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The EU ETS: A Critical Analysis

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The EU ETS: A Critical Analysis

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Abstract

Carbon markets, established via cap & trade programs, are the dominant means by which climate stabilization is currently being pursued worldwide, with many centered around the European Union's Emissions Trading Scheme. As such, a critical analysis of the EU ETS & its effectiveness is crucial to assess whether the EU carbon market is an effective mechanism to achieve climate stabilization. The effectiveness of the overall program was evaluated via a determination of whether the EU ETS, & to a greater extent the EU carbon market, has allowed for emissions reductions in line with the goal for climate stabilization set by the EU, whether emission reductions in line with the climate stabilization goals set by the scientific community were achieved, & a determination of the success of phase 1 of the EU ETS. An evaluation via these criteria indicate that the EU carbon market is a failure.

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Chapter 1: Introduction

The planet's climate and its stability are of the utmost importance for every living being that calls earth home. The natural resources and natural capital that the earth provides are necessary not only for individual wellbeing, but also for the survival and sustainability of current and future life. Because the natural world is the foundation of which all human activity relies on its preservation is crucial, and as such, climate change needs to be addressed before its effects erode the foundation of human life. The destabilizing effects of climate change include: ocean acidification, the increase of abnormal weather patterns, the reduction of arable land, a drastic cut in the degree of food resources available for consumption, mass migrations, and many health concerns (IPCC, 2019). All of these effects have broad and far-reaching impacts on the population of the planet, but especially on vulnerable populations, who live in pollutant dense regions, are already suffering from food instability, or are particularly susceptible to rises in ocean levels. The effects of climate change have always been a global concern; however, they have become a more significant concern over the years as both the population and the degree of pollution have increased, with the uptick in emissions being particularly noticeable in the late 1970s and 1980s.

There has been a staggering trend of global warming compared to preindustrial levels, with the upward trend being particularly noticeable since the 1970s and 1980s (IPCC, 2018). This time range coincides with the beginning of the neoliberal era, as well as increases in globalization and transnationalism (Harvey, 2007). This period saw several significant changes to nations' economies, including increased specialization of production and the importation of other goods or services. The change toward globalization, transnationalism, and neoliberal economic policies increased the degree of transportation necessary in the global economy. With this increase in global transportation, there was an increase in the degree of greenhouse gasses emitted, which are the key drivers of climate change (IPCC, 2018).

The rise in the level of greenhouse gases within the atmosphere are the key influencers of climate change. The most prevalent of the greenhouse gases emitted by human activities is carbon dioxide, otherwise known as CO2 (WMO, 2019). The emission of CO2 due to the human consumption of fossil fuels represents the most significant driver of the current climate emergency. Carbon dioxide in 2015 accounted for 82% of the greenhouse gas emissions in the United States (Armstrong, 2018). In degree of CO2 pollution worldwide, China, the United States of America, the EU 28, and India currently produce the most significant amount as of 2018 (Global Carbon Atlas, 2018). It is these nations, but more specifically, China, the United States of America, and the EU 28, who should bear the vast majority of the burden associated with emissions abatement; due to their advantageous financial position within the world economy. The origination of emissions within these countries vary significantly as the burning of natural gases, oil, coal, and wood are all responsible for carbon dioxide emissions, as well as the decomposition of solid waste or the production of building materials.

At low levels, these carbon dioxide emissions have a positive effect as the greenhouse gas effect is responsible for keeping the earth within warm and habitable levels; however, in excess, they further the greenhouse effect, warming the planet to a higher degree than would naturally occur at the preindustrial level (IPCC, 2019). Increasing greenhouse gas emissions are absorbed by the ocean and can at high levels cause ocean acidification, which impacts all forms of marine life as well as the populations which rely on food sourced from the ocean (Armstrong, 2018). As global temperatures rise and the warming of the ocean continues due to the absorption of the increased heat created by greenhouse gases, more water from glaciers, polar ice, and sea ice are streaming into the ocean, or taking up forms that have more volume, increasing the total volume of the ocean thus increasing sea levels (WMO, 2019). This increase in the ocean level threatens populations that reside near or on the oceanfront as well as the economic viability of many countries whose largest population centers are near the ocean. Rising global temperatures also represent a severe threat to food security, public health, biodiversity, and migration patterns.

Because of the adverse effects of climate change, there is a dire need to achieve climate stabilization to abate any further irreversible damage to the planet and its ecosystems. The primary scope in which these adverse effects from climate change are examined and resolved is through that of mainstream environmental economics.

Environmental economics, as based on neoclassical economics, treats these issues as negative externalities and overuse of the commons. The solution within this lens is an external intervention through government intervention or market mechanisms. This type of intervention allows for the establishment of a price system so to incentivize an efficient use of natural resources. There are, however, multiple approaches to solve the problem of greenhouse gas emissions or other forms of pollution, including regulation, technological innovation, performance standards, and emission pricing (Goulder, 2013). Among these options, emission pricing, solutions under environmental economics, is the most accepted means of pursuing climate stabilization within the international community.

There are two main approaches to emission pricing that receive the most attention and are being put in place more regularly, which are the cap and trade framework and the carbon or emission taxation framework. A carbon or emissions tax is a fee determined by a governing entity imposed on a polluting entity, with varying levels of scale, and is considered a command approach. The tax is determined based on the current degree of emissions produced by a participant and the price of the selected emissions, usually in metric tons, also denoted as Mt (Mintz, 2006). The focus of this thesis, though, is that of the cap and trade framework. Cap and trade establishes a cap or total amount of emissions from participants on varying levels of scale within a given time frame, and then participants may buy, use, or trade allowances to fulfill their requirements; via interaction with the carbon market. Under neoliberalism, a carbon market constitutes the preferred option to tackle climate change; this position is primarily the result of an ideological standpoint, which associates the government with political failures and markets with instruments for allocative efficiency. This preference for carbon markets is also due to the view of cap and trade programs as a means to achieve emissions abatement through balanced economic costs.

The cap that is set initially in the formation of a carbon market is determined so that participants have to exhibit moderate effort in terms of emission abatement; over time the entity regulating the program will lower the cap so polluting industries will pursue means by which to limit the amount of pollution they are producing (Horne, 2008). Within a specified period or phase of the program, there are allowances either released freely based on targeted emissions reductions or auctioned off by the governing entity in order to establish a market. Within this carbon market, these allowances can be bought and traded, thus internalizing carbon emissions into that market. As time goes on, the cap and allowances will be lowered gradually, the cost of carbon emissions increases for those businesses not making positive changes toward abatement. This form of emissions pricing is viewed more favorably, and more popularly, as it sets an absolute cap on emissions, and if polluters go over this cap, there can be additional economic consequences.

Carbon markets, established via cap and trade programs, are the dominant means by which climate stabilization is currently being pursued worldwide; due to their increasing popularity over the years. As of 2019, China, the Republic of Korea, New Zealand, the

European Union, Switzerland, Kazakhstan, Nova Scotia, Mexico, California, Massachusetts, and Oregon all either have a current up and running Emissions Trading Schemes (ETS) program or are in the process of creating a program (ICAP, 2019). Many of the programs currently in existence are based around or have taken lessons from the European Union's Emissions Trading Scheme, which is the longest-running emissions trading scheme, having started in 2005 (Grubb, 2012). As carbon markets, established via cap and trade programs, are considered the primary instrument to achieve climate stabilization, a critical analysis of the EU ETS and its effectiveness is crucial to assess whether the EU carbon market is an effective mechanism to achieve climate stabilization. The EU ETS, the focus of this thesis, was rolled out in three phases from (2005-2008, 2008-2012, and from 2013-2020) in order to allow the businesses time to acclimate to the program and allow for changes in the program in order to improve its effectiveness (Calder, 2009). As of 2017, the scheme covers around 11,000 polluters and proudly boasts 28 EU participants, as well as Norway, Liechtenstein, and Iceland (European Commission, 2017).

