look at the case of the United States in examining the ability of subnational jurisdictions to help lead global efforts to limit climate change.

The United States national government has been and continues to be one of the main reasons why international efforts have failed to have any discernable impact on global GHG emissions. Throughout the twenty eight years and counting of international efforts to limit global warming the United States federal government has consistently refused to take a leadership role in these international efforts and has generally inhibited international efforts to limit global warming. The

United States did not participate in the Kyoto Protocol, the first international institution designed to reduce GHG emissions. The Obama Administration signed the Paris Agreement, the second and current international agreement designed to reduce GHG emissions, but its pledge was widely seen as "insufficient" which means it is not consistent with limiting warming to below 2°C and certainly not the 1.5°C limit, the targets agreed to by the international community.[57]

The U.S. has since elected Donald Trump who ran on an anti-climate change platform to be president including promising to withdraw the U.S. from the Paris Agreement if elected president. After being elected president, Trump fulfilled his campaign pledge by officially signaling the intent of the U.S. to withdraw from the Paris Agreement thus ensuring that at least until the end of 2020, the end of president Trump's first term, the United States is once again not participating in international efforts to limit global warming. President Trump has made it one of his top priorities to eliminate all federal policies designed to reduce GHG emissions, revive the coal industry, and increase domestic fossil fuel production. The Climate Action Tracker now rates the U.S. climate policies as "critically insufficient", its worse possible rating. According to the 2019 Climate Change Performance Index the U.S. exhibits very low climate policy performance, the worst rating a country can receive.[58]

While the U.S. national government drags its feet on climate change, a number of subnational governments in the U.S. have increasingly enacted ambitious climate change policies. These so called nonstate actors are stepping into the void left by the national government and are taking the lead on the issue of climate change mitigation within the U.S. According to one calculation, "22 states, 550 cities, and 900 companies with operations in the U.S. have made climate

[57] U.S. Country Summary, Climate Action Tracker, <https://climateactiontracker.org/countries/usa/> (21 February 2020).
[58] 2019 Climate Change Performance Index, Germanwatch, <https://www.climate-change-performance-index.org/sites/default/files/documents/ccpi-2019-results-190614-web-a4.pdf> (21 February 2020).

commitments, and all 50 states have some type of policy that could bring about emissions reductions".[59]

This dynamic between national and subnational climate change mitigation policies in the United States raises many interesting questions. For example, could these efforts by subnational actors in the U.S. achieve the U.S. pledge for the Paris Agreement even if the national government does not cooperate? One recent study examines subnational climate change mitigation policies in the United States and concludes that if all of the pledges by subnational governments in the U.S. are completely fulfilled then it could result in emissions reductions of 17–24% below 2005 levels in 2025. This would get the U.S. close to its pledge for the Paris Agreement.[60]

Another important question is what explains why these subnational governments are taking such significant and apparently costly action to reduce GHG emissions in lieu of either being required to do so by the national government or an international institution that requires everyone to take such costly action? According to conventional collective action theory it is irrational for these subnational jurisdictions to take such costly action in lieu of an international framework that requires full participation by everyone (Ostrom 2010). For example, if the state of California takes costly action to reduce its GHG emissions and other states in the U.S. and others around the world do not take similar action then California's efforts will have little to no effect on global warming and the impacts of this warming. California would incur significant costs associated with reducing its GHG emissions while still incurring the same amount of costs as a result of the impact of global warming. This doesn't make sense from a narrow rational choice perspective.

[59] U.S. Country Summary, Climate Action Tracker
[60] Ibid

This chapter focuses on the question of what explains the variation in climate change mitigation policies across states in the U.S. Three leading candidates are: (1) vulnerability to climate change, (2) fossil fuel dependence, and (3) ideology. Presumably, states which are more vulnerable to the negative impacts of climate change should be more motivated to participate in efforts to limit global warming. On the other hand states which are the most dependent on fossil fuels should be less willing to take significant and costly action to reduce GHG emissions. Lastly, more conservative states should be less inclined to take climate change seriously.

To determine the main drivers of climate mitigation policies at the state level in the United States a quantitative comparative analysis is conducted. A first of its kind climate change mitigation policy index is constructed which quantifies and compares every state's climate change mitigation policies. This variable is then used in a number of multivariate statistical analyses that analyzes the effect several independent variables have on explaining the variation of climate mitigation policies among states including vulnerability, fossil fuel interests, and ideology.

Literature Review

According to conventional collective action theory it is irrational for actors to take costly action to address a collective action problem in lieu of a central authority that requires it to do so. Climate change is commonly depicted as a collective action problem in which the economic costs of taking action to reduce GHG emissions outweigh the economic benefits of taking such action. The economic costs of reducing GHG emissions are direct and immediate while the benefits of limiting global warming are diffuse, long term, and include more uncertainties. According to this theory a global central authority is needed to force actors throughout the world to go against their rationally calculated short-term self-interest for the greater long-term good.

According to this perspective universal participation is required and positive and/or negative incentives are needed for the institution to be effective. In lieu of such a central authority actors are expected to not take the needed action to reduce emissions in order to achieve a climate pathway that would avoid the worst impacts of climate change (Wiener 2007).

However, in an apparent contradiction of conventional collective action theory both state and nonstate actors throughout the world have taken significant and in many cases costly action to reduce GHG emissions in lieu of such a global framework. This behavior is perplexing if we assume that actors are rational and pursue what they believe is in their short-term best self-interest. Nonstate actors in particular, such as subnational governments, are increasingly taking strong action on climate change throughout the world (Bulkeley et al. 2010).

Numerous scholars within the Neoliberalism framework that dominates discussions of climate change praise this new development and argue that a more decentralized approach to limiting global warming is more effective than a top-down, centralized approach. David Victor and Robert Keohane have been leading advocates for this approach (Victor et al. 2006; Keohane and Victor 2010). Elinor Ostrom also lays much of the foundation for this literature with her 2010 paper which applies her concept of polycentric systems to the issue of climate change (Ostrom 2010). David Feldman goes as far to argue that networks of nonstate actors could potentially "supplant the need for national action to address climate change" (Feldman 2012). A 2007 paper by Nicholas Lutsey and Daniel Sperling titled *America's Bottom-Up Climate Change Mitigation Policy* documents the growing number of city, state, and regional efforts in the U.S. to reduce GHG emissions. The authors conclude that these subnational governments in the U.S. "have largely overcome the 'commons' problem in dealing with climate change" (Lutsey and Sperling 2007).

This rapid development of subnational policies that reduce GHG emissions leads to many interesting and important questions which have been explored by scholars. One such question is why are these subnational governments taking such action in lieu of a central enforcement mechanism which according to conventional collective action theory is the only way to overcome the collective action dilemma? Explanations by scholars for this apparent contradiction can be grouped into five explanations: (1) Vulnerability to climate change, (2) the co-benefits of climate change mitigation policies, (3) political ideology, (4) socioeconomic variables, and (5) fossil fuel dependence. Each of these explanations presented in the literature are reviewed in order.

One possible explanation for why actors are willing to take significant and costly action to reduce GHG emissions is because they believe the costs of climate change outweigh the costs of taking action to reduce GHG emissions. This would certainly be the case for countries that inhabit low lying islands. Such nations face an existential threat from sea-level rise that is worsened by climate change. In the United States some areas are more vulnerable to climate change than others. According to this explanation those areas that are more threatened by climate change should be more willing to do whatever is in their power to reduce GHG emissions thus decreasing their vulnerability.

However, very few studies attempt to measure the effect vulnerability to climate change has on climate mitigation policies at the subnational level in the United States. This is in large part due to the fact that until recently no measurement existed which quantifies and compares vulnerability at the subnational level. One early study that created its own measurement finds that cities in counties more vulnerable to climate change are more likely to join the Cities for Climate Protection (CCP) campaign (Zahran et al. 2008). It should be noted that joining the CCP

is a relatively low cost action and so this finding does not indicate a local jurisdiction is willing to take costly action as a result of being more vulnerable to climate change. Also, these cities could join the CCP to pursue climate adaptation rather than climate mitigation.

More recently, a collaborative effort by scholars has created a vulnerability measurement that measures the projected economic impact of climate change at the county level across the United States (Hsiang et al. 2017). The scholars find that climate change is projected to have very different impacts throughout the United States, some positive and some negative. In a report for the Brookings Institute Mark Muro, David Victor, and Jacob Whiton find that "many of the jurisdictions that have selected political leaders opposed to climate policy are the most exposed to the harms of climate change".[61] However, no scholars, including the authors of the Brookings Report, have attempted to use this data to see if this vulnerability has any effect on subnational climate policies. Although the authors of the Brookings Report suggest there is an inverse relationship in which the most vulnerable parts of the United States are the least supportive of measures to reduce GHG emissions as a result of the impact of ideology.

Another possible explanation for why subnational jurisdictions may enact policies that reduce GHG emissions are so called co-benefits. There is no precise definition for what is meant by co-benefits. For the purpose of this paper co-benefits are defined broadly to include any immediate or near term economic, social, health benefits that result from policies which intentionally or unintentionally reduce GHG emissions. These co-benefits are separate from the possible benefits that may eventually accrue in terms of reducing the impacts of climate change which as has been discussed are diffuse, long-term, and highly uncertain. The conventional collective action theoretical perspective only considers the cost-benefit analysis concerning the direct costs of

[61] Mark Muro, David G. Victor and Jacob Whiton, 'How the geography of climate change could make the politics less polarizing', Brookings Institute Report, 29 January 2019, <https://www.brookings.edu/research/how-the-geography-of-climate-damage-could-make-the-politics-less-polarizing/> (21 February 2020).

climate change mitigation and the benefits associated with reducing the impact of climate change. When considering only these costs and benefits it is thought to be irrational for any actor to take action to mitigate climate change in lieu of a global central authority that forces all actors to go against what is in their best economic self-interest.

A number of scholars have pointed to the co-benefits of climate change mitigation policies to explain why some subnational jurisdictions in the United States are enacting such measures in apparent contradiction to conventional collective action theory. Barry Rabe and his colleagues propose a state competition framework to explain why many states in the United States are enacting ambitious climate change mitigation measures. According to Rabe and his colleagues states may pursue climate change mitigation for a number of strategic reasons to give them a competitive advantage in the global economy. First, they may be strategically protecting their natural resources that give them a competitive advantage from the dangers of climate change. Second, states may pursue such policies to promote energy security, diversity, and independence. Third, states may pursue such policies for economic development purposes such as becoming innovation and technology leaders in the transition away from fossil fuels. Fourth, states may pursue such policies to benefit and take advantage of federal incentives (Rabe et al. 2006). Another often cited co-benefits discussed by scholars include the local health benefits that often times accompany initiatives to reduce GHG emissions such as an improvement in local air quality.

Another common explanation for the variation in climate change mitigation policies among subnational jurisdictions in the United States is ideology. Over the last couple of decades global warming has increasingly become a polarizing issue in the U.S. A clear partisan divide exists in the U.S. concerning opinions about whether global warming is real and human caused and

whether policymakers should do something about it. At the national level the Democratic Party believes global warming is caused by humans, is a serious and growing problem, and policies should be implemented to accelerate the reduction of domestic GHG emissions. The Republican Party on the other hand is much more skeptical of human caused global warming and the idea that it is a serious and growing problem. The Republican Party and most Republican elected officials therefore generally oppose policy proposals to accelerate the reduction of domestic GHG emissions in the U.S. It should be no surprise then that at the subnational level empirical studies have found that more conservative leaning states tend to have weaker climate change policies than more liberal leaning states (Vachon and Menz 2006; Huang et al. 2007; Matisoff 2008; Lyon and Yin 2010; Carley and Miller 2012). These studies have consistently found that ideology and/or partisanship is the main driver of climate policies at the state level.

Scholars have also found that socioeconomic variables such as GDP per capita and education levels play an important role in explaining the variation of energy policies across states. Jess Chandler finds that GDP per capita disposable income is positively correlated with whether states adopt sustainable energy portfolio standards (Chandler 2009). Huang et al. find that education levels and gross state product are positively correlated with whether states adopt renewable portfolio standards (Huang et al. 2007). Those states that have high levels of income and education are more likely to enact policies designed to help develop the renewable energy industry.

Lastly, empirical studies have found mixed results when it comes to the effect fossil fuel production levels have on state level energy policies relating to climate change. In one of the more comprehensive empirical studies that attempts to explain the variation in policies relating to climate change across states in the United States, Daniel Matisoff finds that between 1990 and

2007 states that had higher carbon-intensive economies and that produced more coal and natural gas adopted less renewable energy and energy efficiency policies. These effects held true when controlling for other variables (Matisoff 2008). Other scholars have found fossil fuel dependence is an insignificant variable in explaining state level energy policies related to climate change. Huang et al. find that the share of coal in a state's electricity generation does not have a significant effect on whether that state adopts a renewable energy portfolio standard (Huang et al. 2007).

One important finding from this brief literature review is that no empirical study was found which measures the impact that overall fossil fuel dependence has on overall climate change mitigation policies among all fifty states. The empirical studies found for this review all focus on renewable energy policies and in a few cases energy efficiency policies. However states may pursue these policies for reasons unrelated to the issue of global warming. A state may adopt these policies for the many reasons listed in the previous discussion on co-benefits. For example a state may adopt renewable energy subsidies to create jobs and improve local air quality rather than to address the issue of global warming. In this way, the reduction of GHG emissions and the contribution to limit global warming could be a "co-benefit" to these other political and/or economic goals rather than the other way around as it is normally presented in the literature. The authors of these studies either explicitly or implicitly use these renewable energy and energy efficiency policies as proxies for climate change mitigation policies and perhaps this is justified to some extent. However there is a need to use a more comprehensive measurement for climate change mitigation policies which captures the degree of commitment to addressing global warming more explicitly and directly.

Theory and Hypotheses

Concerning the issue of global warming conventional collective action theory predicts "that no one will voluntarily change behavior to reduce energy use and GHG emissions; an external authority is required to impose enforceable rules that change the incentives for those involved" (Ostrom 2010 citing Brennan 2009). However, as has been discussed many state and nonstate actors throughout the world are taking such action. For instance at the subnational level in the United States many state governments are taking significant and in many cases costly action to reduce GHG emissions within their borders which apparently contradicts conventional collective action theory. From the standpoint of rational choice theory it doesn't make any sense why state governments would take costly action to reduce GHG emissions when other states in the U.S. and much of the rest of the world are not doing so.

These subnational states are bearing the costs of reducing GHG emissions while they will still most likely bear the costs of the impacts of global warming since their individual actions will most likely have little to no effect on global warming. As long as other subnational states in the U.S. and the rest of the world continue to burn fossil fuels at their current rates global warming will continue along its current path which means the states that take the most ambitious actions to reduce GHG emissions will experience the same costs from the impacts of climate change that they would experience even if they had done nothing.

This dilemma makes clear that the central problem that has so far prevented global efforts to limit climate change from being more successful is not the so called free-rider problem, as it is commonly portrayed in the literature (Aklin and Mildenberger 2018), since this would require much higher (near universal) participation rates. The free-rider problem would be the central issue if global efforts are so widespread that the public good secured by such efforts (limiting

climate change below a sustainable level) would be achieved even if some small percentage of actors do not participate. These non-participators would then "free-ride" on the efforts of the rest of the world which would be footing the bill for the transition. However, as this Dissertation has so far made clear global efforts have not come even close to such levels of success. No public good in the form of significantly lower levels of global GHG emissions that would result in limiting global warming below sustainable levels has come even close to being achieved by global efforts and this prospect is highly unlikely in the foreseeable future. Therefore, the free-rider problem has not, is not, and is unlikely in the near future to be the central concern of leading actors when it comes to climate change.

Returning to the case of the U.S., why are these subnational states taking such costly action to reduce their GHG emissions when it will likely have no impact on global warming and its effects? For one, as has been discussed there are many co-benefits which actors receive when taking action to mitigate climate change. In some cases climate change mitigation could itself be the co-benefit or by product of other policy/economic initiatives that have other primary objectives other than addressing climate change such as creating clean energy jobs, being a "first-mover" in terms of leading the transition away from fossil fuels, or improving local air quality. Second, there are no doubt socio-economic and political variables which play roles in affecting whether in this case subnational governments are willing to take costly action to reduce GHG emissions. Third, the costs and benefits of taking various actions to address public good issue vary among actors.

Concerning subnational climate mitigation policies in the United States it is much more costly for some states to take action to mitigate climate change than other states. It is widely thought that in order to address global warming we need to immediately and dramatically decrease the

use of fossil fuels and eventually phase them out altogether. Taking action to mitigate climate change poses a direct socio-economic threat to those states in the U.S. in which fossil fuel production represents a large share of the gross state product. The same is true for those states in the U.S. in which their economies have high levels of carbon intensity. These subnational states face much steeper overall costs in any transition away from fossil fuels than subnational states in which their economies are less dependent on fossil fuels. Some states' economies in the U.S. are heavily dependent on the fossil fuel industry and/or other industries which themselves are heavily dependent on fossil fuels while other U.S. states have little dependency on the fossil fuel industry and/or other industries that are dependent on fossil fuels.

The first three hypotheses of this study concern fossil fuel dependence. First, fossil fuel dependence should be a significant factor that affects the variation of climate change mitigation policies across states in the United States. Second, those states that are most dependent on fossil fuels should be the least likely to adopt strong climate change mitigation policies. These states are likely to view the expected costs of climate change mitigation as outweighing the expected benefits. Third, those states that are the most committed to reducing GHG emissions should have low levels of fossil fuel dependence. These effects should hold true when controlling for GDP per capita, education, and vulnerability to climate change.

H1: Fossil fuel dependence should have a strong and significant effect on the variation of climate change mitigation policies across states even when controlling for vulnerability, education, and income.

H2: Those states most dependent on fossil fuels should have the weakest climate change mitigation policies.

H3: Those states most committed to reducing GHG emissions should have low levels of fossil fuel dependence.

Hypothesis number four concerns ideology. Based on the literature we would expect that ideology should have a strong and significant effect on climate change mitigation policies. Climate change has become a national polarizing issue that divides democrats and republicans, liberals and conservatives. Liberal and conservative media frame the issue of climate change very differently. Fossil fuel interest groups are major stakeholders of the Republican Party while environmental interest groups and climate activists are major stakeholders of the Democratic Party. A state's climate change mitigation ambition level should in large part depend on where a state falls on the ideological spectrum even when controlling for other variables including fossil fuel dependence.

This ideological factor should then play an overriding role in the calculation among voters and policymakers alike on whether they support or oppose taking significant action to reduce GHG emissions. For policymakers there are significant benefits and costs associated with taking a particular position on climate change. For example, a Republican elected representative in a conservative state faces steep political costs if she decides to buck the trend in her party and declares that the state should take significant action to reduce GHG emissions. The same would be true if a Democratic elected representative in a liberal state took the position that we should not take significant action to reduce GHG emissions. Voters face a similar calculation. A conservative or liberal voter faces the threat of being ostracized from her conservative or liberal "tribe" by taking a position on climate change that goes against the grain. This process has been labelled "cultural cognition" by Kahan and colleagues (Kahan and Braman 2006).

H4: Ideology should have a strong and significant effect on state level climate mitigation policies

The fifth hypothesis concerns vulnerability to climate change. Based on the findings presented in an earlier chapter of this Dissertation, the data compiled by the Climate Lab, and the Brookings Institute Report previously discussed, it is expected that any apparent effect climate vulnerability has on state behavior should be explained as a by-product of ideology. The impacts of climate change are complex, uncertain, long-term, and diffuse. These characteristics mean they are unlikely to play a defining role in motivating actors one way or another concerning climate change. It also means how actors think about vulnerability is highly susceptible to political manipulation. Thus we would expect that vulnerability to climate change is largely derivative of ideology.

Hypothesis 5: Ideology should erase any apparent effect vulnerability to climate change has on climate change mitigation policies

Methods and Data

To test these five hypotheses a series of regressions are conducted. These regressions test the effect different variables have on the variation of climate change mitigation polices at the state level in the United States. This study is the first quantitative analysis that compares all fifty states' comprehensive climate change mitigation policies and then analyzes the effect different variables have on these policies. As discussed in the literature review section all of the published studies to date on subnational climate change mitigation policies use renewable energy and energy efficiency as proxies for climate change mitigation policies. However, renewable energy and energy efficiency policies are not necessarily adopted primarily to address the specific issue of climate change. They could be adopted for other primary reasons such as to create jobs, save money, or improve local air quality. It is important to include other state policies that indicate a state's overall level of commitment to addressing the specific issue of climate change. This

analysis is the first of its kind to measure and compare a more comprehensive set of policies that indicate state level commitment to addressing climate change.

