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Climate Change Crisis: Prescribing Alternative Economic Policy Using An Austrian Framework

Elina N. McGill
Rollins College, emcgill@rollins.edu

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Prescribing Alternative Economic Policy Using An Austrian Framework

Elina N. McGill

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Faculty Sponsor: Professor Martina Vidovic
Professor Avraham Baranes

Advisor: Professor Mike Gunter

Rollins College
Winter Park, FL

Abstract

This paper reviews the literature surrounding climate change adaptation and mitigation to assess the possible contributions and limitations of heterodox economics to climate change policy. Through interdisciplinary research between economics and environmental issues, this paper aims to stress the importance of utilizing heterodox schools of economics to create more pragmatic and dynamic policy. The secondary aim is to use Austrian frameworks to contribute to the construction of feasible, efficient, and equitable climate change policy. This paper used qualitative and textual analysis of the Austrian schools of economics conceptualize possible policy responses to climate change. Research found that the Austrian prescription of privatized climate change policy, though robust in internal validity, fallaciously believes in the power of property rights and tort litigation to feasibly, efficiently, and equitably resolve competing interests regarding the use of natural resources. Further research is needed to implicitly analyze the values hidden within adaptation and mitigation strategies. The limits and values of the social system dictate the limits and values that are carried over into economics and thus, climate change policy. It is necessary to understand and predict how economic systems, social systems, and institutions will evolve as economic stability, social cohesion, and institutional cooperation will affect the limits of climate change policy. Findings suggest that policy should abandon 'either/or' solutions in favor of 'both/and' solutions to climate change. This paper is useful in understanding environmental economics and institutional structures and evolution. The research provides further insight into heterodox perspectives of environmental economics.

Keywords: climate change, adaptation, mitigation, neoclassical economics, Austrian economics, carbon pricing

Dedication

For all those uneasy souls that wander
in search of better ways of being human

To all those diligently working
to ethically steward the planet

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List of Acronyms

AR4	Fourth Assessment Report
AR5	Fifth Assessment Report
BAU	Business as usual
CDIAC	Carbon Dioxide Information Analysis Center
CO_2	Carbon dioxide
CO_2-eq	Carbon dioxide equivalent
COP	Conference of Parties
CBA	Cost-benefit analysis
EDGAR	Emissions Database for Global Atmospheric Research
EF	Ecological footprint
EITs	Economies in transition
EU	European Union
FAR	First Assessment Report
GDP	Gross domestic product
GEF	Global Environment Facility
GHGs	Greenhouse gasses
IPCC	Intergovernmental Panel on Climate Change
LDCs	Least Developed Countries
NGO	Nongovernmental organization
OECD	Organization of the Petroleum Exporting Countries
OPEC	Organisation for Economic Co-operation and Development
ppm	Parts per million
SAR	Second Assessment Report
SIDS	Small Island Developing States
SMP	Summary for Policymakers

SYR	Synthesis Report
TAR	Third Assessment Report
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WCED	World Commission on Environment and Development
WMO	World Meteorological Organization
WRI	World Resources Institute

Chapter 1 Introduction

In the summer of 2016, geologists investigated satellite images of the Aru mountain range that had radically shifted overnight. Two months later and without warning, the maps changed again. The serene, ice-covered Aru mountain range in northern Tibet commanded scientists' and geologists' attention on July 17. The avalanche cascaded through a table-top plateau and sent sixty million cubic meters of ice tumbling through a nearby valley. Twenty-four thousand Olympic-sized swimming pools of ice, rock and debris pummeled down on this village, killing nine people and hundreds of livestock (Ravilious 2016).

Not only was this avalanche "exceedingly rare" for this part of the world, but its record-breaking magnitude also alerted geologists (Ravilious 2016). The collapse in the Aru mountain range comes second only to the 2002 event in the Caucasus mountains (Ravilious 2016). After the ice settled and the mountains returned to their frozen slumber, over ten square kilometers[1] of ice covered the terrain thirty meters[2] deep. Then, surprising already baffled scientists, another avalanche occurred.

A privately owned, high-resolution satellite, focused on this area due to increased activity months earlier, noticed something peculiar on September 19. A glacier near the initial collapse exhibited similar characteristics that coincided with the first avalanche: cracks, creases and crevasses that were not present before. Despite scientific predictions that forecasted a low probability of another avalanche, the second glacier failed on September 21 before transmitted satellite images had warned the Chinese government (Robinson 2016). A natural phenomenon of

[1] 38 square kilometers
[2] 98.4 feet

such magnitude that had only occurred once before in recorded history happened twice within months. Geologist and debris-flow specialist Dave Petley commented, “That one such event should occur is remarkable; two is unprecedented” (Petley 2016).

Eight years prior, the German government announced to the world that it was on target to reduce its greenhouse gas (GHG) emissions by 40% by 2020 (Van den Berg 2012b, 19). However, reports uncovered that Germany’s steel conglomerates were disassembled and transferred from the industrial Ruhr Valley in Germany to Jinfeng, China where companies could work their employees for longer hours, pay lower wages, and bypass environmental regulations (Van den Berg 2012b, 4). Though Germany reduced its emissions on a national level, it merely shipped them overseas to a country eager to industrialize. Government announcements of reduced emissions are commendable, but what do they matter when overall cumulative emissions remain the same?

Isolated and decontextualized, the avalanches in the Aru mountain range are just abnormal geological events and the transfer of German steel conglomerates to China is just good business policy. These examples stress two key features of the environmental and economic world we live in. First, the avalanches in the Aru mountain range highlight that climate change is altering ecological processes and systems. Analytic and scientific studies reveal that economic production and consumption processes do not simply overshoot the Earth’s regenerative capacity, but they have also contributed to anthropogenic changes to the climate. If intergovernmental institutions, governments, and multinational corporations do not take aligned steps to combat current and future environmental disruption, more people around the globe will suffer fates similar to the villagers in Tibet.

Second, environmental awareness and economic undertakings are inseparable. Over the decades, media outlets, politicians, and activists have yanked social consciousness and public policy back and forth between the poles of environmental protectionism and economic development. This study expands upon research that attempts to merge these goals into one.

A study of neoclassical economics presents a slew of market failures to investigate. A well-known example of market failure is the Great Depression. The Great Depression wreaked havoc on the economic and social spheres of the United States and countries connected to this economic powerhouse. Was this economic downturn a sleight of the invisible hand? If the Great Depression's effects were not devastating enough, the capitalistic myth rolled along unfettered and unmodified in form and content. It is no surprise then that the 2008 Great Recession—the worst economic downturn since its earlier, darker cousin—struck with vengeful force.

Instead of mentioning market failures themselves, scholarship also cites failures *within* the markets. Commenting on the limitations of mainstream economics, economist Nicholas Stern (2008, 1) argues that the failure of standard economics to combat climate change is "the biggest market failure the world has seen." Neoclassical economics, or business as usual (BAU), has failed to address the externality of pollution, the principal cause of anthropogenic climate change.

On the question of how to combat climate change, neoclassical economists and economically conservative politicians have leaned towards adaptation and away from mitigation which would require heavy environmental protections and economic regulations. Policymakers argue that since populations have repeatedly adapted to climatic change and sociopolitical shocks over the ages, the world can adapt to future climate change. Alternatively, proponents of active

measures to mitigate climate change suggest carbon pricing through taxation and emissions trading. Neoclassical economists analyze the disadvantages and advantages of these common solutions with cost-benefit analyses. However, the limitations of neoclassical economics and its failure to address environmental externalities opens the door to alternative methodologies and policy prescriptions.

Considering this context, the following foundational question demands to be answered: *if standard economic theory has failed to mitigate the effects of climate change on a scale commensurate to the problem, what macro-level policy proposals can Austrian economics offer that will be feasible, efficient, and equitable?* This foundational research question is the guiding tool for this study. However, to achieve the study's outlined aims, research must answer and discuss the following sub-questions:

- How sufficient is mainstream neoclassical economics for handling externalities related to climate change?
- Why is the Austrian perspective useful in analyzing environmental externalities produced by the current economic system of production and consumption?
- What are the stances concerning adaptation and mitigation policies?
- What other options lie outside adaptation and mitigation?
- Why has policy not adequately addressed climate change even amidst scientific findings and public outcry?

This study sets out to investigate the usefulness of alternative economic perspectives to resolving climate change. There are three primary aims of this study: (1) to bridge the

interdisciplinary gap between economics and environmental issues, (2) to stress the importance of heterodox approaches to the field of economics, and (3) to construct feasible, efficient, and equitable adaptation and mitigation policy prescriptions for avoiding dangerous climate change.

To accomplish these aforementioned aims research must accomplish the following objectives:

- Discuss the relevant literature concerning initiated climate change policy
- Explain mainstream economics sufficiency at addressing climate change
- Evaluate the costs and benefits of the common solution: carbon pricing
- Analyze the frameworks of Austrian economics
- Formulate a set of adaptation and mitigation policies considering the heterodox approach to economics

Over the past century, two separate and distinct camps stood firm. One camp studied the variety and complexity of human activity to answer the broadest questions in life: why are we here, what are we doing, and where are we going? The other camp studied non-human activity to answer the same questions through a different lens. These two camps, despite the interconnectedness of its questions, ignored the existence of the other as if they could ever be mutually exclusive. Fortunately, the last three decades have seen a growing trend towards collaboration.

Researchers have conducted many studies incorporating environmental and economic issues into a comprehensive whole. The outstanding literature attempts to produce cost-benefit analyses of possible solutions. Due to deep uncertainty embedded into climate change, the

outstanding literature is incomplete. Not one piece of literature uses alternative economic perspectives.

Perhaps no single field of study uses the knowledge of as many disciplines as that of climate change. From math and forestry to religion and public policy, a study of climate change requires a liberal education in both thought and practice. Liberal education creates the open-ended, holistic search for knowledge to answer one of life's most pressing questions: how should humanity steward the planet? Though environmental studies is disinterested, it is not dispassionate as liberal studies aims to create conscientious and global citizens who realize that knowledge for its own sake is wonderful, but knowledge for ameliorative action is even more virtuous.

The complexity of such a multi-dimensional problem constitutes an interdisciplinary approach. To measure and record the Earth's functions, researchers need all the heavy sciences—physics, chemistry, and biology. To know how humanity affects the Earth, studies require derivatives of the hard sciences including forestry, marine biology, zoology, mineralogy, meteorology, and countless others. The full deployment of the social sciences and humanities from psychology and law to religion and classical studies is needed to understand why humans affect the Earth in the ways that they do and how to alter behavior.

Like all studies, this one too has limitations. By combining research and concepts from economics and environmental studies, not in equal measure but in an equitable measure, this study attempts to be as interdisciplinary as possible. This study excludes the humanities, the hard sciences, and many social sciences. The conscientious inclusion of some disciplines at the exclusion of others presents yet another reason why this project is necessary: to fill the existing

gap in knowledge so that other researchers can climb upon its shoulders, view further into the uncertain future, and move humanity into it with confidence and courage.

This chapter provides an introduction to the following study and describes the contents of this project. Chapter 2: "Methodology" lists conjectures and restates the study's exploratory question. This chapter details the qualitative research design used. Furthermore, this section examines collected information and sources.

Chapter 3: "Literature Review" provides background information on climate change and adaptation and mitigation policies. Next, it reviews carbon pricing through taxation and emissions trading. Lastly, it summarizes the literature on Austrian economics. Only by understanding where we have been and where we are, can we move forward.

Chapter 4: "Findings" provides an objective, factual, and concise restatement of the study's findings.

Chapter 5: "Discussion" summarizes and justifies the prescribed policy for adapting to and mitigating climate change considering the Austrian approach. Within this section, all policy prescription are presented with balanced evidence and support.

Chapter 6: "Conclusion" provides a synopsis of the study and the prescribed climate change policy. Next, it appraises the study to reveal limitations and delimitations. Then, this section presents avenues for further research. This chapter ends with a call to action and an appeal to individual agency.

Chapter 2 Methodology

Though knowledge of climate change is not new, international focus has only been on issues regarding climate change since the late 1970s. After the social and civil upheaval that accompanied the civil rights movement, worker's liberation, and the sexual revolution, issues of climate change pushed to the forefront of social consciousness. Since the late 1970s, research correlating carbon and observed global temperature increases found that the atmospheric concentrations of GHG emissions have reached levels of concern (Allen et al. 2009; Anderson & Bows 2011; Matthews & Caldeira 2008; Solomon et al. 2009). A growing body of literature recognizes that that climate change is anthropogenic (Hansen et al. 2008; IPCC 2001; IPCC 2007; IPCC 2014). Natural forcings of temperature are not to blame; climate change is a human problem with a human cause. Besides gaining international and political recognition of the weight of the climate change crisis, one of the main obstacles in dealing with such an international problem is creating comprehensive policy and solutions.

It is a fundamental truth that without the natural environment, human systems—not to mention humans—would not exist. Reason and reality prove that the economic system cannot exist without the natural system (Adelson et al. 2008; Plater et al. 2008; Van den Berg 2012d). When designing climate change policy, economics must come into play. Economics plays an important role in creating feasible, efficient, and equitable climate change policy. There is an urgent need to assess the validity of using only one tool to address a multidimensional problem. A much-debated question is the role of neoclassical economics in the creation and solution of the climate change crisis.

Up to now, research has paid far too little attention to the field of heterodox economics in relation to environmental issues. Previous studies of Austrian economics have not dealt with the difficulties and limitations of climate change policy deduced from Austrian economic principles (Cordato 2004; Dawson 2011; Dawson 2013; Dolan 2014; Regan 2015). Thus, this paper discusses the contributions of Austrian economics in creating climate change policy that considers economic development, environmental protection, and social equity. The following exploratory, or sub-questions, guided both the research for this study and the organization of the paper:

- How sufficient is mainstream neoclassical economics for handling externalities related to climate change?
- Why is the Austrian perspective useful in analyzing environmental externalities produced by the current economic system of production and consumption?
- What are the stances on adaptation and mitigation policies?
- What other options lie outside adaptation and mitigation?
- Why has policy not adequately addressed climate change even amidst scientific findings and public outcry?

The main reason for choosing the topic of alternative economic perspectives was personal interest. Interested in alternative economic policy grew after taking a course that examined several heterodox economic schools of thought. Realizing that theory must stand trial, I focused this study on one issue: climate change. As this paper is listed underneath the department of

International Relations, this study is fitting. Being such a broad issue requiring deep knowledge of the economic structures within and among states, the nature of political life across national boundaries, and cross-cultural proficiency, climate change seemed a more than fitting topic of investigation.

Given the selection of such a polemic topic, any biases related to the topic should be divulged upfront. Climate change is not a problem; it is a crisis. Further denial is not an option. Not only is denial no longer a choice, but denial puts all of humanity at risk. With that given, is is imperative that the global community collectively addresses climate change. Policymakers should give LDCs and developing countries equal consideration in discussions and forming policy as they will be the first affected though they contributed the least to the crisis. All personal biases against orthodox economics and in favor of heterodox economics were removed from the study. Thus, the "Discussion" chapter of this study attempted to be balanced, fair, and justified in its critique of the proposed policies.

In terms of methodological framework, this investigation used a heterodox framework for two reasons: (1) it justified the interdisciplinary basis of this study in economics and climate change and (2) it justified the analysis of multiple economic perspectives. The heterodox framework is realistic and pragmatic. The realism of the heterodox framework is exemplified in the notion that environmental concerns must be situated inside a political economy (Adelson et al. 2008; Plater et al. 2008). The orthodox approach excluded the environmental and societal sphere of human activity. Adelson et al.'s (2008, 140) research also supports the notion that sustainable development rests upon a "three-legged stool." This is why international justice is an environmental issue, why environmental degradation is an economic issue, why economic

growth is a social issue. This project will attempt to keep the study of alternative economic approaches to climate change centered within in this socio-environmental economic framework.

Second, the heterodox framework justified the analysis of multiple economic schools of thought. The heterodox approach justified using multiple perspectives by granting "freedom in choosing models, interpretations, and issues to work with" (Van den Berg 2012b, 43). The orthodox framework is one tool within economic theory. Using a wide variety of tools can help researchers uncover more knowledge.