To achieve the objective of this analysis, this thesis is structured in the following manner. Chapter 2 will present the current scientific evidence on climate change with a focus on the mechanisms by which climate change occurs and the current state of the climate given the scientific evidence currently available. The range of options to achieve climate stabilization will be carefully reviewed to provide a review of the more extensive solutions available outside of mainstream economics. At this point, a thorough review of emissions pricing theory will be reviewed in order to build a base level of knowledge before an analysis of the EU ETS in chapter 3. Chapter 3 will conduct an in-depth analysis and critical evaluation of the EU ETS through the lens of each phase. The effectiveness of the overall program; however, will be evaluated via a determination of whether the EU ETS, and to a greater extent the EU carbon market, has allowed for emissions reductions in line with the goals for climate stabilization set by the EU, whether emission reductions in line with the climate stabilization goals set by the scientific community were achieved, and a determination of the success of phase 1 of the EU ETS. Chapter 4 will discuss the most important lessons learned from within the EU ETS from phase 1 through phase 3, and focus on the lessons the program learned from its own mistakes. At this point, the limitations of the cap and trade theory will be put forth; so that there may be a greater understanding of the pitfalls inherent within the EU ETS and carbon markets as a whole. Solutions to ongoing challenges within the EU ETS will be reviewed as well as proposed alternatives to achieve climate stabilization. Proposed alternatives within the mainstream neoclassical economic toolkit include: a pure emissions tax, a tax on varying levels, a tax with a dividend, a cap and trade model with a price floor and or ceiling, or a mixed model which incorporates both an emissions tax and a cap and a trade program. Of those options, a mixed model that incorporates a price floor and ceiling, an emissions tax placed upstream, a dividend from said tax for those unable to bear the burden, and clause that ensures no double taxing of participants is one of the more effective options. While the mixed option and many others are valid attempts and should still be pursued, there are inherent weaknesses to staying within the mainstream neoclassical economic toolkit. These weaknesses are going to be examined through a review of non-neoclassical economic climate stabilization options. Chapter 5 will provide a terse summary of findings and provide final conclusions.

Chapter 2: Background

2.1 The Science & History of Climate Change

Whether it is called global warming, climate change, or any other name, the truth is that it is a matter of scientific fact. Not only is climate change real, but the worldwide scientific community has been aware of its existence since 1824 when Jean Baptiste Fourier first described the natural greenhouse gas effect that makes the planet suitable for human life (Fankhauser, 1995). Despite being aware of the natural greenhouse effect for almost 200 years, there has been very little done to combat the impact of human-made pollution. There has been so little effort that recently, 11,000 scientists put forth their signatures to a document clearly stating that the earth is coming face to face with a climate emergency (Ripple, 2019). To build a better understanding of the climate emergency, a terse explanation of the mechanisms by which climate change occurs will be put forth, leading to a review of the current state of climate change, culminating with the effects that the climate emergency will have on the earth. By presenting these facts, a thorough motivation for the urgent need to address the climate emergency is going to be developed in order to frame better the issues that the proposed solutions will need to address urgently. This framing of the issues will start with a review of the greenhouse gas effect.

The natural greenhouse gas effect occurs very similar to that of a greenhouse, wherein the sun shines down its rays, which then passes through the glass of the greenhouse, which in turn warms the air inside, which is now trapped via the glass of the greenhouse. Through this process, plants that would not otherwise be able to grow in certain climates are now able to grow even in cold or harsh climates, and by a somewhat similar method, the entire earth benefits from the natural greenhouse effect. In the case of the natural greenhouse effect that warms the earth, the glass in the previous metaphor is replaced by carbon dioxide, methane, nitrous oxide, and other gases (WMO, 2018). It is through these facets and other natural factors that the rays of the sun enter the greenhouse and prevent the outgoing infrared heat from escaping, which keeps the earth at a suitable temperature for life.

The natural greenhouse effect is hugely beneficial to life on earth from almost any perspective one looks at it; however, the impact of humans has drastically altered this natural process. The idea of human consumption impacting the natural greenhouse effect was first put forth in 1896 by Swedish scientist Svante Arrhenius, who theorized that the consumption of coal in the industrialization process would produce a higher degree of carbon dioxide and thus warm the earth to a greater extent (Fankhauser, 1995). Since 1896, the number of humans alive has drastically increased along with the consumption of coal, wood, and oil, which has only further increased the strength of the greenhouse effect. Along with the growth of the human population came increased consumption habits fueled by better standards of living and the expectation of increasing standards of living. Despite a long history of human life on earth, the industrialization process marked the first notable impact from humans on the greenhouse effect, and created an excess of warming than would occur naturally without industrialized contributions (Armstrong, 2018). The industrialization process contributed and currently contributes to climate change through a variety of factors, including human-made chemical compounds which have directly damaged the ozone layer and contribute to the human influenced greenhouse gas effect.

The natural greenhouse effect does indeed cause global warming, or climate change, via natural mechanisms; however, the concern over climate change and the climate emergency is due to the human impact on this natural process. There has never been a higher number of humans present on the planet, and as such, there exists a notable human impact on the natural processes that take place to keep the earth habitable. Since the discovery of the greenhouse gas effect, there has been a large number of scientists who have produced complex models to estimate the effects of greenhouse gases in the past, present, and future. These models, which are systematically updated, have shown that the human influenced greenhouse gas effect poses a threat to the global community (IPCC, 2018). There have been many meetings with world leaders to discuss this concern, starting with the first of its kind, the World Climate Conference in 1979, where there was an agreement that there should be urgent action on climate change (Ripple, 2019). Despite these agreements, warnings from the scientific community on a worldwide level, and the knowledge of this issue dating back to 1896, there has not been swift progress to address the climate change emergency. The lack of urgent action on the climate emergency is further exacerbated by the long lifetime of greenhouse gases already in the atmosphere. The aim to stabilize current emissions levels is critical; however, even if the world froze emissions levels, the current greenhouse gases in the atmosphere would still persist for a long time; due to the long half-life of such gases (IPCC, 2018). Because of the prevalence and persistence of such greenhouse gases in the atmosphere, post emissions freezing, there needs to be immediate action to address the climate emergency.

There needs to be a coordinated, international effort to address the possible damage to the earth's climate stemming from climate change; otherwise, there will undoubtedly be catastrophic impacts on society, the climate, and the natural ecosystem (IPCC, 2019). One of the links between the climate emergency and humankind is the overconsumption of wealthy lifestyles. The most prosperous nations are primarily responsible for historical greenhouse gas emissions and, in most regards, have the highest per capita emissions worldwide (Ripple, 2019). The desire for a better standard of living is understandable, and one might even hold the assumption of a better standard of living for their children to be a reasonable one; this is wholly different, however, than the pursuit of a wealthy lifestyle at the expense of society at large. By providing or seeking to obtain an overindulgent lifestyle with overconsumption, both nations and the individuals within them are not examining the social costs of their actions and shifting the burden to the world at large.

Historical emissions levels indicate more financially affluent countries are chiefly responsible; however, emissions from emerging countries have rapidly accelerated; as can be seen by the inclusion of India as one of the top 5 polluters worldwide. As of 2018, China, The United States of America, the EU 28, and India are the largest CO2 polluters collectively producing 59% of the total emissions in 2018 (Global Carbon Atlas, 2018). Without useful contributions from these emitters, any attempt at global climate stabilization would fail. Internationally, countries have committed to emission reductions through international agreements, such as the Kyoto Protocol in 1997 and the Paris Climate in 2015 accord such promises were made to address climate change. Unfortunately, a lot of these promises were temporary, or turned out to be inherently flawed by their design or through their implementation. Depending on their design, cap and trade or carbon tax programs can be flawed in that they do not establish a socially optimal price for carbon or other emissions and can, at worse pass on the social cost of pollution solely onto the consumer instead of upstream closer to the site of pollution. Depending on which emissions abatement scheme a nation chooses to participate in, there are a myriad of potential issues that can present themselves with the first and foremost being selling such an emissions abatement plan to the public at large.

2.2 The Current State of Climate Change

The world at large has a general policy of conducting business as usual when it comes to climate change. This tendency to conduct business, as usual, has resulted in levels of carbon dioxide, methane, and nitrous oxide of "146%, 257% and 122% higher than preindustrial levels (before 1750) in 2017" (WMO, 2019). The increased prevalence of greenhouse gases over pre-industrial levels has caused numerous negative impacts on the world at large, the most visible being rising temperatures. As of 2018, human-related activities have caused 1.0°C of worldwide warming, with a range from 0.8°C to 1.2°C, compared to preindustrial levels and there is a high likelihood of reaching 1.5°C during 2030-2052 if current levels of emissions continue (IPCC, 2018). Of particular concern in relation to the climate crisis is that of climate tipping points due to the inertia of climate change and feedback mechanisms. These tipping points are like falling dominos wherein once one is pushed over, there will be no turning back the clock on specific changes, which could lead to a planet whose catastrophic warming is beyond human control (Steffen, 2018). The reaching of these tipping points is the worst-case scenario and will not occur if action is taken to correct the current trend of global climate change. The trend of ever-accelerating global climate change can impact food security, the ocean, public health, and migration through numerous routes.