Dependent Variable

The dependent variable used for the regressions is climate change mitigation policies. This variable is created by quantifying and comparing states' climate change mitigation policies. All fifty states are given a climate mitigation policy score between zero and one hundred which represents their level of commitment to accelerating the reduction of GHG emissions. The score includes five equal parts: energy efficiency policies (20 points); renewable energy policies (20 points); carbon pricing policies (20 points); GHG reduction targets (20 points); and membership in a coalition committed to reducing GHG emissions (20 points). This score does not include all state policies that either intentionally or unintentionally reduce GHG emissions. However it covers most of these policies and thus provides the most comprehensive assessment and comparison of state level commitment to reducing GHG emissions that exists to date.

Three important points about this analysis should be noted. First, this score represents policy output rather than policy outcome. So for example it does not measure policy effectiveness or implementation. It also does not consider any trends in terms of GHG emission levels, such as whether a state's GHG emissions have gone down or up. This is an entirely different question which is beyond the scope of this paper. It is of course an extremely important question which deserves further attention. States may say they are going to take significant action to reduce emissions but then not actually do so. On the other hand, states may appear to have weak climate policies but their emissions may be going down for any number of reasons. Regardless, this paper focuses on climate policy commitment which can be measured by examining and comparing states' climate mitigation policies.

Second, this analysis focuses exclusively on climate change mitigation policies which reduce GHG emissions. Climate change adaptation policies are not included or considered. Climate adaptation policies refer to policies intended to address the impacts of climate change. This is an entirely separate issue which is beyond the scope of this paper. There are many questions related to this issue that are extremely important in their own right and deserve further attention. However this paper focuses on climate change mitigation policies which are designed to limit global warming.

Lastly, a decision was made to equally weight the five categories that comprise the climate change mitigation policies total score. It could be argued certain categories are more important than others. This is perhaps true and is a subjective and arbitrary choice. However each category represents an important aspect of a state's commitment to reduce GHG emissions and so it was decided to not lessen the importance of one category under another. It is the judgement of the author that this score best represents a state's overall commitment to reducing GHG emissions.

Each category is compiled from different sources and then scored by the author on a scale of one to twenty. The energy efficiency score is based on the 2018 Energy Efficiency Scorecard produced by the American Council for an Energy-Efficient Economy (ACEEE).[62] The renewable energy policy score is based on an analysis of the DSIRE database on state energy policies maintained by the U.S. Department of Energy.[63] The carbon pricing and GHG reduction target scores are based on information collected by the Center for Climate and Energy Solutions (C2ES).[64] The participation in a network committed to reducing GHG emissions is based on

[62] The 2018 State Energy Efficiency Scorecard, American Council for an Energy Efficient Economy, 4 October 2018, <https://www.aceee.org/research-report/u1808 > (22 February 2020).
[63] U.S. Department of Energy, Database of State Incentives for Renewables and Efficiency, <https://www.dsireusa.org/> (22 February 2020).
[64] State Climate Policy Maps, Center for Climate and Energy Solutions, < https://www.c2es.org/content/state-climate-policy/> (22 February 2020).

whether a state is a member of the Under 2 Coalition and/or the United States Climate Alliance, the two state based coalitions in the U.S. that focus on reducing GHG emissions. All policies are analyzed and up to date through 2018.

Independent Variables

Fossil fuel dependence is measured using two separate variables. The first variable represents what percentage of a state's gross state product (GSP) comes from the production of petroleum, natural gas, and coal. This number is derived by analyzing data from the U.S. Energy Information Administration (EIA) and calculating the percentage of a state's GSP that comes from the production of fossil fuels using 2017 data for production numbers, sales price for the fossil fuels, and GSP. The second fossil fuel dependence variable represents the carbon intensity of the economy for each state which combines energy intensity with carbon intensity of the energy supply. This data also comes from the EIA. According to the EIA "the states with relatively high energy intensities tend to be in cold climates and rural or have a large industrial base relative to their overall economy…whereas for carbon intensity of the energy supply the states with a lower carbon-intensive energy supply tend to be those states with relatively substantial non-carbon electricity generation from sources such as nuclear or hydropower".[65] Data from 2005 is used in order to avoid as much as possible a potential directionality problem since it is possible a state's climate change mitigation policies could affect the carbon intensity of the economy. Using data from 2005 minimizes this possibility since nearly all climate mitigation policies in most states have occurred since 2005.

[65] U.S. Energy Information Administration, *Energy-Related Carbon Dioxide Emissions by State, 2005-2016* <https://www.eia.gov/environment/emissions/state/analysis/pdf/stateanalysis.pdf> (22 February 2020).

The vulnerability to climate change variable uses data from a Brookings Institute report on the geography of climate change.[66] David Victor and colleagues use data from the Climate Impact Lab to rank states "by the degree of economic harm they may experience from climate change". The Climate Impact Lab calculates the estimated "economic costs of future climate change through the end of the century in the United States". The Lab estimates vulnerability for every county in the United States. This is the most scientific, detailed, and extensive assessment of climate change vulnerability in the United States that has been conducted to date. According to the Climate Lab's analysis there is wide variation in the effects that states in the U.S. will experience due to climate change in areas such as agricultural yields, mortality, coastal damage, and risk to labor. According to Climate Lab's analysis some parts of the United States such as the Pacific Northwest, Interior West, the upper Midwest, and New England are predicted to actually experience net economic benefits from climate change during the 2080-2099 time frame while climate change is likely to lead to significant net losses for much of the Southwest, Southeast, and Florida. The authors of the Brookings report then aggregate the County level data to determine state level vulnerability to climate change. This state level assessment from the Brookings report is then used for the climate change vulnerability variable for this analysis.

Variables for both economic development and education levels are included in the analysis. The economic variable uses GDP per capita that is taken from the U.S. Bureau of Economic Analysis report for 2017.[67] The education level compares states in terms of the percentage of

[66] Mark Muro, David G. Victor and Jacob Whiton, 'How the geography of climate change could make the politics less polarizing', Brookings Institute Report, 29 January 2019, <https://www.brookings.edu/research/how-the-geography-of-climate-damage-could-make-the-politics-less-polarizing/> (21 February 2020).
[67] U.S. Department of Commerce, 'Gross Domestic Product by State, Fourth Quarter and Annual 2018', News Release, Bureau of Economic Analysis, 1 May 2019, < https://www.bea.gov/system/files/2019-04/qgdpstate0519_4.pdf> (22 February 2020).

their population that has a Bachelor's degree or higher. The data is taken from the 2013-2017 American Community Survey administered by the Census Bureau.[68]

The ideology variable is based on a Gallup 2018 tracking poll. The question asks respondents to indicate whether they describe their political views as conservative, moderate, or liberal. The variable used for this analysis represents the difference between the percent of respondents that self-identify as conservatives and those who self-identify as liberals. The poll finds that most states in the U.S. have a higher percentage of citizens who identify as conservative. Only six states have a higher percentage of liberals than conservatives. Moreover in nineteen states conservatives outnumber liberals by over twenty percentage points. Nationally, the overall conservative advantage in ideological identification is nine percentage points.[69]

Results

The first part of the analysis examines states' overall climate change mitigation policies and scores them on a scale of 1 to 100. These scores are then placed into four categories which follows the template used by Climate Action Tracker in analyzing and comparing countries' climate action. These four categories are labelled: (1) two degrees Celsius compatible, (2) Insufficient, (3) Highly Insufficient, and (4) Critically Insufficient.

States that score 80 and above are characterized as having policies which are compatible with a pathway that limits global warming to well below two degrees Celsius above pre-industrial levels (two degree pathway). This is the stated goal of the Paris Agreement signed by nearly every country in the world including the U.S. In other words, if states score at least an 80 then if the rest of the world exhibited the same level of commitment to reducing GHG emissions then

[68] U.S. Census Bureau, '2013-2017 ACS 5 Year Estimates', <https://www.census.gov/programs-surveys/acs/technical-documentation/table-and-geography-changes/2017/5-year.html> (22 February 2020).
[69] Jeffrey M. Jones, 'Conservatives greatly outnumber liberals in 19 U.S. states', Gallup, 22 February 2019, <https://news.gallup.com/poll/247016/conservatives-greatly-outnumber-liberals-states.aspx> (22 February 2020).

there would be a decent chance of limiting global warming to well below two degrees Celsius above pre-industrial levels. Though again, this is dependent on these policies being fully implemented and achieved which is a whole separate question that is beyond the scope of this analysis.

Table 5.1
Climate policy score

State	Energy Efficiency	RPS	GHG Targets	Carbon Pricing	Networks	Total Score
California	20	20	20	20	20	100
Massachusetts	20	20	15	20	20	95
Rhode Island	19	15	20	15	20	89
Vermont	19	15	20	15	20	89
New York	18	15	20	15	20	88
Washington	17	20	15	15	20	87
Connecticut	18	15	15	15	20	83
Maine	15	20	20	15	10	80
Oregon	18	15	20	0	20	73
Minnesota	17	15	20	0	20	72
New Hampshire	12	10	15	15	20	72
Maryland	16	15	10	15	10	66
Michigan	16	10	20	0	20	66
Delaware	12	10	10	15	10	57
Colorado	15	20	10	0	10	55
Hawaii	14	20	0	0	20	54
New Jersey	13	15	15	0	10	53
Illinois	16	10	15	0	10	51
Pennsylvania	13	10	15	0	10	48
New Mexico	6	20	10	0	10	46
North Carolina	10	10	10	0	10	40
Virginia	10	10	0	0	20	40
Arizona	14	15	10	0	0	39
Nevada	9	20	0	0	10	39
Florida	11	0	15	0	0	26
Wisconsin	9	5	0	0	10	24
Utah	12	10	0	0	0	22
Montana	6	5	0	0	10	21
Louisiana	19	0	0	0	0	19
Ohio	9	10	0	0	0	19
Missouri	7	10	0	0	0	17
Iowa	11	5	0	0	0	16
Texas	10	5	0	0	0	15
Kansas	2	10	0	0	0	12
Idaho	10	0	0	0	0	10
Oklahoma	5	5	0	0	0	10
Indiana	4	5	0	0	0	9
Kentucky	9	0	0	0	0	9
Arkansas	7	0	0	0	0	7
South Dakota	2	5	0	0	0	7
North Dakota	1	5	0	0	0	6
Tennessee	6	0	0	0	0	6
Georgia	5	0	0	0	0	5
Alaska	4	0	0	0	0	4
South Carolina	4	0	0	0	0	4
Alabama	3	0	0	0	0	3
Mississippi	3	0	0	0	0	3
Nebraska	3	0	0	0	0	3
West Virginia	1	0	0	0	0	1
Wyoming	1	0	0	0	0	1

As shown in Table 5.1 this analysis finds that as expected states exhibit wide variation in their commitment to reducing GHG emissions. Only eight states score 80 or above indicating a high level and comprehensive commitment to reducing GHG emissions within their jurisdictions that is consistent with a two degree pathway. These states check all the boxes in terms of carbon

pricing through a cap-and-trade program, strong renewable energy mandates and energy efficiency standards, ambitious short term and long term GHG emission reduction targets, and collaboration with other jurisdictions. They have shown a strong and consistent commitment in recent years to doing their part in reducing GHG emissions in line with a climate pathway that would limit global warming to well below two degrees Celsius above pre-industrial levels.

Ten states fall within the second category of insufficient climate change mitigation policies. If the rest of U.S. states and the world followed the same level of ambition as these states then the world would likely come close to achieving the two degree pathway but would likely fall short. These states have more mixed records but generally have positive records and exhibit some significant yet insufficient commitment to reducing GHG emissions.

The third and fourth categories include the majority (32) of states in the U.S. that exhibit highly and critically insufficient commitment to reducing GHG emissions. If all U.S. states and the rest of the world followed the ambition level of these states then there is virtually no chance we would be able to achieve the two degree pathway. These states exhibit scores of 50 and below. The states at the top end of this range have mixed records but generally fall short of overall ambition while the states at the bottom end have exhibited little to no commitment to reducing GHG emissions.

Next, multivariate tests are conducted to analyze the possible effect fossil fuel dependence, vulnerability to climate change, education levels, and income levels have on this variation of climate change mitigation policies across states while controlling for each other. As seen in Table 5.2 taken together these variables explain 50-60% of the variation of climate change mitigation policies across states. Hypothesis #1 is confirmed as both variables used to represent fossil fuel dependency exhibit strong and significant effects when controlling for the other socio-

economic and climate vulnerability variables. It appears those states that exhibit higher levels of fossil fuel dependency are less willing to commit to ambitious climate mitigation policies which would reduce this dependence.

Table 5.2
Predictors of climate change mitigation policy commitment (multivariate regressions)

Variables	Test 1	Test 2
Fossil Fuel Production	-.672* (.270)	
Carbon Intensity		-.033*** (.008)
Vulnerability to Climate Change	-1.772* (.769)	-1.977** (.710)
GDP Per Capita	.306 (.420)	.286 (.373)
Education Level	2.591* (.998)	1.605 (.985)
Observations	49	49
Adjusted R Square	.529	.597

*** Statistically significant at the .1 percent level
** Statistically significant at the 1 percent level
* Statistically significant at the 5 percent level

This analysis also confirms hypotheses #2 and #3. As shown in Table 5.3 the states that exhibit strong overall commitment (green states) to reducing GHG emissions have economies that have low levels of dependence on fossil fuel production. Only Colorado exhibits any significant fossil fuel production in the next category of states that have insufficient climate mitigation policies. For the other fossil fuel dependence variable, carbon intensity of the state economy, all of the states in the top two categories are below average except for Maine and Michigan which are right at average carbon intensity of the state economy compared to the other

states. Conversely, those states most dependent on fossil fuels exhibit the weakest commitment to reducing GHG emissions.

Table 5.3
Climate policy score and fossil fuel dependence

State	Climate Policy Score	Fossil Fuel Production	Carbon Intensity	Vulnerability	Ideology	GDP Per Capita
CA	100	0.44	201	2	0	74
ME	95	0	450	-3	2	48
VT	89	0	264	-2.5	-4	54
RI	89	0	222	0	4	58
NY	88	0	187	-1.5	-3	86
WA	87	0	233	-2	-3	74
CT	83	0	190	0	3	76
MA	80	0	224	-0.5	-14	82
OR	73	0	267	-2.5	4	57
MN	72	0	379	-1.5	7	65
NH	72	0	338	-2	-2	63
MI	66	0.25	442	-2.5	10	53
MD	66	0	282	2.5	1	69
DE	57	0	294	3	5	77
CO	55	4.91	400	-1	7	64
HI	54	0	354	8	-6	64
NJ	53	0	261	1	2	70
IL	51	0.28	375	4.5	4	67
PA	48	7.55	497	0	10	62
NM	46	24.69	742	3	18	47
NC	40	0	393	6	18	54
VA	40	0.38	325	4.5	9	63
AZ	39	0	385	7.5	16	48
NV	39	0	374	0.5	10	55
FL	26	0	337	13	14	48
WI	24	0	441	-2	11	58
UT	22	3.35	652	0.5	26	56
MT	21	4.94	1028	-2.5	21	47
LA	19	10.16	955	11	28	54
OH	19	2.94	529	2	15	57
MO	17	0	570	7	21	52
IA	16	0	583	1.5	14	60
TX	15	8.75	575	10	18	61
KS	12	2.65	625	5	21	56
OK	10	18.39	796	8	25	51
ID	10	0	308	-2	23	43
KY	9	1.57	936	6.5	19	47
IN	9	0.42	868	3	22	55
AR	7	5.91	606	11	26	42
SD	7	0.17	401	0	31	59
ND	6	57.65	1960	-2	21	73
TN	6	0	499	7	26	54
GA	5	0	434	10	20	56
AK	4	26.99	1183	-4	23	73
SC	4	0	539	9	25	45
AL	3	1.76	835	11	32	45
MS	3	1.48	714	12.5	38	38
NE	3	0.11	538	2	14	64
WY	1	64.49	2125	-1	28	70
WV	1	30.93	1829	2.5	28	43

Notes: Fossil Fuel Production (Fossil fuel production sales as a percentage of state gross product for 2017); Carbon Intensity (Carbon intensity of the state economy for 2005); Vulnerability (Estimated economic impact from climate change by 2080-2099); Ideology (Conservative advantage); GDP per Capita (thousands)

Next, ideology is added to the equation which then confirms hypothesis #4. As seen in Table 5.4 ideology has a strong and significant effect and eliminates the statistical significance of the other variables. Adding ideology to the mix increases the explanation for the variance to seventy six to seventy seven percent. Ideology is highly significant at the .1% level. The other variables

lose both their significance and their strength. Looking at the 50 states it becomes clear why ideology exerts such a strong influence and trumps the two fossil fuel dependence variables. First, concerning fossil fuel production, there are a number of states that have little to no fossil fuel production that exhibit little to no commitment to reducing emissions. These states include South Carolina, Georgia, Tennessee, Idaho, and Missouri. Among these states it seems their relatively conservative political ideologies trump their relatively low dependence on fossil fuels in explaining why they exhibit low levels of commitment to reducing emissions.

Table 5. 4
Predictors of climate change mitigation policy commitment (multivariate regressions)

Variables	Test 3	Test 4
Ideology	-2.259*** (.340)	-2.062*** (.349)
Fossil Fuel Production	-.104 (.211)	
Carbon Intensity		-.011 (.007)
Vulnerability to Climate Change	-.841 (.567)	-1.051 (.559)
GDP Per Capita	-.361 (.317)	-.264 (.297)
Education Level	.328 (.790)	.031 (.790)
Observations	49	49
Adjusted R Square	.759	.770

*** Statistically significant at the .1 percent level
** Statistically significant at the 1 percent level
* Statistically significant at the 5 percent level

Carbon intensity of the economy on the other hand gives ideology a closer battle for effect as seen in Table 5.4. As noted earlier and indicated in Test #2, carbon intensity of the economy exerts a strong and significant influence when ideology is not included in the mix. However,

there are a few exceptions in which a few states have relatively high carbon intensity and exhibit relatively strong commitment to reducing emissions and a few states have relatively low carbon intensity and exhibit relatively weak commitment to reducing emissions. Ideology edges out carbon intensity due to the fact that there are no exceptions to its influence. All of the twenty one states that are in the lowest category of climate policy commitment are more conservative than the average state. On the other hand not one state in the top two categories of climate policy commitment is more conservative than the average state and the states in this category are the most liberal states in the country regardless of their level of fossil fuel dependence.

Hypothesis #5 is also confirmed by the analysis. When ideology is not included in the equation vulnerability to climate change appears to have a significant effect on climate change mitigation policies. It would appear that counterintuitively more vulnerable states tend to be less committed to limiting global warming. However, when ideology is added to the equation the vulnerability variable loses its significance. As predicted the climate vulnerability variable seems to be a derivative of ideology.

Conclusion

This quantitative comparative analysis of state level climate change mitigation policies in the U.S. produces three primary findings. First fossil fuel dependence plays an important role in explaining the variation of climate mitigation policies across states. The states most committed to reducing GHG emissions have no significant levels of fossil fuel dependence whereas the most fossil fuel dependent states exhibit low levels of commitment to reduce GHG emissions. Second, ideology has a strong overriding effect on state level climate change mitigation policies in the U.S. Lastly, the effect of vulnerability to climate change on climate mitigation policies is found to be largely a derivative of ideology. These findings lead to four main implications.

First, collective action theory still does a fairly good job of predicting and explaining behavior concerning climate change contrary to the criticisms found in the literature noted earlier. States in the U.S. are for the most part following what they consider to be in their best short-term interest which for many states means continuing to develop and depend on fossil fuels. Those states that are the most dependent on fossil fuels and thus face the steepest costs in terms of reducing GHG emissions are the least committed to doing so whereas the most committed states have low levels of fossil fuel dependence and thus face relatively less costs in enacting strong climate change mitigation policies. As the findings of this study show the states that are the most committed to reducing GHG emissions are not those which are the most vulnerable to the impacts of climate change. Rather, these states are motivated primarily by ideology. They believe the short-term benefits of climate mitigation outweigh the costs regardless of the effects taking such action may have on the longer term impacts of global warming.

This first implication leads to the second main implication derived from the findings of this study which is that any change in states' profiles concerning climate change mitigation policies is likely to be driven by economic and political forces and interests rather than any improvement in knowledge or awareness about the impacts of climate change. Policymakers and scholars who adhere to the Neoliberalism framework have placed their faith in a simple equation: Growing impacts of climate change plus growing awareness of the impacts of climate change equals growing motivation to reduce GHG emissions and thus reducing these impacts of climate change. The problem with this belief is that as this analysis shows this has not happened up to the present time. Neoliberalism scholars believe this will happen at some point in the future but they would need to explain why this hasn't happened yet even as both the impacts of climate change and our awareness of these impacts have grown in recent decades. In fact as the impacts

and our awareness of these impacts have grown the opposite has occurred in the U.S. as both the Brookings Report and this analysis shows.