Many researchers have used a quantitative cost-benefit analysis to measure the effectiveness of economic policy (Fankhauser 1996; Maddison 1995; Stern 2007; Stern 2008; Tol 2002). A quantitative cost-benefit analysis (CBA) of the policy approaches to climate change in relation to the heterodox schools of thought, Austrian economics, may require more space than this paper provides. The two primary disadvantages of CBA are that the CBA of climate change policy falls back into the rigidity of orthodox economics and that climate change is teeming with uncertainty. It is widely known that neoclassical economics relies on mathematical formalism. Thus, it seemed internally invalid to use a method that this project sought to critique and improve (Azar and Lindgren 2003; Van den Bergh 2004). Second, it is also known that climate change is full of uncertainties—uncertainties surrounding the climate systems sensitivity, the social cost of carbon, the precise rate at which climates may change, and the future predictions of social, political, and economic institutions (Lind 1995; Murphy et al. 2004; Stainforth et al. 2005; Tol 2003). In sum, at the outset of this project, a CBA seemed both internally invalid and impractical.

The chosen method of analysis for this project was qualitative. The qualitative approach to this paper practiced heterodoxy through and through by giving primacy to verbal reasoning and internal consistency. Qualitative methods allowed for verbal reasoning and internal consistency necessary to this project's method due to its subject matter. One of the objectives of this project was to take theoretical research and craft practical policy. The conclusions of this project will be prescriptive. To expand, the policy prescriptions of this paper will be international as climate change is a malaise that affects all nations. Until these policies, or similar policies, are initiated, there can be no singular, verified, and agreed upon truth to the policy prescriptions. This is why internal consistency and verbal reasoning, or a qualitative approach, was crucial. In sum, a qualitative methodology fully captured the complexities of the climate change crisis.

As per the research strategy, this project referenced a wide variety of sources such as institutionally produced conference reports and datasets, books, peer-reviewed journals, magazine articles, and websites. All sources were selected based on their reliability and the credentials of the authors and institutions. Thus, this investigation asserts a high confidence in the credibility and reliability of the sources cited.

The first step in this investigation was to formulate the criteria for analysis. Creation of the policy criteria attempted to its best efforts to align to the three-legged stool of sustainable development (Adelson et al. 2008). Forming the criteria at the onset of the investigation was a crucial step as it helped to eliminate researcher bias. If the results of the study were delineated and then the criteria were formed, the findings and conclusions of this study may have confirmed either intentionally or unintentionally to the criteria. Hence, a criterion is crucial to reliable conclusions.

To evaluate climate change policy, this study used the following criteria: feasibility, efficiency, and equity. This threefold criterion is related to the "three-legged" stool of sustainable development and the three spheres of human activity **(**Adelson et al. 2008; Van den Berg 2012a**)**. Feasibility relates to economic growth. This study held the assumption that economic systems are evolutionary. Thus, instantaneous devolution or evolution of economic systems and processes is not feasible. Though policy may affect economic growth to some extent, a policy that might entail the complete reversal of economic evolution or that might entail a market collapse is not feasible. Therefore, a policy is feasible if, theoretically and pragmatically, it protects economic development with little to no economic disadvantages or risk of economic collapse.

Efficiency relates to sustainable development, environmental protection in general and reducing carbon emissions in particular. It should go without saying that a policy is not efficient if it does not reasonably address the problem it set out to solve. Taking into consideration the other two criteria, a policy is efficient if, theoretically and pragmatically, it results in a reduction of GHG emissions commensurate to the problem.

Last, equity relates to social equity and international justice. This study held the assumption that the natural, social, and economic spheres are interconnected. Thus, an environmental policy that respected economic development and reduced GHG emissions but neglected issues of international justice was not enough. Therefore, a policy is fair if, theoretically and pragmatically, it gives due consideration to emitters, non-emitters, developed countries, and developing countries alike (Büchs et al. 2011; Ciplet et al. 2013; Liu et al. 2017).

After the creation of the policy criteria, proposed climate change policy was deduced from the economic principles of the chosen school of thought. Once the proposed policy was deduced from the economic principles of the chosen school, the policy was analyzed with the aforementioned criteria. This study also recognized that other criteria will give rise to other conclusions and policy suggestions. This is another reason it was necessary to explain the criteria of analysis. The "Discussion" chapter will discuss in full the proposed economic policies. In the next chapter, this study will present a review of literature.

Chapter 3 Literature Review

Since the 1970s, the scientific community has informed governments of past, present, and future effects of GHGs. Though policy may disagree, the science concerning climate change is unequivocal. The outstanding literature is thorough, unmistakable, and disconcerting. Much of the current literature pays attention to investigating the anthropogenic effect on climate change (Allen et al. 2009; Arrow et al. 1995; IPCC 2013; Lynas 2008; Solomon 2009; Stern 2008; Wackernagel 1999; Wackernagel et al. 2002). The science is clear. The existing body of research has established that human activity, not natural ecological processes, is the principal cause of climate change. Though the body of literature is immense, it can be distilled into a few broad statements and contentions about what is happening to the climate and what measures should we take.

Data from several studies have confirmed that the environmental system *is* exhaustible and climate-change is *our* problem. Humanity's ecological footprint (EF) shows that economic production and consumption has reached levels incompatible with the Earth's regenerative capacity (Wackernagel 1999; Wackernagel et al. 2002). Carbon emissions have been a major area of interest within the study of climate change because they provide enough information to compare countries and construct policy. Thus far, several studies and research have revealed a correlation between carbon emissions and global temperature (Allen et al. 2009; Kerr 2004; Lynas 2007; Pittock 2005; Stern 2007; Stern 2008). Though 2° does not sound like a large increase in temperature, in Earth's delicate ecosystems, the literature suggests that 2° would be devastating.

Since the First Climate Conference in 1979, numerous reports, conferences, and policies have been created to avoid the consequences of dangerous climate change. Climate change knowledge, history, and policy can be categorized as follows: reports, parties and party groupings, and policies and protocols. Since its establishment in 1988 by the WMO and UNEP, the IPCC has led the academic community in climate change research and discussion (Gupta 2010). In total, the IPCC has published five lengthy assessment reports that deal with the physical evidence for anthropogenic climate change, assessment of adaption and vulnerability, options for mitigation, the social effects of climate change, and other numerous special topics. Research has revealed that the intergovernmental community in relation to climate change is organized generally along developed-developing lines. The most well-known climate change policy is the Kyoto Protocol that attempts to limit the carbon emissions of Annex I countries. The literature review will more thoroughly address the above-summarized points.

Last, but not least, the literature review will highlight the history of the Austrian school of economics in relation to neoclassical economics. Next, the literature review will examine the contentions and disagreement with neoclassical economic applications to climate change from an Austrian perspective. The review of literature will also analyze the overarching economic principles and methodologies that constitute this school. In Chapter 5 “Discussion”, this alternative economic policy will be discussed and analyzed in detail to contribute to the creation of feasible, efficient, and equitable adaptation and mitigation policy.

Limits and Effects of Human Activity on the Planet

The Ecological Footprint (EF)

First, the environmental system is exhaustible. To date, several studies have attempted to evaluate the impact of human activity on the planet through various analytical models (Arrow et al. 1995; Wackernagel 1999; Wackernagel et al. 2002). The study by Wackernagel et al. (2002) offers probably the most comprehensive empirical tool for revealing the magnitude of human production and consumption. In their study, Wackernagel et. al (2002) developed an analytical framework to measure and track the ecological overshoot of production and consumption processes. The ecological footprint (EF) is an analytical tool that compares "the annual demand on nature with nature's regenerative capacity" (Wackernagel et al. 1999, 2). The EF reveals that the global economic system of production and consumption, guided by neoclassical principles, cannot continue to exist within a bounded ecological system.

In 1961, at the beginning of the United States's consumerist ideology, global economic production operated at 70% of the Earth's regenerative capacity (Wackernagel et al. 2002, 9266). By 1999, all economic processes exceeded Earth's regenerative capacity by 20% (Wackernagel et al. 2002, 9266). As Wackernagel et al. describe, "In other words, 20% overshoot means that it would require 1.2 earths, or one earth for 1.2 years, to regenerate what humanity used in 1999" (2002, 9268). The results show that global production and consumption is unsustainable.

Though intergovernmental and nongovernmental organizations use the EF, it has its critics. Previous research has established that the EF has several fundamental problems (Arrow et al. 1995; Ayres 2000; Fiala 2008; Van den Bergh & Verbruggen 1999). The key critiques of the EF may be divided into three categories: evolutionary processes, land degradation, and emissions. The EF does not acknowledge that evolutionary processes such as technological

development and biological mutation can affect the Earth's ecological capacity. Neither land degradation nor sustainable land use is factored into the EF's methodology. The EF fails to delineate the effects of GHG emissions on ecological capacity. Thematically, elaborations on the main critiques of the EF are as follows.

First and foremost, one criticism of the EF is that its methodology excludes important factors such as technological development and biological diversification which may vary ecological capacity. Technological development can influence ecological capacity as processes requiring natural resources become more sustainable, but the EF has no way of evaluating and including these technologies (Arrow et al. 1995, 520; Fiala 2008, 521). Thus, the EF between consecutive years are not adequately comparable because they fail to account for the technological developments that may have affected the ecological capacity of the planet.

Furthermore, Arrow et al. (1995) acknowledged that the EF fails to consider the effect of evolutionary change on ecological capacity. Commenting on the EF's limitations, Arrow et al. argue that the EF is methodologically flawed because the "consequences of human innovation and biological evolution are inherently unknowable" (1995, 521). Without addressing changes in biological diversity, the EF does not provide an accurate measure of the Earth's regenerative capacity. Like technological development, biological mutation is to some degree a near spontaneous and evolutionary process that researchers can only predict with little certainty (Arrow et al. 1995). For example, species vary in productive capacity over the years as well as adapt and mutate. If these variations are not held constant, or if no proportionate measurement is created, researchers cannot accurately compare the EF across years.

Second, Fiala (2008) and Van den Bergh and Verbruggen (1999) agree that the EF is too

static a measurement because it does not properly address land degradation. Reason maintains that if the rate of land degradation increases, ecosystems and natural resources become more limited. Thus, humanity's ecological overshoot will increasingly exceed the Earth's regenerative capacity. Unsurprisingly, the initial EF in 1961 did not alarm policymakers because they were uninformed of the underlying land degradation and compounding environmental factors that caused this number to skyrocket in the following decades. Furthermore, Fiala (2008) and Van den Bergh and Verbruggen (1999) mentioned that the EF does not differentiate between sustainable land use and unsustainable land use, a factor that would affect the Earth's ecological capacity.

Lastly, Fiala (2008) criticized the EF because it does not include a measure of GHG emissions. The EF stays true to its name; it is very much a *footprint.* The EF incorporates land use—water and earth—while excluding other ways to evaluate humanity's effect on the planet. By neglecting GHG emissions, the EF cannot accurately assess the totality of anthropogenic environmental degradation nor its interrelations.

In summary, a review of the aforementioned literature has shown that the EF is helpful but incomplete in comparing the unsustainable rate of economic processes with Earth's regenerative and absorptive capacities. Moreover, the outstanding literature up to this point also provides fundamental critiques of the EF. The EF attempts to calculate global economic production and consumption in relation to environmental capacity *ceteris paribus.*[3] However, those 'other things' are crucial to adequate and thorough calculations. Ayres also observes, "What the EF does not provide, however, is a meaningful rank-ordering of countries. Still less does it have any value for policy evaluation or planning purposes" (2000, 349). To overcome the

[3] *Ceteris paribus* is Latin for "all other things being equal."

EF's limitations, researchers, environmentalists, and policymakers have consulted data regarding carbon emissions.

Carbon Dioxide (CO_2) Emissions

The data surrounding carbon emission is harder to contend with. There is a consensus among scientists that the effects of human activity on the planet are dreadful at best and disastrous at worst. Since the beginning of the pre-industrial period, human activity has inundated the atmosphere with GHG emissions, specifically carbon dioxide, from reliance on coal and oil energy. The 2013 Intergovernmental Panel on Climate Change stated that "carbon dioxide concentrations have increased by 40% since pre-industrial times, primarily from fossil fuel emissions (11). Carbon emissions have been a major area of interest within the study of climate change because they provide enough information to compare countries and construct policy.

In two separate studies by Allen et al. (2009) and Solomon et. al (2009) found that the some of the effects of GHG emissions are irreversible. The literature surrounding climate change suggests that unless immediate action is taken, at some point in the future GHG emissions will reach a turning point at which no amount of mitigation or reduction will stop the effects (Ayres 2000, 349). Models currently indicate that even if all carbon emissions were to commence immediately, global average temperatures would still continue to rise and then "remain approximately constant despite zero further emissions" (Solomon 2009, 1705). In other words, the increases in the number and magnitude of natural disasters and tragedies like the ones that occurred in the Aru mountain range are the result of our past actions. Imagine the natural

disasters, the rise in sea level, and the species extinctions due to carbon emissions we have already induced due to our past and current actions.

Thus far, several studies and research have revealed a correlation between carbon emissions and global temperature (Allen et al. 2009; Kerr 2004; Lynas 2007; Pittock 2005; Stern 2008). In an investigation into carbon emissions and global temperature increases, Allen et al. (2009, 1163) found that at one trillion ton of carbon emissions—roughly 3.67 trillion tons of CO_2—the planet will experience a collective 2°C warming. As a species bent on ecological domination, overproduction, and overconsumption, we had already emitted half of that by 2009 (Allen et al. 2009, 1163).

Though models consistently correlate carbon dioxide emissions with temperature rises, these models do not agree on exactly how much warming is expected. In 2001, the IPCC predicted that twice the current CO_2 concentrations could raise temperatures 1.5° to 4.5°C (Pittock 2005, 153). One study authored by Murphy et al. (2004, 770) under the guidance of the Hadley Center for Climate Prediction and Research reported with 95% confidence global temperature in the range of 2.4 to 5.4°C. In other words, the research by Murphy et al. (2004) predicted that if concentrations of CO_2 doubled, there was only a one in twenty chance that temperatures would be below or above this range (Pittock 2005, 153).

However, University of Oxford scientist David Stainforth, a collaborator on the Murphy et al. (2004) study, attempted to circumvent anecdotal evidence that researchers tailor their models based on already existing models, creating closed loops of similar data inputs and results. In this controversial study, Stainforth et al. (2005, 403) found using aggregate models that an increase in global temperature due to doubled CO_2 concentrations could lie between 1.9° to

11.5°C, well outside the IPCC predictions. The studies reviewed here and the outstanding literature on climate change suggest a positive correlation between CO_2 emissions and temperature. However, such studies clearly indicate that the uncertainties embedded in the climate system make finding a singular model difficult for scientists.

What is known about carbon emissions and future global temperature increases is largely based on aggregate computer models. For that reason, much of the previous research on climate change has been quantitative in nature. Drawing on an extensive body of quantitative research, *Six Degrees: Our Future on A Hotter Planet* by Mark Lynas (2008) paints an alarming picture of a 2°C rise in temperature. In an article summarizing the key claims of *Six Degrees*, Lynas (2007) describes what a 2°C temperature might look like:

> The oceans may become the new deserts as the world's temperatures reach 2°C above today's . . . . Two degrees may not sound like much, but it is enough to make every European summer as hot as 2003 when 30,000 people died from heatstroke . . . . Two degrees is also enough to cause the eventual complete melting of the Greenland ice sheet, which would raise global sea levels by seven meters . . . . The impacts of two degrees warming are bad enough, but far worse is in store if emissions continue to rise.

Though 2° does not sound like a large increase in temperature, in Earth's delicate ecosystems, the literature suggests that 2° would be devastating.

In view of all that has been mentioned so far, CO_2 emissions currently provide the most accurate measure of humanity's effect on the planet. The literature surrounding climate change suggests that, given the delayed effects of the ecosystem, warming that has already occurred is

irreversible. Furthermore, if governments and institutions do not take immediate action, at some point in the future GHG emissions will reach a turning point at which no amount of mitigation will stop the effects. The literature correlating CO_2 emissions to global temperature increases is limited by uncertainty and, at this point in time, can only provide a wide range of temperatures and probabilities. Last, data on CO_2 emissions is beneficial to creating a rank-ordering of nations and to constructing policy to reduce the possibility of dangerous warming.