2.2.1 Food Security

Climate change has impacted global food security due to changes in global weather patterns and the increase of severe weather patterns. These changes are resulting in lower yields of corn and wheat in low latitude areas, while those in higher latitude regions have seen increased crop yields in those very same crops (IPCC, 2019). Ultimately, this means that the global south will see decreased agricultural production if climate change continues on its current path. Extreme weather patterns and increasing climate variance were compounding factors behind current rises in hunger levels within 26 of 33 countries; and the leading cause in 12 of 26 countries who had food crises in 2018 (WMO, 2020). This is important because the strength of the food supply looking into the future is estimated to be reduced by the increase in extreme weather patterns and decreases in the nutritional value of crops; due to increased carbon dioxide levels at the atmospheric level (IPCC, 2019). Unfortunately, nations with an already high sensitivity to precipitation levels, high-temperature variation, and who already suffer from drought will be hit the hardest in terms of agricultural production capability loss (WMO, 2019). The decrease in production capability loss is only compounded by an ever-growing human population.

The demands brought on by an ever-increasing population have increased the need for agricultural land and forestry and have supported the loss of natural capital and ecosystem services, the accumulation of greenhouse gases in the atmosphere, and the loss of current sinks. Sinks are natural parts of the environment, such as vegetation and the ocean, which absorb emissions as part of the natural regulation process of the earth's climate; unfortunately, the destruction of these natural sinks can then release these captured emissions. This is of particular interest due to ever-increasing demands for arable land and food from agriculture practices, as old sinks are disturbed in order to meet current demand. The destruction of natural sinks in order to free up arable land and meet current food demands may not be necessary. Looking at the food supply and consumption habits from 1961 to 2019 it can be seen that the supply of meat and vegetable oils per capita has more than doubled and the supply of calories has increased close to one third; however, a quarter of the total food produced worldwide is lost and or wasted (IPCC, 2019).

This seems to indicate that there are unnecessary losses and that land repurposed for agricultural use, to some degree, is not necessary considering a quarter of the current food produced is lost or wasted. This is especially concerning when drought and erosion prevention, as well as greenhouse gas absorption factors, are taken into account in deciding whether to appropriate land for agricultural use. Almost a quarter of human-induced greenhouse gas pollution ranging from 2007 to 2016 was due to forestry, agriculture, and other uses, which highlight the unsustainability of current land use and consumption habits with regard to current climate change projections (IPCC, 2019). Current conventional agricultural practices put too much strain on the available arable land, and then seek previously undisturbed land, in order to produce food in an unsustainable manner that will at best be lost while those in need of food go malnourished. Despite food waste and poor agricultural practices, there have been significant reductions in world hunger due to increased gains in the agricultural sector, these gains are being threatened by emerging extreme weather patterns with a new rise in worldwide hunger after a long period of decline (WMO, 2019). Overall, there needs to be reductions in emissions, increased efficiency in food distribution and consumption, and a move toward agricultural practices that are environmentally restorative if climate change and world hunger are to be solved.

2.2.2 The Ocean

Ocean warming, caused by climate change, can increase deoxygenation, stratification, and acidification, which all together can lead to a decrease in biodiversity, coral bleaching, a rise in infectious diseases, and a redistribution of habitats (WMO, 2020). The impact on the ocean via climate change can be seen by looking at the melting of sea ice. Currently, sea ice is melting faster and to a higher degree than seen before, and as a result, there has been a decline in the summer sea ice in Greenland and the Arctic (Ripple, 2019). The global sea levels rise when melted ice, originating from land, finds its way into the ocean, or sea ice melts, taking up a state that has a higher volume. This is of importance because global sea levels are one of the best worldwide climate indicators, and currently shows that the sea level is continuously rising at an accelerated rate; with global mean sea levels for 2018 being 3.7 millimeters above the year prior and the highest on record (WMO, 2019).

The rate at which global sea levels rise is of great importance, particularly for coastal populations. The rate at which climate change continues to grow will predict the rate that sea levels will rise, with warming of 1.5°C resulting in a 0.1 meter lower rise compared to 2°C by 2100 (IPCC, 2018). By anticipating this change in the sea level and providing those impacted by rising sea levels the ability to migrate, adapt, or mitigate their risk, it is possible to prevent a significant degree of the impact this change may have. While preventing these negative impacts from happening at all is the optimal response, attention should always be paid to mitigation and adaptation in order to prepare for the worst possible climate change pathway. Unfortunately, adaption and mitigation cannot be enacted to prevent the loss of natural resources and capital in the form of total fish stock, and coastal resources such as coral reefs. Rising sea levels are a significant concern and an urgent matter to address, in addition to ocean acidification and salinization.

2.2.3 Public Health & Migration

The changes in the world's climate can increase both internal and external migration as past ways of life, livelihood, and food availability are threatened via climate change (IPCC, 2019). As of September 2018, over 2 million internally displaced persons reported being displaced due to issues related to climate and or extreme weather events, with storms, floods, and droughts being responsible for the most significant degree of natural disaster displaced individuals (WMO, 2019). In 2019 alone, over 6.7 million people were internally displaced, starting in January and ending in June, due to environmental factors, with it expected to reach 22 million by the end of 2019 (WMO, 2020). These internally displaced individuals are susceptible to new risks and are extremely vulnerable to further climate-related disasters, quality of life issues, health issues, and have a reduced capacity to mitigate risk due to their new surroundings and lack of resources. The mental impact of climate-related displacement through flooding, air pollution, drought, wildfires, and hurricanes cannot be overlooked, as these can cause detrimental health impacts for many years post original displacement (Armstrong, 2018). For these reasons, internally and nationally displaced individuals need to be provided appropriate resources in order to ensure their success and the reestablishment of their capacity; in order to return to their steady-state. Returning to a steady state where one's quality of life is the same as before displacement and their capacity to mitigate risk is once again restored is a difficult task and one even more difficult for women, children, and the elderly due to increased risk levels.

Climate-linked displacement, as previously mentioned, can be very direct when viewed in the form of a drought, hurricane, flooding, or loss of arable land. However, human migration resulting from climate-linked issues can also appear as civil war, political unrest, a revolution, ethnic cleansing, and a myriad of other issues. While at first glance, it may not be obvious how these social issues may be linked to climate change or extreme weather events, social issues can be exacerbated or created by climate change. A prolonged period of drought can cause civil unrest directed at the government, or the blame for the prolonged drought may be falsely placed at the feet of a racial or religious minority, thus forcing individuals to be displaced. Another prime example of climate-linked displacement would be overcrowding in more urban central cities within a nation, due to flooding in the mountains or extreme storms by the coast, which puts excessive pressure on urban cities and causes civil conflict to sprout. In some of the examples presented, and others present in the world, climate change-related events can interact with already occurring conflicts as a sort of multiplier or bring about new conflict at the intersection of climate change events and conflict. A prime example of this would be Somalia in 2018, when a number of fast-paced and slow-onset climate events built on one another and then were compounded by conflict in the area, which lead to 1.1 million persons being recognized as internally displaced (WMO, 2019). In this way, climate change can be linked to many forms of displacement, whether directly or indirectly.

Another example of climate-linked displacement, and the vulnerability faced by those individuals, is the humanitarian crisis that has and continues to occur to the Rohingya refugees. The Rohingya were pushed out of their original homes and, after their displacement in 2018, were impacted by a secondary displacement, from extreme weather patterns that resulted in landslides and large scale flooding, with estimates indicating that 200,000 of the 900,000 refugees were exposed to these harsh weather events (WMO, 2019). These individuals that had already suffered due to their original displacement did not have or did not yet regain the necessary capacity to cope with the extreme weather events that they were faced with, and as a result, suffered a secondary displacement. This cycle of displacement can continue indefinitely or result in refugees living in areas where they may never regain their original capacity to reduce their disaster risk and rebuild their resilience, which can cause these displaced persons to never return to their steady-state capacity. Quite simply, the effects of climate change will increase as long as emissions continue to rise year after year, and, as such, it should be expected that climate-related displacement and migration will rise at an increasing rate (IPCC, 2018). While the negative impacts of displacement and migration due to climate-linked events are essential to the overall health of these, and all, individuals will continue to suffer at large due to climate change.