It is much more likely that at least in the foreseeable future states' commitment to reducing GHG emissions will continue to be driven primarily by economic and political forces rather than any concern over the impacts of climate change. Undoubtedly states that are the most committed to reducing GHG emissions are concerned about climate change. However, it is unlikely this motivation by itself is enough to sustain the increasing costs that are associated with reducing emissions to the degree these states have proposed. Indeed, these states talk as much if not more about the co-benefits of taking such action than they do about the effect any such action will have on global warming. As this analysis shows ideology also plays an important role in initiating and sustaining such commitment over time. Therefore, economic and political forces are likely to continue to drive state policies concerning climate change mitigation.

This means appeals to economic interests are likely to be more effective than appeals to the impacts of climate change in persuading voters and policymakers to take costly action to reduce GHG emissions. The results from this study suggest that appeals focused on short-term political and economic interests are more likely to be effective in persuading conservative states to reduce GHG emissions than focusing on the impacts of climate change. This would mean focusing less on the impacts of climate change and more on the near-term economic/political/health co-benefits of climate mitigation policies.

The third main implication derived from the findings of this study is the growing hope by some policy makers and scholars within the Neoliberalism framework that nonstate actors such as subnational governments can lead global efforts to limit climate change is highly optimistic and unlikely. Concerning the U.S. it has been proposed that perhaps states can lead the charge

and still fulfill the U.S. pledge even without the cooperation of the national government. The findings presented in this chapter suggest that this prospect is highly unlikely considering the majority of states in the U.S. have shown little to no commitment to reducing GHG emissions. These states are controlled by economic and political forces that would like to sustain the fossil fuel era for as long as possible. Only a small number of states have shown any serious commitment to reducing GHG emissions to the degree necessary to achieve internationally agreed to targets and these states are both liberal and exhibit low levels of dependence on fossil fuels which is not the case for most U.S. states. As just discussed this could change as a result of economic and political forces changing but such change has not occurred to the present time and is unlikely in a time frame that would enable the U.S. to achieve its Paris Pledge.

Lastly, this study points to the need to better understand the relationship between ideology and fossil fuel interests in explaining the variation of commitment to reducing GHG emissions among actors. This chapter's findings show that both fossil fuel interests and ideology have the biggest impact in explaining the variation of commitment to reducing GHG emissions among states in the U.S. When included in the same model ideology drowns out the fossil fuel interest effect thus indicating ideology is the most important variable explaining this variation among states in the U.S. However, the conservative-liberal ideology divide in the U.S. is national in scope. Furthermore, there are economic interests that have contributed to this divide. For example, the fossil fuel industry is one of the biggest contributors to the Republican Party which is the standard bearer of the conservative ideology. Therefore, it is important to examine the role fossil fuel interests play in the formation and continuation of the conservative ideology.

6

How Internal Structural Dynamics have Inhibited Climate Change Action in the U.S.

Introduction

The previous chapter of this Dissertation finds that both fossil fuel interests and ideology play important roles in explaining the variation of climate change mitigation policies among states in the United States. When combined together in a single analysis it is then found that ideology trumps fossil fuel interests in explaining this variation. However, as noted at the end of the last chapter, ideology in the U.S. is national in scope and further fossil fuel interests quite possibly play an important role in the formation and spread of the conservative ideology. Therefore it is important to examine the link between fossil fuel interests and ideology in greater depth and detail.

This chapter attempts such an examination within the Neorealism theory of climate change developed in Chapters Two and Three of this Dissertation. It is explained in these chapters that state behavior and international relations concerning the issue of climate change generally follow the logic of Neorealism. However, conventional Neorealism as constructed by Kenneth Waltz is not able to fully explain the variation of state behavior and interaction across units or over time. In order to provide a fuller account of state behavior concerning climate change a Neorealism theory of climate change was constructed which revises Neorealism in three ways. The first two proposed developments add the natural environment and ideology to the political structure as the three fundamental structural forces that explain state behavior and interaction. The third proposed development enhances the importance of the relative capabilities of states in explaining state behavior and international politics. State behavior, international politics, and the global

balance of power are the outcomes of an interaction of internal (within states) and external (global) structural dynamics, namely political structure, ideology, and the natural environment.

This chapter focuses on the role the three internal structural dynamics just described play in explaining the behavior of the U.S. national government concerning the issue of climate change. Perhaps no other country in the world, with the possible exception of China, has been and continues to be more important in determining the global climate pathway. The U.S. is responsible for more cumulative emissions than any other country in the world. As of 2017 it had been responsible for twenty five percent of global cumulative carbon dioxide emissions. [70] To this day the U.S. is the second leading annual emitter of greenhouse gas (GHG) emissions behind only China. [71] Further, the U.S. is one of the most powerful and influential countries in the world. The political, economic, and cultural influence and power the U.S. has had and continues to have on the rest of the world is incalculable. There are perhaps no more important questions for the fate of global warming than those surrounding the behavior of the U.S. in terms of what explains the way it has acted and continues to act concerning climate change.

The rest of this chapter consists of four sections. The first section analyzes the roles the Constitution, ideology, and geography of the U.S. play in inhibiting the U.S. response to climate change. The second section then discusses the effects of these internal structural dynamics on U.S. domestic and foreign climate policies. Next, the overall outcome of these dynamics and policies are discussed in terms of GHG emissions and domestic energy production. Lastly, the paper concludes with a few final thoughts concerning the implications of the findings.

---

[70] Hannah Ritchie and Max Roser, 'CO2 and greenhouse gas emissions', Our World in Data, December 2019, <https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions> (22 February 2020).
[71] Statistical Review of World Energy 2019, British Petroleum, June 2019, <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html> (22 February 2020).

Internal Structural Dynamics

The U.S. Constitution

The U.S. Constitution has played a significant role in inhibiting U.S. action on climate change due to its conservative nature. Numerous scholars have noted the conservative nature of the U.S. political system which then in turn serves to protect the status quo (Bosso 1987; Cobb and Elder 1983; Cobb and Ross 1997; Schattschneider 1975). In reviewing their own groundbreaking research on public policy making in the U.S., Baumgartner and Jones state that "American political institutions were conservatively designed to resist many efforts at change" (True et al. 1999). Concerning the issue of climate change the Constitution plays a significant role in enabling those economic and political forces that want to maintain the fossil fuel era for as long as possible and is a major impediment for those economic and political forces in the U.S. and throughout the world that want to accelerate the reduction of GHG emissions in order to achieve the two degree pathway. A few aspects of the U.S. Constitution are examined which have played the biggest roles in affecting how the U.S. has responded to climate change.

First, it is important to note that the Constitution was constructed and ratified during a time of deep skepticism of centralized power. The revolutionary war which led to the U.S. Constitution was first and foremost a war against an overbearing, corrupt government, the British Monarchy. The general sentiment among the ruling class was that they did not want to replace an overbearing government with another. This prevailing sentiment among the ruling class led to the essential characteristics of the Constitution which are limited government, federalism, and checks and balances. These aspects of the Constitution led to a conservative political system which protects the status quo and severely restricts the power and effectiveness of the federal government to enact social and/or economic change.

The first and most obvious constitutional check that has a profound effect on the U.S. ability to cooperate with the rest of the world in responding to climate change concerns the making of treaties. Article II, Section 2 states that the president has the power to sign a treaty with other countries but then it gives the U.S. Senate the power to ratify the treaty. Ratification of a treaty requires two-thirds, or sixty seven, of Senators approve of the treaty for it to become binding law in the U.S.[72] This high bar means it is extremely difficult for U.S. presidents to help form and/or join an international institution that would accelerate the reduction of global GHG emissions consistent with the Paris Agreement target of two degrees Celsius above pre-industrial levels (the two degree pathway). It would require near consensus in the U.S. on the need to take such transformative action that has not existed in the U.S. and is unlikely to exist in the foreseeable future.

This leads to the second conservative aspect of the U.S. political system that has hindered the ability of the U.S. to respond to climate change and that is the U.S. Senate. The U.S. Senate is a fundamentally anti-democratic institution which gives the five hundred and seventy thousand people in the state of Wyoming (the state in the U.S. with the lowest population) as much power in the U.S. Senate as the forty million people who live in the state of California (the U.S. state with the highest population). The U.S. Senate has become even more anti-democratic in recent decades through the widespread use of the filibuster rule which essentially gives forty senators veto power over national legislation. As a consequence, to pass any significant legislation (outside of the budget reconciliation rules) sixty votes are needed to invoke cloture and end a filibuster. At the same time the U.S. Senate has significantly more power over both domestic and foreign policy concerning climate change than the U.S. House of Representatives as the

[72] Annenberg Classroom, 'The Annenberg guide to the United States Constitution', < https://www.annenbergclassroom.org/constitution/> (19 March 2020).

Constitution gives the Senate the power to ratify treaties and advice and consent powers over presidential appointments.

Furthermore, recent demographic trends in the U.S. exacerbate the undemocratic and conservative nature of the Senate to the detriment of efforts to limit climate change. The many small rural states throughout the U.S. have increasingly become strangleholds for the Republican Party. As a result Republican senators represent far fewer people than Democratic senators. According to one 2017 analysis the fifty one Republican senators represented about 143 million people while the forty nine Democratic Senators represented about 182 million people.[73] This disparity is expected to grow in the coming decades as a consequence of two related ongoing trends. First, there is an increasing divide between urban and rural voters as rural voters become increasingly Republican voters and urban voters become increasingly Democratic voters (Rodden 2019). Second, the U.S. population is expected to continue its decades' long trend of more and more people moving to big cities.

This has had profound consequences that have severely limited the ability of the U.S. to enact domestic climate change policies or cooperate with other states to accelerate the reduction of GHG emissions. As will be discussed in more detail in the next section on ideology, conservatives are the strongest faction in the U.S. against taking bold action to limit climate change. What it means is that small conservative rural states have a virtual veto power over both domestic and international policies concerning climate change. Of the twenty eight states with five million or less people, nineteen are more conservative than the median state according to a

[73] Ronald Brownstein, 'Small states are getting a much bigger say in who gets on the Supreme Court', CNN Politics, 10 July 2018, <https://www.cnn.com/2018/07/10/politics/small-states-supreme-court/index.html> (27 February 2020).

survey that asks residents whether they are liberal, conservative, or moderate.[74] The added population of these nineteen states is forty nine million people which is just ten million more people than the single state of California. According to the comparative analysis presented in the previous chapter all but three of these states have higher than average fossil fuel dependence and all but one have worse than average overall climate policy scores. Furthermore, Senators from these small, conservative states with high fossil fuel dependence occupy key leadership positions.

When the Republican Party has a majority of seats in the U.S. Senate these Senators occupy key positions of power in which they are able to prevent strong climate policies from being enacted nationally or internationally. The Republican Party has controlled the Senate for eighteen of the twenty eight year history of international efforts to limit climate change. Most recently Republicans have been in control of the Senate since 2015. The two main Senate Committees that oversee climate change related policies are the Energy and Natural Resources Committee and the Environment and Public Works Committees. The current (as of 2020) Chairs of these two committees are Lisa Murkowski of Alaska and John Barrasso of Wyoming. Wyoming is the smallest state by population, the fifth most conservative, and is the most fossil fuel dependent state in the U.S. Alaska is the third smallest state, the thirteenth most conservative, and fourth most fossil fuel dependent state. The current Senate Majority Leader who controls the agenda of the Senate is Senator Mitch McConnell of Kentucky which is the twenty forth smallest state, the twentieth most conservative, and is the fifth largest producer of coal in the U.S. Due to the conservative nature of the U.S. Constitution three Senators who represent just under six million people are able to effectively prevent strong climate policy by the

[74] Jeffrey M. Jones, 'Conservatives greatly outnumber liberals in 19 U.S. states', Gallup, 22 February 2019, <https://news.gallup.com/poll/247016/conservatives-greatly-outnumber-liberals-states.aspx> (22 February 2020).

U.S. which contains 327 million people as these policies directly threaten the interests of the fossil fuel industry that these Republican senators from small, conservative, rural states represent.

The previous Chair of the Senate Committee on Environment and Public Works was Senator Jim Inhofe from Oklahoma which has four million people, is the eleventh most conservative state, and is the sixth most fossil fuel dependent state in the U.S. Senator Inhofe has been one of the leading political figures in the U.S. that has fought against efforts to limit global warming. In 2012 he wrote a book titled *The Greatest Hoax: How the Global Warming Conspiracy Threatens Your Future*. Inhofe is infamous for once bringing a snowball to the Senate floor as "evidence" that climate change is a hoax.[75] Senator Inhoffe was the Chair of the Senate Committee on Environment and Public Works from 2003-2007 and again from 2015-2017.

The third conservative constitutional check that inhibits the U.S. to take bold action on climate change is the Electoral College. The Electoral College is another fundamentally anti-democratic aspect of our political system as instituted by the Constitution. As explained by Alexander Hamilton in Federalist Paper Number Sixty Eight the Electoral College is intended to act as a check against democratic impulses which were generally feared and not trusted by the ruling class at the time.[76] In its present form each state is given a certain number of Electoral College votes that correspond with the number of representatives that state has in Congress. This rule has two main interrelated consequences. First it gives disproportionate power to smaller, more rural states such as the state of Wyoming over the election of the president. It also makes it

[75] Philip Bump, 'Jim Inhofe's snowball has disproven climate change once and for all', Washington Post, 26 February 2015, <https://www.washingtonpost.com/news/the-fix/wp/2015/02/26/jim-inhofes-snowball-has-disproven-climate-change-once-and-for-all/> (22 February 2020).
[76] Federalist Paper Number 68, U.S. Congress Online Resources, <https://www.congress.gov/resources/display/content/The+Federalist+Papers#TheFederalistPapers-68> (22 February 2020).

possible that a president can be elected who does not win the popular vote. There have only been five presidential elections in U.S. history in which the winner lost the popular vote. However it has happened twice in the past five elections and so two of the last three presidents of the U.S. have lost the popular vote.

In recent times this has benefitted the Republican candidate for president due to the demographic and party trends explained earlier. In the two most recent cases the more conservative candidate won the Electoral College vote and lost the popular vote, George W. Bush in 2000 and Donald Trump in 2016. Trump lost the popular vote by over three million votes or two percent of the overall vote. The same phenomenon will likely occur if he is re-elected to a second term in the 2020 election. It is speculated that he could lose the popular vote by as much as five million votes and still be elected president via the Electoral College.[77] A recent study finds that this trend of more conservative presidents losing the popular vote and winning the Electoral vote is likely to continue into the foreseeable future (Geruso et al. 2019). It is quite possible this could become a regular occurrence as more liberal voters continue to move to more urban states thus packing liberal voters in a small number of highly populated, urban, heavily liberal states such as New York and California leaving behind a large number of small conservative states. This has profound implications concerning the issue of global warming because these smaller, more rural states tend to be more conservative and have higher levels of fossil fuel dependence as just discussed.

Ideology

While a country's constitution certainly plays an important role in determining the behavior of a state, a state's ideology plays an equally important role. Ideology is a loaded term which has

[77] Nate Cohn, 'Trump's electoral college edge could grow in 2020, rewarding polarizing campaign', New York Times, 19 July 2019, <https://www.nytimes.com/2019/07/19/upshot/trump-electoral-college-edge-.html> (22 February 2020).

many different meanings and definitions. In terms of the political role ideology plays as a structural force in a state it can be defined as encompassing "all relatively coherent sets of cultural symbols-ideas, beliefs, and attitudes that are action oriented and whose function it is to interpret the political system and to direct and justify public policy". In this way ideology "shapes understandings or misconceptions of the social and political world" (Freeden 1998). Ideology plays a number of political and social functions in a society including integration, distortion, and legitimation (Ricoeur 1985). In any given society political ideologies compete for the right to govern.

This chapter focuses more narrowly on one aspect of ideology, namely views concerning the role government should play in the economy. In this way the global (macro) ideologies can be placed along a left to right ideological spectrum with communism on the far left, socialism on the left, liberalism (Liberalism) on the right, and libertarianism on the far right in terms of their respective views concerning how active the government should be in managing the economy.

The dominant macro ideology throughout U.S. history has been Liberalism. Liberalism here means the philosophical tradition as constructed by John Locke, Adam Smith, and other predominately British and American philosophers and intellectuals in the 17th through 19th Centuries. The core values of Liberalism include an emphasis on individual rights, secularism, private property, and limited government. Liberalism and Capitalism have co-evolved as they feed off of each other and share many of the same values. This interdependence of Liberalism and Capitalism is symbolized historically by the fact that Adam Smith's *Wealth of Nations* and the signing of the U.S. Declaration of Independence occurred in the same year of 1776.

Within this macro ideology of Liberalism in the U.S. there exists two micro ideologies, liberalism and conservativism, that represent the left and right sides of Liberalism. These

political forces have been in perpetual conflict throughout American history as they have fought for and against, among other things, a more active federal government in managing domestic and global affairs. Examples of the most important policies that liberal and conservative forces have fought for and against the federal government taking a more active role include: ending slavery; instituting reconstruction; enacting social welfare policies; ending segregation; enacting and expanding federal civil and political rights for women, minorities, and the LGBTQ community; instituting a federal right to abortion; implementing environmental regulations; increasing high income and corporate taxes; enacting federal education standards; expanding the federal government's role in managing health care; implementing affirmative action; instituting national gun control; and joining multilateral international institutions to address environmental issues such as climate change. Liberal forces have fought for a more active government in these areas while conservative forces have fought for a less active government.

Throughout American history the U.S. has exhibited tendencies in both directions and these tendencies play off each other in a reactionary process that create political cycles (Schlesinger 1939). At times the U.S. has flirted with socialism on the left and libertarianism on the right and these forces have always existed to different degrees but the strong forces on both sides have kept the U.S. firmly between these two extremes within the macro Liberalism paradigm. The American sage Ralph Waldo Emerson perhaps best articulates this perpetual antagonism between conservativism and liberalism in his essay *The Conservative* when he says: "It is the counteraction of the centripetal and the centrifugal forces. Innovation is the salient energy; Conservativism the pause on the last movement" (Emerson 1983).

Compared to other countries around the world the U.S. has a more conservative ideology when it comes to views concerning the role the government should play in the economy. The

American government is more conservative in terms of the role the government plays in the economy than most countries in the world. According to the Heritage Foundation's 2019 Index of Economic Freedom the U.S. ranks as the twelfth freest country in the world out of one hundred and eighty countries and third out of the top twenty five countries in terms of GDP.[78] An example of this is the fact that the U.S. is the only developed country in which the national government does not provide some version of universal healthcare.[79] This conservative ideology has played a significant role in inhibiting the U.S. federal government from taking a more active role either domestically or globally to accelerate the reduction of GHG emissions in order to achieve the two degree pathway.

From the very beginning there has always been a strong sentiment in the U.S. that is deeply skeptical of a strong federal government. There have been exceptions, times in U.S. history in which the ideology of the country shifted to the left which led to a more active government in the economy. But over time as is the case at the present moment, the pendulum swings back to the more conservative ideology that is at the root of American political culture. This sentiment is perhaps most famously expressed by Henry David Thoreau in his essay *Civil Disobedience* when he states: "I heartily accept the motto,—'That government is best which governs least'". The fact that he says this is a motto and then places the comment in quotation marks indicates that it was a widespread American value among many in the American population at the time. As discussed in the previous section the U.S. Constitution reflects this more conservative ideology which intentionally led to a relatively dysfunctional and weak federal government for much of early American history.

[78] Country Rankings, 2019 Index of Economic Freedom, Heritage Foundation, <https://www.heritage.org/index/ranking> (22 February 2020).
[79] Stephen Lendman, 'America the only developed country without universal healthcare', Global Research, Centre for Research on Globalization, 9 July 2017, <https://www.globalresearch.ca/america-the-only-developed-country-without-universal-healthcare/5598311> (22 February 2020).

This weak and ineffectual federal government was then transformed by the combined shocks of the Great Depression and World Wars I and II. These events were earth shattering earthquakes which shook the foundation of the American political system and altered the ideological landscape in the U.S. For about forty years beginning in the 1930s and lasting through the mid-1970s the U.S. enacted a number of liberal policies and constitutional amendments which gave the federal government vast new powers. The federal income tax dramatically increased especially for corporations and the wealthy. Social welfare programs, labor laws, and environmental regulations were instituted that gave the federal government considerable power over the economy and social affairs. Major civil rights were won by disenfranchised groups such as women and African Americans. These federal policies and overall ideological shift to the left in the U.S. was the result of a number of social movements that swept across the country through the early and middle periods of the twentieth century.

This move to the left from the 1930s to the mid-1970s then led to a reaction of conservative forces that culminated in the conservative revolution beginning in the mid-1970s. McCright and Dunlap have characterized this modern conservative movement as an anti-reflexive movement against reflexive modernization (RM). According to scholars who study RM, reflexivity, which includes the environmental movement and environmental science, is necessary in order to solve the legitimacy, ecological, and technological crises associated with modernization. These reflexive forces function as a sort of critical self-evaluation, "a self-confrontation with the unintended and unanticipated consequences of modernity's industrial capitalist order" (McCright and Dunlap 2010).