The History of Climate Change Policy

Since the First World Climate Conference in 1979, numerous reports, conferences, and policies have been created to avoid dangerous anthropogenic climate change. What follows is a brief account of the history of climate change policy. Due to the overwhelming amount of information produced by intergovernmental bodies, national bodies, and NGOs relating to climate change, only the most foundational and key milestones are presented. The history of climate change policy may be classified based on content and purpose into three main categories: reports, parties and party groupings, and policies and protocols.

Reports

In 1987, the UN held the World Commission on Environment and Development (WCED), also known as the Brundtland Commission (WCED 2008, 138). Within its report, Our Common Future, the WCED defined sustainable development as "achieving our own goals without impeding those of other future generations" (2008, 138). In summary, this report focused broadly on the role of the international economy in creating sustainable development, the

potential of food scarcity and subsequent security risks, extinction patterns of species, and the need to invest in cleaner sources of energy (WCED 1987).

In the case of climate change research, the IPCC has led the way in providing collaborative and thorough research on the science, future implications, and possible responses. A year after the WCED report, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the IPCC (Gupta 2010, 637). With the establishment of the IPCC, research on climate change was institutionalized, centralized, and produced by an internationally recognized body. The major IPCC reports were published in 1990, 1995, 2001, 2007, and 2014. What follows is a brief, chronological description of the major themes and discoveries of each IPCC report.

In 1990, the IPCC FAR define the scope of climate change, provided initial definitions, and established common ground for scientists and policymakers to build on. In the IPCC FAR SYR, the contributors felt "certain" that "emissions resulting from human activities are substantially increasing the atmosphere concentration of the greenhouse gases" (52). This IPCC report also predicted increase temperatures and sea level rises due to this increase in the concentration of greenhouse gasses (52). In response to climate change, the IPCC FAR (1990) described a breadth of strategies including, but not limited to, the expansion of technologies, new monitoring systems, reducing emissions, and increased cooperation between developing and developed nations.

In 1995, the IPCC SAR focused on the scientific basis of anthropogenic climate change, seminal discussions of adaptation and mitigation, and the economic and social dimensions of climate change. Using careful and precise language, the IPCC SPM stated that "the balance of

evidence suggests that there is a discernible human influence on global climate" (22). Furthermore, this report expanded its section on adaptation and mitigation by focusing on key industries that could easily be adapted to climate change such as "energy, industry, residential/commercial, and agricultural/forestry" (36). Lastly, this report also investigated how to deal with the economic costs of climate change in the face of such limited knowledge. In response to such uncertainty, the IPCC replied as follows: "The challenge is not to find the best policy today for the next 100 years, but to select a prudent strategy and to adjust it over time in light of new information" (45).

The organization and focus of the 2001 IPCC TAR reflected the shift in current literature. Whereas the report of 1995 addressed adaptation and mitigation together, the 2001 IPCC TAR recognized the importance of giving adaptation and mitigation their equal value in addressing climate change. For that purpose, this report set the model for the following two reports, focusing on the advances in the scientific understanding of anthropogenic climate change, issues of vulnerability within adaptation, and options for mitigation. In regards to anthropogenic climate change, the 2001 IPCC SPM stated, "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities" (5). Furthermore, this report presented adaptation as a necessity and not an option (23). Lastly, this report offered "a portfolio of policy instruments" for mitigating climate change, but also mentioned the "technical, economic, political, cultural, social, behavioral, and/or institutional barriers that prevent the full exploitation of technological, economic, and social opportunities of these options" (24). By the publication of the 2001 IPCC TAR, the scientific community had found strong evidence for anthropogenic climate change, had presented adaptation and mitigation as policy options, and had uncovered that several options were available to address the problem.

At this point in the review of IPCC Assessment Reports, the 2007 and 2014 reports can be lumped together as the findings of the 2001 IPCC TAR were improved on and expanded. In the 2007 and 2014 IPCC Assessment Reports, the evidence for anthropogenic climate change increased in certainty. By 2007, the IPCC SYR expressed "very high confidence" in the effect of human activities on warming (37). By 2014, the warming was "unequivocal" (IPCC 2014, 40). With increasing specificity, the IPCC AR4 and IPCC AR5 addressed a wide range of adaptation and mitigation strategies in multiple sectors for reducing climate change.

Parties and Party Groupings

Under the UNFCCC and throughout the literature on climate change policy, countries are referred to by three main groupings that categorize industrialized and developing nations. As categorized by the UNFCCC, these main groups are Annex 1, Annex II, and Non-Annex I countries (UNFCCC 2017b). The Annex I country grouping is comprised of the original nations in the Organization for Economic Co-operation and Development (OECD) in 1992 (UNFCCC 2017b). Annex I countries also include countries with economies in transition (EIT) to the industrialized state. Also included in the Annex I grouping are the Baltic States and some post-Soviet Union Republics. To see a complete list of Annex I countries and a list of countries with EITs, refer to Appendices A and B respectively.

Annex II includes OECD countries, but not EIT parties. As prescribed by the UNFCCC, Annex II countries are responsible for providing funding to developed countries as well as facilitate the equitable transfer of technologies and information. Those in the Annex II grouping must take all possible measures to adapt and mitigate climate change so as to alleviate the

pressure on Non-Annex I countries (UNFCCC 2017b. To see a complete list of Annex II countries, refer to Appendix C.

Lastly, Non-Annex I countries included developing countries that are "especially vulnerable to the adverse effects of climate change" (UNFCCC 2017b.

However, the three main groupings created by the UNFCCC are more so related to who gives and who receives funding. Within these categories of industrialized and developing nations, there are also regional groupings of countries with similar self-interests (UNFCCC 2017c. Within the developed nation cohort, the following country groupings meet collectively to discuss climate change as it refers to their own self-interests: the EU, the Umbrella Group,—a "loose coalition of non-EU developed countries"— and the Organization of Petroleum Exporting Countries (OPEC) countries (UNFCCC 2017c. To see a complete list of the countries in the grouping, refer to Appendices E, F, and G respectively.

Due to their specific positions as developing, non-culpable, and vulnerable countries, Annex II countries and EITs have also developed their own party groupings. The main groupings of developed countries include the G-77, the African States, the Small Island Developing States (SIDS), and the Least Developed Countries (LDCs) (UNFCCC 2017c. To see a complete list of these four party groupings, refer to Appendices H, I, J, and K respectively.

Policies and Protocols

Though there have been numerous conferences, conventions, policies, and protocols related to climate change, two of these are most important in past and current literature. There is no doubt that these two international agreements, the UNFCCC and the Kyoto Protocol, will

continue to be important to the literature of climate change and to policy. For that purpose, the UNFCCC and the Kyoto Protocol are reviewed in this section.

The United Nations Framework Convention on Climate Change (UNFCCC) provides the foundational principles that were used in subsequent climate change discussions and international policies. The UNFCCC, created in 1992, is one of three Rio Conventions. In the same year, the Earth Summit in Rio de Janeiro included the UNFCCC, UN Convention on Biological Diversity, and the Convention to Combat Desertification (UNFCCC 2017a). The UNFCCC entered force in 1994 and currently has 197 members (UNFCCC 2017a). Per the UNFCCC (UNFCCC 2017a), the six aims of the Convention are as follows: (1) recognize that climate change was a problem even in the face of scientific uncertainty, (2) stabilize GHG emissions at a level that would prevent dangerous anthropogenic climate change, (3) compel Annex I countries to reduce their emissions to 1990 levels by 2000, (4) direct funds and technology to developing countries, (5) increase country reporting and accountability, (6) acknowledge the increasingly important role of adaptation to discussions of climate change.

If the UNFCCC is the bark, then the Kyoto Protocol is the bite. At the COP-3 the Kyoto Protocol was drafted (Gupta 2010, 639). A year later signatories of the UNFCCC realized that to meet such a lofty goal and address climate change properly, they would need to implement a stronger protocol. Thus, the Kyoto Protocol created "stricter demands" than the UNFCCC (UNFCCC 2017a). It put quantitative numbers and "mandatory targets" to the UNFCCC's main aim of stabilizing emissions at 1990 levels to avoid dangerous anthropogenic climate change (UNFCCC 2017a). Furthermore, following the lead from the IPCC AR4 and AR5, the Kyoto Protocol includes "a menu of policies and measures" to meet GHG emissions targets from which countries can select (Gupta 2010, 643). As of this writing, the United States is a signatory of the

Protocol but has not yet ratified. In regards to Canada, she withdrew from the Protocol in December 2012 (UNFCCC 2017d).

Adaptation Policy

When it comes to the topic of climate change, most researchers will readily agree that something needs to be done. Where this agreement usually ends, however, is on the question of what should be done. Whereas some are convinced that adaptation is the best route to combat climate change, others maintain that mitigation strategies are our only hope. Pittock, a leading atmospheric scientist, argues that we're going to need as much adaptation as possible to combat already emitted GHG emissions (Pittock 2005, 150). After providing and discussing proposed definitions of adaptation in the current literature, this section will present the pertinent literature regarding some of the key economic environmental and institutional questions that Austrian and policy must address.

Agreeing on a Precise Definition of Adaptation

Like with most social and global problems, a lack of agreement on definitions lies at the root of climate change policy. Just as sustainable development remains elusive to those on both sides of the environmental and economic rift, so does adaptation. Adaptation does not escape the problem of definition. Adaptation's vagueness in traditional discourse gives rise to multiple definitions. As defined by the IPCC Synthesis Report on Climate Change, adaptation is a set of adjustments in "natural and human systems in response to actual or expected climatic stimuli or

their effects" (IPCC 2001). This definition is useful because it was provided by an internationally recognized body.

However, the definition of adaptation provided by the IPCC is problematic as it lacks the specificity necessary for having productive conversations around such a polemic topic as climate change. Thus, the definition of adaptation varies in the literature and there is terminological confusion (Adger et al. 2009; Adger et al. 2005). While a variety of definitions of the term adaptation have been suggested, this paper will use the definition suggested by Adger et al. (2009, 78) who defined it as "an adjustment in *ecological, social, or economic systems* in response to *observed or expected changes* in climatic stimuli and their effects and impacts in order *to alleviate adverse impacts of change or take advantage of new opportunities* [italics added]." Adger et al.'s (2009) definition of adaptation is more beneficial in discussions of climate change than the IPCC for two reasons. First, this definition addresses the triad system in which climate change occurs. Second, it expands the purpose of adaptation from purely preventative measures to ones that includes ameliorative measures as well.

Creating Equity in Adaptation Policy

Since adaptation does not occur within an economic and sociocultural vacuum, it must discuss the accompanying dimensional spillovers. Commenting on the social spillovers into discussions of adaptation, King (2004, 177) acknowledges that "issues of justice lie at the heart of the climate change mission." Creating adaptation policy and addressing issues of justice involve their fair share of politicking. To borrow from the lay definition of politics by Harold Dwight Lasswell, equity focuses on answering *the question of who gets what, when and how.*

What follows is an account of how the outstanding literature on adaptation addresses these fundamental questions related to equity.

In previous studies on equitable adaptation policy, researchers have acknowledged that the '*who'* of this question refers to individual countries, particularly developing countries (Adger et al. 2005; Ciplet et al. 2013; King 2004). National governments are crucial to discussions of adaptation to climate change because no suprainternational authority exists that can enforce internationally agreed upon policy and protocols. Thus, national governments—with their varying self-interests—must take initiative and be held accountable for ratifying and implementing these policies. In research by Ciplet et al. (2013, 50) the concern that varying national interests will impede international consensus is termed the "The Wedge". This concern is aptly named as the relationship between donors and recipients—specifically between developed countries and developing countries—drives a wedge between them that could hinder the creation of climate change policy (2013, 50).

Furthermore, the literature on the inequalities in adaptation highlighted that not only must developing countries address the effects of climate change, effects that they had virtually no role in causing, but they will have to deal with these effects sooner than developed countries (Adger et al. 2005; Ciplet et al. 2013; King 2004). Developing countries bear the burden of managing a problem they did not create by using infrastructure and money they do not have. The '*who'* component of the equity question also addresses the issue of assessing vulnerability and need (Ciplet et al. 2013). Which countries are most vulnerable to the effects of climate change? Which countries are most in need of financing? How do governments prioritize observed climatic changes such as famines and droughts with less immediate concerns such as predicted sea level

rise and temperature change? These are only some of the questions which a comprehensive adaptation framework must address.

Any act of '*getting'* requires an equal and opposite act of giving. Thus, several studies note that issues of equity with adaptation policy must also address the culpability and responsibility of developed nations (Adger et al. 2005; Ciplet et al. 2013; King 2004). The type and amount of monetary funding and financing provided by developed nations to developing nations answers '*what'* is given. Though monetary funding and financing are key issues in adaptation policy, they should not be they only issues. Developed countries will need financing for infrastructural adjustments, but they could also benefit from the free and flowing exchange of technologies as well.

Moreover, intergovernmental bodies must address the governance and deliverance of funds (Ciplet et al. 2013). Issues of equity are not solely embedded into assessments of which countries receive monetary funding for adaptation measures. Issues of equity are also embedded into the governance process. Should developed countries get to decide which developing countries are the most vulnerable or are most in need? Are the institutional bodies that govern these policies and funds structured in a way that is equitable to all or just the developed world? The deliverance of funds also highlights a key of 'how' these developed countries get funding and financing. Respectively, Cipet et al. (2013, 50) term these concerns "The Gap" (in funding) and the "The Dodge" (from institutional responsibility).

Last and certainly not least, all research on climate change policy worth its spit emphasizes that the implementation of adaptation measures—as well as the whole issue of climate change—is time-dependent and -sensitive.

Mitigation Policy: Carbon Pricing

In this study, I attempt to defend the view that heterodox perspectives to climate change policy provide useful theoretical and practical contributions to the field of economics. This paper discusses the feasibility, efficiency, and equity of proposed climate change policy from the Austrian school of economics. As previously stated, one of the main methods of mitigating climate change is through carbon pricing. What follows is a brief review of the literature concerning the primary neoclassical methodologies for mitigating climate change by establishing a carbon price. Before proceeding to examine methodologies of carbon pricing, it is important to first provide some context for these mitigation mechanisms.

In the words of Joseph Stiglitz, the world is currently conducting a global experiment with catastrophic consequences (Stiglitz 2006b, 161). A wealth of scientific research has shown that increasing emissions of GHGs into the atmosphere have contributed to an increase in global observed temperatures (Allen et al. 2009; Kerr 2004; Lynas 2007; Pittock 2005; Stern 2007; Stern 2008). In a gradually heating bathtub, we would cook to death before we even noticed. The long-lived fable is playing out. Finally, we have realized that the water is warming, but we are still figuring out the best way to get out the tub.

The need for carbon pricing arrives on the heels of the failure of the Kyoto Protocol. Though the Kyoto Protocol claims to be legally binding, studies have shown that the Kyoto Protocol has less bite than policymakers expected (Chang 2010; Finus 2008; Norhaus 2006; Nordhaus 2014). Research indicates that the channels for enforcement are rather weak. Thus, advocates and proponents of carbon pricing cite the failure of the Kyoto Protocol to reduce levels commensurate with the climate change crisis. Furthermore, proponents of the climate change

crisis also cite the failure of the Kyoto Protocol to secure and retain participation of key states. Stiglitz (2006b, 180) writes, "Kyoto was the natural approach to global warming. The problem: excessive emissions. The solution: reduce the emissions. But life is never so simple or easy." Under the current commitment phase of the Kyoto Protocol, the United States, the second largest emitter of GHGs, is not under any emissions commitments (UNFCCC 2017d). Furthermore, though China is the largest emitter of GHGs, it is not given an emissions reduction target either because it is considered a developing country (UNFCCC 2017d). Canada, a large industrialized country, withdrew from the first commitment period with virtually no consequences (UNFCCC 2017d).

Much of the current literature on carbon pricing focuses on the nature of this free-rider problem (Nordhaus 2014; Stiglitz 2006a). Within the literature, economics suggests that though countries may feel concern about climate change and though they recognize the need to address the issues as soon as possible, they also have their own economic self-interests (Stiglitz 2006a; Stiglitz 2006b; Stiglitz 2010). Thus, countries do not want to commit to emissions reduction targets because it would disproportionately hurt their own economic self-interests if other countries also do not reduce their emissions. Thus, instead of voluntary commitments with little to no mechanisms for enforcement, market-based measures present an alternative solution to mitigating climate change.