Climate-related events are increasing in prevalence and are particularly impacting public health at large through mechanisms such as heat, and air quality. Warming trends around the world are increasing, with 2019 likely to be the second hottest year on record with above-average temperatures being commonplace, with the last five year averages being the hottest years ever recorded (WMO, 2020). The current scientific literature on heat shows that since the pre-industrial period, ranging from 1850 to 1900, the mean land surface air temperature has been rising at a higher rate than the global mean surface temperature, which encompasses both land and ocean (IPCC, 2019). This warming trend indicates a higher prevalence of heat-related events such as heatwaves and droughts over land (WMO, 2019). Of specific concern is the increase in the number of hot days in all regions with the effect being especially pronounced in the Tropic and Sub-Tropic areas (IPCC, 2018). These land air warming trends are particularly concerning considering in 2015, 500 million people resided in areas that were impacted by desertification that had occurred from1980-2010; of those areas mainly were the Middle East as well as South and East Asia (IPCC, 2019).

While many other aspects of climate change are extremely important, the impact of heat and heatwaves cannot be understated, due to heat's impact on human health, agriculture, water supply, and livestock. From 2007-2016, the number of people impacted by heatwaves rose by 125 million, with 175 million during just 2015 being exposed to 627 heatwaves, compared to the time period from 1986 to 2008 (WMO, 2019). These effects are felt harder in lower latitude regions in addition to areas where heat waves and prolonged droughts are already frequent. Heat can also act as a multiplier worsening already occurring health conditions, causing civil distress, or bringing about heatstroke in affected individuals (IPCC, 2018). Air quality, heat, and climate change may often be explored through different lenses with somewhat different policy, government, social, and business responses, however, they are indeed linked.

This link starts with air pollutants that are directly introduced via human activity and damage the ozone layer, thus resulting in increased global warming levels and declining air quality. In this way, air quality and air pollutants are linked with climate change and can have a tremendous impact on the environment and human health. Air pollution is not just a concern outside but also inside the home. It is estimated that 90% of urban residents are breathing polluted air that well exceeds the levels of pollutants set by the WHO, and that the combined effects of outdoor and indoor air pollution is the second-highest cause of death not linked to communicable diseases (WMO, 2019). Air quality is crucial to the health, development, and happiness of every human and, as such, addressing air pollutants both within and outside urban areas is a matter of urgent concern, especially as these air pollutants can have long-lasting impacts on climate change.

2.3 Perspectives on Environmental Problems

2.3.1 Free-Market Environmentalism

The first of these theories to be explored will be that of free-market environmentalism, whose supporters primary focus is a complete system of property rights and the increased use of free-market mechanisms to solve the issues of resource use and pollution (Harris, 2018). Free-market environmentalists believe that if property rights are well defined, and there are no, or low, transaction costs involved in mediation that the correct distribution of natural resources will be achieved (Hahnel, 2014). This relies heavily upon the assumption that there will be no transaction costs incurred in the form of court fees or any other costs involved in the mediation process between the respective parties. One such example of the actors that may be involved would be that of a polluter upstream of a creek and that of a farmer downstream, who may be suffering from said company's polluting. If property rights are well assigned, it should be self-evident who has the right to pollute and who has the right to be free of pollution; which in and of itself is a rather large assumption. If these two parties could not determine the proper allocation of property rights from the start, then they would wish to enter some sort of private arbitration process through a medium that would not incur any transaction costs. In this case, the transaction costs that do not exist would be that of court fees, the hiring of a representative such as a lawyer, any costs involved with arriving in court, and the time spent within this process (Hahnel, 2014).

Another assumption within free-market environmentalism is that even if property rights are properly assigned, and transaction costs are zero, there can still be pollution; which implies that human and natural capital can be sustained in the presence of pollution. If, for example, a company upstream has the right to pollute, they may freely continue to pollute, in which case there would be social costs, as that pollution is not limited to merely the farmer downstream, but rather the whole world. However, if property rights are assigned to the farmer, it may still be possible for the company to pollute provided they adequately compensate the farmer, in which case there is still a net positive pollution output. There is also the issue of multiple parties being involved in the arbitration process wherein the upstream pollution impacts the farmer but also all the families that rely on the creek for clean drinking water, thus involving a growing number of impacted parties. In such an instance, with perfect property rights defined and zero transaction costs, there could still yet be an issue with holdouts who may be looking to maximize their payout from the company, thus complicating the arbitration process (Hahnel, 2014).

2.3.2 An Ecological Perspective

An ecological perspective differs significantly from many other fields in that it views the economic system as a subset of a broader ecosystem that is governed by biophysical laws, sustainability is defined in ecological terms rather than economic terms, and there is a belief in the use of methodological pluralism (Harris, 2018). This view of the economic system as a subset of the higher system is a crucial factor in the ecological perspective, as there are no particular economic principles to this perspective. This framework of thinking heavily relies on a wide range of ideologies and theories as opposed to that of free-market environmentalism, which focuses purely on the economic perspective of climate change. On example of this is the belief in an inherent value of a facet rather than strictly an economic value. Their proposed ideas include putting the natural world first through the introduction of alternative measures other than GDP. One such measure is that of sustainable yield levels, which measure the degree of natural facets that can be harvested without depleting their stock and absorptive capacity, which measures the ability of the natural world to harmlessly absorb the waste of human production (Harris, 2018). By incorporating this measure and many others into national accounting, the hope is to focus on the world's economic system on the natural world instead of the financial. The ecological approach also approaches human capital, natural capital, and their view of the world differently; through the full world rather than empty world economics.

Empty world economics, within the ecological perspective, is the outdated idea that there is an overabundance or limitless supply of natural capital and that the impact of humans on the natural world is relatively small; if not none at all (Hahnel, 2014). While this idea may have been the case many years ago before the industrial revolution, it is clearly not the case and should not be used to inform policy and consumption decisions. Full world economics, on the other hand, is the belief that humans do have an impact on natural capital and that there are limits to growth and expansion, also known as natural limits (Costanza, 2014). While this may seem like a simple idea, it can be a somewhat contentious point between those who follow the ecological standpoint versus those who center their focus on the economy.

Another idea that the ecological perspective disagrees with is the substitutability of natural capital with human capital (Harris, 2018). Examples of this may include replacing the ecosystem services offered by bees, marshlands, or trees and shrubbery with those of human capital. Bees, which are an essential facet of agricultural production, could be replaced with drones that may accomplish the same job, while marshlands may be replaced with a water levy in order to prevent flooding. Trees and shrubbery, which may prevent soil erosion and therefore land/mudslides could be replaced with concrete stabilizers in order to prevent said landslides. Although based in the neoclassical framework, one of the more popular solutions that the ecological perspective pushes for is that of absolute decoupling. Absolute decoupling would see an increase in economic growth is linked to a decrease in adverse environmental effects, with this approach being progressive and restorative nature compared to relative decoupling (Costanza, 2014).

2.3.3 Traditional Environmental Economics

Environmental economics is mainly the study of how the environment and the economy interact through pathways such as policy, production levels, emissions levels, and human health. The main principles of environmental economics includes the theory of environmental externalities, the management of common property and common goods, natural resource management over time, and the economic valuation of the natural world (Harris, 2018). In neoclassical foundations based environmental economics, the environment is treated as an externality, meaning that any positive or negative impact on or from the environment is not directly accounted for; while environmental problems are treated as market failures. An example would be the cost of pollution not being accounted for in the cost of a good such as gasoline, paper, electricity, or a cell phone, which leads to an increase in social costs. Social costs are things like increased air pollution due to fossil fuels, less green space for recreational use, or a decrease in the supply of fish in the ocean. These costs impact individuals on the micro and the macro level, with mainstream environmental economics' most popular solution to these issues is to internalize these externalities. This can be accomplished through an emissions pricing framework with a cap and trade program or an emissions tax. Both of these mechanisms broadly operate the same in that they establish a price on emissions; however, the approach each takes is entirely different, with each having their own positives and negatives.

2.4 Options to Combat Climate Change

There are more ideas on how to combat change than there are rays of the sun beating down on the earth. However, not all of these ideas are equal, with a number of solutions not taking enough action against climate change, some remain unpopular to world governments, for some the theoretical foundation behind them may be flawed, or they may rely on hopeful expectations of future technological improvements. For these reasons and many more, a small review of current options to combat climate change will be examined, including those of which are currently most popular in the international community, such as emissions pricing theory and the many forms this may take. After these policy initiatives which address issues related to consumption habits, reducing emissions, transforming the energy sector, the protection of nature, agricultural food production, and the growth imperative of the current economic system is going to be examined.