McCright and Dunlap document how beginning in the 1970s economic, political, and social forces mobilized and coalesced to create the conservative movement to oppose RM and "to

reassert the dominance of industrial capitalism…by directly challenging progressive social movements and the use of impact science". It has been well documented by McCright and Dunlap and many other scholars and journalists how these conservative forces used fundraising, lobbying, think tanks, the media, foundations, and educational institutions to push the country in a more conservative direction (Hacker and Pierson 2010; Mayer 2017) . Concerning the issue of climate change they attacked climate science with the ultimate objective of sowing doubt and creating division (Oreskes and Conway 2011).

This modern conservative movement which began in the mid-70s led to the 1980 election of Ronald Reagan as president of the U.S. who then initiated the widespread implementation of conservative policies at the national and international levels. The conservative revolution has had profound effects on the U.S. political and socio-economic systems which continue to this day. Reagan expresses the central idea of this conservative movement best when he states in his First Inaugural Address that "government is not the solution to our problem, government is the problem"[80]. This concise and direct statement captures what the conservative revolution is all about and what it stands for. It also resonates with large segments of the U.S. population as an expression of a root American value as noted earlier in the quote from Thoreau and discussion concerning the construction of the U.S. Constitution.

This shift to the right in American society is reflected in the growing distrust in the federal government that began in the late 1960s. In 1964 seventy seven percent of respondents said that they trusted the government in Washington always or most of the time. This trust in government dramatically and consistently decreased until 1980 on the eve of Reagan's inauguration when only twenty six percent of respondents said they trusted the government in Washington always or

[80] Ronald Reagan First Inaugural Address, Ronald Reagan Presidential Foundation and Institute, 20 January 1981, <https://www.reaganfoundation.org/ronald-reagan/reagan-quotes-speeches/inaugural-address-2/> (22 February 2020).

most of the time. Public trust in the federal government has stayed low ever since, never going above fifty percent. After a brief spike following the horrific events of 9/11 when the country rallied around the flag, public trust in the federal government has consistently declined hitting an all-time low of seventeen percent in a recent March 25, 2019 poll.[81]

Concerning the issue of climate change it is important to note that the fossil fuel industry has played a key role in initiating and sustaining the modern conservative movement in the U.S. Two of the leading figures in the fossil fuel industry who have played important roles in this ideological shift are the Koch brothers. David and Charles Koch own 80% of Koch Industries which is the second largest privately held company in the United States with annual revenues of $110 billion mostly as a result of the manufacturing, refining, and distribution of petroleum. The Koch brothers are the second wealthiest family in the United States. Each is worth approximately $51 billion making them tied for the eleventh richest individuals in the world.[82]

Both individuals have been instrumental in leading and sustaining the conservative revolution beginning in the 1970s and continuing to the present day (Mayer 2017). The brothers founded the Cato Institute, the leading and most influential libertarian think tank in the U.S. Their political advocacy efforts which include organizing and giving hundreds of millions of dollars to candidates and the Republican Party were organized under the advocacy group Americans for Prosperity. The brothers have given hundreds of millions of dollars to other highly influential conservative think tanks and organizations such as the Heritage Foundation and the Manhattan Institute. This infrastructure constructed by the Koch brothers has been described as rivaling the

[81] Little Public Support for Reductions in Federal Spending, Pew Resarch Center, April 2019, <https://www.people-press.org/2019/04/11/public-trust-in-government-1958-2019/> (22 February 2020).
[82] Forbes, 'The richest people in the world', < https://www.forbes.com/billionaires/#12702075251c> (19 March 2020).

Republican National Committee in influence and power.[83] The overriding objective of the Koch Brothers and their efforts is to promote free-market capitalism unencumbered by government taxes and regulations. Their core policy objectives are to reduce the size of government and reduce government regulations and taxes. These objectives obviously directly threaten efforts to limit climate change which require extensive taxes and/or regulations, especially of the fossil fuel industry.

However, as powerful as the Koch brothers have been in driving the conservative movement they are only one part of the massive power and influence of the fossil fuel industry as a whole in affecting elections, public opinion, and the policymaking process. According to Open Secrets from 1990 to 2018 the oil and gas industry, electric utilities, and the coal industry spent a total of $565 million in contributions to influence federal elections.[84] This total does not include the hundreds of millions of dollars spent by other organizations which are filed in other categories in the Open Secrets database. Thus the actual amount spent by the fossil fuel industry and other related interests on elections during this time period is much higher than this but difficult to quantify. This influence of the fossil fuel industry over U.S. elections has no doubt become much stronger and yet also more difficult to track with the landmark Citizens United U.S. Supreme Court decision which led to Super-PACs and "dark money" in which corporations can spend unlimited amounts of unregulated money influencing elections as long as they do not coordinate

[83] Kenneth P. Vogel, 'Behind the retreat of the Koch brothers' operation, Politico, 27 October, 2016, <https://www.politico.com/story/2016/10/koch-brothers-campaign-struggles-230325> (22 February 2020).
[84] Energy/Natural Resources, Center for Responsive Politics, <https://www.opensecrets.org/industries/indus.php?ind=E> (22 February 2020).

their efforts with candidates or the political parties. To give a clue as to the magnitude of this spending, for the 2016 federal elections alone, spending by Super PACs totaled $1.7 billion.[85]

Once the fossil fuel industry has influenced who gets elected it then spends huge sums of money influencing the policymaking process through lobbying expenditures. According to Open Secrets from 1998 to 2019 electric utilities spent $2.5 billion on lobbying federal officials, the third most among all industries during this time period. The oil and gas industry spent $2.2 billion, sixth most among all industries. Business associations such as the Chamber of Commerce and Business Roundtable which are well represented by the fossil fuel industry and again generally fight against ambitious policies to reduce GHG emissions spent $2.4 billion during this time period, fifth most among industry groups. Added together these interest groups spent some $7 billion over the last twenty years to influence federal policies.[86] These interests in protecting the status quo have faced weak opposition among forces trying to change the status quo when it comes to climate change. According to one study examining lobbying expenditures concerning climate change from 2000-2016 "the environmental organization and the renewable energy sectors were outspent by the corporate sectors involved in the production or use of fossil fuels by a ratio of approximately 10 to 1" (Brulle 2018).

Most of this money by the fossil fuel and related interests has gone towards electing Republican candidates and lobbying Republican officials. The fossil fuel industry and related interest groups have used the Republican Party to block efforts to enact ambitious climate change mitigation policies. Eighty percent of the previously mentioned contributions from the oil and gas industry from 1990 to 2018 went to Republicans. In the 2016 election cycle the oil and gas

[85] 2016 Outside Spending, by Race, Center for Responsive Politics, <https://www.opensecrets.org/outsidespending/summ.php?cycle=2016&disp=R&pty=A&type=A> (22 February 2020).
[86] Industries, Center for Responsive Politics, <https://www.opensecrets.org/lobby/top.php?showYear=a&indexType=i> (22 February 2020).

industry gave more money to the Republican Party than any other industry except for the real estate industry.[87] Most of the money spent by these groups on lobbying goes toward influencing Republican leaders and policymakers. As mentioned earlier, even more importantly, this money has been a key driving force in the formation of the conservative ideology. These efforts have contributed to the increasing polarization between the Republican Party and the Democratic Party in which the Republican Party is now almost completely aligned with the conservative ideology and the Democratic Party is now almost completely aligned with the liberal ideology.

These investments by the fossil fuel industry have paid off handedly as the Republican Party has effectively blocked ambitious climate efforts at all levels of government in the U.S. for decades. At the federal level Republicans have consistently used all the instruments at their disposal to block efforts to enact policies that would accelerate the reduction of GHG emissions. When Republicans have been in control of Congress they have prevented legislation on climate change from even being considered. When they are in the minority they use every tool at their disposal from preventing climate policies from being enacted.

However, the conservative movement and influence of the fossil fuel industry has also had an impact on the Democratic Party which is exemplified by the role the Democratic Leadership Council (DLC) played in shifting the Democratic Party to the right beginning in the 1980s. The DLC was a non-profit corporation created in 1985 by Al From, a Democratic Party political operative, in reaction to the 1984 landslide defeat of Democratic presidential candidate Walter Mondale. The main objective of the DLC was to move the Democratic Party away from the left and towards the center of American politics. It has been described as promoting market-oriented

[87] Top Industries, 2016 Cycle, Republican Party, Center for Responsive Politics, <https://www.opensecrets.org/parties/indus.php?cmte=RPC&cycle=2016> (22 February 2020).

approaches to policy.[88] The DLC dominated the Democratic Party through the 1990s and its influence still looms large within the Democratic Party establishment to this day. DLC members included former Vice Presidents Al Gore and Joe Biden, who is now the presumptive nominee for the Democratic Party to face Donald Trump in the 2020 Presidential election. Former Chairs of the DLC include Richard Gephardt who was the House Majority Leader from 1989 to 1995, former Vice Presidential candidate Joe Lieberman, and most importantly former president Bill Clinton who was Chairman of the DLC from 1990-1991.[89] In the year 2000 the DLC had 5,000 members and was a $7 million a year operation.[90] Much of the funding for this multimillion dollar operation came from multinational corporations such as the fossil fuel industry. Donors from the fossil fuel industry included ARCO, Chevron, and Koch Industries.[91]

The DLC influence on the Democratic Party and American public policy is best exemplified by the presidencies of Bill Clinton and Barack Obama. Both presidents generally supported the free-market policies advocated by the DLC and raised large sums of money from corporations and the super-wealthy. For example, President Obama raised $750 million for his 2008 presidential and $722 million for his 2012 re-election campaign most of it raised from large donors.[92] This is more money than any candidate has ever raised before or since for a single campaign for office. As the former Chair of the DLC Bill Clinton implemented the core agenda of the DLC and transformed the Democratic Party once he became president. Two of his signature achievements, the enactment of NAFTA and welfare reform, were both conservative

[88] Bill Turque, 'The soul and the steel', Newsweek, 20 August 2000, <https://www.newsweek.com/soul-and-steel-158731> (22 February 2020).
[89] The Democratic Leadership Council, Source Watch, The Center for Media and Democracy, <https://www.sourcewatch.org/index.php/Democratic_Leadership_Council> (22 February 2020).
[90] Ari Berman, 'Going nowhere', The Nation, 3 March 2005, <https://www.thenation.com/article/going-nowhere/> (22 February 2020).
[91] 'The soul and the steel', Newsweek.
[92] 2008 Presidential Race and 2012 Presidential Race, Center for Responsive Politics,< https://www.opensecrets.org/pres08/, https://www.opensecrets.org/pres12/> (27 February 2020).

policies pushed by the DLC and other advocates of free-market capitalism. Although president Obama was never an official member of the DLC he did once refer to himself as a "New Democrat" which is code for the moderate, centrist wing of the Democratic Party which the DLC helped cultivate.[93] Both Democratic presidents generally took moderate, middle of the road policy positions on most issues. Concerning the issue of climate change both presidents prioritized other issues, especially economic growth and energy security, over dealing with climate change (Royden 2002).

This conservative revolution is also reflected in a shift to the right in public opinion polls beginning in the mid-1970s. Tom Smith analyzed 455 survey trends from the 1940s to the 1980s. He finds that America generally moved in a liberal direction until the mid-1970s when many liberal trends slowed, some stopped, and others reversed in a conservative direction. Forty six trends Smith examines changed direction after 1974. Of these, thirty six changed in the conservative direction while only ten changed in the liberal direction. Two of the trends that changed in the conservative direction after 1974 that are most relevant concerning the issue of climate change are views concerning economic regulation and foreign affairs (Smith 1990). Unfortunately views concerning environmental issues were not included in the analysis.

The conservative revolution is also reflected in self-identification public opinion polls that began in the 1990s. In 1992, Gallup began asking respondents to identify themselves as conservative, liberal, or moderate. That year thirty six percent of respondents self-identified as conservative while seventeen percent self-identified as liberal. These numbers remained the same for the next twelve years when this gap began to narrow which it continues to do so to this day thus reflecting a recent liberal trend that has accelerated in response to the Trump

[93] Carol E. Lee and Jonathan Martin, 'Obama: 'I am a new Democrat', Politico, 11 March, 2009, <https://www.politico.com/story/2009/03/obama-i-am-a-new-democrat-019862> (22 February 2020).

Administration.[94] However, even the latest poll in 2018 shows that conservatives outnumber liberals by ten percentage points.[95]

Lastly, the effect of the conservative revolution and the misinformation campaigns by the fossil fuel industry as documented by Oreskes and Conway's *Merchants of Doubt* and by other scholars and journalists can be seen in the shift in public opinion concerning climate change beginning in the 1990s (Dunlap and McCright 2008). Up until the late '90s Republican and Democratic voters held fairly similar views concerning global warming. For example, as late as 1997 52% of Democrats and 48% of Republicans responded that the effects of global warming have already begun. Over the next ten years the gap between Democrats and Republicans widened concerning this question so that by 2008 76% of Democrats answered in the affirmative to this question while only 42% of Republicans said yes to this question (Dunlap and McCright 2008). This polarization between Republicans and Democrats over the issue of climate change has continued to the present time and shows no signs of relenting. A 2019 survey by the Pew Research Center asks voters which issue should be the top priority for Trump and Congress this year and finds the issue that has the biggest partisan gap is climate change.[96]

This survey question reveals the last way this conservative revolution has impacted public opinion. The Pew Research Center survey question concerning what should be the federal government's top priority reveals climate change ranks as next to last on the list of priorities. Only global trade ranks lower. This is largely due to polarization as only twenty one percent of

[94] 'Donald Trump's presidency has moved America left', The Economist, 15 June 2019, <https://www.economist.com/united-states/2019/06/15/donald-trumps-presidency-has-moved-america-left> (22 February 2020).
[95] Lydia Saad, U.S. still leans conservative, but liberals keep recent gains', Gallup, 8 January 2019, <https://news.gallup.com/poll/245813/leans-conservative-liberals-keep-recent-gains.aspx> (22 February 2020).
[96] Trump Begins Third Year with Low Job Approval and Doubts about his Honesty, Pew Research Center, 18 January 2019, <https://www.people-press.org/2019/01/24/publics-2019-priorities-economy-health-care-education-and-security-all-near-top-of-list/> (22 February 2020).

Republicans say climate change should be the top priority. However, climate change didn't even make the top five for Democrats as it ranks as the sixth most important priority. This lack of public pressure and the prioritization of other issues for both parties play important roles in inhibiting domestic policies and international efforts to take the level of action that would be necessary to accelerate the reduction of GHG emissions in line with the two degree pathway. The conservative revolution and the relentless, well-funded campaign by the fossil fuel industry that has fueled this conservative revolution has certainly played significant roles in affecting this public opinion.

Geography

Geography has played an important role in inhibiting the U.S. response to climate change mainly due to the abundant domestic supplies of fossil fuels in the U.S. As explained in previous chapters of this Dissertation, the production of fossil fuels is correlated with both state power and climate change policies. The findings presented in Chapter Three show that those countries which have higher levels of petroleum production tend to have weaker climate change policy performance. It is also found that countries which have higher levels of petroleum production tend to be more powerful than countries with low production levels. When looking at the three most powerful countries in the world, the U.S., China, and Russia, these relationships become clearer.

The fossil fuel industry and related interests have been central to the development of the U.S. (Coll 2012; Yergin 2011). Abundant domestic reserves of petroleum, natural gas, and coal have literally fueled the rise of the U.S. into a global superpower. According to the most recent estimates, the U.S. has twenty four percent of the world's coal reserves, more than any other

country by far; the fifth most amount of natural gas; and the ninth most amount of petroleum.[97] Combined together no other country in the world has the amount of fossil fuel reserves found in the U.S.

These abundant fossil fuel reserves led to the development of an extremely powerful fossil fuel industry that has played a critical role in the development of domestic fossil fuel production and has inhibited the U.S. ability to address climate change. Standard Oil is one of the most powerful corporations in U.S. history. Today, Exxon-Mobil, the primary offspring of Standard Oil, is the eighth largest company by revenue in the world at two hundred and ninety billion dollars a year. It is the second largest corporation in the U.S. behind only Walmart.[98] Exxon Mobil has played a major role in U.S. energy policy both domestically and internationally for decades. It is one of the most politically powerful corporations in the U.S. (Coll 2011). As big and powerful as Exxon Mobil is, it is just one corporation among dozens of others that exert considerable political influence over all aspects of the American political system.

As discussed throughout this Chapter, the fossil fuel industry has exerted its power over U.S. climate policy through its impact on ideology, public opinion, elections, and policymaking. Research has shown how over the last few decades the U.S. fossil fuel industry orchestrated a disinformation campaign intended to mislead the U.S. public on climate change (Cook et al. 2019). As detailed in the previous section on Ideology, the fossil fuel industry has been a central driving force behind the modern conservative movement (Mayer 2017). These efforts have been extremely effective in dividing the public and policymakers on the issue of climate change. This

[97] Statistical Review of World Energy 2019 Report, British Petroleum, June 2019, <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html> (20 February 2020).
[98] Fortune, 'Global 500', < https://fortune.com/global500/> (19 March 2020).

polarization is one of the main reasons why the U.S. has not taken serious action to limit climate change either domestically or internationally (McCright and Dunlap 2003).

Policy Output

When looking at the actions of the federal government over the last thirty years it becomes clear how these internal structural dynamics have interacted with global structural dynamics to inhibit the U.S. response to climate change. The U.S. federal government response to climate change during this time period has been weak overall as it has consistently prioritized other issues over seriously addressing climate change. This section highlights how the U.S. federal government has consistently undermined international climate efforts and been unwilling to enact strong climate policies that would accelerate the reduction of GHG emissions consistent with a two degree pathway.

The Kyoto Protocol

The U.S. government is the only developed state which did not participate in the Kyoto Protocol which was the first international treaty on climate change signed by every country in the world including the U.S. in 1997. It is the only state in the world yet to ratify the treaty.[99] The Protocol includes two periods, from 2008-2012 and 2012-2020. Developed countries that joined the Protocol agreed to binding reductions in their domestic GHG emissions that they can achieve through various mechanisms. Fifty two developed countries participated in the first commitment period including the European Union, Russia, Canada, Japan, and Australia. The Protocol exempts the developing world from committing to any domestic GHG emissions under the principle of "common but differentiated responsibilities" which all countries agreed to as part of signing the United Nations Framework Convention on Climate Change (UNFCCC) in 1992. This

[99] Ratification status of the Kyoto Protocol, United Nations Treaty Collection, status as of 22 February 2020, <https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-a&chapter=27&clang=_en> (22 February 2020).

principle is based on the fact that up until the signing of the UNFCCC in 1992 developed countries were responsible for most of the cumulative GHG emissions. Every country that signed the UNFCCC, including developed countries such as the U.S., agreed that developed countries have more responsibility in reducing GHG emissions and so should take the lead.

Then on the eve of international negotiations concerning the Kyoto Protocol in 1997 within the framework of the UNFCCC the U.S. Senate unanimously passed a Resolution advising then President Bill Clinton to not sign the Protocol and any such agreement. Remarkably, not one of the ninety seven Senators who voted yes for the Resolution objected to the main message of the Resolution that the U.S. should not sign an international agreement in which developing countries such as China are exempt from binding GHG reduction commitments that "could result in serious harm to the United States economy, including significant job loss, trade disadvantages, increased energy and consumer costs".[100]

This Resolution exemplifies the logic of Neorealism and how Neorealism expects state actors to behave. The Resolution clearly demonstrates that the U.S. was reneging on the common but differentiated responsibilities principle of the UNFCCC which it signed and agreed to just five years earlier in 1992. As noted earlier, the U.S. is responsible for more cumulative emissions than any other country in the world so it should bear more responsibility to help lead international efforts to do something about it as it agreed to when it signed the UNFCCC. However the resolution clearly reveals that five years after agreeing to this principle it then decided it is more concerned over the potential relative short-term economic losses over absolute long-term gains that could result from joining the Kyoto Protocol as would be expected by Neorealism. In other words it shows the U.S. is more concerned about how joining the Protocol

[100] U.S. Congress, 'Senate Resolution 98 (1997)', 27 July 1997, <https://www.congress.gov/bill/105th-congress/senate-resolution/98> (22 February 2020).

may affect U.S. relative power in the short term over the potential long-term impact of climate change. Notably, every single Democratic Senator agreed with this assessment.

The unwillingness of the U.S. to meaningfully participate in the Kyoto Protocol is also the result of the internal structural dynamics described in this chapter. An insightful article by McCright and Dunlap shows how the growing conservative movement, driven by fossil fuel interests, effectively derailed the U.S. ability to join the Kyoto Protocol (McCright and Dunlap 2003). Conservative forces mobilized public opinion and policymakers to portray the Kyoto Protocol as a danger to the U.S. economy and risked putting us at a competitive disadvantage against our global competitors as stated in the Congressional Resolution. The anti-democratic elements of our political institutions along with the dominant conservative ideology and powerful fossil fuel interests effectively inhibited the U.S. ability to help lead international efforts to seriously address climate change during the critical time period in the 1990s when it was critical to redirect the global economic system in order to have any chance of attaining the two degree pathway.