Carbon pricing is a market-based mechanism used to mitigate climate change and encourage the investment in cleaner energies. Much of the literature on carbon pricing emphasizes one of two methodologies: carbon taxation or carbon trading (Arrow et al. 1997; Stiglitz 2006a; Stiglitz 2006b; Stiglitz 2010). Data from several studies suggest that advocates of carbon taxation argue that this market-based mechanism eliminates the need for country specific

reductions targets; opponents argue that the policy surrounding carbon taxation is hasty and haphazardly constructed. Nonetheless, most neoclassical economists are in favor of market-based approaches to mitigate climate change. The following excerpt is from a memo drafted by Arrow et al. (1997) and signed by twenty-five hundreds economists collectively expressing their stance towards carbon pricing:

> The most efficient approach to slowing climate change is through market-based policies. In order for the world to achieve its climatic objectives at minimum cost, a cooperative approach among nations is required—such as an international emissions trading agreement. The United States and other nations can most efficiently implement their climate policies through market mechanisms, such as carbon taxes or the auction of emissions permits. The revenues generated from such policies can effectively be used to reduce the deficit or to lower existing taxes.

The following is a brief description of the stances towards carbon taxation found in the literature reviewed.

Carbon taxation is frequently prescribed as a market-based policy for mitigating climate change and encouraging investment in cleaner energy. In the field of economics, carbon taxation has been instrumental in our understanding of Pigouvian taxes beyond theory.

The literature on carbon pricings has highlighted several reasons why a carbon tax is the best and most efficient mechanism of reducing GHG emission and motivating investments in cleaner energies (Nordhaus 2014). Up to date, several studies have suggested that a carbon tax would eliminate the need for reductions underneath the Kyoto Protocol (Stiglitz 2006a; Stiglitz

2006b; Stiglitz 2010). The research has showed that the Kyoto Protocol currently has no mechanisms for enforcement and also leaves too much room for voluntary negotiations of reduced emissions target based on the countries own self-interest (Stiglitz 2006a; Stiglitz 2006b). This protocol fails because every country must negotiate its own emissions reduction. Thus, cumulative emissions flows must then be calculated as each country agrees to its own reduction target to keep the global cumulative emissions level below the annual target. The review of literature suggests that a carbon tax is an easier and more effective ways to reduce carbon emissions because it bypasses the need for arguments of self-interests. Regardless of self-interest, emitters pay for what they emit.

A carbon tax effectively creates a market for carbon emissions where one does not exists. By calculating the social cost of carbon and then artificially imposing a price on carbon where one does not exist, a carbon tax uses a price mechanism to convey information about the marketplace. This price mechanism conveys to consumers and producers a signal to increase or decrease supply or demand. In the case of a carbon tax, a price on carbon emissions where there was none before would communicate the need to emit less carbon emissions if revenue is to be kept the same. In sum, it would communicate that carbon emissions are bad and to either be paid for or progressively reduced until the carbon tax does not apply as much to their production processes.

Thus, previous research has established that a market-based mechanism such as carbon taxation might coax industrialized and developed countries like the United States and Canada to participate (Stiglitz 2006a; Stiglitz 2006b; Stiglitz 2010). This research highlights that if there is overwhelming participation in a carbon tax, then industrialized and developed countries would

feel that their economic interests are no longer at a disadvantage compared to those countries who do not have emissions targets under the Kyoto Protocol.

Third, it has been suggested that a carbon tax mechanisms on carbon emissions is both practical and efficient because the price signal can be changed (Nordhaus 2014; Stiglitz 2006a; Stiglitz 2006b). As economists Joseph E. Stiglitz (2006a, 3) argues, "As technologies evolve, and the nature of the threat of global warming becomes clearer, the tax rate could adjust, perhaps up, perhaps down." Economists suggest that something must be done to mitigate carbon emissions. Once a carbon price is set on carbon emissions, the price can then be increased or decreased as needed to convey information. Thus, in the time that it would take to create political and international pressure on countries that have not ratified the Kyoto Protocol and countries that have withdrawn, a carbon market can be created and adjusted accordingly.

The evidence reviewed here suggests that a major qualm with the Kyoto Protocol is the lack of enforcement mechanisms for countries that overshoot their targets or countries that withdraw from the protocol. Thus, the neoclassical market-based mechanisms of a carbon tax could remedy this limitation of the Kyoto Protocol. Economists have begun to examine the use of economic sanctions towards countries that have not initiated a carbon tax (Nordhaus 2014; Stiglitz 2006a; Triole 2008). The use of economic sanctions towards countries that have not initiated a carbon tax would transfer the economic disadvantage from countries with a carbon tax to high emitting countries. Thus, the United Sates and other developed countries would retain their economic advantage and not be penalized economically for helping to solve the climate crisis.

On the other hand, despite recent findings about the role of carbon pricing in reducing GHG emissions, several studies have indicated that carbon taxation is not without its own limitations and drawbacks. Here many economists object that carbon taxation is unnecessary, puts developed countries at a disadvantage in trade, and posits unresolved questions. The following will address each of these claims individually.

It has been suggested that carbon taxation is an unnecessary regulation because high energy prices will naturally do the job (Murphy et al. 2015). As stated above, carbon taxation is a price mechanism used to give information to producers and consumers about the nature of resources and goods. However, opponents of a carbon tax argue that these price mechanisms already exist in the form of oil prices and the prices of other energy sources. These critics of carbon taxation argue that energy prices on their own are already showing an increasing trend and these prices will dissuade emitters on their own. Opponents of the carbon taxation method of carbon pricing disagree with the artificial injection of prices into the marketplace.

Opponents of carbon taxation also argue that a carbon tax would make countries with a carbon tax uncompetitive in the global trade system (Murphy et al. 2015). Some researchers have noted that implementation of a carbon tax might put countries with this policy at a disadvantage in terms of trade. A carbon tax would lead to an increase in production costs which would make goods costlier on the international market. Thus, these goods produced underneath an economic system with a carbon tax would be at an economic disadvantage on the market and might result in a decrease in profits.

Last, the research suggests that critics of a carbon tax demonstrate that the implementation of a carbon tax is not without its own unresolved questions, just like the Kyoto

Protocol. The unresolved question related to the Kyoto Protocol was what mechanisms are in place to keep countries from reneging on their commitments. In terms of carbon taxation, critics argue that the carbon taxation mechanism also has its own unresolved question: what will happen to the revenue from taxation (Murphy et al. 2015)? Opponents of carbon taxation suggest that revenue from the carbon tax could be allocated towards investments in cleaner energies, given to developing countries to leap-frog energy intensity technologies, distributed amongst the population on a per capita basis, or substituted in place of other taxes such as income tax. The mechanism of carbon taxation is still in its infancy and there are numerous disputes over how to best manage the revenues from the taxes.

To conclude this section, the literature identifies that carbon taxation is one of the main neoclassical market-based mechanisms for mitigating climate change and increasing investment in cleaner energies. In summary, though the neoclassical market-based mechanisms are promising, opponents of a carbon tax raise considerable arguments.

The Economics of Climate Change

Under the value system of neoclassical economics, researchers have attempted to apply aggregate calculations to the ecological sphere. Neoclassical economists have attempted to calculate not only the costs to protect the environment, and the social cost of carbon, but they have also attempted to calculate the total value of Earth's ecosystems and natural capital (Costanza et al. 1997; Costanza et al. 2014; De Groot 1998; Pearce 1998). The literature reveals that these calculations are not without their own uncertainties and value judgements. Lastly, this section will also provide an overview of the historical traditions and principles of the Austrian

framework in relation to climate change policy.

The Calculated Cost

Let us now turn to the literature regarding the economics of climate change. Two interesting threads of research reveal some of the limitations of applying economics to climate change. Where previous studies attempted to assess the extent of human activity through the ecological footprint, other studies have attempted to place a monetary value on the planet's ecological services (Costanza et al. 1997; Costanza et al. 2014; De Groot 1998; Pearce 1998). Furthermore, some studies have even come to a consensus on how much it would cost to reduce carbon emissions back to levels that would prevent the disastrous effects of a 2°C rise in temperature (Stern 2007; Stern 2008).

Several lines of evidence suggest that the value of global ecosystems can, in fact, be calculated (Costanza et al. 1997; Costanza et al. 2014; De Groot 1998; Pearce 1998;). These large-scale meta-analyses considered dozens of biomes and ecosystems and their provisioning, regulating, habitat, and cultural services. In 1997, a seminal study by Costanza et al. caused public debate when they declared the value of the Earth's ecosystems and natural capital to total $33 trillion dollars (259). At the time, this value was equivalent to 1.2 times the global GNP (Costanza et al. 1997, 259; Pearce 1998). One serious weakness with Costanza et al.'s (1997) valuation of the global ecosystem was that the methodology ignored common economic principles like marginal analysis and marginal cost of production while relying on willingness to pay. Commenting on Costanza et al.'s (1997) methodology, Pearce argues:

> *Just as it would be absurd to calculate the full volume of a human being on the basis of his or her wage-earning power, . . .* there exists no absolute value of ecosystem services waiting to be discovered and revealed to the world by a member of the intellectual community [italics original]. (Pearce 1998, 24).

Setting aside the underlying methodological and philosophical flaws of Costanza et al.'s (1997) research, the study accomplished one of its aims. The study demonstrated that the Earth's global ecosystems and natural capital are valued at more than what is reflected in our lack of conservation and attention to climate change. To the surprise of critics, Constanta et al. (2014) repeated the study with updated parameters. Using the same biomes as in the prior study, the 2014 study suggested that the total for all Earth's global ecosystem services and natural capital was $145 trillion per year (Costanza et al. 2014, 157). However, individuals must not be naïve in thinking that even this large increase in price represents the truth of the matter. Price should not be confused with value.

Not only has research shown the unprecedented price of the Earth's ecosystems and the natural capital they provide, but it has also calculated the amount to avoid dangerous climate change. Stern (2007, 260) and Stern (2008, 3) concluded that it would cost 1-2% of global GDP to avoid a 2°C rise in temperature. In the same vein, Van den Berg (2012c, 570) asks why wouldn't governments spend $25 dollars to insure an asset worth $100,000. As the previous review of adaptation/mitigation and the subsequent review of economics reveals, the meeting space of economics and climate change is never that simple.

Austrian Economic Principles

Overview

Since Hayek's renewal of Austrian economics in the 1970s, the school of Austrian economics has dwindled in popularity and academic coverage. For that matter, the school of Austrian economics is a framework of both normative and positive principles that govern the exchanges people make to satisfy their wants and needs. From this framework, Austrian economists use foundational principles to draw out policy prescriptions.

Though extensive research surrounds the school of Austrian economics, it remains outside of mainstream economic application and thought. Thus, Austrian economics is rooted strongly in the heterodox tradition. Since Austrian economic principles were expounded by a relatively small group of scholars that followed in Menger's mid-19th century tradition, modern day Austrians are still in the beginning stages of expanding the methodological and epistemological boundaries of Austrian economics. How have they attempted to do so? From the texts of early Austrian writers like Menger, Hayek, Böhm von Bawerk, and Mises, modern day Austrians have relied on textual exegesis. Another critique of Austrian economics is that it falls into the trap of providing only normative principles of economics and has no positive application to how economics works in reality.

Understanding the main economic principles of the Austrian school lies at the heart of understanding the view Austrians take towards climate change policy. Peter Boettke, a modern proponent of the Austrian school, summarized in *The Concise Encyclopedia of Economics* the main principles of Austrian economics which are reproduced here in full with original emphasis:

The Science of Economics

Proposition 1: Only individuals choose.

Proposition 2: The study of the market order is fundamentally about exchange behavior and the institutions within which exchanges take place.

Proposition 3: The 'facts' of the social sciences are what people believe and think.

Microeconomics

Proposition 4: Utility and costs are subjective.

Proposition 5: The price system economizes on the information that people need to process in making their decisions.

Proposition 6: Private property in the means of production is a necessary condition for rational economic calculation.

Proposition 7: The competitive market is a process of entrepreneurial discovery.

Macroeconomics

Proposition 8: Money is nonneutral.

Proposition 9: The capital structure heterogeneous goods that have multispecific uses that must be aligned.

Proposition 10: Social institutions often are the result of human action, but not of human design. (Boettke 2017)

Austrian economists believe that only individuals choose (Cordato 2004, 4; Dawson 2011, 7; Regan 2015, 225). Since only individual can choose, all economic activity must be

examined from the starting point of the individual. Commenting on human behavior, Von Mises (1998, 11) writes:

> Human action is purposeful behavior. Or we may say: Action is will put into operation and transformed into an agency, is aiming at ends and goals, is the ego's meaningful response to stimuli and to the conditions of its environment, is a person's conscious adjustment to the state of the universe that determines his life. Such paraphrases may clarify the definition given and prevent possible misinterpretations. But the definition itself is adequate and does not need complement of commentary.

In literature regarding Austrian economics, the term that refers to the purposefulness of human behavior is termed the action axiom. Austrian economics holds that if humans act purposefully, and given inherent temporal and spatial limits, then scarcity arises. Purposeful ends require means. Taken together, the subjective individualism, praxeology, and human action axiom constitute the means-ends framework of Austrian economics (Von Mises 1998, 92).

Furthermore, another reoccurring theme surrounding the Austrian view of climate change policy and environmental issues is the notion of property rights. On the importance of property rights to Austrian economic thought, Von Mises (1998, 678) argues:

> Private ownership of the means of production is the fundamental institution of the market economy. It is the institution the presence of which characterizes the market economy as such. Where is it absent, there is no question of a market economy.

The literature surrounding Austrian economic thought and environmental issues designated property rights as the linchpin (Dolan 2014, 207). Within the literature surrounding mitigation

strategies under neoclassical frameworks, the key theme was one of allocation of scarce resources. However, the praxeological framework of Austrian economics sees conflict in human action as the cause of environmental issues (Dolan 2014, 198). Thus, to Austrian economic thought economic policy that protects the rights of the individual must first addresses the conflict over individual's means to attain their ends.

Critique of Neoclassical Approach

Neoclassical and Austrian economics do not inherently produce a specific set of policy prescriptions. These economic perspectives should be viewed as a set of economics principles that attempt to describe how the world works. Thus, economists must tease out policy from these principles. This is the very reason conservative and liberal mainstream economists will provide different policy prescriptions using similar principles.

With that in mind, it is only logical to first describe and explain the Austrian critique of neoclassical economics as it relates to environmental policy. The main critiques of the neoclassical approach to climate change can be found in two principles: the use of unreliable aggregate models of macroeconomics and the faulty belief in perfect competition and equilibrium (Brownstein 1980; Cordato 2004; Dawson 2011; Dawson 2013; Dolan 2014; Regan 2015). What follows is a brief description of the main critiques of neoclassical economics in regards to environmental policy from an Austrian economic perspective.

First, the existing Austrian analyses of neoclassical economics in regards to environmental policy are extensive and pay attention to the aggregate methodology of neoclassical economics (Brownstein 1980; Dawson 2011; Dawson 2013; Dolan 2014; Regan

2015). When Adam Smith and David Ricardo laid the classical foundations upon which neoclassical economics was built, they very literally stood on the shoulders of giants. Austrian economists point out that neoclassical economics, to be viewed as more credible and empirical, was built on borrowed science. Neoclassical economics borrows heavily from the methodologies of the Scientific Revolution. Classical economists, and thus neoclassical economists, became fascinated with the mathematical laws and formulations embedded within the natural world. Thus, neoclassical economics retains some of that scientism; it attempts to mathematically and analytically determine the laws that govern the exchanges that people make to satisfy their needs and wants. Within the field of macroeconomics, these mathematical and analytical formulations can only occur on the aggregate level. This methodology of calculating aggregate social welfare and efficiency leaves Austrian economists displeased with the application of neoclassical economics to environmental issues.