2.4.1 Policy Options

The type of energy used and the consumer's consumption habits need to change in a transformative way towards efficiency and reduced use. The most prevalent greenhouse gas emitted is that of carbon dioxide whose production can be linked to the burning of natural gases, oil, coal, wood, as well as the decomposition of solid waste, and the production of cement which respectively accounts for 5% of global CO2 emissions (Armstrong, 2018). Reduction in the use of fossil fuels is one of the main policy initiatives that should be pursued in an equitable manner, with wealthier countries supporting less wealthy countries' transition away from more polluting energy sources. Assuming that there are remaining stocks of fossil fuels left in the ground, they can be preserved indefinitely or used sparingly in a way that supports select areas of the world where access to renewable energies is currently impossible or unfeasible. Along with the reduction of fossil fuels, there needs to be a policy put forth that expands the reduction of other harmful pollutants such as hydrofluoric carbons and methane. The reduction of emissions is essential for the protection of the planet's ecosystems, which help support human life.

Many ecosystems and animals that provide essential natural capital and ecosystem services are being threatened by climate change and human activity, such as the Amazon rainforest, coral reefs, forests, wetlands, peatlands, and the very soil which is responsible for nutrition and food supply. The human race needs to establish and enforce protections in these areas in order to prevent the rerelease of carbon from sinks and preserve the ability for future generations to have access to these vital ecosystem services and natural capital. This may take the form of intergovernmental protections being established for endangered areas, special protections being implemented, or a universal agreement to reduce the human impact on nature as a whole. Of great importance is the preservation of forests and the reforestation of previously destroyed areas. This increase in forestation increases the carbon sequestration capacity of the planet and, in turn, helps to mitigate climate change. These protections and policy initiatives need to be implemented on a global scale; otherwise, there will inevitably be issues of equity and the possibility of free riders who hope to avoid the temporary costs associated with these initiatives. In a very similar manner, consumption habits worldwide need to change in regard to food, the economy, and population growth.

There is an ample supply of food and calories currently present in the world; however, there are issues of accessibility, food loss, and overconsumption. Shifting away from western diets and toward food consumption patterns that support a more balanced diet with an increase in fruit and vegetable consumption and a decrease in animal products can positively impact health and reduce emission levels (Ripple, 2019). The reduction in the consumption of animal products will free up previously used pasture land for the use in sustainable growing practices to support the increased consumption of fruit and vegetables. This simple change in consumption patterns has the potential to impact emissions on a large scale, especially when combined with a reduction in overall consumption patterns. In some areas of the world, the encouragement to consume goods and services in order to be a productive member of society, or to display one's affluence, has impacted the climate in a negative way and needs to be combated through social change.

This would look like using electronic products for much more extended periods of time instead of opting for a new device, repairing old and or damaged products for further use, traveling in a sustainable way via public transportation options, and not consuming food in excess or wasting it. These are only some of the small ways changes can be made in order to decrease emissions levels. The primary means which this needs to occur is through a shift away from an economy focused on GDP growth and toward an economy whose focus is on improving human wellbeing, with the least impact possible on the natural environment through relative or absolute decoupling. On a larger scale, this would look like a reduction in the extraction of natural capital and the overexploitation of the natural world in order to drive fruitless and inequitable economic growth. The focus of the world economy should be reducing poverty, improving global health standards, increasing education levels, preserving the natural world for future generations, and increasing overall human wellbeing. By increasing access to healthcare, raising living standards, increasing human rights, and increasing education levels, there will also be a decrease in the rate of population growth, which benefits sustainability efforts and reduces the rate at which greenhouse gas levels are rising (Ripple, 2019). In addition to policy initiatives, there are also many different frameworks that address how best to handle climate change, including that of environmental economics, ecological economics, free-market environmentalism, and many more.

2.4.2 Emissions Tax

An emissions tax is a way to internalize the cost of pollution; through a command approach. An emissions tax is often referred to as a carbon tax, as it is usually placed on carbon-producing fossil fuels. Depending on where the tax is placed, the idea is to disincentive the use or extraction of pollution while promoting energy conservation and the movement toward alternative energy sources. The rate determination of the tax is dependent on multiple factors and may need to be adjusted over time. There can be issues of feasibility when it comes to implementing an emissions tax, as in general, taxes in many places are not considered a positive change, with the feasibility issue being much more pronounced depending on the tax rate determined. Solutions to solving the feasibility and who bears the burden of the tax can be resolved through certain design elements.

One such solution is to allocate the tax revenue from the emissions tax to lower other taxes, such as social security taxes, thus possibly making it a more politically neutral idea and making it a tax neutral policy. Another idea along a similar vein is to have an emissions tax with a dividend in that the tax revenue would be distributed to those individuals who are most impacted by the tax. This would ideally see those individuals with lower income receive support from the dividend in order to alleviate some of the tax burden that would inevitably be passed onto the consumer from those producers who are being taxed. It is important to note that an emissions tax should not be placed directly on the consumer but rather on producers and those who are extracting fossil fuels; this is known as an upstream tax (Harris, 2018). Because these producers and extractors will likely choose to pass on the price of the emissions tax, a dividend sort of system or a tax cut on some other tax is needed in order to prevent the consumer from bearing an undue burden. Admittedly, some of the burden being passed on to the consumer is an integral part of an emissions tax, as it can shift consumer behavior; however, that burden should be equitable and manageable. For many income levels, a small increase in price being passed on from the producer to the consumer will not impact them in no small degree; however, there are those who cannot. Because there are individuals who cannot bear the weight being passed on to the consumer, there has to be policy to protect these individuals from an untenable burden, or the emissions tax needs to be designed with equity in mind.

2.4.3 Cap & Trade

A cap and trade program acts very similar to an emissions tax in that they both aim to reduce emissions by internalizing the negative externality that is pollution; however, a cap and trade program sets an absolute cap on emissions while an emissions tax does not. The cap referred to in the cap and trade theory refers to the limits of emissions within a given time period from participating entities. The cap that is initially set is determined so that participants have to exhibit moderate effort in terms of emission abatement, and over time the cap will be lowered, thus encouraging polluting industries to reduce their emissions (Horne, 2008). The means by which they seek to limit their emission can be through technological innovations, conservation efforts, the use of renewable energy, or changing their production methods. The entity overseeing the program, however, does not choose the means by which this reduction takes place, but, if they so choose, the governing entity can offer up solutions.

One of the benefits of the cap and trade system is that the entity setting the cap can focus on the issue of global climate change while making the polluters responsible for their activity. Ideally, this plan would encourage companies to pursue clean energy initiatives, energy efficiency, and other activities that would have a positive impact on the environment. It is up to the governing entity to determine which sectors to focus on in terms of cap and trade regulation, such as electric generation, construction, or transportation sectors. It is also possible to make the program voluntary or government-mandated, depending on what is more efficient.

Once the participants have been determined for the program, the overseeing entity will then determine each business or sectors emissions levels through self-reporting or through monitoring; ultimately, this is determined on a case by case basis. The allowances that will be issued in the future will be based on these levels of emissions, with the emissions usually being measured in Mts. The governing entity then decides how to allocate these permits through free or auctioned allocation. In free allocation, permits are given to sectors of the economy based on the targeted sectors or based on the sector's output; as such, business sectors that are responsible for 10% of the output in the economy would receive 10% of the allocated allowances. In the auctioned allocation method, participants in the program buy allowances through an auction whereby companies that pollute less would pay less for these allowances. Through the auction allocation method, additional revenue is generated for the governing body for the purpose of funding low carbon investments or other projects (Harris, 2018). Whichever decision the governing body makes, the number of permits allocated to the participants is extremely vital in determining the market price established for emissions.

Once the allowances have been tallied out or auctioned off, participants who will go over their emissions cap will have to purchase allowances from under polluting companies or face a financial penalty. The financial penalty would, of course, have to be set at an adequate level in order to encourage participation in the market rather than facing the penalty. These carbon allowances represent one Mt of emissions, but they can also measure the value of emissions offset by projects commonly known as carbon offsets (Calder, 2009). Carbon offset projects are an alternative available in some program designs and often are undertaken when polluters either do not have the proper number of allowances, or find it cost-efficient to pursue carbon offset projects. Some examples of carbon offset projects would be renewable energy projects, reforestation, or funding efficiency upgrades for other businesses at a lower cost.