The Energy Policy Act of 2005

In the area of domestic policy The Energy Act of 2005 best illustrates how other priorities have superseded any efforts to limit global warming in the United States. The five hundred and fifty page act is the foundation of U.S. energy policy to this day. It replaced the 1992 Energy Act and no federal energy policy has been enacted to replace it since. The Act largely implements the recommendations of the National Energy Policy Development Group chaired by Vice President Dick Cheney. Two weeks after winning the presidential election (and losing the popular vote), George W. Bush created the Group to recommend a national energy strategy. The Group focused on increasing domestic supplies of energy in order to reduce the country's dependence on foreign

sources of energy and thus improve national security, the domestic economy, and energy independence and security. The Act accomplishes these objectives through dozens of provisions designed to increase domestic supplies of fossil fuels, nuclear energy, and renewable energy. For example it authorized $14.5 billion of tax incentives over eleven years to encourage domestic energy production including about $4.5 billion for renewable energy, a $2.6 billion package of oil and gas incentives, nearly $3.0 billion for coal, and more than $3.0 billion in electricity incentives (which includes a new production tax credit for nuclear power).[101] However an analysis of the major provisions of the Act finds that most of the Act is dedicated to increasing domestic production of fossil fuels.

For example, one of the most significant provisions of the Act which helped spur a transformation of the energy sector in the U.S. concerns the issue of hydraulic fracking (Fracking). Fracking is primarily responsible for the recent increase in natural gas and oil production in the U.S. From the very beginning the federal government has played a critical role in the development of fracking technology and this is a perfect example of the fundamental role public policies play in economic development. As recounted by the Department of Energy on its website: "The increase in shale oil and gas production in the United States follows many years of investment and research carried out by the federal government. Between 1978 and 1992, DOE invested about $137 million in the Eastern Gas Shale Program, which helped demonstrate and commercialize many of the technologies in use today".[102] The Energy Policy Act of 2005 further enabled the dramatic increase of fracking as it included a provision now known as the "Halliburton loophole" that exempts hydraulic fracking from EPA regulation thus enabling the

[101] Congressional Research Services, U.S. Congress, 'Energy Policy Act of 2005: Summary and Analysis of Enacted Provisions', 8 March 2006, <https://www.everycrsreport.com/reports/RL33302.html> (22 February 2020).
[102] U.S. Department of Energy, Office of Fossil Energy, 'Shale Research and Development', <https://www.energy.gov/fe/science-innovation/oil-gas-research/shale-gas-rd> (22 February 2020).

widespread use of fracking throughout the U.S. The Act directly benefits Halliburton as it is involved in Fracking operations throughout the U.S. Dick Cheney was CEO of Halliburton before becoming Vice President.

It is important to understand that this overall energy policy of the U.S. which has consistently enabled an increase in development of domestic supplies of fossil fuels has been sustained with support from the Democratic Party. The Energy Policy Act of 2005 was widely supported by Democrats in Congress. A majority of Democrats voted for the Act in both the House and Senate. These Congressmen and women represent the centrist part of the party the DLC helped cultivate. One of the Democratic Senators who voted for the Act was then Senator Barack Obama. Once Obama became president he then helped lead these efforts which he termed his "all the above energy strategy".

As described by Jason Furman, the Chairman of President Obama's Council of Economic Advisors, in a blog published on the White House website that summarized a report by the Council, President Obama pursued an all-the-above energy strategy including domestic fossil fuel development. According to the Report this increase in fossil fuel development in the U.S. has led to substantial economic and energy security benefits. The report finds that the increases in oil and gas production played an important role in leading the U.S. out of the recent recession as it "contributed 0.2 percentage point to real GDP growth in both 2012 and 2013, and employment in these sectors increased by 133,000 between 2010 and 2013". It notes this impact does not include "all of the economic spillovers, so the overall impact on the economy of this growth in oil and gas production is even greater". It goes on to note how this increased domestic oil and gas production has improved national security as it has reduced "the vulnerability of the

U.S. economy to oil price shocks stemming from international supply disruptions".[103] This report exemplifies the consistent position of the U.S., shared among most of the political establishment including both the Democratic and Republican Parties going back decades to at least the oil embargoes and shocks of the 1970s that made energy security and energy independence a national security priority of the highest importance. These priorities of energy independence and security primarily through the increased production of domestic supplies of fossil fuels have consistently drowned out efforts to seriously address climate change.

The American Clean Energy and Security Act of 2009

The American Clean Energy and Security Act (ACES) of 2009 was the only time Congress has seriously debated a comprehensive national policy designed to reduce GHG emissions. The Act would have among other things established a national cap-and-trade program. The 2008 election led to Barack Obama being elected as president and Democrats winning a large majority in the House and a supermajority in the Senate. Climate activists saw this as a historic opportunity to finally enact a serious national climate change policy. However, the internal structural dynamics described throughout this chapter interacted to prevent the Act from being enacted. This historic window of opportunity then shut in 2010 when Republicans gained control of the House and picked up seats in the Senate. Republicans have since controlled one or both houses of Congress thus precluding any possibility of enacting a national climate plan ever since.

A number of factors contributed to the ACES not being enacted into law. Perhaps most importantly the Obama Administration did not put its full weight behind the Act as it was preoccupied with other priorities such as passing health care reform and reviving the economy

[103] Jason Furman and Jim Stock, 'New Report: The All-of-the-Above Energy Strategy as a Path to Sustainable Economic Growth', The White House, President Barack Obama, 29 May 2014, <https://obamawhitehouse.archives.gov/blog/2014/05/29/new-report-all-above-energy-strategy-path-sustainable-economic-growth> (22 February 2020).

following the recession. There is little doubt that if the Obama Administration had thrown its hard won political capital behind the effort that it would have passed. Another factor is that the Act divided Democrats. For example, environmental groups were divided as some opposed the legislation saying it was too weak and did not go far enough. The more conservative wing of the Democratic Party thought the Act went too far while the more liberal wing thought it didn't go far enough. Republicans on the other hand were nearly completely united in their opposition. Conservative media and think tanks lambasted the Act as a "job killer". The Act barely passed the House 219-212 with 44 of 211 Democrats voting against it. It was never brought to a vote in the Senate in which Democrats had a supermajority. This was a historic missed opportunity for efforts to enact a domestic climate policy that has not come again since and may not come again in the foreseeable future.

The Paris Agreement

Following the failure of the Kyoto Protocol, international negotiations proceeded for many years to replace the Protocol with a more effective international institution. These negotiations culminated in the 2015 signing of the Paris Climate Agreement. The Agreement stipulates that every five years states must submit pledges that outline GHG emission reduction targets and how they plan on achieving their targets. The Agreement does not include any enforcement or compliance mechanisms. States may pledge whatever they feel comfortable with and if they do not achieve their pledges there are no penalties. As described in previous chapters of this Dissertation the Paris Agreement is generally a weak institution that has had no effect on state behavior and is very unlikely to have any effect in the foreseeable future. The voluntary pledges are insufficient to achieve the two degree pathway and so far all industrialized countries are not on track to even meet their insufficient pledges (Victor 2016).

The U.S. played a critical role in this weak outcome in at least three ways. First, the inability of the U.S. to pass the ACES undermined the Obama Administration's credibility during negotiations. Second, the weak incentive structure and non-binding nature of the Paris Agreement is at least in part the result of the internal structural dynamics within the U.S. as described in this paper. The pledge submitted by the Obama Administration is a reflection of these internal structural dynamics as it was rated as insufficient by Climate Action Tracker since "it is not stringent enough to limit warming to 2°C".[104] Third, since being elected President in 2016, Donald Trump has actively and directly sought to undermine the Paris Agreement.

The election of Donald Trump perhaps best exemplifies how the three internal structural dynamics of the U.S. described in this paper have undermined global efforts to accelerate the reduction of GHG emissions consistent with a two degree pathway. First, Trump won the presidency through the Electoral College even though he lost the popular vote by over three million votes. Second, he won critical battleground states, many of which have strong fossil fuel interests such as Pennsylvania and Ohio, partly due to his campaign pledges to withdraw the U.S. from the Paris Agreement, eliminate Obama's climate policies, and increase domestic production of fossil fuels. Once he was elected President Trump fulfilled each of these campaign pledges to the delight of his supporters. He appointed Rex Tillerson, the former CEO of Exxon Mobil, as Secretary of State to lead American diplomacy. The current head of the Environmental Protection Agency (EPA) is Andrew Wheeler who before being nominated was a lead lobbyist for Murray Energy, one of the largest coal mining companies in the country.[105]

[104] Country Summary, Climate Action Tracker, <https://climateactiontracker.org/countries/usa/> (22 February 2020).
[105] Jeff Turrentine, 'Who is Andrew Wheeler? (And why you should be afraid of him)', 13 April 2018, NRDC, < https://www.nrdc.org/onearth/who-andrew-wheeler-and-why-you-should-be-afraid-him> (19 March 2020).

Trump uses Neorealism logic in explaining why he decided to withdraw the U.S. from the Paris Agreement. According to Trump the Paris Agreement "disadvantages the United States to the exclusive benefit of other countries". In language eerily similar to the Congressional Resolution passed twenty years earlier, Trump claims the Agreement would put the U.S. at a competitive disadvantage compared to other countries such as China and India. Trump claims it will lead to job losses and transfer the jobs and wealth generated by the fossil fuel industry to other countries.[106] Trump's explanation for why the U.S. is withdrawing from the Paris Agreement reads like a Neorealism manifesto for climate change. However, this logic expressed by president Trump has been the consistent position of the U.S. throughout the twenty eight years of international efforts to limit climate change. Twenty three years have passed since the 1997 Byrd-Hagel Resolution but President Trump's speech explaining why the U.S. intends to withdraw from the Paris Agreement proves not much has changed. It shows that although there is much disagreement and division within the U.S. concerning climate change the country as a whole has been unwilling to take significant action on climate change and has consistently undermined global efforts to accelerate GHG emissions consistent with a two degree pathway.

Policy Outcomes

These policies of the U.S. over the last thirty years have led to a dramatic increase in domestic production of fossil fuels. This increasing production then has major implications concerning global efforts to address climate change. The dynamics described in this chapter have led the U.S. to now being the leading fossil fuel producer in the world. The U.S. is the number one producer of petroleum; the number one producer of natural gas; and the number three producer

[106] Donald Trump, 'Statement by President Trump on the Paris Climate Accord', White House, 1 June 2017, <https://www.whitehouse.gov/briefings-statements/statement-president-trump-paris-climate-accord/> (22 February 2020).

of coal. Overall, it produces twenty percent of the world's fossil fuels.[107] From 2006 to 2016 U.S. imports of petroleum decreased three percent while exports during this same time period increased fourteen percent.[108]

This trend is expected to continue as the dynamics discussed in this chapter have unleashed a growing wave of domestic fossil fuel production. According to a 2019 report by Oil Change International "between now and 2030, the United States is on track to account for 60 percent of world growth in oil and gas production, expanding extraction at least four times more than any other country".[109] This extraordinary development has major implications concerning climate change, U.S. national security, the U.S. economy, and international relations. For example this development makes the U.S. less dependent on volatile regions of the world that supply much of the world's petroleum such as the Middle East, Nigeria, and Venezuela to name a few. However, as the Oil Change International Report makes clear this increasing production also "will impede the rest of the world's ability to manage a climate-safe, equitable decline of oil and gas production".[110]

This increase in production of fossil fuel production in the U.S. is both the cause and effect of what scholars have labelled a carbon lock-in phenomenon in which industrial economies "have become locked into fossil fuel-based technological systems through a path-dependent process driven by technological and institutional increasing returns to scale" (Unruh 2000). This chapter describes how the internal structural dynamics in the U.S. have acted as positive feedback loops

[107] Jeff Desjardins, 'Mapped: fossil fuel production by country', World Economic Forum, 19 June 2019, <https://www.weforum.org/agenda/2019/06/mapped-fossil-fuel-production-by-country/> (22 February 2020).
[108] Statistical Review of World Energy 2019, British Petroleum, June 2019, <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html> (22 February 2020).
[109] Kelly Trout and Lorne Stockman, 'Drilling towards disaster: Why U.S. oil and gas expansion is incompatible with climate limits', Oil Change International, January 2019, <http://priceofoil.org/content/uploads/2019/01/Drilling-Towards-Disaster-Web-v3.pdf> (22 February 2020).
[110] Ibid.

in not only perpetuating the status quo and leading to climate policy inertia but in recent years increasing domestic production of fossil fuels as a result of public policies as described earlier. Public policy activity and economic activity interact as they feed off of each other in a positive feedback loop.

Conclusion

Climate change is a global problem which requires a global solution. No one country can solve climate change. However, one country, especially if it is one of the most powerful countries in the world, can make it extremely difficult if not impossible to solve the problem. No country has had a larger impact on the global climate pathway than the U.S. No country is more responsible for climate change and the world's response to climate change. This chapter has attempted to explain the role internal structural dynamic within the U.S. plays in preventing the U.S. from enacting domestic policies or participating in international efforts to accelerate the reduction of GHG emissions consistent with a two degree pathway. Only by fully understanding the interaction between these internal structural dynamics and the global structural dynamics can we explain the role the U.S. has played in why global efforts have so far failed to limit climate change.

The interaction of the core, structural dynamic of geography, ideology, and political constitution has led the U.S. to being responsible for more accumulated emissions than any other country and prevented the U.S. from enacting domestic policies or participating in international efforts to reduce emissions consistent with a two degree pathway. The conservative and anti-democratic elements of the U.S. political institution have played critical roles in inhibiting efforts to seriously address climate change. Similarly, the core, conservative ideology which has dominated much of the history of the U.S. and is the dominant ideology in the U.S. today has

undermined any efforts to address climate change. Lastly, the geography of the U.S., in particular the abundant reserves of fossil fuels found within the U.S., has led to powerful fossil fuel interests that in turn have led to public policies that continue to expand the exploitation and development of these domestic resources while preventing policies to reduce GHG emissions.

One major implication of this chapter is that it warns against simplistic depictions and solutions concerning climate change. The problem is not merely the fossil fuel industry or the Republican Party or Donald Trump or lack of public support or lack of awareness of the negative impacts of climate change. Rather, the reasons that explain U.S. behavior concerning climate change run much deeper and are more complex. In other words these are the effects not the causes of the problem. The causes of these effects are the deeper structural dynamics both internal and external as described in this chapter and throughout this Dissertation.

This understanding then indicates that the only way the U.S. will change its behavior concerning climate change in the future is if there is a fundamental change in these internal structural dynamics. This is of course a much more daunting proposition but that is exactly the point. We should not be deluded into thinking that by merely electing a new president or changing public opinion that this will lead to real and sustained change in the behavior of the U.S. concerning climate change. Rather the findings of this chapter indicate that the problem runs much deeper and would require a fundamental transformation of the underlying structural dynamic of the American political system.

Such transformation of the underlying structural dynamic of the American system is extremely unlikely in the foreseeable future. Thus, we should expect that the behavior of the U.S. concerning climate change should not change much for the foreseeable future. In other words, we should expect that the U.S. should behave for the next twenty eight years much as it has for

the last twenty eight years of international relations to limit climate change. We should expect the U.S. to continue to prioritize geostrategic power and the production of domestic fossil fuels over doing anything about climate change. We should expect the U.S. to continue to drag its feet in terms of both enacting domestic policies that would reduce domestic emissions and participating in international efforts to reduce global emissions. In other words the U.S. should continue to behave exactly how Neorealism would expect it to behave.

7

Summary and Conclusion

In this concluding chapter, each chapter's main findings are highlighted before ending with final conclusions, implications, and recommendations.

Chapter Highlights

Chapter One

The first chapter examines one of the core assumptions of the Liberalism paradigm that guides both global efforts to limit climate change and the science and literature surrounding these efforts which is that climate science motivates leading state actors to coordinate efforts to limit global warming. This core assumption is examined by analyzing three areas of climate change research: climate pathway models; the economic costs and benefits of climate change impacts; and the economic costs and benefits of climate change mitigation.

This analysis finds that this core Liberalism assumption is not being met for three main reasons. First, the low emissions models produced by the 2014 IPPCC AR5, that informed international negotiations leading up to the 2015 Paris Agreement, are based on several highly optimistic and unrealistic assumptions that are not happening and are extremely unlikely to occur in the future. In the highly unlikely scenario that these assumptions are met they will include major tradeoffs that are not accounted for in these models and are likely unfeasible. One of these assumptions is the widespread deployment of negative emissions technology such as bioenergy carbon capture and storage (BECCS) which is at the current time science fiction at the scale imagined in low emissions models. This assumption raises major questions including its feasibility, the tradeoffs and impacts if it is implemented, and perhaps most importantly the

moral hazard it presents as it justifies the continuation and even long term expansion of fossil fuel development and consumption. Therefore, these models can't be trusted and they are serving to rationalize and perpetuate the status quo rather than motivate state actors to accelerate reduction of GHG emissions. As a result they are not serving the purpose they are designed for which is to inform policymakers so they can make well-informed decisions.

Second, the costs and benefits associated with climate mitigation and climate adaptation are highly asymmetrical. Various populations and regions both across and within countries face very different benefits and costs associated with both climate mitigation and climate adaptation. This means these various actors would be expected to act differently based on their particular cost-benefit equation. This undercuts one of the main assumptions of the Liberalism paradigm which is that we are all in the same boat and will suffer the same consequences from climate change. In fact, the little information and understanding we do have about the impacts of climate change reveals that these impacts vary greatly across populations and regions of the world. As these differences in terms of impacts become clearer this information could just as easily serve to divide actors rather than motivate them to work together.

Lastly, there is a large degree of uncertainty and complexity involved with these climate models. This is especially true for long term projections and those involving the complex calculations involved with the costs and benefits of climate mitigation and climate impacts. This extremely limited and complex information is not conducive to informing and motivating state behavior and international relations concerning climate change. The costs and benefits associated with taking relative levels of action concerning climate change are not clear to experts and scientists much less political leaders for them to take into consideration as they make decisions concerning climate change.

Chapter Two

Chapter two first finds that as the theoretical foundation on which both diplomacy and scholarship on climate change have been built, Neoliberalism has failed to lead to an adequate response to climate change and explain the reasons for this failure. The core assumptions of Neoliberalism fail to address the strategic and power calculus of state actors throughout the world which has been the primary obstacle to seriously reducing global concentrations of emissions in line with what climate scientists say is necessary to avoid the worse effects of climate change. The expectations and logic of Neoliberalism have not been met in the real world of state actors who are primarily concerned about their relative power and security which at least so far has not included climate change as a national security priority.

It then finds that Neorealism is much better able to explain state behavior and international relations concerning climate change. From a Neorealism perspective it is expected that any international institution concerning climate change would be weak, have no independent effect, and would not alter state behavior. It would also expect states to renege on any agreement when it is politically convenient. Any international institution should serve more to reflect and perpetuate the current balance of power since states would not agree to abide by any institution that would compromise its relative power. States then would be expected to continue to act as short-term utility maximizers prioritizing other more pressing concerns over seriously addressing climate change.

As discussed in Chapter Two these expectations of Neorealism accurately reflect state behavior and international relations concerning climate change throughout the twenty eight year history of international efforts to address climate change. International efforts through the United Nations Framework Convention on Climate Change (UNFCCC) have failed to have any

discernable impact on global GHG emissions or climate change. Multiple countries have reneged on their agreements throughout the history of the UNFCCC. The most recent international agreement, the 2015 Paris Agreement, is a weak institution which does not seriously alter the prevailing incentive structure that guides state behavior. The logic of Neorealism is perhaps best exemplified by the actions of the U.S. that led efforts to form the weak Paris Agreement; submitted an insufficient pledge; and then when political conditions in the U.S. changed decided to renege on its pledge and withdraw from the Agreement. This is exactly how Neorealism would expect a superpower to act and exemplifies why no other superpower states do or should trust any commitments made by the U.S. or any other superpower for that matter. Overall, the voluntary pledges offered by states to the Paris Agreement are insufficient to reduce global GHG emissions in line with limiting global warming to under two degrees Celsius above pre-industrial levels (even with the unrealistic assumptions of the under two degree model as just discussed). Even worse, all industrialized countries are not even on track to meet their insufficient pledges. Meanwhile, following the signing of the Paris Agreement, global GHG emissions have accelerated.

Chapter Two then builds on the Neorealism framework to develop a Neorealism theory of climate change. This theory adds ideology and the natural environment as fundamental structural forces that along with political structure enable and/or constrain the behavior of actors. It then places greater emphasis on the distribution of capabilities part of the Neorealism equation in explaining the behavior and interaction of state actors.

At the global level the fundamental structural dynamic of an anarchic political structure, dominant Liberalism/Capitalism ideology, and extensive deposits of fossil fuels has been the cause of global warming and at the same time has inhibited efforts to limit this global warming.