The use of aggregate mathematical and analytical models within neoclassical applications to environmental issues gives rise to a top-down policy that Austrians economists disagree with. Within the neoclassical perspective, mathematical models attempt to calculate the social cost of externalities, carbon in particular (Dawson 2011, 13; Dawson 2013, 185; Dolan 2014, 211). As Dawson (2013, 187) suggests, the social cost of carbon is not as easy to calculate as prior studies by Stern claimed (2007; 2008). First, calculations must find the optimal concentration of carbon that averts dangerous climate change. Second, these calculations must then determine the optimal level of carbon emissions that allow for suitable environment protectionism and economic development. Lastly, the state then must artificially place a social cost, or price of carbon, onto carbon emissions to dissuade emitters (Dawson 2013, 187). From the Austrian perspective, this top-down, aggregate methodology artificially creates markets and impinges on individual liberty.

The fault in neoclassical economics' aggregate methodology is that it displaces the individual liberty of rational economic agents—a key value in neoclassical economics—in favor of aggregate social welfare (Brownstein 1980; Cordato 2004; Dawson 2011; Dawson 2013). In his critique of aggregate welfare within neoclassical economics, environmental economist Graham Dawson (2013, 141) argues the following:

> Neoclassical welfare economics is grounded in the defense of the rights of the individual against the state but its applications to environmental issues in general and to climate change in particular subordinates individual rights to aggregate or social welfare, measured by the monetary value of the benefits and costs of policy.

Dawson properly notes that finding the optimal climate change policy with neoclassical methodologies leaves the rights of the individual unprotected. Austrian economics has no problem with the ends of neoclassical economics in regards to climate change. The greatest amount of aggregate or social welfare is a noble and worthy ideal. The problem lies in the means. Within the Austrian economic framework, in achieving the greatest aggregate welfare where all parties are better off, individual rights and liberty must remain protected and not subordinate to the state.

Furthermore, previous research has established that aggregate models within neoclassical economics abandon Pareto optimality (Brownstein 1980; Cordato 2004; Dawson 2013; Regan 2015). Economists use the term 'Pareto optimality' or 'Pareto efficiency' to refer to a state of completely efficient allocation of resources in which one individual's condition cannot be made better off without making another individual's condition worse off (Brownstein 1980; Cordato

2004, 4; Dawson 2013, 189). Thus, Austrian economists argue that from the individual-centered roots of Pareto optimality, aggregate welfare economics and the subsequent policies of top-down environmental protections cannot be logically deduced (Brownstein 1980, 95).

Second, a number of studies have found that Austrian economists disagree with the neoclassical idea of equilibrium between supply and demand that leads to the efficient allocation of resources (Cordato 2004; Dawson 2013; Regan 2015). Neoclassical economics contains the assumption of equilibrium. Within economics, equilibrium is the state in which supply and demand within markets are equal and prices stabilize. Commenting on the mathematical treatment of economics, Ludwig von Mises writes, "In the world of real human action, in the life of a licing human being, there can never be a state that corresponds to the mental construct of a static economy" (Von Mises 1977, 99). The literature regarding Austrian economics sees this static view of equilibrium as a fault in neoclassical theory. As environmental and property rights scholar Regan (2015, 203) writes, "Neoclassical economists study markets as if they exist in or rapidly attain a state of equilibrium." As proponents of Austrian economics note, neither markets nor ecological systems attain equilibrium (Dawson 2011; Dawson 2013; Regan 2015). In relation to climate change policy, neoclassical economists assume that there is an optimal balance between supply and demand.

Neoclassical environmentalists would view demand as the quantity of carbon that emitters require for their production and consumption functions. Conversely, neoclassical economists would view supply as the quantity of carbon that environmental policy measures stipulate. Uncertainties within climate change science make finding these optimal quantities difficult. The studies regarding the ecological footprint, increased carbon concentrations, and global temperature rises already attest to the fact that the global demand for carbon emissions has

already exceeded the natural ecological rate of supply (Allen et al. 2009; Kerr 2004; Lynas 2007; Pittock 2005; Stern 2008; Wackernagel 2002;).

Moreover, recent ecological research is also reverting the age-old myth that ecosystems attain equilibrium (Regan 2015, 204). Regan states blatantly: "Indeed, for much of their history ecologists have tended to study ecological systems as if they achieved equilibria. Although equilibrium models are analytically appealing, they have proven to be inconsistent with the way ecosystems function in reality" (Regan 2015, 208). Ecosystems—just like markets—grow, adapt, and must respond to ecological booms and busts (Regan 2015, 208). To Austrians, the neoclassical idea of equilibrium and the resulting market-based attempts to efficiently allocate carbon emissions is not only theoretical but also counter to the ecological principles in which the problem of climate change occurs.

Chapter 4 Findings

Purpose and Organization

Fundamentally, this study holds a singular principle to be true of academic discovery in general and liberal education in particular. Small questions, safe and necessary, lead to small discoveries. Bigger questions are dangerous. Bigger questions, when hurled at unyielding ears and positioned against the status quo, can be fatal to the inquirer. Bigger questions can create mental empowerment and insatiable curiosity. Bigger questions can revolutionize and radicalize whole societies. The big question that this study focuses on is how should humanity steward the planet.

Economics is an important component in addressing climate change. This discipline lies at the heart of the climate change problem and its possible solutions. The excessive production and consumption that leads to increased GHG emissions and climate change are fundamentally rooted in the economic sphere. The values rooted within economic schools and perspectives then provide the best way to manage carbon emissions to avoid dangerous climate change.

Considering the literature surrounding climate change and neoclassical economics, the following research question arises: *if standard economic theory has failed to mitigate the effects of climate change on a scale commensurate to the problem, what macro-level policy proposals can Austrian economics offer that will be feasible, efficient, and equitable?* The purpose of this study is to address and discuss whether the Austrian policies toward climate change are feasible, efficient, and equitable. In short, this study set out to determine whether these alternative economic schools of thought shed light on solutions to climate change in a more constructive

manner than neoclassical economics. This paper critically challenges the view that heterodox economic perspectives should be viewed as unreasonable and purely theoretical.

The exploratory question of proper stewardship and the research question of alternative policy prescriptions require a project of limited scope as these questions are extensive. Thus, this paper aimed to (1) bridge the gap between environmental protectionism and economic development, (2) highlight the importance of the heterodox economic school of thought, and (3) construct feasible, efficient, and equitable policy to climate change. To adequately answer the research question and accomplish the study's aims, the study must also accomplish the following objectives:

- Discuss the relevant literature concerning initiated climate change policy
- Explain mainstream economics sufficiency at addressing climate change
- Evaluate the mitigation policy of carbon pricing
- Analyze the frameworks of Austrian economics
- Formulate a set of adaptation and mitigation policies considering the heterodox approach to economics

The purpose of this chapter is to present and describe the study's results in a systematic, concise, and detailed manner. The information and data presented in this chapter summarizes the findings of the research. Following in the tradition of the heterodox approach that shies away from purely mathematical reasoning and aligning with the interdisciplinary nature of this study, the results presented in this chapter will be both qualitatively and quantitatively summarized. The study's results will be organized based on the study's aforementioned objectives. For all qualitative findings, these will be addressed thematically. For all quantitative findings, a synopsis

of overall trends will be provided along with key observations. Tables and figures are labeled numerically in the order in which they are presented. All tables and figures whose messages are better conveyed in color are produced in color. Tables and figures that retain their message without color are presented in grayscale.

Concerning Initiated Climate Change Policy

Science

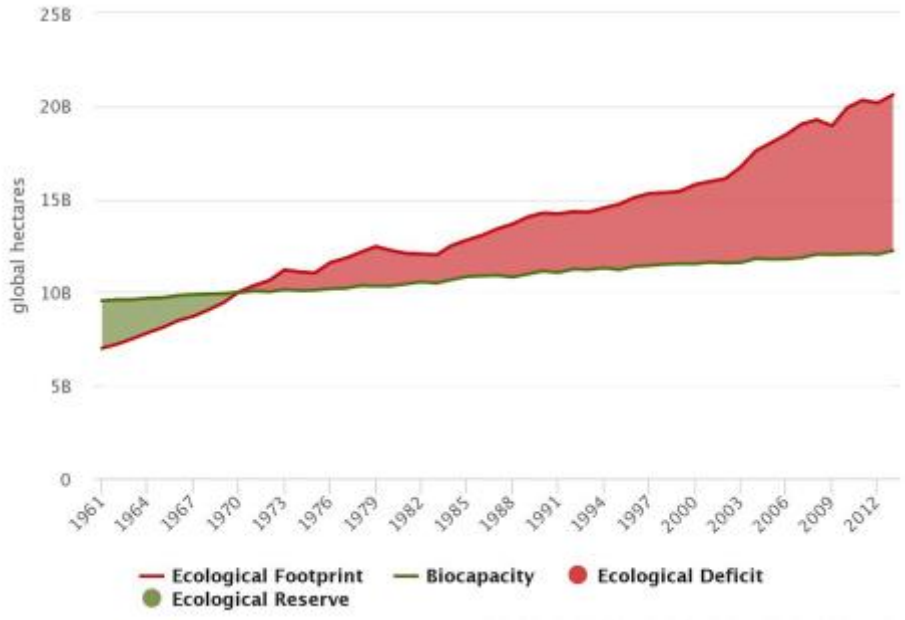

Figure 1. World ecological footprint and biocapacity represented in billions (B) of global hectares over time, 1961-2013. The ecological footprint represents global demand on the Earth's resources. Biocapacity represents the Earth's natural regenerative capacity. Respectively, the ecological reserve and ecological deficit represent global production and consumption staying within and exceeding biocapacity. Source: Global Footprint Network 2017.

Figure 1 presents an overview of the world's ecological footprint and biocapacity as a result of economic production and consumption processes. From this figure, it is apparent that global demand on Earth's natural resources has exceeded the Earth's regenerative and absorptive capacity. Interestingly, the global ecological footprint has increased even since the rise of

extensive environmental discussions and protections and the First World Climate Conference in 1979. Overall, these results indicate that the global system of economic production and consumption have exceeded ecologically sustainable rates.

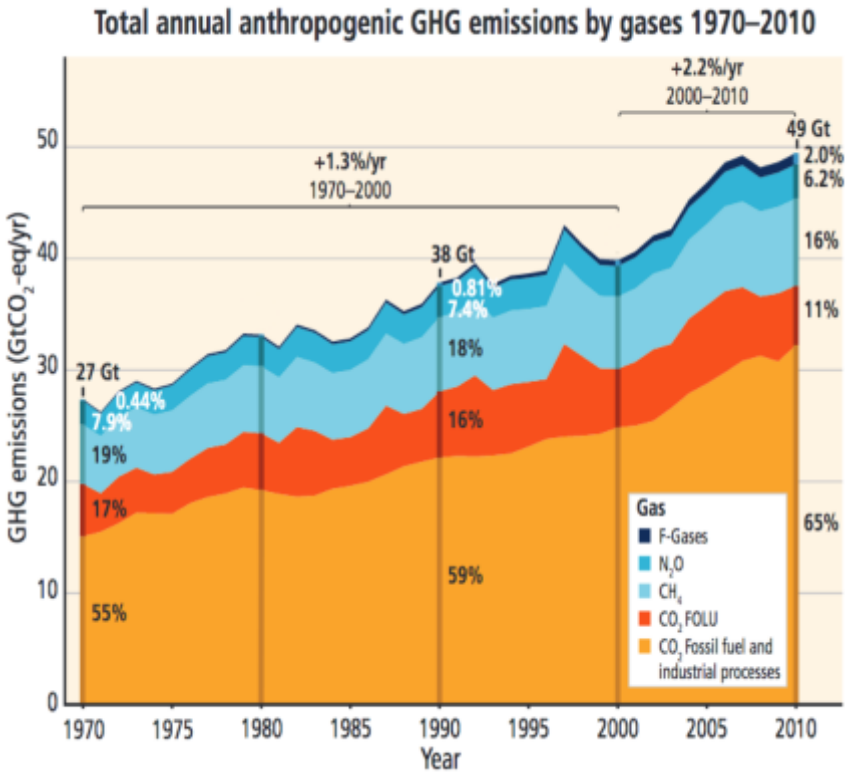

Figure 2. Total annual anthropogenic greenhouse gas (GHG) emissions (gigatonne of CO_2-equivalent per year, $GtCO_2$-eq/yr) for the period 1970 to 2010 by gases: CO_2 from fossil fuel combustion and industrial processes; CO_2 from Forestry and Other Land Use (FOLU); methane (CH_4); nitrous oxide (N_2O); fluorinated gases covered under the Kyoto Protocol (F-gases). Source: IPCC 2014, 5.

Figure 2 provides the quantitative breakdown of annual anthropogenic GHG emissions by type of gas. From the graph above we can see that annual emissions of nitrous oxide (N_2O), methane (CH_4), carbon dioxide (CO_2) from forestry and other land use have decreased from 1970 to 2010. What stands out in this figure is the overwhelming contribution of CO_2 from fossil fuels and industrial processes to total annual anthropogenic GHG emissions. CO_2 from fossil fuel

and industrial processes represented 65% of the total annual GHG emissions in 2010. From the period of 1970 to 2010, CO_2 emissions from fossil fuel and industrial processed increased by 10%. In Figure 2 there is a clear trend of increasing annual emissions, specifically CO_2 from fossil fuel usage, despite mechanisms to reduce carbon emissions.

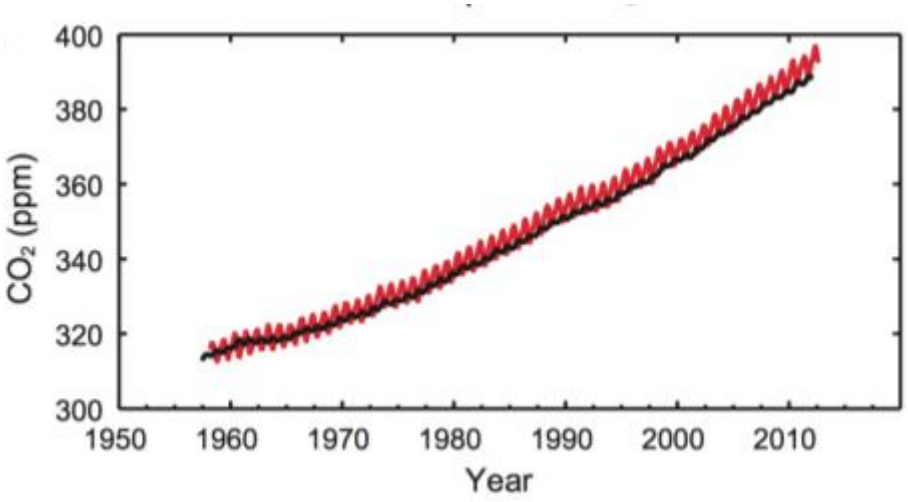

Figure 3. Cumulative atmospheric carbon dioxide (CO_2) concentration represented in the ratio of parts per million of carbon dioxide molecules to all molecules in the atmosphere, since 1958. Atmospheric concentrations of CO_2 measurements from Mauna Loa (19º32'N, 155º34'W—red) and South Pole (89º59'S, 24º48'W—black) since 1958. Source: IPCC 2013, 12.

As shown in Figure 3, cumulative CO_2 emissions represented in parts per million (ppm) have steadily increased over time. Data from this figure can be compared with the data in Figure 2 which shows the quantitative breakdown of annual anthropogenic GHG emissions by type of gas. IPCC Assessment Reports (2007; 2014) and Hansen et al. (2008) argue for a stabilization level of 350 ppm to avoid dangerous climate change. Figure 3 show clearly that as of the late 1980s, atmospheric concentrations of CO_2 have surpassed the recommended stabilization level.

Table 1. Likelihood (in percentage) of exceeding a temperature increase at equilibrium

Stabilization level (in ppm CO_2e)	2ºC	3ºC	4ºC	5ºC	6ºC	7ºC
450	78	18	3	1	0	0
500	96	44	11	3	1	0
550	99	69	24	7	2	1
650	100	94	58	24	9	4
750	100	99	82	47	22	9

Note: Stabilization level represented in parts per million of CO_2-equivalent. Source Stern 2008, 5.