The idea is that carbon offset projects benefit the seller and the buyer in that the polluter benefits from reducing carbon dioxide production, and the seller gains funding for the aforementioned projects. Of course, some projects are more beneficial to the environment, such as the funding of renewable energy projects like hydroelectric dams, wind energy, or solar energy. This is in part because the carbon sequestration gained from the reforestation projects could be displaced or released in the future due to future harvesting decisions. Additionally, projects that reduce greenhouse gas emissions but are cheaper, such as the purchase of technological improvements for a different polluting sector, are generally considered a cheap way of getting out of producing real change in the sectors that need to reduce pollution. The alternative options, such as reforestation or technological improvements in a different sector, are generally the projects that receive funding, rather than clean energy investment.

Once companies have determined whether or not they will reduce their emissions by buying allowances or through carbon offset projects, the market will have been established. The carbon market will ideally be influenced by the forces of supply and demand, which means with fewer numbers of allowances or offsets, the price of emissions will increase with demand. While it may be easier for companies to purchase carbon offsets initially, the idea is that as the demand for carbon offsets increases as the cap is reduced, the price will go up, eventually making it cheaper for businesses to reduce their own emissions rather than purchase offsets or buy allowances. It is because of this that the cap and trade model is generally considered a cost-effective way to reduce the emission of greenhouse gases.

2.4.4 Cap and Trade vs. Emissions Tax

An emissions tax and a cap and trade program both have their benefits and can both potentially contribute to the reduction in emissions; however, they both have the potential to make no impact. There is much debate surrounding whether or not a cap and trade program or a tax is the right way to pursue emissions reductions. Both of these options can limit emissions, generate revenue for the governing entity, and they both have the potential to raise consumer's prices. An emissions tax, while less popular due to the inclusion of the word tax, is, in some sense, more straightforward and more accessible for individuals to understand and therefore manage. The issue of the tax is in the determination of tax rate itself, and if not correctly adjusted frequently, the tax may be too overbearing on the economy in the opinion of private firms, or it may be too lax, resulting in no meaningful emissions reduction. A carbon tax is relatively quick to implement, given that the tax rate was determined correctly, and because of this, it is uniquely equipped to impact climate change rapidly. Furthermore, if the tax rate is guaranteed for a specific time period, it allows businesses and consumers to plan for the future and adjust to the tax ahead of time, which would provide some security for those individuals. Targeting a specific emissions reduction goal within the framework of a tax could prove rather tricky because the tax operates as a disincentive to consume, but the degree that consumption is reduced will not be indeed known until after the tax is implemented.

A cap and trade program, on the other hand, is much more accessible, in part because it does not include the word tax, but also because the emissions reductions target can be set directly by the administrators. By determination of the cap, and proper management of the allowances, there can be a guaranteed reduction in emissions compared to the hope of emissions reductions with a tax. While a tax may need some adjustment, a cap and trade program may need constant adjustments and perhaps the governing entity stepping in to maintain price levels in order to ensure emissions reductions. One of the benefits of cap and trade is that it encourages technological innovation in green technology; however, this may possibly lead to a reduction in the price of emissions; without a reduction in the cap and allowances (Harris, 2018). In short, a cap and trade program guarantees a specified reduction in emissions but requires constant oversight, while a carbon tax does not guarantee a specific emissions reduction; however, it is easier to adjust and can provide more price security.

Chapter 3: A Critical Analysis by Phase

3.1 Phase 0

The European Union's Emission Trading Scheme, also referred to as the EU ETS, can trace its roots back to the 1997 Kyoto Protocol, also known as the KP, which at the time set legally binding emissions abatement goals for 37 countries and illustrated the need for policies to be implemented in order to reach these goals (EU Commission, 2020). The EU ETS became and currently is the primary means by which the EU addresses its international environmental commitments. The scheme's primary objectives are the reduction of emissions balanced with economic costs, to raise revenue for the investment in low carbon technology or energy efficiency programs, and to help contribute to the EU's commitments to developing countries through the Clean Development Mechanism (Grubb, 2012). The program's inception began in 2000 when a green paper was published on the possibility of an emissions trading scheme that would focus on complimenting other existing schemes and meeting the targets set by the Kyoto Protocol (Ellerman 2016). Later, in 2003, the Emission Trading Directive laid out the features of the scheme with the first phase running from 2005 to 2007 with 95% of the allowances freely allocated and would precede the full implementation period which would span from 2008 to 2012 where 90% of the allowances would be allocated freely (Delarue, 2008) (Ellerman, 2016).

In 2004, the previous directive was amended by the inclusion of a linking directive that allowed facilities to substitute a predetermined number of allowances with Clean Development Mechanisms that take place in less industrialized countries not signed on to the KP, and Joint Implementation credits that take place in industrialized countries (Ellerman 2016). These CDM and JI programs are alternatives to reducing emissions for polluters and often are undertaken when businesses find it more cost-efficient to use carbon offset credits as opposed to the purchase of allowances. Examples of carbon offset projects are renewable energy projects, reforestation, or the funding of efficiency upgrades for other businesses. Of course, some projects are more beneficial to the environment, such as the funding of renewable energy projects like hydroelectric dams, wind energy, or solar energy compared to reforestation.

These renewable energy projects are considered very viable and beneficial to the environment, while the planting of trees for reforestation is considered less viable due to possible afforestation in the future. The alternative options, such as reforestation through CDM programs or technological improvements in a different sector through JI programs, are generally the projects that receive funding rather than clean energy investment; this is due to their cost-efficient nature. The location of these programs is also essential as they are required to take place in countries not currently signed on to the Kyoto Protocol and are defined as less industrialized per the international standards (Calder, 2009). After years of debate and building the program’s parameters from scratch, the EU ETS was rolled out in three phases from 2005 to 2007, 2008 to 2012, 2013 to 2020, and from

2021-2030 in order to allow business to acclimate to the program and allow for changes in the program to improve its effectiveness over time (Calder, 2009).

3.2 Phase 1 2005-2007

The EU ETS started in 2005 and was aimed at 10,500 businesses ranging from power plants to energy-intensive industries that produced the most substantial carbon dioxide emissions within the EU (Calder, 2009). Within the energy sector, power stations with less than 20 megawatts thermal rating output were included, and within the industrial sector, iron and steel plants, cement, lime, gas, paper, pulp, ceramics, board, oil refineries, and coke ovens were covered under the phase 1 cap of 2,096 Mts of CO2 (ICAP, 2019). During this phase, 95% of allowances were allocated to sectors for free, and the penalty for non-compliance was 40 euros per Mt (EU Commission, 2020). This represented the price of ensuring a high participation rate during the first trial phase of the program. At this point, the UK Environmental Agency was in charge of policing the program and responsible for directly contacting the businesses involved to ensure the program was proceeding as planned, though the businesses emissions were verified by an independent third party (Calder, 2009). This would later be revised in order to ensure that there would be no bias from the policing entity. During phase 1, the use of Joint Implementation and Clean Development Mechanism credits was unrestricted (ICAP, 2019). Again, this represented another price of participation, but this also allowed countries to pursue meeting their Kyoto Protocol goals through these mechanisms. At this point, the scheme was up and running with the program acting as a sort of compilation of multiple emission trading schemes with a somewhat overarching framework.

Phase 1 of the program can best be thought of as a linking system of states where each state would individually set their own cap and disbursement of allowances, providing these National Allocation Plans were not denied by the EU Commission (Ellerman, 2016). The scheme was mainly the sum of a number of different caps which had to meet the overall governing requirements. These businesses within each state have to submit one allowance for each Mt of CO2 pollution produced with the possibility to trade and buy allowances in order to pollute over their original yearly allocation. In this way, it opens up the opportunity for businesses to reduce their emissions under their cap and then sell those allowances in order to make a profit by assisting over-emitting firms. Even if over-emitting firms do buy allowances on the market in order to make up for their over pollution, the overall cap on emissions will still be met if the number of allowances is appropriately determined. The critical component of the program working correctly is the proper determination of the cap, which was reasonably generous in phase 1 due to the trial nature of this phase.