The global economic and political system is largely based on the Liberalism/Capitalism ideological framework. International institutions such as the World Trade Organization, International Monetary Fund, World Bank, Organization of Economic Cooperation and Development, and United Nations are based on the core principles of the Liberalism/Capitalism ideology. These and many other international institutions within the Liberalism/Capitalism framework have together been the driving forces behind the current global economic and political systems that have led to global warming and have guided international efforts to limit global warming.

This global structural dynamic then interacts with the particular structural dynamics that operate at the state level to explain the behavior and interaction of state actors concerning climate change. A state's particular mix of political structure, ideology, and natural environment interacts with the global structural dynamic to explain its behavior and interaction with other state actors concerning climate change. For example, a state's level of dependence on the production of fossil fuels, a function in part of its particular natural environment, presumably would affect its behavior concerning its level of participation in global efforts to limit climate change.

Chapter Two then ends by examining the geostrategic considerations involved with both the impacts of climate change and global efforts to reduce GHG emissions. It is quite possible that some climate impacts such as the warming of the Arctic could actually enhance the power of some states such as Russia in the coming decades. International efforts to limit climate change also threaten the core geostrategic interests of many states around the world including the most powerful states in the world. Seen through the lens of Neorealism it then becomes clear why

international efforts to limit climate change have failed when considering how climate change affects these core geostrategic interests of leading state actors.

Chapter Three

Chapter Three then presents the findings of a cross national statistical analysis that examines the role fossil fuel interests have played in explaining the variation of climate change policy performance across states and in inhibiting global efforts to limit climate change. First it finds that petroleum production has a significant impact on the distribution of state power even when controlling for GDP. States that have higher levels of petroleum production tend to have more power than states with lower levels of petroleum production. It then finds that fossil fuel production, fossil fuel dependence, and resource rents as a percentage of GDP all have strong and significant impacts on the variation of climate change policy performance across states even when controlling for other variables. The states with the highest climate policy performance have low levels of dependence on fossil fuels while countries most dependent on fossil fuels all exhibit low climate policy performance. Other factors such as climate vulnerability, economic development, and level of democracy are found to not have significant effects when controlling for other variables.

These findings provide further evidence that Neorealism is a better framework to understand state behavior and international relations concerning climate change. States that have a significant stake in the fossil fuel industry have inhibited efforts to limit global warming. These states are acting as rational short-term utility maximizers as expected by Neorealism. Fossil fuel resources are an important source of state power for many states throughout the world. This is especially true when looking at the three most powerful countries in the world: the U.S., China, and Russia which are the top fossil fuel producers in the world. All three countries have

exhibited weak climate policy performance and have not helped lead international efforts to accelerate the reduction of GHG emissions consistent with a two degree pathway. As explained by Neorealism this is most likely not a coincidence as these states have prioritized the domestic production of fossil fuels over seriously addressing climate change in order to maximize their short-term and relative power.

Chapter Four

Chapters Four and Five then analyze the efforts of subnational governments and their networks to accelerate the reduction of GHG emissions. Some scholars from the Neoliberalism tradition have discussed the prospect that perhaps these so called nonstate actors can potentially fill the leadership void left by state actors and lead a decentralized solution to global warming. One scholar has expressed the prospect that these networks could even potentially supplant international efforts by state actors. Others have expressed the prospect that efforts by these nonstate actors in the United States could possibly achieve the U.S. pledge to the Paris Agreement even without the active leadership or even participation of the U.S. national government. To assess these claims research is conducted on a transnational network of subnational states and regions and on state climate policies in the United States. The findings of these two research projects are presented in Chapters Four and Five.

Chapter Four presents the findings of an analysis of the Under 2 Coalition which is a coalition of subnational states and regions committed to accelerating the reduction of GHG emissions. This examination finds that not one subnational state or region has joined the coalition from one of the top fifty countries in the world that are most dependent on fossil fuel production. Then, when comparing the states and regions that have and have not joined the Coalition from the U.S., Canada, Germany, Australia, India, South Africa, Brazil, and Mexico it is found that 92% of the

states and regions that have joined the Coalition from these countries have low levels of fossil fuel dependence compared to the states and regions in the same countries that have not joined the Coalition. These findings provide evidence that transnational efforts by subnational governments run into the same obstacle that has hindered international efforts by state actors, namely that those regions of the world that have a stake in the fossil fuel industry are not interested or willing to participate in any global effort to accelerate the reduction of GHG emissions consistent with a two degree pathway. This suggests that efforts by nonstate actors are likely to have no more success in accelerating the reduction of overall GHG emissions than efforts by state actors. In fact, the findings presented in this chapter suggest that these efforts are likely to have little impact on overall global GHG emissions over and above the efforts of state actors.

Chapter Five

Chapter Five then presents the findings from a quantitative comparative analysis of state climate change mitigation policies in the United States. It finds a strong and significant correlation between fossil fuel dependence and climate change policies. Those U.S. states in which their state economies are most dependent on the production of fossil fuels exhibit little to no commitment to accelerating the reduction of GHG emissions. On the other hand those states that exhibit the strongest commitment to accelerating the reduction of GHG emissions have low levels of dependence on the production of fossil fuels. However, ideology trumps all other variables including the fossil fuel dependence variable when it comes to explaining the variation of states' commitment to accelerating the reduction of GHG emissions. Climate change has become a polarizing ideological issue that has divided Democrats and Republicans. Therefore this effect is to be expected. However, these findings raise the question of the relationship between fossil fuel interests and ideology which is explored in Chapter Six.

Chapter Six

Chapter Six then uses the Neorealism theory of climate change developed in Chapter Two to explain the behavior of the U.S. concerning climate change. It shows how the internal structural dynamics of the United States play fundamental roles in explaining why the U.S. has not enacted a significant domestic climate mitigation policy and has not cooperated with other states to accelerate the reduction of GHG emissions consistent with a two degree pathway. The Constitution, ideology, and geography of the U.S. have played key roles in inhibiting the U.S. and by extension the world's ability to adequately respond to climate change.

The conservative nature of the U.S. Constitution has played a fundamental role in inhibiting the ability of the U.S. to take strong action on climate change. Various aspects of the U.S. Constitution serve to protect the status quo and prevent large scale change. The strict treaty ratification provision, Electoral College, and U.S. Senate are just a few examples of undemocratic and essentially conservative elements of the U.S. Constitution that have enabled the status quo to obstruct efforts to enact a strong climate change policy or cooperate with other states to accelerate the reduction of GHG emissions.

The dominant Liberalism ideology of the U.S. has also played a major role in inhibiting the ability of the U.S. to take strong action on climate change. The U.S. embodies the Liberalism/Capitalism ideology perhaps more so than any other country in the world. Limited government and free-market capitalism are two of the fundamental values that underpin the political and economic system in the U.S. Following the Great Depression and World War II the U.S. moved to the left on this Liberalism ideological spectrum as it enacted high income taxes and strong regulations. The social movements in the 1960s moved the U.S. further to the left which led to strong environmental laws. This shift to the left then led to a reactionary movement

beginning in the mid-1970s in which a number of corporations and wealthy families, led by the fossil fuel industry, mobilized to form a conservative revolution which continues to this day. This conservative revolution has had a major impact on public opinion, the two political parties, and ultimately public policies all of which have inhibited the U.S. ability to participate in global efforts to limit climate change.

Lastly, the natural environment has played a key role in inhibiting the U.S. ability to take action on climate change. Its extensive deposits of fossil fuels played a key role in fueling the U.S. rise to global superpower status. Increasing domestic production of fossil fuels has been a consistent geostrategic priority of the U.S. no matter which political party is in power. Both political parties in the U.S. have emphasized energy independence, energy security, and the economic benefits of domestic fossil fuel production over efforts to limit climate change. These extensive fossil fuel deposits have led to a powerful fossil fuel industry which is one of the most powerful interest groups in the U.S.

As explained by the Neorealism theory of climate change these internal structural dynamics within the U.S. have interacted with the global structural dynamics to produce three important outcomes. First, the U.S. is now the number one producer of fossil fuels in the world. It produces twenty percent of the world's fossil fuels. This boom in U.S. fossil fuel production is expected to continue into the foreseeable future and threatens international efforts to limit climate change. Fossil fuels continue to constitute a core strategic interest for the U.S. which is supported by the political establishment including both major political parties. Second, this interaction of domestic and global structural dynamics has led to the U.S. being unwilling to help lead international efforts to accelerate the reduction of GHG emissions consistent with a two degree pathway. In fact the U.S. has played the opposite role of inhibiting these efforts. These first two outcomes

then lead to the last outcome which is that without the U.S. participation international efforts have failed to limit global warming. The U.S. is not the only reason why global efforts have failed but it is certainly one of the main reasons.

Final Conclusions

This Dissertation has examined global efforts to limit climate change from a number of different angles and has found that these efforts have largely failed and that an updated version of structural Realism best explains why these efforts have failed. As this Dissertation has shown, within an anarchic global political structure the economic growth imperative and fossil fuel interests among the most important state and nonstate actors have consistently trumped any efforts to reduce GHG concentration levels in the atmosphere consistent with a climate pathway that scientists say is necessary in order to avoid the worst case scenarios.

Within this global structural dynamic market forces have largely determined the climate pathway the world has followed and constrained the response of the leading state and nonstate actors. The world remains state-centric dominated by state actors and especially the most powerful state actors such as the United States, China, and Russia. As explained by Neorealism these state actors are primarily concerned with relative power in a competitive world. Fossil fuel interests remain at the heart of many if not all of these state actors' geostrategic interests and domestic economies which comprise their relative power. At the same time the leading nonstate actors when it comes to climate change are fossil fuel companies and related industries. These industries have consistently inhibited global efforts to limit climate change which threaten their very survival. Taken together, global efforts to limit climate change threaten the core interests of the most relevant and powerful state and nonstate actors in the world. Understood as such it should be no surprise that these leading state and nonstate actors have consistently inhibited

global efforts to limit climate change and that as a consequence these efforts have failed up to the present time. Furthermore, the proposed solutions within the Neoliberalism framework both among diplomats and scholars as recounted throughout this Dissertation have thus far failed and have little chance of being successful now or in the future due to the prevailing fundamental global structural dynamics.

In much of the world state actors (at both the national and subnational levels), the fossil fuel industry, and the manufacturing industry are caught in a vicious cycle of interdependency that has led to the carbon lock-in phenomenon. Public policies implemented by governments throughout the world have facilitated the development of the fossil fuel industry and its central place in the global economic system. According to a 2019 IMF Working Paper, global fossil fuel subsidies are approximately $5.2 trillion a year, which is about 6.4% of the global gross domestic product.[111] The fossil fuel industry for its part has been integral in ensuring these policies are enacted through lobbying, campaign expenditures, and manipulation of public opinion through the media. This interdependency has only increased in recent decades through the process of nationalization of the fossil fuel industry that has occurred in much of the world. The manufacturing industry including automobile and construction industries are also largely dependent on the fossil fuel industry and thus contribute to this vicious cycle and carbon lock-in. As an example of how this dynamic plays out in the real world, according to the IEA's World Energy Outlook 2019 Report, from 2010-2018 the rising sales of SUVs throughout the world was the second-largest contributor to the increase in global CO2 emissions.[112]

[111] International Monetary Fund, 'IMF Working Paper: Global fossil fuel subsidies remain large: An update based on country-level estimates', May 2019, <file:///C:/Users/User/Downloads/WPIEA2019089.pdf > (17 March 2020).
[112] Laura Cozzi and Apostolos Petropoulos, 'Growing preference for SUVs challenges emissions reductions in passenger car market', IEA, 15 October 2019, < https://www.iea.org/commentaries/growing-preference-for-suvs-challenges-emissions-reductions-in-passenger-car-market> (17 March 2020).

The end result is that global efforts to limit climate change over the last thirty years have had little to no impact on the global economic system and global emissions. Throughout these thirty years fossil fuels have remained approximately 80% of global energy supply.[113] Global emissions have consistently followed baseline or business-as-usual scenarios. As noted in the Introduction, in 1958 Charles David Keeling began measuring atmospheric CO levels at Hawaii's Mauna Loa Observatory. That year atmospheric CO2 levels were measured at 315 ppm. The annual measurements have shown a steady rise in CO2 levels. The latest measurements in 2019 found that levels are now at 415 ppm. Even more damming of global efforts to limit climate change is the fact that the rate of growth in CO2 concentration levels in the atmosphere has accelerated over time. The last three decades have witnessed the highest growth rates which have increased each decade. Four out of the five largest single annual growth rates in CO2 atmospheric concentration levels in history have occurred since 2010.[114]

Implications

The question then becomes what this all means for the future? This Dissertation leads to four interconnected implications. The first implication is that we are most likely headed towards a much warmer global climate with all the dire consequences for the global ecosystem that a much warmer planet entails. The second implication is that the possibility of limiting climate change to anywhere near the two degrees target would most likely occur if the underlying structural dynamics are transformed in the near future (next few decades). The third implication is that any possibility of such a transformation is likely to come about as a result of a collapse of the global economic system due to the world overshooting the carrying capacity of the world. The fourth implication is that the impacts of climate change and global efforts to limit climate change are

[113] The World Bank, 'Fossil fuel energy consumption', 1960-2015, DataBank, <https://data.worldbank.org/indicator/eg.use.comm.fo.zs> (17 March 2020).
[114] CO2.Earth, 'CO2 acceleration', 8 January 2020, <https://www.co2.earth/co2-acceleration> (17 March 2020).

likely to be one of if not the most important issues facing the world for the rest of the twenty first century. These implications are discussed in order.

The primary implication of this Dissertation is that we are very likely headed toward a much warmer global climate. It is extremely unlikely that we will limit global warming to anywhere near two degrees Celsius above pre-industrial levels, the target of the latest international agreement, the 2015 Paris Agreement. Achieving this two degree pathway most likely would have required the world to take drastic actions over the last thirty years of global efforts to limit climate change which for the reasons explained throughout this Dissertation did not happen. It is likely that it is already too late to reach this target. Any realistic chance of hitting this target would most likely require an immediate and increasing reduction in global GHG emissions, which again is not happening. This in turn would require an immediate and massive overhaul of the global economic system. As described throughout this study the underlying structural forces have prevented such a transformation up to this point in time and this structural dynamic will likely continue to prevent this from occurring in the foreseeable future. The research conducted and climate science reviewed for this project indicate that global warming is likely to increase 3-4 degrees Celsius above pre-industrial levels by the end of this century. Three degrees Celsius is probably best case scenario and we are likely headed to around 4 degree Celsius above pre-industrial levels at this point unless there are drastic changes in the next decade or two.

According to the Neorealism theory of climate change developed in this Dissertation, the global climate pathway is largely determined by the underlying structural forces. In order to have any chance of achieving the two degree pathway there would need to be a transformation of the underlying structural dynamic within the next two to three decades. Both the political and ideology structural dynamics are unlikely to be the catalysts for the scale and immediacy of

emissions reductions necessary to limit global warming to anywhere near the two degree pathway. The anarchic global political structure is unlikely to change on its own. The resurgence of nationalism throughout the world in recent years makes clear that any movement towards a stronger more powerful international political system that would effectively regulate global GHG emissions is unlikely in the near future. In fact it seems the world is heading in the opposite direction of weaker international institutions and state actors reasserting their sovereignty.

Similarly, the Liberalism/Capitalism/Neoliberalism ideology that dominates the international economic and political systems as described in this Dissertation is unlikely on its own to be defeated by any other competing ideologies in the near future. The economic growth imperative that lies at the heart of this ideology and drives the global economic system and global GHG emissions is likely to continue into the foreseeable future. Both the global economy and population are expected to continue to grow exponentially in the coming decades. This then translates into exponential growth in global energy demand that will largely be met by fossil fuels. According to the 2019 International Energy Outlook published by the Energy Information Administration (EIA) global energy consumption is expected to increase almost fifty percent by 2050 due to expected population and economic growth especially in China and India. As a result, the consumption of fossil fuels is expected to grow at a 0.6 percent rate per year. The EIA expects that in 2050 overall fossil fuel consumption will increase as it supplies approximately sixty nine percent of the world's growing energy consumption.[115] As explained in Chapter One if the median estimates for both population and economic growth by 2050 and 2100 are achieved then there is little chance we will get anywhere close to the two degree target.

[115] Institute for Energy Research, 'EIA's international energy outlook shows demand for fossil fuels increasing', 30 September 2019, < https://www.instituteforenergyresearch.org/international-issues/eias-international-energy-outlook-shows-demand-for-fossil-fuels-increasing/> (17 March 2020).

The Liberalism ideology includes optimistic assumptions concerning human nature, cooperation, technology, and markets. As explained throughout this Dissertation, this optimistic logic has not led to any discernable progress when it comes to addressing the growing threat of climate change. Up to the present time humans and by extension their technology and institutions have not come even close to solving the global warming collective action dilemma. In fact, ironically, this optimistic logic of Liberalism is a central obstacle to solving this dilemma.

An important example of how this optimistic logic of Liberalism has not led to any real progress is the example of renewable energy. The development of renewable energy is a central plank of efforts to limit climate change. The extraordinary development and expansion of solar and wind energy in recent years has given hope to many, especially among climate activists, that technology innovation and development can effectively limit climate change. There are three main problems with this hope. First, although renewable energy has experienced exponential growth in recent years, it is not happening nearly fast enough to limit climate change. Leading climate scientist Ken Caldiera and colleagues estimated in 2003 that in order to limit climate change to below two degrees Celsius above pre-industrial levels the world would need to add approximately 1,100 MW of carbon free energy per day between the years 2000 and 2050 (Caldeira et al. 2003). In a 2018 reassessment Caldeira found that the world is adding roughly 151 MW a day. At that pace it would take approximately four hundred years to transform the energy system, not the fifty years needed to achieve the two degree pathway.[116] Second, recent research has found that renewable energy is not replacing fossil fuels but rather merely adding to the overall energy supply to help meet growing energy demand resulting from population and economic growth (York 2012; York and Bell 2019). Third, if the world were to replace fossil

[116] James Temple, 'At this rate, it's going to take nearly 400 years to transform the energy system', MIT Technology Review, 14 March 2018, < https://www.technologyreview.com/2018/03/14/67154/at-this-rate-its-going-to-take-nearly-400-years-to-transform-the-energy-system/> (1 April 2020).

fuels to the degree required under low emissions models then it would require massive amounts of land and material extraction and in the case of nuclear energy massive amount of radioactive waste and disposal.

Therefore, as long as the anarchic global political structure remains in place and the economic and population growth imperative continues to drive the global economic system then "no matter how fabulous its technologies, no matter how efficient its economy, no matter how wise its leaders" it is likely not possible to avoid an eventual collapse of the system as a result of overshooting the world's biocapacity to sustain this growth (Meadows et al. 2002). Efforts by state actors to design an effective international institution to limit climate change will likely continue to fail. Efforts by nonstate actors such as subnational governments will also likely continue to fail for the same reasons. Market forces and technology innovation and development will also continue to inhibit solutions or be insufficient to seriously limit climate change. Environmentalism and the global environmental movement will likely continue to be powerless to these much more powerful global structural forces.

This leads to the natural environmental structural dynamic as the most likely candidate which could possibly act as a brake on rising global emissions that could then limit climate change to anywhere near the two degree pathway. In the near future (next couple decades) this natural environment variable is likely to lead to a continuation of business-as-usual as states continue to focus on short-term economic growth and geopolitics which for many of these states depend on the continued production and consumption of fossil fuels. In lieu of a global government, sovereign states will likely continue to respond to climate change as competitors and rivals not as partners and cooperators as has been the case up to the present time. Up to the present time positive feedback has dominated in the natural environment which has enabled continued

exponential global economic and population growth. Within this natural environment context leading state and nonstate actors are likely to continue to prioritize the production and consumption of fossil fuels as explained throughout this Dissertation.

As previously described this continued exponential economic and population growth is likely to lead to certain tipping points in the natural environment. According to the Limits to Growth baseline scenario exceeding these thresholds leads to a transition in the global ecological system in which negative feedback mechanisms begin to dominate rather than the positive feedback mechanisms that have dominated thus far. According to this scenario if we continue to follow this path then at some point during the middle of this century the world economy will experience a collapse as a result of "humanity having to divert more and more capital to cope with the problems arising from a combination of constraints". This collapse would then result in "failing health, conflict, ecological devastation and gross inequalities" as well as a prolonged decline in global population and economic production (Meadows et al. 2002). A global economic depression in which population and economic growth is stopped and even reversed for a prolonged period of time would certainly have major, immediate, and direct effects on global emissions, essentially driving down these emissions for many years as economic activity and population declines.

Beyond this immediate and direct impact it is impossible to predict with any degree of probability what such a historic, global collapse of the economic system would entail. Conventional Neorealism would predict that in general such a global catastrophe would lead to more conflict rather than more cooperation. As this Dissertation has shown the behavior and interaction of state actors concerning climate change have followed the logic of Neorealism up to the present time. We should then expect that the behavior and interaction of state actors would

most likely follow the logic of Neorealism in reaction to any possible collapse of the global economic system.