Table 1 illustrates the likelihood of exceeding various temperature increases according to multiple stabilization levels represented in parts per million (ppm) of carbon dioxide equivalent (CO_2e). This chart confines the resulting likelihood of exceeding temperatures to the range of 2ºC to 7ºC for the stabilization levels 450 ppm CO_2e to 750 ppm CO_2e. A stabilizing level of 450 ppm CO_2e offers some protection against temperature increases of 4ºC and more. From the table above, a stabilization level of 450 ppm CO_2e produces a 78% likelihood of exceeding a 2ºC temperature increase at equilibrium. The literature surrounding climate change policy denotes that 2ºC constitutes potentially dangerous climate change. Overall, these results indicate that a stabilization level around or greater than 450 ppm CO_2e has a higher likelihood of inducing dangerous climate change at equilibrium.

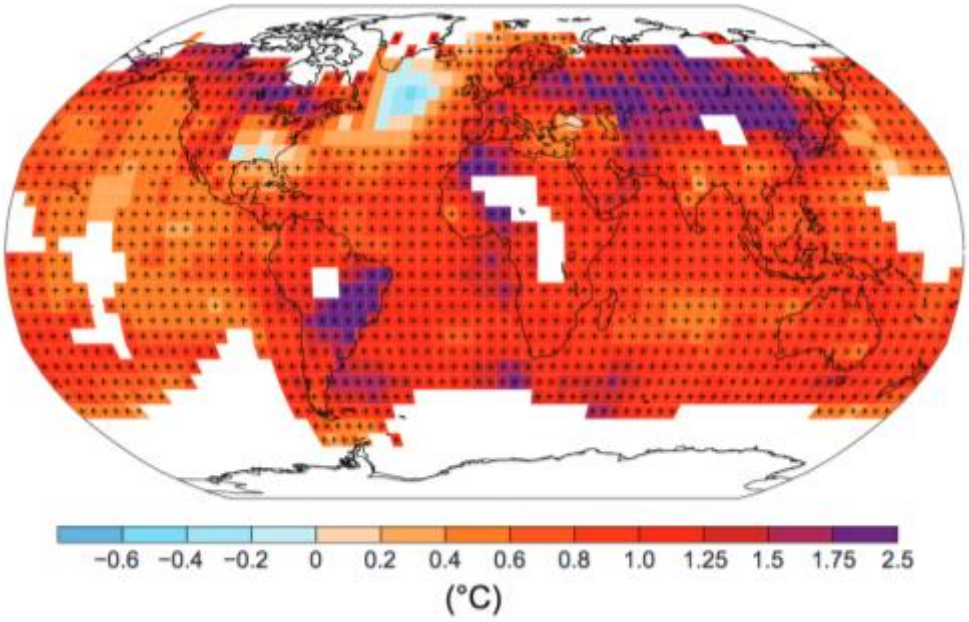

Figure 4. Map of observed surface temperature change from 1901 to 2012 derived from temperature trends determined by linear regression from one dataset. Trends have been calculated where data availability permits a robust estimate (i.e., only for grid boxes with greater than 70% complete records and more than 20% data availability in the first and last 10% of the time period). Other areas are white. Grid boxes where the trend is significant at the 10% level are indicated by a + sign. Source: IPCC 2013, 6.

Figure 4 reveals that there has been a marked increase in global observed surface temperatures since 1901. According to the data, areas within South America, in the Sahara, and across Asia have experienced a sharp increase of 1.5ºC or more since 1901. The Atlantic Ocean and parts of the southern parts of the United States have experienced a drop in observed surface temperature since 1901. Figure 4 shows overall that the trend for global observed surface temperature from 1901 to 2012 is one of marked increase.

Adaptation & Mitigation

This section within "Findings" will present the qualitative themes found within the research into adaptation and carbon taxation of climate change. Within this section, quantitative

data will be presented to address both adaptation funding commitments and the embedded inequalities in the climate change problem.

Adaptation, given the already irreversible effects of climate change, is not a choice. Reference to Table 1 supports this finding. Table 1 shows that a stabilization level around or greater than 450 ppm CO_2e has a higher likelihood of inducing dangerous climate change at equilibrium. With a stabilization level of 450 ppm CO_2e, there is a 78% likelihood of exceeding a 2ºC temperature increase at equilibrium. Taking into account increased production and consumption processes, the lack of support for the Kyoto Protocol's second commitment period, and the uncertainty sensitive of the climate system, the cumulative concentration of CO_2 is likely to increase after 2017 and increase the likelihood of a 2ºC temperature increase. A comprehensive adaptation policy is a must (Anderson & Bows 2011).

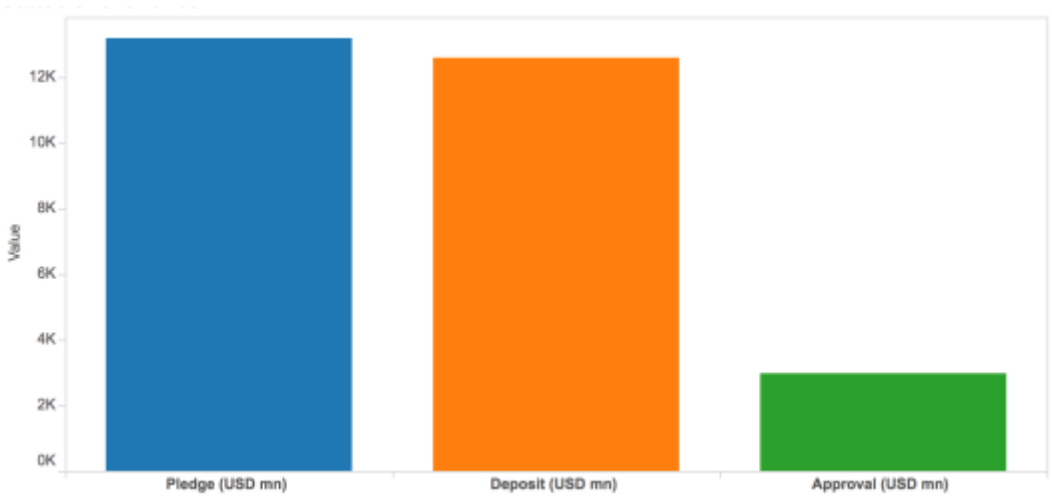

Figure 5. Graph of the status of adaptation funds. Pledged, deposited, and approved funds are represented in millions of U.S. dollars. Amounts have been totaled from the Adaptation Fund, the sixth phase (2014-2018) of the Global Environment Facility (GEF) Trust Fund, the Green Climate Fund, and the Least Developed Countries Fund. Source: Climate Funds Update 2016.

Table 2. Status of adaptation climate funds (in millions of US$)

Funding Source	Pledged	Deposited	Approved
Adaptation Fund	569.15	546.91	348.91
GEF[a] Trust Fund	1101.12	1078.05	455.74
Green Climate Fund	10255.39	9896.38	1174.23
LDC[b] Fund	1250.16	1077.01	981.24
Total	13175.82	12598.35	2690.12

[a] Global Environmental Facility, 2014-2018

[b] Least Developed Country

Note: Funding amount rounded to the nearest $10,000. According to the Climate Funds Update, all data is up to date as of the end of October 2016. Source: Climate Funds Update 2016.

Measures of adaptation and mitigation do not occur in a vacuum devoid of global issues related to funding and financing (Ciplet et al. 2013). Figure 5 and Table 2 represent that status of adaptation funding in millions of US$ in two different formats. Figure 5 shows the overall trend with adaptation funding. Table 2 numerically represents this trend of slow allocation of adaptation funding. Though over 95% of pledged funding across these four funds have been deposited, only 20% of the funding has been allocated to its recipients. What is surprising about the data is the approval of funding for the Green Climate Fund. Only 11% of funding pledged to the Green Climate Fund has been approved. The aforementioned figure and table reveal that though funding commitments have been made to adaptation funds, these deposits have not been yet allocated.

Figure 6. Map of multilateral pledges of adaptation funds. Pledged funding amounts are represented in millions of U.S. dollars. The data in this chart is based on information received from the twenty-six multilateral, bilateral, regional, and national climate funds regularly monitored by the Climate Funds Update. Source: Climate Funds Update 2016.

Figure 6 displays the global distribution of pledged adaptation funding by country. The figure above shows that the overall trend of adaptation funding is from developed, industrialized countries. The map also shows little to no pledged adaptation funding from developed countries. Not shown clearly on the map are the top three pledges of adaptation funding: United Kingdom, Germany, and France. Figure 6 shows that pledges of adaptation funding are overwhelmingly OECD members.

Figure 7. Map of multilateral recipients of adaptation funds. Received funding amounts are represented in millions of U.S. dollars. The data in this chart is based on information received from the twenty-six multilateral, bilateral, regional, and national climate funds regularly monitored by the Climate Funds Update. Source: Climate Funds Update 2016.

Figure 7 shows the global distribution of received adaptation funding by country. As shown in the above figure, the overall trend of adaptation funding is towards developing countries, countries with economies in transition (EITs), least developed countries, and small island developing states (SIDS). Not clearly represented on the map are the top ten recipients of adaptation funding: Bangladesh, Niger, Cambodia, Mozambique, Nepal, Bolivia, Zambia, Tajikistan, Mali, and Samoa. The figure shows that these countries lie overwhelming in the Caribbean, Central and South America, Africa, and Asia.

A considerable amount of literature has been published on GHG emissions, specifically focusing on carbon emissions (CDIAC 2017; EDGAR 2016; World Bank 2016; WRI 2017). These studies and numerous others have provided an accurate, empirical measurement of GHG

emissions and CO_2 emissions, the main cause of atmospheric warming. This body of empirical research shows alarming trends. As of 2015, previous studies have reported that China, the United States, India, Russia, and Japan are the top five emitters of CO_2 (CDIAC 2017; EDGAR 2016: World Bank 2016; WRI 2017). In 2006, China overtook the United States as the world's leading emitter of GHGs and CO_2 (World Bank 2016).

Explain Mainstream Economics' Sufficiency

Mainstream neoclassical economics ignores the interconnected social and natural spheres in which the economic sphere is embedded (Plater et al. 2008). Two major themes occurred within the research. First, mainstream neoclassical economics ignores the unbalanced demand of the marketplace economy on the natural economy. Economic processes of production and consumption occur within a natural economy that is not infinite. Neoclassical economics imposes equilibrium on to economic and ecological systems that organically operate in more dynamic ways. Neoclassical economics ignored the economic spheres connection to the natural sphere by prioritizing profit over environmental protection. An excerpt from a memo signed by Lawrence Summers, former Chief Economist of the World Bank, reveals the dangerous of applying economic logic to environmental issues:

> Just between you and me, shouldn't the World Bank be encouraging more migration of the dirty industries to the LDCS? . . . I think the economic logic behind dumping a load of toxic waste in the lowest-wage country is impeccable and we should face up to that.

> The costs of pollution are likely to be non-linear as the initial increments of pollution probably have very low cost. I've always thought that under-populated countries in Africa are vastly under-polluted. (Summers 1992a).

Solid neoclassical logic suggests that there are vast economic advantages to dumping toxic waste in LDCs and allowing LDC to bear the consequences of environmental degradation. Neoclassical economics, or capitalism as "business as usual", is insufficient as a model for handling climate change because it gives primacy to immediate profit over future ecological concern (Foster 1993; Summers 1992a; Summers 1992b).

Second, findings show that neoclassical economics removes climate change from its human origins in. The literature surrounding climate change focuses on the *human* cause of increased GHG emissions. The research findings show that neoclassical economics, with its aggregate methodology, removes climate change from its individualistic and human-centered origins.

Analyze Austrian Economics

The research showed that a heterodox framework is necessary to break free from the confines of sustainability as defined solely by economic growth (Klitgaard 2013). Austrian economics provides a more individualistic conception of climate change than neoclassical economics. To conserve space, the proposed Austrian economic policy is addressed in detail in the "Discussion."

Policy Construction

A new imagination of the organizational principles of economic exchanges may shed light on solutions to the climate change crisis. These economic perspectives should provide not only a new theoretical basis but must also be applicable to reality. Infertile theory, though it fosters discussion, does not lead to practical solutions. Three broad themes that Austrian economics must address emerged from the research: adaptation, mitigation, and pragmatism.

First, alternative economics perspectives must address adaptation to climate change. Regarding adaptation policy, Austrian economics must address the inadequacy of adaptation funding, the difficulties of recipient criteria, and the realities of governance (Adger et al. 2005; Adger et al. 2009; Ciplet et al. 2013). Findings suggest that there is a gap between pledged funds and allocated funds for adaptation measures. These perspectives must address how to calculate vulnerability and economic need. Vulnerability is a question grounded in ecological theory, but it is also an economic question because GDP aside, there are various ways to assess the economic growth and need of countries. As mentioned, economic processes cannot function without a civic-societal component. The combined values embedded in civic society and inherent in economic thought give rise to the economic system in which adaptations funds are allocated. Exogenous measures such as Pigovian taxes and carbon taxes require a civic society, or state, to levy and enforce them. Other means of endogenous adaptation policy and mitigation policy also requires civic-societal organization to ensure fruitful coordination and cooperation.

Second, Austrian economics must address mitigation to climate change. Policy must address the already established mechanism of carbon pricing.

Third, any policies that are formulated must be pragmatic. The findings of the research

suggest that pragmatic adaptation and mitigation policies can be assessed by the feasibility, efficiency, and equity of the policy (Büchs et al. 2011; Liu et al. 2017). Feasibility is a question of the policies practicality. Does the economic perspective provide only theoretical solutions? What are the barriers to enforcing such a policy? What are the dimensional spillovers of such a policy? Efficiency is a question of finding the maximum outcome with minimal effort, waste, dimensional spillovers, or other negative effects. Within the framework of the various economic perspectives, what is efficient economic policy? Lastly, given viewpoints that arose in the literature review, findings suggests that economic policy must address the inequalities embedded in the climate change crisis. Will the proposed economic policy protect the interests of industrialized and developing countries equitably? How do these proposed economic policies protect the liberties of emitters and non-emitters alike?

Chapter 5 Discussions

The "Introduction," presented sub-questions. This section will not only discuss those questions but will also present a thorough analysis of the Austrian perspective to climate change. Regarding Austrian economics, this section will discuss the ideas of privatizing climate change policy, defining property rights, and using tort litigation. This discussion section will also address how might a privatized climate change policy affect measures of adaptation and mitigation. Within this discussion, this paper will address carbon pricing, emissions trading, and technology and energy pricing. An adequate discussion of the literature review and the findings will also include the implications for economic development, sustainable development, and equity. Last, policies will also be analyzed for their feasibility, efficiency, and equity.

Neoclassical Economics' Sufficiency

The first question sought to determine neoclassical economics' sufficiency for handling climate change externalities. Though it presents promising and practical solutions to the climate change crisis, the research found that neoclassical economics has limitations and cautions neoclassical economics uses market-based measures to mitigate climate change. However, carbon taxation as it currently stands can only do so much to mitigate climate change.

First, this study must note certain value judgments. Neoclassical economics should not be confused with capitalism. Neoclassical economics and capitalism contain their own distinct value judgments. Whereas non-academic and mainstream critiques of climate change policy under BAU conflate neoclassical economics and capitalism, this study is cognizant of keeping them separate. Neoclassical economics is only one approach to economic theory. It views economic

exchanges between rational individuals as a way of maximizing profit or utility of goods. On the other hand, capitalism is a social, political, economic, and legal system that advocates for individual rights, freedom, private over state control of markets, and the subjective rule of law. Neoclassical economics can be seen as just one economic theory and capitalism as just one way of practicing that theory within a social, political, and legal context.

From the research and findings on climate change science, it is easy to see that the economic production and consumption is assumed to be a contributor to rising GHG emissions and pushing the planet towards dangerous climate change. The findings of the study show that global economic demand for production and consumption resources has already exceeded the Earth's natural supply, or in other words, its regenerative capacity (Allen et al. 2009; Arrow et al. 1995; IPCC 2013; Lynas 2008; Solomon 2009; Stern 2008; Wackernagel 1999; Wackernagel et al. 2002). It can thus be suggested that the neoclassical model with conceptions of infinite growth cannot survive on a finite planet.