Phase 1 of the program was generally considered a learning by doing phase, which would lead to the second phase, where the program would need to function effectively (EU commission 2020). The National Allocation Program in phase 1 was one such difficult learning period as there were disputes over emissions benchmarking being either too strict or too loose. The Amended Directive resolved these issues by requiring the benchmarks to be set by the "average emissions rate per unit of output for those installations in each ETS sector constituting the 10% with the lowest CO2 emission rate in 2005" (Ellerman, 2016). This essentially amounts to historical emissions reports from said sectors being the standard benchmark even with the benchmark focused on the lowest 10% of emitters in a given sector. The issues with the NAPs did not stop there, as it took 18 months into the first phase for the last NAP to be approved by the EU Commission, after which the second NAP approval cycle started and would only be finalized just one month before the start of the second phase (Ellerman, 2016). The NAP process before and during phase 1 was rushed and illustrated a vast under-preparedness from ETS participant states and the EU Commission; however, despite this, the program pushed on and put a price on carbon emissions.

When the first phase of the EU ETS started, the price for allowances in the EU started between 5-10 euros per Mt of CO2 and slowly increased to almost 30 euros per Mt of CO2 as it was believed that the first allocation of allowances was short in order to encourage a moderate level of abatement; however, in April 2006, it was revealed that this was not the case (Delarue, 2008) (Declercq, 2011). In April 2006, the price for allowances dropped dramatically from nearly 30 euros per Mt of CO2 down to 13, due to the release of reports which showed that a number of member states and regions including the Netherlands, Spain, France, Estonia, the Belgian Walloon Region, and the Czech Republic were 50 Mts below their expected emissions levels (Ellerman & Buchner, 2008) (Ghoulder, 2013). There was a small revival before prices inevitably spiraled down below 1 euro per Mt of CO2 in May of 2007 for phase 1 allowances (Delarue, 2008). This decline in the price for allowances was partially due to the many sectors covered having net long positions by almost 20 Mts with the industrial sectors being nearly120 Mts long; however, the heat and power sectors EU wide were short by over 20 Mts (Declercq, 2011) (Delarue, 2008). One possible reason for this difference between sectors is the over-allocation of allowances to encourage participation from the industrial sector, which is more readily susceptible to international competition. The power sector, however, competes more locally and has the ability to pass on the costs of allowances onto consumers with more ease due to this. An alternative analysis from 2006 shows that there indeed was a net long position, although by only 60 Mts, with heat and power short by about 50 Mts, and industry long by 110 Mts (Delarue, 2008). These two analyses together show that the price of bringing the industrial sectors into the program was an over-allocation of allowances in order to ensure that they did not face any undue outside competition; however, this does not mean that abatement did not technically take place.

Disentangling the effect of emissions abatement from other factors while simultaneously estimating the abatement within phase 1 and beyond can be difficult depending on the type of analysis used; however, that does not mean that these estimates do not exist. Abatement within phase 1 occurred mainly within the power sector through switching from high polluting coal to lesser polluting gas, with evidence of this shift found in a correlation between movement in the price of European Union Allowances

(EUA) and the movements in coal and gas throughout phase 1 (Grubb, 2012). Throughout the first phase, there was some indication of fuel switching due to the price of carbon, with this being noticeable when looking at the lower level of emissions in the summer of 2005 when the price of carbon was high, compared to the summer of 2006 when the price of carbon plummeted (Delarue, 2008). Using an econometric model, Delarue found that the power sector's emissions abatement was 90 Mts in 2005 and 60 Mts in 2006 (Delarue, 2008) Abatement was mainly seen in the power sector during this phase; however, that does not mean that it did not occur elsewhere.

Ellerman and Buchner, using an econometric model, estimate that abatement in phase 1 ranged from 120 to 300 Mts of CO_2, which aligns with the power sector estimates by Delarue (Ellerman & Buchner, 2008). Utilizing dynamic panel data to estimate abatement in phase 1, Anderson and Di Maria found a similar estimate with abatement, standing at 247 Mts of CO_2 (Anderson, 2011). While these studies show that some abatement did occur during the first phase, there is still yet more to be explored by looking at energy intensity during this time. From 1990-2004, emissions intensity within the EU ETS member states decreases by 1.07% per year compared to 1.5% per year from 2005-2008; however that reduction in emissions intensity was mainly due to a cut between 2007-2008 and without it, there would be no decline in the levels compared to pre-EU ETS years (Grubb, 2012). It appears that the program cannot take the credit for reductions in energy intensity during this time; however, the program can technically claim that abatement took place in that the total cap for this phase was not met or exceeded. Still, concerns remain, particularly around whether or not businesses profitability was impacted and whether or not the cost of this "abatement" was passed onto consumers

One concern within the cap and trade framework, in general, is whether or not the cost of abatement is passed onto the consumer via the producer, thus violating the polluter pays principle of the scheme. Empirical studies using survey and econometric approaches found that there is strong evidence that costs are passed onto consumers in both the Netherlands and UK power sectors, with pass-through costs in the range of 60-100% (Grubb, 2012). This passing on of costs within the energy sector is a somewhat expected reaction when producers face outside costs beyond their control; however, this violates the polluter pays principle of the program. The pass-through rate is not ubiquitous within each locale due to other influencing factors. Chernyavs'ka found that the pass-through cost rate is strongly influenced by factors including the power plant mix in the market, the power demand level, the available capacity, and the degree of market concentration (Chernyavs'ka, 2008). The passing on of costs from polluters is not appropriate no matter what factors influence such a decision; however, the one bright side of this effect is the indication that there should be very little to no loss of international competitiveness due to the passing on of costs.

When looking at empirical research on the competitiveness of EU sectors during phase 1, it appears that there was no noticeable impact on competitiveness in cement, oil refining, and aluminum; however, there does appear to be a small loss of competitiveness within the steel and iron sectors (Newell, 2013). It should not be surprising that there was no considerable impact on competitiveness during phase 1, given the over-allocation of allowances, especially within the industrial sector. In a similar vein, the over-allocation of allowances within phase one resulted in one somewhat, hopefully, unintended consequence in the form of businesses making windfall profits from the over allocation. Due to the fact that 95% of the allowances were allocated for free and overall over-allocated, this resulted in windfall profits to the tune of £800million a year for the UK power sector; however, when combining power sectors in DE, UK, FR, BE and NL at 20 euros per Mt of CO2, there were windfall profits to the tune €5.3-7 billion per year (Grubb, 2012). The drivers of these windfall profits are the over-allocation of allowances, the high incidence of cost pass-through to consumers, and massive profits for these entities due to the sale of allowances. While the possibility of profit is an intrinsic element of the EU ETS, it is questionable as to whether these windfall profits accumulated due to emissions reductions, or more likely from an over-allocation of allowances within the first phase due to concerns of participation and issues with the National Allocation Program. Despite these apparent failures, the first phase of the program was over and could now be evaluated in order to course-correct.

Overall, the first phase of the program was considered a success by the EU Commission in that the first phase succeeded in establishing a price for carbon, facilitated free trade of the EUA throughout the EU, and established the needed infrastructure to verify, monitor, and report emissions from the sectors covered (EU Commission, 2020). The program was further characterized as a success, although not looking at the price of allowances, which ranged from below 1 euro to 30, but by a change in thinking (Delarue, 2008). There were perhaps changes in thinking and decision making due to the fact that emissions have a price and are therefore taken into account more readily in the investment and production processes (Ellerman, 2010). While the trial phase of the program was viewed as a success by the EU Commission, the first phase is, and should be characterized, as an overwhelming failure; due to the pervasive flaws and failures present.

The issues with the National Allocation Program are one such failure that began within this phase due to complications with the timing of their approval. It was not until 18 months into the first phase that the final NAP was approved, illustrating a lack of preparation on the part of individual nations and the EU Commission (Ellerman, 2016). These National Allocation Programs vastly overestimated historical emissions levels, resulting in an overly generous cap of 2,096 Mts of CO2 for phase 1(ICAP, 2019). On top of an overly generous cap and an over-allocation of allowances, 95% of said allowances were allocated for free (EU Commission 2020). These factors combined resulted in some of the harshest criticisms of the program in this phase due to their effects which included massive price volatility, the presence of enormous windfall profits, and allegations of competitive distortions due to widely differing NAPs (Ellerman, 2016) (Calder, 2009) (EU Commission, 2020). This phase of the program had a number of flaws with the first and foremost being the price volatility that took place.