However, the Neorealism theory of climate change developed in this Dissertation leaves the door open for a number of different possible scenarios that could result from such a collapse. According to this theory the core structural forces of ideology, natural environment, and political structures interact at both the global and state levels. If such a collapse as envisioned by the Limits to Growth baseline scenario were to happen it would no doubt have a major impact on both the political and ideology structural dynamics at both the state and global levels. It is impossible to predict how this dynamic would play out in the real world.

In a best case scenario (though not most likely, at least according to Neorealism) this could lead to a new structural dynamic more favorable to sustainable development which operates within the natural limits of the world. Such a scenario would require the formation of some sort of global political system that would effectively regulate the global economic system that has been constructed and take the necessary action to drive global emissions down and keep emissions within sustainable limits. At the present time it seems unimaginable that such a global political system would be created especially considering the recent resurgence of nationalism around the world as previously mentioned. However it was undoubtedly just as unimaginable in the early twentieth century that the European countries would in a matter of a few decades construct a European Union. For such an outcome to occur the world would most likely need to experience something of the magnitude of the Great Depression, World War II combination that resulted in the European Union.

Regardless of how or whether this ever happens, it is clear that some sort of global political system along the lines of a European Union at the world level will likely be needed to seriously

reduce global GHG emissions within sustainable limits. The current anarchic global political structure would likely need to be transformed. At the present time we have a global economic system without a global political system to regulate it. A proper global political system would perform two primary functions concerning the issue of climate change. First, it would implement and enforce an immediate global price on carbon that accurately represents the true cost of carbon not as it has been narrowly defined so far and represented in climate models such as in the RCPs but rather broadly defined to include the numerous environmental and health impacts of climate change throughout the world. This broad definition would lead to a much higher carbon price than has been proposed and is thus politically unrealistic in the current real world conditions for the reasons explained in this Dissertation. This revenue would then be used to help pay for climate mitigation and adaptation efforts among vulnerable populations in both the developed and developing world.

Such a development would require a transformation of the Liberalism ideology structural dynamic at the heart of the current global economic and political system. The economic and population growth model that is the foundation of the current global economic system would need to be replaced with a sustainable development model that would require a much greater role for government at the global level to properly regulate this global economic system. Efforts to transition the world to a sustainable development model have been ongoing for decades as most recently represented by the United Nations Sustainable Development Goals. However, these efforts have largely failed and are likely to continue to fail in terms of achieving their environmental goals as long as the underlying structural dynamic described in this Dissertation remain the same. These efforts by the United Nations and other international institutions have attempted to pursue sustainable development goals within the

Liberalism/Capitalism/Neoliberalism dominant global framework that prioritizes economic growth over all other values and largely ignores population growth. Such efforts have failed and will likely continue to fail because they do not transform the underlying structural causes of these environmental problems such as climate change. These efforts are likely to continue to operate at the margins of the global economic system as long as they operate within the Liberalism/Capitalism/Neoliberalism framework and within an anarchic global political structure.

There is the need for a paradigm shift in which sustainable development replaces economic growth as the dominant ideology that governs world affairs. This sustainable development ideology would prioritize environmental protection over economic growth and focus on ensuring that human development occurs within natural limits imposed by planet Earth. As Einstein famously stated "we cannot solve our problems with the same level of thinking that created them". This Dissertation is a testament to this truism. There is a need for a new vision that guides human development into the future.

It should be noted here that the other macro ideologies in the world such as Communism and Socialism as practiced in the past and present are no different than Liberalism concerning the issue of climate change and so as presently constructed they would be inadequate replacements of Liberalism as the dominant global ideology in terms of limiting climate change. Liberalism, Socialism, and Communism have many differences. However, they all value economic growth and development as a core imperative. None of these ideologies emphasize as a core value the protection of the environment or sustainable use of resources as a top priority. They are all branches of the same historical (European) tree that emphasizes and prioritizes economic growth and development as a core value over and above any environmental concerns. This core value

then operates as the logic of these ideologies as implemented through their various economic and political systems throughout the world.

Accordingly, the findings and conclusions of this research project indicate that: (A) The only viable solution to the global warming dilemma would be the formation of an international government in which state actors give up some degree of core sovereign power. This global government would then need to be based on and implement a new sustainable development ideology that would truly operate within the natural limits of the world. (B) Such a development, if it is to come about, would most likely be the result of a collapse of the global ecological system including the global economic system along the lines envisioned by the Limits to Growth baseline scenario.

A useful framework in which to think about this is punctuated equilibrium theory. According to the theory of punctuated equilibrium as proposed by Niles Eldridge and Stephen Jay Gould in a 1972 paper, the evolution of species throughout history is the result of abrupt changes in the natural environment. This theory is opposed to the gradualism theory in evolutionary biology in which the evolution of species occurs gradually over time. Eldridge and Gould argue that the fossil records indicate that throughout history there have been long periods of stasis in which very little to no evolution occurred. Then, these periods of relative stasis are interrupted by abrupt changes in the natural environment that then leads to rapid evolutionary development among species over a short period of time (Gould and Eldridge 1972). Social scientists have attempted to apply this theory in explaining change in public policies and political systems (Baumgartner and Jones 2010). The main idea is that there are periods of relative stability in which the status quo is able to prevent change. This stability of a public policy or political

system is then altered when there is some abrupt change in the social environment that then leads to fundamental political changes.

This Dissertation has shown how over the twenty eight year history of global efforts to limit global warming not much has changed concerning these efforts. Seen from the perspective of punctuated equilibrium theory we are in a period of stasis and inertia in which the status quo has been able to resist efforts to enact fundamental change that would lead to an alternative climate pathway than the business-as-usual pathway we have been following for twenty eight years and counting. Seen from the perspective of Neorealism this is due to the fact that the fundamental structural forces have not changed over these twenty eight years as explained throughout this Dissertation and reiterated in this Conclusion. States in particular and the world more generally have fallen prey to path-dependency and carbon lock-in.

The third note concerning the possibility of the formation of some sort of global political system is that if this were to happen at some point in the future (and this is a big if) then this would change the world as we know it and would require new models to explain this new world order. Both the Realism and Liberalism models describe a world in which there is no world government and neither envisions a future with a strong global government in which states cede core sovereign powers. In the field of International Relations the offshoots of these traditions Neorealism and Neoliberalism are similarly based on the assumption of an anarchic global political structure. New models would need to be constructed to describe these new developments. If history is any guide then these models constructed by humans will both inspire and reflect these developments in the real world.

The fourth and final implication of the findings presented in this Dissertation is that climate change and global efforts to limit climate change are likely to become one of if not the most

important international issues in the remaining decades of the twenty first century and beyond. So far, as explained throughout this Dissertation, climate change has remained a periphery concern for most of the leading state and nonstate actors on the world stage as they have prioritized other interests and concerns. The conclusions of this Dissertation suggest that this will most likely change in the coming decades as the impacts of climate change become more severe and global efforts to address these growing threats become more persistent and urgent. Global warming and other related environmental changes associated with continued exponential economic and population growth will likely transition from a sideshow to take center stage at some point within the next few decades. At some point climate change and global efforts to address climate change will likely transition from a second order to a first order concern for many of the most powerful state and nonstate actors in the world.

This transition of climate change from a second order to a first order concern does not necessarily mean state actors will then find it in their best interest to cooperate to collectively address the growing threats climate change presents. On the contrary, as this Dissertation has explained, within the Neorealism framework in which state and nonstate actors operate, this transition is more likely to lead to more conflict rather than more cooperation as states continue to pursue their narrow, short-term self-interests and relative power independently in a competitive anarchic world.

Recommendations

Finally, these implications then lead to two interrelated recommendations. Since we are likely headed toward a much warmer global climate with all the dire consequences such an outcome entails, it becomes even more important that climate scientists and policymakers work together to best prepare and plan for this future. More effort should be paid to construct the most realistic

climate models that would inform behavior and decision making of individuals, policymakers, businesses, organizations, and industries. Second, more attention and resources should be paid to climate adaptation efforts to prepare as best as possible for the consequences of the much warmer climate that we are likely to experience. These two recommendations are discussed in order.

As explained in the first chapter climate models take a deductive approach. They begin by choosing a temperature target that represents a radiative forcing level each scenario leads to by the end of this century that are then aligned with particular likelihoods of leading to certain global warming ranges. The models then make any number of assumptions in order to achieve the end target. As a result, these models are not intended to predict the climate pathway the real world is most likely to follow and as explained earlier these models include a number of unrealistic assumptions that are not occurring in the real world and are unlikely to occur in the future.

The findings of this Dissertation indicate a need for the development of an inductive climate pathway model in which the model represents the most likely scenario based on past and present trends. Such a probability based model would be based on the most realistic (median) assumptions concerning population growth, economic growth, energy demand, technology innovation and development, carbon pricing and the impacts of carbon pricing, etc. Experts in these various areas would contribute to the development of this model so that the best available knowledge would lead to the most realistic projection.

Such a model would be extremely useful for a variety of purposes. Climate scientists throughout the world could use the results of this model to then construct the most likely impacts of climate change at the global, national, regional, and local levels throughout the world. Such

information would then be extremely useful for policymakers, organizations, businesses, the insurance industry, and individuals to make well-informed decisions on a whole host of issues relating to climate change. Such information would no doubt have a major impact on decision making concerning a whole host of issues including land-use planning, agriculture, insurance, housing development, commercial development, and industrial development. It would also ground global efforts to mitigate climate change in a more realistic framework than is the case now in which policymakers and observers are relying on hypothetical models that do not reflect real world conditions.

Unfortunately, the climate modelling community is going in the opposite direction. In preparation for the Sixth Assessment Report (AR6) which is due to be published in 2021 and will then form the foundation of climate models going forward, the climate modelling community has produced climate pathways that are even more hypothetical and complex and thus even less user-friendly than the RCPs. These "Shared Socioeconomic Pathways" (SSPs) include five narratives that include a more complex and confusing array of assumptions and hypotheticals than are included in the RCPs. These pathways include the same unrealistic assumptions made in the RCPs including the assumption of widespread deployment of negative emissions technology. Consequently, it will be even more difficult to project which pathway is the most likely scenario well into the future. They include so many different assumptions that really no model will resemble whatever pathway the world does ultimately follow in the real world. These models are not likely to be very helpful or useful in the real world.

Special emphasis concerning this recommendation should be paid to the issue of negative emissions technology. Four specific recommendations are in order concerning the issue of negative emissions technology. First, models that attempt to predict future pathways should not

include the assumption of negative emissions technology. This assumption has now been baked into most low emissions models and presents a very serious moral hazard as it rationalizes and justifies the continuation and even the expansion of fossil fuel use with the expectation that at some point technology will be developed to suck these emissions out of the atmosphere. Second, if models do include this assumption then it should be noted front and center and include a serious caveat noting that it is not a realistic assumption at this point in time, presents a moral hazard, and does not include the tradeoffs that would likely make any such deployment unfeasible, or at least extremely costly. Third, any analyses of state or global level action to mitigate climate change should not be based on low emissions models that include negative emissions assumptions and if it is then it should be stated very clearly. Fourth, journalists and environmental organizations that comment on climate models that include these assumptions should again make this assumption very clear to their consumers and members and make it clear that these assumptions are unrealistic at the present time, present serious moral hazards, and do not include the many tradeoffs which make these assumptions quite possibly infeasible. However, none of these last four recommendations concerning negative emissions assumptions are necessary if climate modelers followed the first recommendation which the author of this study believes is necessary in order to alleviate the moral hazard and damage that has been done and will continue to be done by including these unrealistic assumptions in low emissions models that are intended to guide policymakers.

Lastly, this Dissertation leads to the recommendation that much more attention and resources need to be paid to climate adaptation and efforts to prepare and plan for the much warmer climate we are likely to experience. As just emphasized these efforts are really dependent on having accurate and realistic information on what these impacts are likely to be which is why the

development of a realistic, most likely climate pathway scenario is so important. Such a model would tell us whether we are most likely headed towards a three, four, or five degrees Celsius above pre-industrial future so that we can plan accordingly.

More than anything climate change disproportionally affects vulnerable populations which are a large portion of the world's population in both developed and developing countries and thus have much less power and influence over climate change mitigation and adaptation policies. People living in failed or failing states, conflict prone areas, desert environments, low lying islands, and poverty (in both developed and developing countries) are already being severely affected by climate change much more so than other populations. Climate change is increasingly exacerbating these underlying vulnerabilities and contributing to the vicious cycle of poverty and violence so much of the world's population experiences. According to the World Bank some 100 million people could be pushed into poverty by 2030 and some 143 million people will become climate refugees as a result of climate change.[117] Parts of the world will become uninhabitable as a result of climate change. Climate change will also exacerbate the increasing levels of inequality that the world is experiencing.

Global, national, and local efforts should focus on climate adaptation and provide financial assistance, support and information to vulnerable populations that will be most severely and negatively impacted by climate change. International institutions and organizations such as the United Nations, World Bank, and the Organization for Economic Co-operation and Development should focus on these efforts. Corporations, especially the fossil fuel industry, should be pressured and even possibly forced into making significant contributions for such efforts. National and subnational governments and policymakers need to prioritize such efforts both

[117] The World Bank, 'Climate change', < https://www.worldbank.org/en/topic/climatechange/overview> (19 March 2020).

within their jurisdictions and globally. Lastly, scientists and scholars should focus their efforts on providing as much user-friendly information as possible to help policy makers, industries, businesses, and individuals prepare and plan for the impacts of climate change.

It should be emphasized that nothing in this Dissertation suggests that we should stop trying to limit climate change. It should go without saying that of course we should continue to do everything we can to try to limit climate change as much as possible. The more we can limit global warming the better off the planet and all of its inhabitants will be. This Dissertation should not be used as an excuse to raise the proverbial white flag. To the contrary, this study points to the urgent need to accelerate efforts to mitigate climate change as much as possible.

However, the findings of this Dissertation lead to the conclusion that due to the underlying structural dynamic we are unlikely to limit climate change to anywhere near two degrees Celsius above pre-industrial levels which at least according to some scientists means that much of the world will experience increasingly harsh conditions that in many instances will have devastating impacts.. Consequently, it is imperative that we now equally prioritize climate adaptation. Most of the emphasis up to the present time has been on climate change mitigation which has largely been unsuccessful for the reasons stated in this Dissertation. Climate change adaptation efforts have been even less emphasized than climate mitigation efforts and have been equally unsuccessful. Nonetheless it is now time to prioritize and focus on preparing for the consequences of a much warmer global climate that we are likely to experience in the coming decades which is the result of the world's inability to limit climate change to any significant degree.

References

Aklin, Michaël and Mildenberger, Matto. 2018. “Prisoners of the Wrong Dilemma: Why Distributive Conflict, Not Collective Action, Characterizes the Politics of Climate Change” (November 8, 2018). Available at SSRN: http://dx.doi.org/10.2139/ssrn.3281045

Anderson, Kevin, and Glen Peters. 2016. “The Trouble with Negative Emissions.” *Science* 354: (6309): 182-3.

Andonova, Liliana B., Thomas N. Hale, and Charles B. Roger. 2017. "National Policy and Transnational Governance of Climate Change: Substitutes or Complements?" *International Studies Quarterly* 61(2): 253-68.

Arrow, Kenneth, et al. 1996. “Economic Growth, Carrying Capacity, and the Environment.” *Environment and Development Economics* 1(1): 104-10.

Ascensão, Fernando, Lenore Fahrig, Anthony P. Clevenger, Richard T. Corlett, Jochen AG Jaeger, William F. Laurance, and Henrique M. Pereira. 2018. "Environmental Challenges for the Belt and Road Initiative." *Nature Sustainability* 1(5): 206-9.

Auty, Richard M. 1994. "Industrial Policy Reform in Six Large Newly Industrializing Countries: The Resource Curse Thesis." *World development* 22(1): 11-26.

Bansard, Jennifer S., Philipp H. Pattberg, and Oscar Widerberg. 2017. "Cities to the Rescue? Assessing the Performance of Transnational Municipal Networks in Global Climate Governance." *International Environmental Agreements: Politics, Law and Economics* 17(2): 229-46.

Barrett, Scott. 2003. *Environment and Statecraft: The Strategy of Environmental Treaty-making*. Oxford, United Kingdom: Oxford University Press.

Bättig, Michèle B., and Thomas Bernauer. 2009. "National Institutions and Global Public Goods: Are Democracies More Cooperative in Climate Change Policy?” *International Organization* 63(2): 281-308.

Baumgartner, Frank R., and Bryan D. Jones. 2010. *Agendas and Instability in American Politics*. University of Chicago Press.

Bodansky, Daniel, and Lavanya Rajamani. 2018. "The Evolution and Governance Architecture of the United Nations Climate Change Regime." *Global Climate Policy: Actors, Concepts, and Enduring Challenges*, edited by Urs Luterbacher and Detlef F. Sprinz, MIT Press, 13-66.

Bosso, Christopher J. 1987. *Pesticides and Politics*. University of Pittsburgh Press.

Brulle, Robert J. 2016. "The Climate Lobby: A Sectoral Analysis of Lobbying Spending on Climate Change in the USA, 2000 to 2016." *Climatic Change* 149(3-4): 289-303.

Bulkeley, Harriet, Liliana B. Andonova, Michele M. Betsill, Daniel Compagnon, Thomas Hale, Matthew J. Hoffmann, Peter Newell, Matthew Paterson, Stacy D. VanDeveer, and Charles Roger. 2014. *Transnational Climate Change Governance*. Cambridge University Press.

Burke, Marshall, Solomon M. Hsiang, and Edward Miguel. 2015. "Global Non-linear Effect of Temperature on Economic Production." *Nature* 527(7577): 235-9.

Caldeira, Ken, Atul K. Jain, and Martin I. Hoffert. 2003. "Climate Sensitivity Uncertainty and the Need for Energy without CO2 Emission." *Science* 299(5615): 2052-4.

Carley, Sanya, and Chris J. Miller. 2012. "Regulatory Stringency and Policy Drivers: A Reassessment of Renewable Portfolio Standards." *Policy Studies Journal* 40(4): 730-56.

Chandler, Jess. 2009. "Trendy Solutions: Why do States Adopt Sustainable Energy Portfolio Standards?" *Energy Policy* 37(8): 3274-81.

Cobb, Roger W., and Charles D. Elder. 1983. *Participation in American Politics: The Dynamics of Agenda-building*. Johns Hopkins University Press.

Cobb, Roger W., and Marc Howard Ross, eds. 1997. *Cultural Strategies of Agenda Denial: Avoidance, Attack, and Redefinition*. University Press of Kansas.

Cole, Matthew A., Anthony J. Rayner, and John M. Bates. 1997. "The Environmental Kuznets Curve: An Empirical Analysis." *Environment and Development Economics* 2(4): 401-16.

Coll, Steve. 2012. *Private Empire: ExxonMobil and American Power*. Penguin Press.

Cook, John, Geoffrey Supran, Stephan Lewandowsky, Naomi Oreskes, and Ed Maibach. 2019. "America Misled: How the Fossil Fuel Industry Deliberately Misled Americans about Climate Change." George Mason University Center for Climate Change Communication. https://www.climatechangecommunication.org/america-misled/.

Cullenward, Danny, Mason Inman, and Michael Mastrandrea. 2018. *"California's Cap-and Trade Reforms: October 2018 Comment Letter."* Submitted to the Air Resources Board. Carnegie Institute for Science, Department of Global Ecology, Stanford University. http://www.nearzero.org/wp/2018/10/22/californias-cap-and-trade-reforms-october-2018-comment-letter/.

Dasgupta, Susmita, Benoit Laplante, Hua Wang, and David Wheeler. 2002. "Confronting the Environmental Kuznets Curve. 2002. "*Journal of Economic Perspectives* 16(1): 147-68.

Diamond, Jared M. 1999. *Guns, Germs and Steel: The Fates of Human Societies.* W.W Norton & Company, Inc.

Diamond, Jared. 2005. *Collapse: How Societies Choose to Fail or Succeed*. Penguin Press.

Dolšak, Nives. 2009. "Climate Change Policy Implementation: a Cross-sectional Analysis." *Review of Policy Research* 26(5): 551-70.

Dunlap, Riley E., and Araon M. McCright. 2008. "A Widening Gap: Republican and Democratic Views on Climate Change." *Environment: Science and Policy for Sustainable Development* 50(5): 26-35.

EASAC. "Negative Emissions Technologies: What Role in Meeting the Paris Agreement." European Academies Science Advisory Council. https://easac.eu/publications/details/easac-net/.

Emerson, Ralph Waldo. 1983. *Essays & Lectures*. Vol. 15. Library of America.

Esty, Daniel C., and Anthony LI Moffa. 2012. "Why Climate Change Collective Action has Failed and What Needs to be Done within and without the Trade Regime." *Journal of International Economic Law* 15(3): 777-91.