Carbon pricing relies on climate change science. As the findings evinced, carbon pricing depends upon a complex set of steps with deeply embedded uncertainties. Scientists can calculate annual carbon emissions flows and cumulative atmospheric concentrations of carbon dioxide and other GHGs with increasing accuracy. However, the science is not perfect. To predict future increases in observed global temperatures, computational models rely on a wide range of data sets that attempt to correlate cumulative carbon dioxide emissions with temperature increases. From these data sets and computational models a stabilization target, or level at which dangerous climate change can be avoided, can be calculated. In the "Findings" chapter data showed that a stabilization level of 450ppm CO_2-eq still presented a high possibility of leading to a 2°C increase in temperature. Thus, scientists and policymakers can argue for any stabilization

level below 450ppm CO_2-eq.

From this complex science, scientists and intergovernmental organizations must then determine appropriate levels of annual CO_2 carbon dioxide emissions flows so as not to exceed the cumulative stabilization target. From these stabilization targets, the social costs of carbon can be calculated and artificially injected into the marketplace. With both carbon pricing and carbon trading, there is responsibility falls on individual countries to place a price on carbon pollution to mitigate climate change and increase investments in cleaner options.

Opponents to carbon pricing and carbon trading reveal the implicit value assumptions woven into the social cost of carbon. Nature provides provisioning services, regulating services, and cultural services (Van den Berg 2012c, 563). Provisioning services relate to those goods that humans consume directly (Van den Berg 2012c, 563). Even in the presence of rapid globalization, industrialization, and urbanization, humans still depend fundamentally on the Earth's provisioning services. Every good produced comes from natural and raw materials. The earth regulates the climate in a myriad of ways such as converting the air we breathe, converting minerals and soil into the crops we eat, and recycling the water we drink. Cultural services are those services that integrate into other aspects of social life (Van den Berg 2012c, 563). The environment functions as a social and spiritual reservoir. In the calculations of the social cost of carbon, how can one possibly calculate all of the Earth's provisioning, regulating, and supporting services, let alone its cultural services? Neoclassical economics in that regard confuses price with value.

The hidden value assumptions within the neoclassical economic approach to climate change are not the only fault in its measures. Implementing the resulting policy is also

impractical. According to the research, intergovernmentally agreed upon climate change policy may come to a standstill because there is no suprainternational authority to regulate and enforce the policies (Chang 2010; Finus 2008; Norhaus 2006; Nordhaus 2014). Thus, it becomes the responsibility of countries to ratify policies such as the Kyoto Protocol. Neoclassical economics fails to see that the economic sphere is also embedded within the civic societal sphere. It seems likely that in an ideal world with a suprainternational authority with the power to implement and enforce internationally agreed upon policies, the neoclassical economic solution of carbon pricing, and thus carbon trading, would be ideal. Unfortunately, economic theory must face the realities of governance.

For example, the Kyoto Protocol which attempts to regulate the carbon emissions of Annex I countries, claims that it is "legally binding." Underneath the Kyoto Protocol, countries must voluntarily agree to reduce emissions flows over two commitment period as mentioned in the literature review. These annual emission targets are voluntarily agreed upon and self-negotiated (Chang 2010; Finus 2008). It is interesting to note that the United States is not a ratifying member of Kyoto Protocol. Canada also is not a member of the Kyoto Protocol. China, the current leading emitter of carbon dioxide, has no emission restrictions. It is surprising that the Kyoto Protocol claims to be legally binding. Binding protocols like the Kyoto Protocol and the UNFCCC promise to be legally binding, but the research shows they are relatively unenforceable (Chang 2010; Finus 2008).

These results seem to suggest that as an economic model neoclassical economics is promising though insufficient at addressing climate change. The neoclassical model of economics based on obtaining equilibrium within the marketplace does not address the overlapping spheres of the natural economy and the civic societal economy. Furthermore, the

solutions of mainstream economics, though internally valid and seemingly practical, has major drawbacks; one being the inability of mainstream economics to calculate the social cost of carbon accurately, adequately, and sufficiently based on uncertain science. Perhaps the most serious disadvantage of the neoclassical solutions to climate change lies in the civic-societal sphere. Climate change policies such as the Kyoto Protocol may provide more bite than the UNFCCC, but without truly legally binding measures, they are still toothless. If countries withdraw from the Kyoto Protocol or their emissions targets are not met, they only risk looking hypocritical to the international political community (Chang 2010; Finus 2008).

Proposed Austrian Environmental Policy

The second sub-question presented in the "Introduction" asked why the Austrian perspective is useful in analyzing environmental externalities produced by the current economic system of production and consumption. The following pages will discuss this question using the literature review and findings.

Reason would have it that if the current global processes of economic production and consumption guided by mainstream economic principles have contributed to the global climate change crisis and have provided only cursory solutions, then there is a need for alternative theories and practices. The findings of the study support the idea that there is a place for Austrian economics within discussions of climate change policy.

The Austrian economic perspective is useful in analyzing externalities produced by the current economic system of production and consumption. The research found that Austrian economics is not just a subfield of neoclassical economics, but an entirely different framework

that prioritizes different principals and ways of reasoning. The research found that Austrian economics contains the principles of praxeology, the human action axiom, the principal of subjective costs, and the means-ends framework (Cordato 2004; Dawson 2011; Dawson 2013; Dolan 2014; Von Mises 1977; Von Mises 1998). These principles are not found within the neoclassical system of economic analysis. Thus, this study has demonstrated that Austrian economics is a new angle from which to view the climate change crisis.

This study found that the Austrian policies of privatizing all existing climate change policy, resolving conflicts that arise from the use of resources, and relying on tort litigation to solve interpersonal conflicts have their limitations. The research on Austrian economic policy for climate change suggests that Austrian economics' privatization of policy, though internally valid, may not be feasible, efficient, or equitable.

Turing to the proposed policy, the following quote by Dawson (2011, 19) summarizes the Austrian approach to climate change policy:

> The Austrian or libertarian policy must, therefore, be to prioritizing 'climate change policy,' repealing all existing climate change legislation. The tax treatment of fossil fuels should be revised to eliminate any tax contributions that have been imposed with the intention of reducing carbon emissions. Regulations aimed at reducing carbon emissions should be rescinded. National or supranational emissions trading systems should be wound up; private firms and individuals wish to continue to issue and trade permits, it would, of course, be free to do so. Official carbon emissions reduction targets should be abandoned. There should be no climate change policy objectives or instruments.

Based on the research and literature, Austrian economics proposes the repeal of all state-based climate change policy regulating carbon emissions, carbon taxation, and national or supranational emissions trading systems. According to the findings, we can infer that this type of policy may be unfeasible. It is possible that Austrians have ignored the three spheres of society. Yes, policy measures can be rescinded. However, these national and supranational regulations, taxations, and emissions trading systems, taxations have also contributed to investment in clean energies options. It is, therefore, likely that the repeal of all public climate change policies may cause a decline in clean energy investments. One major drawback of the Austrian economic policy is that it does not address the economic and social spillovers that a mass repeal of climate change policy may cause.

Regarding adaptation measures, Austrian economists believe the only appropriate policy to climate change is the policy of adaptation (Dawson 2011, 2). Austrian economists overlook that calculating the cost of adaptation contains some of same the limitations as calculating the social cost of carbon. From the research and the findings, it seems that calculating the cost of adaptation measures does not receive the same intensity of opposition. From the literature review and the findings of the study, Austrian economists may approve of adaptation policy because it is not necessarily dependent upon top-down national and supranational infringement on individual liberty. It is possible that from the Austrian economic point of view individuals and firms if they would like to do so, could implement adaptation policy without state intervention.

The literature review and findings support the initial assumption that Austrian economics provides important theoretical contributions to creating climate change policy. Austrian economics does well to not leave policy within a vacuum. In general, the Austrian economic perspective is averse to the concept of market failures because market booms and busts are part

of the natural catallactic efficiency of economies (Cordato 2004; Dawson 2011; Dawson 2013). Thus, the research and findings show that from the Austrian perspective climate change is not a market failure but an interpersonal conflict. It follows that public policy in relation to environmental issues should not concern itself with efficiently allocating resources. Instead, public policy should concern itself with resolving the conflict over resources from which externalities occur.

The Austrian economic framework is rooted in a strong theoretical and scholarly tradition. As Hardin's (1968) iconic article "The Tragedy of the Commons" explains, when public goods or means are used to satisfy the complex and varied ends of individuals, the tragedy is twofold. Public use of the public good to suit so many needs will ultimately lead to destruction and the use of these public goods will result in conflict over the formation of plans. Thus, Austrian economists, following in the tradition of Von Misses proposal that property rights are the linchpin for a functioning marketplace, believe that lack of property rights cause externalities such as pollution. In relation to climate change policy, Austrian economists argue that poorly defined property rights are the root cause of externalities. In summary, Stocker (1996, 4) writes:

> If the structure of property rights leaves too much room for externalities, i.e. there's uncertainty about what can be done with certain resources, (like e.g. air and ground water, oil-fields or fishing grounds etc.) the handling of these resources can almost a certainty assumed to be far from efficient.

Thus, the privatization of climate change policy and the proper definition of property rights contributes new definitions to discussions of climate change. From the literature and

research, Austrian economics provides new definitions to the terms polluter and pollution. In environmental studies, it is widely agreed that pollution can be defined as excessive GHG emissions or other substances that deplete or degrade the Earth's natural quantity and quality of air, water, or land. However, Austrian economics contributes to the field of environmental issues by providing a human context for climate change. Within this framework, a polluter can be said to be one that, using their own means, infringes upon the use of another individual's means to achieve their ends. These new definitions are not without their limitations.

Cordato (2014, 8) claims:

> If there were no recreational users of the river or housing developments downwind from the pig farm there be no pollution. Environmental problems are not really problems for or with the environment, but human problems of mutual formulation and achievement of goals.

Cordato's argument relies too heavily on the subjective individualist concepts of praxeology and the human action axiom. From the point of view of the Austrians, if no other individual's rights are impinged upon, then pollution does not exist. In reference to direct land degradation from polluted rivers, streams, and lakes, victims may directly determine whether the use of one individual's resources has negatively affected their land, crops, or other resources. However, the case is not so simple for carbon emissions and air pollution. From an ethical, or environmental perspective, can the concept of pollutions' existence only if there is a witness to it, only if another party or individual finds fault, be accepted?

Instead of asking how should humanity steward the planet, Austrians prefer to ask how

do institutions help resolve conflicts of human demand on the Earth's dynamically changing resources. These two radically different questions will contribute different answers to discussions of climate change policy.

Prior studies have noted that a final contribution from the Austrian literature to climate change policy is the concept of mass litigation. The current study found that once property rights are well-defined, Austrian economists believe that using strict liability, tort litigation can take the place of all existing national and suprainternational emissions regulations and trading schemes. In a sense, privatized climate change policy and tort litigation are equitable. However, the Austrian framework fails to address the large procedural and institutional barriers that such as ill-defined property rights, the burden of proof, and the issue of compensation.

Regarding compensation, tort litigation can result in damages for the complainant or in a reduction of harm, in this case being GHG emissions. If this tort litigation results in compensation for the complainant, the complainant would receive damages for any harm or injury as a result of the pollution. It is possible, therefore, that the compensation would be the mechanism that would communicate to other emitters the price of pollution and other emitters could then preemptively exempt themselves from future tort litigation by voluntarily reducing their GHG emissions and investing in cleaner options.

On critiquing the Austrian economic framework for climate change policy, Dolan (2014, 213) argues that "failure to compensate is not only unjust; it distorts choices about the use of environmental resources and inhibits coordination." However, if under tort litigation the complainant is returned to their original state, then compensation is unnecessary. In regards to the feasibility of Austrian economic policy to climate change, the lack of compensation for

complainants is not only inequitable; it is unjust. The research shows that Austrian economists make no attempt to give sufficient consideration to this injustice.

What is surprising is that the main contention that Austrian economists have with neoclassical economics becomes a contradiction within the Austrian economic framework. As the literature shows, the Austrian economic framework disapproves of the aggregate methodology of neoclassical economics and calculating the social cost carbon. Furthermore, the literature also shows a distrust of climate change science. However, the same mathematical calculations, aggregate methodologies, and climate change science would factor into calculating damages for pollution victims. According to this data, we can infer that it is not, in fact, the use of aggregate methodologies in place of true Pareto optimality that Austrian disapprove of. These findings suggest that the main contention with public climate change policy is that it uses public mechanisms to deal with a problem that should be handled privately.

This research, while preliminary, suggests that Austrian economic policy for mitigating climate change, though rooted in a strong history and internally valid, is not feasible, is inefficient, and only partially equitable. Privatizing climate change policy is not feasible or efficient because the Austrian economic school, in relation to environmental issues, commits the Nirvana fallacy. Thus, the Austrian economic framework is a model for normative economics that examines and determines how the world *should* work. One criticism of much of the literature on Austrian economics is that the school of thought does not contribute to positive economics, or how economics is practiced. Concerning property rights, they are cloudy. Concerning enforcement, it is shallow. As Dolan (2014, 212) critiques further, “The starting point [of Austrian economics] is a reality in which there’re no markets for pollution and no prices.” In sum, the research suggests that Austrian economic policy is unfeasible and inefficient because

the starting point for Austrian economics is a world in which large procedural and institutional barriers exist to its implementation.

In terms of economic development, these results further support the idea that the Austrian economic framework protects the entrepreneurial discovery of each individual through the definition and expansion of property rights so as to avoid the tragedy of the commons. In terms of environmental protection, these findings suggest that the Austrian economic framework situates climate change mitigation in an institutional and social system that does not yet exist and leaves climate change adaptation to private firms and individuals. In terms of social equity (the last leg of the three-legged stool of sustainable development), this paper suggests that the Austrian economic framework, with its proposal of strict liability under tort litigation, creates a legal impossibility for pollution victims. Furthermore, the Austrian economic framework fails to address the institutional and procedural impossibility of mass tort litigation for LDCs with unstable, poorly defined, and chaotic social, civic, and legal institutions. This research, though precursory, proposes that for mitigating climate change the Austrian economic framework, though it is internally robust and is a model for normative economics, is not feasible, is inefficient, and only partially equitable.

Thus, from the review of literature, the findings, and the discussion of Austrian economics, this research suggests that "both/and" solutions as opposed to either/or solutions are necessary (Ehrhardt-Martinez et al. 2015, 226). To combat dangerous climate change, both mitigation and adaptation should be given equal consideration. This study also reveals that both neoclassical economics and Austrians economics have their limitations. Neoclassical economics offers a practical solution based on unsound logic. On the other hand, Austrian economics offers rock solid internal logic but a policy that is hard to implement. Thus, this paper offers the

both/and solution of leaving the Kyoto Protocol for the creation of a global carbon price under the mechanism of carbon taxation while also strengthening and defining property rights where they are valid. This paper is of the view point that the application of property rights to the public good of airspace is harder to implement, than say, for waterways and fisheries. However, where property rights can be more strongly defined, this paper suggests that such a task is undertaken. If this paper is to provide a both/and solution to climate change, it should not fail to address adaptation. Though this prescription is cursory, but all revenues from a global carbo tax could be allocated towards investments in cleaner energy sources and towards adaptation funds with preference given to LDCs and developing countries.

The chapter that follows will present key implications drawn from the "Disucssion." Next, this chapter will pinpoint the limitations of the research. Last, this chapter will close with suggestions for further research and a call to individual agency in solving the climate change crisis.

Chapter 6 Conclusion

The data surrounding the anthropogenic effect of human activity on the planet all points in the same direction: our actions are "certainly damaging [and] potentially catastrophic" (Van den Berg 2012c). The climate change crisis will only get worse in the coming decades if a coherent and international policy is not implemented as soon as possible. Currently, the largest emitters of carbon dioxide are the China and the U.S. If cooperative action is not taken, the situation will get worse. Within the next twenty to twenty-five years, China will emit more than the U.S. and Europe have emitted combined over the last hundred years (Stern 2008, 28). And China is not the only threat. As the other regional BRICS begin to industrialize, CO_2 emissions will only increase unless there is a global carbon price mechanism to replace the Kyoto Protocol.

Researchers and policymakers should not continue to look at the climate change crisis from an either/or perspective. The heterodox framework of Austrian economics revealed that though neoclassical market-based mechanisms offer a pragmatic solution, the theory in which it is rooted in does not completely justify carbon pricing.