Esty, Daniel C., and Michael E. Porter. 2005. "National Environmental Performance: an Empirical Analysis of Policy Results and Determinants." *Environment and Development Economics* 10(4): 391-434.

Falkner, Robert. 2016. "The Paris Agreement and the New Logic of International Climate Politics." *International Affairs* 92(5): 1107-25.

Feldman, David Lewis. 1992. "*Iterative Functionalism and Climate Management Regimes: From Intergovernmental Panel on Climate Change to Intergovernmental Negotiating Committee*." No. CONF-9205167--1. Oak Ridge National Lab.

Feldman, David L. 2012. "The future of Environmental Networks—Governance and Civil Society in a Global Context." *Futures* 44(9): 787-96.

Fiorino, Daniel J. 2011. "Explaining National Environmental Performance: Approaches, Evidence, and Implications." *Policy Sciences* 44: 367-89.

Fredriksson, Per G., and Jim R. Wollscheid. 2007. "Democratic Institutions Versus Autocratic Regimes: The Case of Environmental Policy." *Public Choice* 130(3-4): 381-93.

Freeden, Michael. 1998. "Ideology." *The Routledge Encyclopedia of Philosophy*, Vol.4, 1998.

Geruso, Michael, Dean Spears, and Ishaana Talesara. 2019. *Inversions in US Presidential Elections: 1836-2016*. No. w26247. National Bureau of Economic Research.

Giddens, Anthony. 2009. *Politics of climate change*. Polity Press.

Global CCS Institute. *The Global Status of CCS 2018*. Global Carbon Capture and Storage Institute, https://www.globalccsinstitute.com/resources/global-status-report/.

Gould, Stephen Jay, and Niles Eldredge. 1972. "Punctuated Equilibria: an Alternative to Phyletic Gradualism." In *Essential Readings in Evolutionary Biology*, eds. Francisco J. Ayala and John C. Avise, 82-115. John Hopkins University Press.

Grossman, Gene M., and Alan B. Krueger. 1991. *Environmental Impacts of a North American Free Trade Agreement*. No. w3914. National Bureau of Economic Research.

Grundig, Frank. 2006. "Patterns of International Cooperation and the Explanatory Power of Relative Gains: An Analysis of Cooperation on Global Climate Change, Ozone Depletion, and International Trade." *International Studies Quarterly* 50(4). 781-801.

Haas, Peter M. 1992. "Obtaining International Environmental Protection through Epistemic Consensus." In *Global Environmental Change and International Relations*, eds. Ian H. Rowlands and Malory Greene, 38-59. Palgrave Macmillan.

Hacker, Jacob S., and Paul Pierson. 2010. *Winner-take-all Politics: How Washington Made the Rich Richer--and Turned its Back on the Middle Class*. Simon and Schuster.

Hale, Thomas. 2016. "All Hands on Deck: The Paris Agreement and Nonstate Climate Action."*Global Environmental Politics* 16(3): 12-22.

Hansen, James, et al. 2015. "Ice Melt, Sea Level Rise and Superstorms: Evidence from Paleoclimate Data, Climate Modeling, and Modern Observations that 2° C Global Warming is Highly Dangerous." *Atmospheric Chemistry & Physics Discussions* 15(1): 20059-20179.

Hardin, Garrett. 1968. "The Tragedy of the Commons." *Science* 162(3859): 1243-1248.

Haya, Barbara. *Policy Brief*: *The California Air Resources Board's U.S. Forest Offset Protocol Underestimates Leakage*. Center for Environmental Public Policy, University of California, Berkeley, https://gspp.berkeley.edu/assets/uploads/research/pdf/Policy_Brief-US_Forest_Projects-Leakage-Haya_2.pdf.

Hsiang, S., Kopp, R., Jina, A., Rising, J., Delgado, M., Mohan, S., Rasmussen, D.J., Muir-Wood, R., Wilson, P., Oppenheimer, M. and Larsen, K. 2017. Estimating Economic Damage from Climate Change in the United States. *Science 356*(6345): 1362-9.

Huang, Ming-Yuan, Janaki RR Alavalapati, Douglas R. Carter, and Matthew H. Langholtz. 2007. "Is the Choice of Renewable Portfolio Standards Random?" *Energy Policy* 35: 5571-5.

Hovi, Jon, Detlef F. Sprinz, and Guri Bang. 2012. "Why the United States did not Become a Party to the Kyoto Protocol: German, Norwegian, and US Perspectives." *European Journal of International Relations* 18(1): 129-50.

Inglehart, Ronald, and Pippa Norris. "Trump and the Populist Authoritarian Parties: The Silent Revolution in Reverse." *Perspectives on Politics* 15(2): 443-54.

IPCC 2014. *Summary for Policymakers*. 2014. Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_summary-for-policymakers.pdf.

Kahan, Dan M., and Donald Braman. 2006. "Cultural Cognition and Public Policy." *Yale Law and Policy Review* 24: 149-72.

Kennel, Charles F., Stephen Briggs, and David G. Victor. 2016. "Making Climate Science More Relevant." *Science* 354(6311): 421-2.

Keohane, Robert O. 2005. *After Hegemony: Cooperation and Discord in the World Political Economy*. Princeton University Press.

Keohane, Robert Owen. 1986. *Neorealism and its Critics*. Columbia University Press.

Keohane, Robert O., and Lisa L. Martin. 1995. "The Promise of Institutionalist Theory." *International Security* 20(1): 39-51.

Keohane, Robert O., and David G. Victor. 2011. "The Regime Complex for Climate Change." *Perspectives on Politics* 9(1): 7-23.

Keohane, Robert O., and David G. Victor. 2016. "Cooperation and Discord in Global Climate Policy." *Nature Climate Change* 6: 570-5.

Kinley, Richard. 2017. "Climate Change after Paris: From Turning Point to Transformation." *Climate Policy* 17(1): 9-15.

Klare, Michael. 2009. *Rising Powers, Shrinking Planet: The New Geopolitics of Energy*. Macmillan Press.

Klein, Daniel, María Pía Carazo, Meinhard Doelle, Jane Bulmer, and Andrew Higham, eds. 2017. *The Paris Agreement on Climate Change: Analysis and Commentary*. Oxford University Press.

Knutti, Reto, Joeri Rogelj, Jan Sedláček, and Erich M. Fischer. 2016. "A Scientific Critique of the Two-degree Climate Change Target." *Nature Geoscience* 9(1): (2016): 13-18.

Kolbert, Elizabeth. 2014. *The Sixth Extinction: An Unnatural History*. A&C Black.

Krasner, Stephen D. 1991. "Global Communications and National Power: Life on the Pareto Frontier." *World Politics* 43(3): 336-66.

Kuznets, Simon. 1955. "Economic Growth and Income Inequality." *The American Economic Review* 45(1): 1-28.

Lacy, Mark. 2012. *Security and Climate Change: International Relations and the Limits of Realism*. Routledge.

Laing, Tim, Misato Sato, Michael Grubb, and Claudia Comberti. 2017. "*Assessing the Effectiveness of the EU Emissions Trading System.*" Centre for Climate Change Economics and Policy. http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2014/02/WP106-effectiveness-eu-emissions-trading-system.pdf.

Lachaapelle, Erick, and Matthew Paterson. 2013. "Drivers of National Climate Policy." *Climate Policy* 13(5): 547-71.

Lange, Glenn-Marie, Quentin Wodon, and Kevin Carey. 2018. *The Changing Wealth of Nations 2018: Building a sustainable future*. The World Bank.

Lee, Taedong. 2014. *Global Cities and Climate Change: The Translocal Relations of Environmental Governance*. Routledge.

Le Quéré, Corinne, et al. 2018. "Global Carbon Budget 2018." *Earth System Science Data* 10: 2141-94.

Lenton, Timothy M., Johan Rockstrom, Owen Gaffney, Stefan rahmstorf, Katherine Richardson, Will Steffen, and Hans Joachim Schellnhumber. 2019. "Climate Tipping Points – too Risky to Bet Against." Nature 575: 592-5.

Lenton, Timothy M. 2011 "Early Warning of Climate Tipping Points." *Nature Climate Change* 1(4): 201-9.

Luterbacher, Urs, Detlef F. Sprinz, Daniel Bodansky, Lavanya Rajamani, and Michaël Aklin. 2018. *Global Climate Policy: Actors, Concepts, and Enduring Challenges*. The MIT Press.

Lutsey, Nicholas, and Daniel Sperling. 2008. "America's Bottom-up Climate Change Mitigation Policy." *Energy Policy* 36(2): 673-85.

Lyon, Thomas P., and Haitao Yin. 2010. "Why do States Adopt Renewable Portfolio Standards? An Empirical Investigation." *The Energy Journal* 31(3): 133-57.

Matisoff, Daniel C. 2008. "The Adoption of State Climate Change Policies and Renewable Portfolio Standards: Regional Diffusion or Internal Determinants?" *Review of Policy Research* 25(6): 527-46.

Matthew, Richard A. 2011. "Is Climate Change a National Security Issue?." *Issues in Science and Technology* 27(3): 49-60.

Mayer, Jane. 2017. *Dark money: The Hidden History of the Billionaires Behind the Rise of the Radical Right*. Anchor Books.

McBain, Bonnie, Manfred Lenzen, Mathis Wackernagel, and Glenn Albrecht. 2017. "How Long Can Global Ecological Overshoot Last?" *Global and Planetary Change* 155: 13-9.

McCright, Aaron M., and Riley E. Dunlap. 2010. "Anti-reflexivity." *Theory, Culture & Society* 27(2-3): 100-33.

McCright, A. M., & Dunlap, R. E. 2003. "Defeating Kyoto: The Conservative Movement's Impact on US Climate Change Policy." *Social Problems 50*(3): 348-73.

Mearsheimer, John J. 1995. "A Realist Reply." *International Security* 20(1): 82-93.

Mearsheimer, John J. 2019. "Bound to Fail: The Rise and Fall of the Liberal International Order." *International Security* 43(4): 7-50.

Mearsheimer, John J. 1994. "The False Promise of International Institutions." *International Security* 19(3): 5-49.

Morgenthau, Hans. 1993. "*Politics Among Nations: The Struggle for Power and Peace. Brief Edition*." McGraw-Hill.

Nadel, Steve. 2016. "Learning from 19 Carbon Taxes: What Does the Evidence Show." *Proceedings of the 2016 ACEEE Summer Study on Energy Efficiency in Buildings, Pacific Grove, CA*: 21-26.

Neumayer, Eric. 2002. "Do Democracies Exhibit Stronger International Environmental Commitment? A Cross-country Analysis." *Journal of Peace Research* 39(2): 139-64.

Nordhaus, William. 2013. *The Climate Casino: Risk, Uncertainty, and Economics for a WarmingWorld*. New Haven & London: Yale University Press.

Nordhaus, William, and Andrew Moffat. 2017. *A Survey of Global Impacts of Climate Change: Replication, Survey Methods, and a Statistical Analysis*. No. w23646. National Bureau of Economic Research.

Nye, Joseph S., and Robert O. Keohane. 1971. "Transnational Relations and World Politics: An Introduction." *International Organization* 25(3): 329-49.

Olson, Mancur. 2009. *The Logic of Collective Action*. Vol. 124. Harvard University Press.

Oreskes, Naomi, and Erik M. Conway. 2011. *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. Bloomsbury Publishing.

Ostrom, Elinor. 2009. *A Polycentric Approach for Coping with Climate Change*. The World Bank.

Ostrom, Elinor. 2010. "Polycentric Systems for Coping with Collective Action and Global Environmental Change." Global Environmental Change 20(4): 550-7.

Pal, Jeremy S., and Elfatih AB Eltahir. 2016. "Future Temperature in Southwest Asia Projected to Exceed a Threshold for Human Adaptability." *Nature Climate Change* 6(2): 197-200.

Payne, Rodger A. 1995. "Freedom and the Environment." *Journal of democracy* 6(3): 41-55.

Pierson, Paul. 2000. "Increasing Returns, Path Dependence, and the Study of Politics." *American Political Science Review* 94(2): 251-67.

Pellegrini, Lorenzo, and Reyer Gerlagh. 2006. "Corruption, Democracy, and Environmental Policy: An Empirical Contribution to the Debate." *The Journal of Environment and Development* 15(3): 332-54.

Rabe, Barry. 2018. *Can We Price Carbon?* London: MIT Press.

Rabe, Barry G., Mikael Roman, and Arthur N. Dobelis. 2005. "State Competition as a Source Driving Climate Change Mitigation." *New York University Environmental Law Journal* 14(1): 1-53.

Randers, Jorgen. 2012. "The Real Message of The Limits to Growth A Plea for Forward Looking Global Policy." *GAIA-Ecological Perspectives for Science and Society* 21(2): 102-5.

Riahi, Keywan, et al. 2017. "The Shared Socioeconomic Pathways and Their Energy, Land Use, and Greenhouse Gas Emissions Implications: An Overview." *Global Environmental Change* 42: 153-68.

Ricke, Katharine, Laurent Drouet, Ken Caldeira, and Massimo Tavoni. 2018. Country-level Social Cost of Carbon. *Nature Climate Change* 8: 895-900.

Ricoeur, Paul. 1986. "*Lectures on Ideology and Utopia*." Ed. George H. Taylor. Colombia University Press.

Rodden, Jonathan A. 2019. *Why Cities Lose: The Deep Roots of the Urban-Rural Political Divide*. Hachette.

Rogelj, Joeri, David McCollum, Andy Reisenger, Malte Meinshausen, and Keywan Riahi. 2013. Probabilistic Cost Estimates for Climate Change Mitigation. *Nature* 493: 79-83.

Rosen, Amanda M. 2015. "The Wrong Solution at the Right Time: The Failure of the Kyoto Protocol on Climate Change." *Politics & Policy* 43(1): 30-58.

Ross, Michael. 2012. *The Oil Curse: How Petroleum Wealth Shapes the Development of Nations*. Princeton University Press.

Ross, Michael L. "What have we learned about the resource curse?." *Annual Review of Political Science* 18 (2015): 239-259.

Ross, Michael L., and Erik Voeten. 2015. "Oil and International Cooperation." *International Studies Quarterly* 60(1): 85-97.

Royden, Amy. 2002. "US Climate Change Policy under President Clinton: A Look Back." *Golden Gate UL Rev.* 32: 415-78.

Schattschneider, Elmer Eric. 1975. The Semisovereign People: A Realist's View of Democracy in America. Wadsworth Publishing Company.

Schellnhuber, Hans Joachim, Stefan Rahmstorf, and Ricarda Winkelmann. 2016. "Why the Right Climate Target was Agreed in Paris." *Nature Climate Change* 6(7): 649-53.

Schlesinger, Arthur M. 1939. "Tides of American Politics." *Yale Review* 29(2): 215-30.

Schmalensee, Richard, and Robert Stavins. 2015. *Lessons Learned from Three Decades of Experience with Cap-and-Trade* (No. w21742). National Bureau of Economic Research.

Seto, Karen C., Steven J. Davis, Ronald B. Mitchell, Eleanor C. Stokes, Gregory Unruh, and Diana Ürge-Vorsatz. 2016. "Carbon Lock-in: Types, Causes, and Policy Implications." *Annual Review of Environment and Resources* 4: 425-452.

Smith, Tom W. 1990. "Liberal and Conservative Trends in the United States Since World War II." *Public Opinion Quarterly* 54(4): 479-507.

Sokolov, Boris. 2018. “The Index of Emancipative Values: Measurement Model Misspecifications.” *American Political Science Review* 112(2): 395-408.

Steffen, Will, et al. 2018. "Trajectories of the Earth System in the Anthropocene." *Proceedings of the National Academy of Sciences* 115(33): 8252-9.

Symons, Jonathan. 2019. "Realist Climate Ethics: Promoting Climate Ambition within the Classical Realist tradition." *Review of International Studies* 45(1): 141-60.

Tang, Shiping. 2013. *The Social Evolution of International Politics*. Oxford: Oxford University Press.

Tollefson, Jeff, and Natasha Gilbert. 2012. "Rio Report Card: The World has Failed to Deliver on Many of the Promises it Made 20 Years Ago at the Earth Summit in Brazil." *Nature* 486(7401): 20-4.

True, James L., Bryan D. Jones, and Frank R. Baumgartner. 1999. "Punctuated Equilibrium Theory." *Theories of the Policy Process* 175-202.

Tubi, Amit, Itay Fischhendler, and Eran Feitelson. 2012. "The Effect of Vulnerability on Climate Change Mitigation Policies." *Global Environmental Change* 22(2): 472-482.

Turner, Graham. 2014. "*Is Global Collapse Imminent? An Updated Comparison of the Limits to Growth with Historical Data*." MSSI Research paper.

United Nations 2019. 2019. *World Population Prospects 2019: Highlights*. United Nations Department of Economic and Social Affairs. https://population.un.org/wpp/Publications/Files/WPP2019_10KeyFindings.pdf.

Unruh, Gregory C. 2000. "Understanding Carbon Lock-in." *Energy Policy* 28(12): 817-30.

Van Vuuren, Detlef, Elie Bellevrat, Alban Kitous, and Morna Isaac. 2010. Bio-energy Use and Low Stabilization Scenarios. *The Energy Journal* 31 (1): 193-221.

Van Vuuren, Detlef, Jai Edmonds, Mikiko Kainuma, Keywan Riahi, Allison Thomson, Kathy Hibbard, George Hurtt, Tom Kram, Volker Krey, Jean-Francois Lamarque, Toshiiko Masui, Malte Meinshausen, Nebojsa Nakicenovic, Steven Smith, and Steven Rose. 2011. The Representative Concentration Pathways: An Overview. *Climatic Change* 109: 5-31.

Van Vuuren, Detlef, Elke Stehfest, Michel den Elzen, Tom Kram, Jasper van Vliet, Sebastiaan Deetman, Morna Isaac, Kees Goldewijk, Andries Hof, Angelica Beltran, Rineke Oostenrijk, and Bas van Ruijven. 2011a. RCP2.6: Exploring the Possibility to Keep Global Mean Temperature Increase Below 2 C. *Climatic Change* 109: 95-116.

Vasquez, John A. 1997. "The Realist Paradigm and Degenerative Versus Progressive Research Programs: An Appraisal of Neotraditional Research on Waltz's Balancing Proposition." *American Political Science Review* 91(4): 899-912.

Venables, Anthony J. 2016. "Using Natural Resources for Development: Why Has it Proven so Difficult?." *Journal of Economic Perspectives* 30(1): 161-84.

Victor, David G. 2011. Global Warming Gridlock: Creating More Effective Strategies for Protecting the Planet. Cambridge University Press.

Victor, David G., Keigo Akimoto, Yoichi Kaya, Mitsutsune Yamaguchi, Danny Cullenward, and Cameron Hepburn. 2017. "Prove Paris Was More Than Paper Promises." *Nature News* 548(7665): 25-7.

Victor, David G. 2016. "What the Framework Convention on Climate Change Teaches Us About Cooperation on Climate Change." *Politics and Governance* 4(3): 133-41.

Victor, David G., Joshua C. House, and Sarah Joy. 2005. "A Madisonian Approach to Climate Policy." *Science* 309(5742): 1820-1.

Waltz, Kenneth N. 1986. "Reflections on Theory of International Politics: A Response to My Critics." In *Neorealism and its Critics,* ed. Robert O. Keohane, 322-345. Colombia University Press.

Waltz, Kenneth N. 2010. *Theory of International Politics*. Waveland Press.

Walt, Stephen M. 2018. *The Hell of Good Intentions: America's Foreign Policy Elite and the Decline of US Primacy*. Farrar, Straus and Giroux.

Watson, Jim, Florian Kern, and Nils Markusson. 2014. Resolving or Managing Uncertainties for Carbon Capture and Storage: Lessons from Historical Analogues. *Technological Forecasting and Social Change* 81: 192-204.

Welzel, Christian. 2013. *Freedom Rising*. Cambridge University Press.

Wiener, Jonathan B. 2007. "Think Globally, Act Globally: The Limits of Local Climate Policies." *University of Pennsylvania Law Review*155(6): 1961-79.

World Bank 2018. *State and Trends of Carbon Pricing 2018*. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/29687

Yergin, Daniel. 2011. *The Prize: The Epic Quest for Oil, Money & Power*. Simon and Schuster.

York, Richard. 2012. "Do Alternative Energy Sources Displace Fossil Fuels?." *Nature Climate Change* 2(6): 441-3.

York, Richard, and Shannon Elizabeth Bell. 2019. "Energy Transitions or Additions?: Why a Transition From Fossil Fuels Requires More Than the Growth of Renewable Energy." *Energy Research & Social Science* 5: 40-3.

Zahran, Sammy, Samuel D. Brody, Arnold Vedlitz, Himanshu Grover, and Caitlyn Miller. 2008. "Vulnerability and Capacity: Explaining Local Commitment to Climate-change Policy." *Environment and Planning C: Government and policy* 26(3): 544-62.