This investigation revealed that in terms of economic development, these results further support the idea that the Austrian economic framework protects the entrepreneurial discovery of each individual through the definition and expansion of property rights so as to avoid the tragedy of the commons. In terms of environmental protection, these findings suggest that the Austrian economic framework situates climate change mitigation in an institutional and social system that does not yet exist and leaves climate change adaptation to private firms and individuals. In terms of social equity (the last leg of the three-legged stool of sustainable development), this paper suggests that the Austrian economic framework, with its proposal of strict liability under tort

litigation, creates a legal impossibility for pollution victims.

Thus, from the review of the literature, the findings, and the discussion of Austrian economics, this research suggests that "both/and" solutions, as opposed to either/or solutions, are necessary (Ehrhardt-Martinez et al. 2015, 226). To combat dangerous climate change, both mitigation and adaptation should be given equal consideration. This study also reveals that both neoclassical economics and Austrians economics have their limitations. Neoclassical economics offers a practical solution based on unsound logic. On the other hand, Austrian economics offers rock solid internal logic but a policy that is hard to implement.

Thus, this paper offers the both/and solution of leaving the Kyoto Protocol for the creation of a global carbon price under the mechanism of carbon taxation while also strengthening and defining property rights where they are valid. This paper also concludes that in order for a carbon price mechanism to work, be it taxation or trading, there needs to be a global carbon price or a global emissions trading scheme that incorporates all countries. The investigation holds that without overwhelming cooperation, humanity will continue to inch closer to dangerous climate change. Unless the international community adopts a global price mechanism, dangerous climate change will not occur.

Furthermore, this paper supports the viewpoint that the application of property rights to the public good of airspace is harder to implement, than say, for waterways and fisheries. However, where property rights can be more strongly defined, this paper suggests that such a task is undertaken. Take together, these findings support strong recommendations for Austrian economists, if they are truly committed to the theoretical underpinning of their policy, to take on the responsibility of defining property rights and creating the institutional structure for tort

litigation to be successful implemented. If this paper is to provide a both/and solution to climate change, it should not fail to address adaptation. Though this prescription is cursory, all revenues from a global carbon tax could be allocated towards investments in cleaner energy sources and towards adaptation funds with preference given to LDCs and.

The major limitation of this study was the sheer scope and size. This investigation recognizes in hindsight that covering adaptation and mitigation, as well as market-based mechanisms of mitigation, and alternative economic policy was a reach. This study was inspired by the process of asking big questions but recognizes that each section in this paper could be given its own treatment. Notwithstanding this limitation, this study did substantiate the claim that Austrian economics can contribute an entirely different perspective for dealing with the climate change crisis. Further research on the following questions could better under the interconnectedness between economic theory, sustainable development, and international justice:

- How can Austrian economists overcome the institutional barriers of tort litigation? What does a fully defined climate change policy based solely on tort litigation look like? What policy proposals can other heterodox schools offer? What is a fair global carbon price? What should happen to carbon tax revenues?
- What are the underlying values and assumptions within adaptation and mitigation strategies? Specifically, which areas will be affected first by dangerous climate change under BAU? To what extent are the famines in Somalia, Nigeria, South Sudan, and Yemen caused by already observed anthropogenic climate change?
- In the coming years, how are economic, political, and social institutions predicted

> to change? How will these changes impact the climate change discuss? What scenarios or set of circumstances encourage international cooperation? To what extent are sanctions helpful in coercing participation?

As Joseph E. Stiglitz pointedly summarized, the world is engaged in a mass science experiment to determine what happens to the Earth's temperature when excess GHGs are emitted. The science has been telling us all along. As far as science has revealed, this one Earth, this pale blue dot, is all that we have. For all of humanity regardless of nationality, this one Earth is home. We do not have the option to pack up and leave when temperatures increase, sea levels rise, ice caps melt, and climates swap. As the social and economic spheres are embedded in the natural sphere, climate change is not merely an environmental issue. This interconnectedness means that climate change is just as much an issue as economic downturn, social instability, and political insecurity. Climate change has the power to cause all three. Thus, it is up to us, to ask each other, but most importantly ask ourselves, one urgent question: how should humanity steward the planet?

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Appendices

Appendix A: List of Annex I Countries

- Australia
- Austria
- Belarus
- Belgium
- Bulgaria
- Canada
- Cyprus
- Czech Republic
- Denmark
- Estonia
- European Union
- Finland
- France
- Germany
- Greece
- Hungary
- Iceland
- Italy
- Japan
- Latvia
- Liechtenstein
- Lithuania
- Luxembourg
- Malta
- Netherlands
- New Zealand
- Norway
- Poland
- Portugal
- Romania
- Russian Federation
- Slavakia
- Slovenia
- Spain
- Sweden
- Turkey
- Ukraine
- United Kingdom of Great Britain and Northern Ireland
- United States of America

Source: UNFCCC. 2017. "List of Annex I Parties to the Convention." Accessed April 1, 2017. http://unfccc.int/parties_and_observers/parties/annex_i/items/2774.php.

Appendix B: List of Countries with Economies in Transition (EITs)

- Belarus
- Bulgaria
- Croatia
- Czech Republic
- Estonia
- Hungary
- Latvia
- Lithuania
- Poland
- Romania
- Russian Federation
- Slovakia
- Slovenia
- Ukraine

Source: UNFCCC. 2017. “The Climate Change Convention.” Accessed April 1, 2017. http://unfccc.int/not_assigned/b/items/2555.php.

Appendix C: List of Annex II Countries

- Australia
- Austria
- Belgium
- Canada
- Denmark
- European Union
- Finland
- France
- Germany
- Greece
- Iceland
- Ireland
- Italy
- Japan
- Luxembourg
- Netherlands
- New Zealand
- Norway
- Portugal
- Spain
- Sweden
- Switzerland
- Turkey
- United Kingdom of Great Britain and Northern Ireland
- United States of America

Source: IPCC. 2001. *Climate Change 2001: Appendix V List of Annex I, Annex II, and Annex B Countries. A Contribution of Working Group III to the First Assessment Report of the Intergovernmental Panel on Climate Change*. Report. Accessed April 1, 2017. http://www.ipcc.ch/ipccreports/tar/wg3/index.php?idp=478.

Appendix D: List of Non-Annex I Countries

- Afghanistan
- Albania
- Algeria
- Andorra
- Angola
- Antigua and Barbuda
- Argentina
- Armenia
- Azerbaijan
- Bahamas
- Bahrain
- Bangladesh
- Barbados
- Belize
- Benin
- Bhutan
- Bolivia
- Bosnia and Herzegovina
- Botswana
- Brazil
- Brunei Darussalam
- Burkina Faso
- Burundi
- Cambodia
- Cabo Verde
- Cameroon
- Central African Republic
- Chad
- Chile
- China
- Colombia
- Comoros
- Congo
- Cook Islands
- Costa Rica
- Cuba
- Côte d'Ivoire
- Democratic People's Republic of Korea
- Democratic Republic of the Congo
- Djbouti
- Dominica
- Dominican Republic
- Ecuador
- Egypt
- El Salvador
- Equatorial Guinea
- Eritrea
- Ethiopia
- Fiji
- Gabon
- Gambia
- Georgia
- Ghana
- Grenada
- Guatemala
- Guinea
- Guinea-Bissau
- Guyana
- Haiti
- Honduras
- India
- Indonesia
- Iran (Islamic Republic of)
- Iraw
- Israel
- Jamaica
- Jordan
- Kazakhstan
- Kenya
- Kiribati
- Kuwait
- Kyrgzstan
- Lao People's Democratic Republic

- Lebanon
- Lesotho
- Liberia
- Libya
- Madagascar
- Malawi
- Malaysia
- Maldives
- Mali
- Marshall Islands
- Mauritania
- Mauritius
- Mexico
- Micronesia (Federated States of)
- Mongolia
- Montenegro
- Morocco
- Mozambique
- Myanmar
- Namibia
- Nauru
- Nepal
- Nicaragua
- Niger
- Nigeria
- Niue
- Oman
- Pakistan
- Palsu
- Palestine
- Panama
- Papua New Guinea
- Paraguay
- Peru
- Phiippines
- Qatar
- Republic of Korea
- Republic of Moldova
- Rwanda
- Saint Kitts and Nevis
- Saint Lucia
- Saint Vincent and the Grenadines
- Samoa
- San Marino
- Sao Tome and Principe
- Saudi Arabia
- Senegal
- Serbia
- Seychelles
- Sierra Leone
- Singapore
- Solomon Islands
- Somalia
- South Africa
- South Sudan
- Sri Lanka
- Sudan
- Suriname
- Swaziland
- Syrian Arab Republic
- Tajikistan
- Thailand
- The former Yugoslav Republic of Macedonia
- Timor-Leste
- Togo
- Tonga
- Trinidad and Tobago
- Tunisia
- Turkmenistan
- Tuvalu
- Uganda
- United Arab Emirates
- United Republic of Tanzania
- Uruguay
- Uzbekistan
- Vanatu
- Venezuela (Bolivarian Republic of)
- Viet Nam
- Yemen

- Zambia
- Zimbabwe

Source: UNFCCC. 2017. “List of Non-Annex I Parties to the Convention.” Accessed April 1, 2017. http://unfccc.int/parties_and_observers/parties/non_annex_i/items/2833.php.

Appendix E: List of European Union (EU) Countries

- Austria
- Belgium
- Bulgaria
- Croatia
- Cyprus
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Latvia
- Lithuania
- Luxembourg
- Malta
- Netherlands
- Poland
- Portugal
- Romania
- Slovakia
- Slovenia
- Spain
- Sweden
- United Kingdom

Source: Europa. 2017. “EU Member Countries in Brief.” Last modified April 18, 2017. https://europa.eu/european-union/about-eu/countries/member-countries_en.

Appendix F: List of Umbrella Group Countries*

- Australia
- Canada
- Japan
- New Zealand
- Kazakhstan
- Norway
- The Russian Federation
- Ukraine
- United States

Source: UNFCCC. 2017. "Party Groupings." Accessed April 1, 2017. http://unfccc.int/parties_and_observers/parties/negotiating_groups/items/2714.php.

*The UNFCCC "Party Groupings" website mentions that there is no official listing of Umbrella Countries, though the above list is a usual grouping.

Appendix G: List of OPEC Countries

- Algeria
- Angola
- Ecuador
- Gabon
- Iran
- Iraq
- Kuwait
- Libya
- Nigeria
- Qatar
- Saudi Arabia
- United Arab Emirates
- Venzuela

Source: OPEC. 2017. “Member Countries.” Accessed April 1, 2017. http://www.opec.org/opec_web/en/about_us/25.htm.

Appendix H: List of G-77 Countries

- Afghanistan
- Algeria
- Angola
- Antigua and Barbuda
- Agentina
- Bahamas
- Bahrain
- Bangladesh
- Barbados
- Belize
- Benin
- Bhutan
- Bolivia (Plurinational State of)
- Bosnia and Herzegovina
- Botswana
- Brazil
- Brunei Darussalam
- Burkina Faso
- Burundi
- Cabo Verde
- Cambodia
- Cameroon
- Central African Republic
- Chad
- Chile
- China
- Colombia
- Comoros
- Congo
- Costa Rica
- Côte d'Ivoire
- Cuba
- Democratic People's Republic of Korea
- Democratic Republic of the Congo
- Djbouti
- Dominica
- Dominican Republic
- Ecuador
- Egypt
- El Salvador
- Equatorial Guinea
- Eritrea
- Ethiopia
- Fiji
- Gabon
- Gambia
- Ghana
- Grenada
- Guatemala
- Guinea
- Guinea-Bissau
- Guyana
- Haiti
- Honduras
- India
- Indonesia
- Iran (Islamic Republic of)
- Iraq
- Jamaica
- Jordan
- Kenya
- Kiribati
- Kuwait
- Lao People's Democratic Republic
- Lebanon
- Lesothos
- Liberia
- Libya
- Madagascar
- Malawi
- Malaysia
- Maldives
- Mali
- Marshall Islands
- Mauritania
- Mauritius
- Micronesia (Federated States of)
- Mongolia
- Morocco
- Mozambique
- Myanmar
- Namibia
- Nauru
- Nepal
- Nicaragua
- Niger
- Nigeria

- Oman
- Pakistan
- Panama
- Papua New Guinea
- Paraguay
- Peru
- Philippines
- Qatar
- Rwanda
- Saint Kitts and Nevis
- Saint Lucia
- Saint Vincent and the Grenadines
- Samoa
- Sao Tome and Principe
- Saudi Arabia
- Senegal
- Seychelles
- Sierra Leone
- Singapore
- Solomon Islands
- Somalia
- South Africa
- Sri Lanka
- State of Palestine
- Sudan
- Suriname
- Swaziland
- Syrian Arab Republic
- Tajikistan
- Thailand
- Timor-Leste
- Togo
- Tonga
- Trinidad and Tobago
- Tunisia
- Turkmenistan
- United Arab Emirates
- United Republic of Tanzania
- Uruguay
- Vanuatu
- Venezuela (Bolivarian Republic of)
- Viet Nam
- Yemen
- Zambia
- Zimbabwe

Source: The Group of 77. 2017. “The Member States the Group 77.” Accessed April 1, 2017. http://www.g77.org/doc/members.html.

Appendix I: List of African States

- Algeria
- Angola
- Botswana
- Burkina Faso
- Burundi
- Cabo Verde
- Cameroon
- Central African Republic
- Chad
- Comoros
- Congo
- Côte d'Ivoire
- Democratic Republic of the Congo
- Djbouti
- Egypt
- Equatorial Guinea
- Eritrea
- Ethiopia
- Gabon
- Gambia
- Ghana
- Guinea
- Guinea-Bissau
- Kenya
- Lesotho
- Liberia
- Libya
- Madagascar
- Malawi
- Mali
- Mauritania
- Mauritius
- Morocco
- Mozambique
- Namibia
- Niger
- Nigeria
- Rwanda
- São Tomé and Principe
- Senegal
- Seychelles
- Sierra Leone
- Somalia
- South AFrica
- South Sudan
- Sudan
- Swaziland
- Togo
- Tunisia
- Uganda
- United Republic of Tanzania
- Zambia
- Zimbabwe

Source: UN. 2014. "United Nations Regional Groups of Member States." Last modified May 9. 2014. http://www.un.org/depts/DGACM/RegionalGroups.shtml.

Appendix J: List of Small Island Developing States (SIDS)

- Antigua and Barbuda
- Bahamas
- Barbados
- Belize
- Cabo Verde
- Comoros
- Cuba
- Dominica
- Dominican Republic
- Fiji
- Grenada
- Guinea-Bissau
- Guyana
- Haiti
- Jamaica
- Kiribati
- Maldives
- Marshall Islands
- Mauritius
- Micronesia (Federated States of)
- Nauru
- Palau
- Papua New Guinea
- Saint Kitts and Nevis
- Saint Lucia
- Saint Vincent and the Grenadines
- Samoa
- São Tomé and Principe
- Seychelles
- Singapore
- Solomon Islands
- Suriname
- Timor-Leste
- Tonga
- Trinidad and Tobago
- Tuvalu
- Vanatu

Source: UN Division for Sustainable Development. 2017. "List of SIDS." Accessed April 1, 2017. https://sustainabledevelopment.un.org/topics/sids/list.

Appendix K: List of Least Developed Countries (LDCs)

- Afghanistan
- Angola
- Bangladesh
- Benin
- Bhutan
- Burkina Faso
- Burundi
- Cambodia
- Central African Republic
- Chad
- Comoros
- Congo (Democratic Republic of the)
- Djbouti
- Equatorial Guinea
- Eritrea
- Ethiopia
- Gambia
- Guinea
- Guinea-Bissau
- Haiti
- Kiribati
- Lao People's Democratic Republic
- Lesotho
- Liberia
- Madagascar
- Malawi
- Mali
- Mauritania
- Mozambique
- Myanmar
- Nepal
- Niger
- Rwanda
- Samoa
- São Tomé and Principe
- Senegal
- Sierra Leone
- Solomon Islands
- Somalia
- Sudan
- Timor-Leste
- Togo
- Tuvalu
- Uganda
- United Republic of Tanzania
- Vanatu
- Yemen
- Zambia

Source: UN Conference on Trade and Development. 2017. "UN List of Least Developed Countries." Accessed April 1, 2017. http://unctad.org/en/pages/aldc/Least%20Developed%20Countries/UN-list-of-Least-Developed-Countries.aspx.