In the first year of the program, prices remained somewhat consistent; however, the price of allowances dropped drastically from nearly 30 euros per Mt of CO2 down to 13 in April of 2006 after news broke that a number of states were well below their expected emission levels (Ghoulder, 2013) (Ellerman & Buchner, 2008). This eventually led to the price falling to zero in 2007 and the restriction of allowances from being banked into the second phase (EU Commission, 2020). This extreme price change made the market for allowances somewhat volatile and very ineffective, not only as a market for carbon emissions, but also as a framework for reducing emissions. While this price crash is an expected reaction to new information about a market, it does not coincide with the primary goal of the program of reducing emissions. While the news released reported individual nations being under their expected emissions level, and overall there are empirical findings that illustrate that some abatement took place during the first phase, those claims are questionable. The EU Commission openly acknowledges that there was an over-allocation of allowances and, therefore, an overestimated cap, of which the NAPs are partially responsible for, which means that the claim of abatements during the trial phase is ambiguous (EU Commission, 2020). If abatement is considered not going above the overly generous cap for phase one, then indeed there was a reduction in emissions during this time in addition to polluters accumulating massive amounts of money.

The existence of profits within the EU ETS framework for the participants was expected; however, the massive windfall profits they were able to accrue while making little to no reduction in emissions were not. Windfall profits were accrued to the tune of

£800million a year for the UK power sector, and when combining power sectors in DE, UK, FR, BE and NL at the price of 20 euros per Mt of CO2, there were windfall profits to the tune €5.3-7 billion per year (Grubb, 2012). The existence of these massive profits on top of the fact that a number of power sectors in Germany, the UK, and Italy were able to pass on the full cost of the EUA onto the consumer shows evident flaws within not only phase 1 of the EU ETS, but in market-based approaches such as this (Chernyavs'ka, 2008) (Grubb, 2012).). The drivers of these windfall profits are the over-allocation of allowances, the high incidence of cost pass-through to consumers, and massive profits for these entities due to the sale of allowances. Overall, phase 1 of the EU ETS was a failure with the accumulation of windfall profits, the over-allocation of allowances, extreme price volatility, no discernible improvement in low carbon investment, and a significant degree of cost of pollution passed onto the consumer. If the goal was to make polluting industries a significant degree of profit while producing little to no discernable emissions abatement or improvement in low carbon investment, then the EU ETS program could have simply paid polluters to continue their businesses as usual.

3.3 Phase 2 2008-2012

At the end of phase 1, estimated emissions in phase 2 were expected to exceed the yearly cap by nearly 300 Mts, which would make the second phase short by almost 1,500 Mts of allowances (Delarue, 2008). This gap in allowances could be made up through a higher price in emissions, which could potentially encourage fuel switching in the power sector, as seen in phase 1. By the beginning of the second phase, the cap on emissions was reduced by 6.5%, nitrous oxide emissions were included, free allocation was at 90%, the penalty for noncompliance was 100 Euros per Mt of emissions, and three nations joined the EU ETS including Iceland, Liechtenstein, and Norway (European Commission, 2020). Countries including the Netherlands, Austria, Ireland, Hungary, Germany, Lithuania, the United Kingdom, and the Czech Republic opted to auction 3% of their allowances (ICAP, 2019). Phase 2 also saw the aviation sector included as of January 2012, with 85% of allowances allocated for free; however, flights to and from Non-European nations were not included within the program (European Commission, 2020). Businesses within this phase were allowed to buy international offset credits except nuclear power credits and which totaled 1.4 billion Mts of emissions, and no credits from nuclear power or industrial gas projects were allowed (Ellerman, 2016) (EU Commission, 2020). With these changes, it seemed that the program would do better than phase one. Because one phase of the scheme had already passed, there was now verified data on emissions, and, as such, the cap was lowered to 2,049 Mts of CO2 (ICAP, 2019) (EU Commission, 2020). With phase two coinciding with the first period of the KP, this now gave EU ETS participant countries hard emissions targets and set the program up for success. The success of this phase seemed possible, with high allowance prices going into phase 2.

Phase 2 allowances were seemingly healthy through 2007 and some of 2008 with high oil and gas prices pushing the price up and providing some price stability for the market (Grubb & Laing, 2012). This seemed to indicate that there would once again be emissions reductions due to fuel switching in the power sector. In terms of emissions reductions during phase 2, it was projected that a price of 20 euros per Mt of CO2 would result in a possible switch to gas instead of coal in the power sectors during the summer, causing abatement, while a price of 40 euros would heavily reduce emissions during summer and winter due to fuel switching (Delarue, 2008). The analysis, based on a price of 20 euros per Mt of CO2, indicated that there would indeed be some abatement due to fuel switching in the second phase. A higher price of 60 euros per Mt of CO2 would be enough to encourage switching and reduce emissions throughout the year, and if the rate reaches 120 per Mt of CO2, both switching, and a reduction in emissions is present throughout the year (Delarue, 2008). Although the price of allowances has never gone as high as 60 euros, and most certainly not 120 euros, this possible price point illustrates the possible promising effects of a much stricter cap on the power sector. It appeared that in the second phase of the EU ETS, there would be better results given the trials and lessons learned from the first phase; however, in the summer of 2008, the world economy was hit by a recession.

This global recession would have the most profound effects on the program during 2008 and 2009 when the demand for electricity, fuel, and EUAs, also known as European Union Allowances, dropped dramatically (Declercq, 2011). At the beginning of phase 2, the price for allowances nearly rose to 30 euros per Mt in July of 2008; however, this price would not hold for long as the price took a drastic dip to the tune of a 50% drop in late 2008 due to the economic crisis (Grubb & Laing, 2012). The price would stabilize in early 2009 with a price around 15 euros per Mt of CO2 before it would fall once again in the summer of 2011, down to 7 euros, at which point it dropped down again to a low of 4 euros at the end of phase 2 (Delarue, 2008) (Ellerman, 2016) (Elsworth, 2011). This made it clear that there would be a surplus of allowances created by the recession, and with these allowances being banked into phase 3, it seemed the surplus would persist out until 2020 (Grubb, 2012). Due to the surplus of allowances and economic recession, it seemed emissions abatement might not occur during this phase.

The recession would make it extremely difficult to analyze the performance of the EU ETS during this phase, and the recession would have far-reaching impacts on the level of pollution during this phase. Emissions within the EU through 1990-2004 decreased at a rate of 0.08%, while emissions in 2005-2010 decreased at a rate of 1%, with the decreases in 2008 and 2009 being the most pronounced during that time due to the financial crisis (Grubb, 2012). The effect of the recession was substantial, but particularly so in Spain with emissions-reducing by 7.7% in 2007 and 2008 in addition to a drop in the growth rate by 2.7% before a further contraction by 3.7% in 2009 (IMF, 2011). Overall, the whole EU economy experienced a similar decrease in growth rates and emissions. The EU 28 saw a decrease in their growth rate from 3.2% in 2007 down to 0.3% in 2008, with some countries within the EU seeing even more significant declines with the Baltic state contracting by 14% as of 2009 (Grubb, 2012). The financial crisis during phase 2 contracted much of the economy in the EU, with the GDP of the EU28 falling by nearly 5% in 2009 (Grubb & Laing, 2012). During this time, disentangling the effects of emissions abatement from the EU ETS apart from the economic downturn that took place in both the power and industrial sectors during this phase would prove quite tricky.

Declercq analyzes the impact of the recession on the emissions of the power sector by constructing a counterfactual in which the recession never took place, and although the results may be somewhat skewed due to the difficulties in constructing a counterfactual, it should still reveal some insights. Within this model, the emissions from power generation are determined by the amount generated, the fuels used, and the efficiency of the process while the demand for power is a composite of the price of allowances, fuel prices, and the composition of the power sectors. It was determined that the decrease in demand during 2008 and 2009 resulted in 175 Mt less emissions with 2008 and 2009, seeing reductions of 21Mt CO2 and 150Mt respectively within the power sector when compared to the counterfactual (Declercq, 2011). While the model constructed by Declercq in 2011 can only be used to gain theoretical insights due to the model's use of a counterfactual, a later study by Sansoussi would reveal that the model was actually somewhat accurate.

Emissions in Germany, the UK, France, and Spain decreased both during the economic growth period taking place after 2009 by 80 MtCO2, and the economic crisis period of 2008 and 2009 by 175 Mt CO2 (Sansoussi, 2018). This shows clearly that the economic crisis of those years had the most significant impact on emissions reductions by over double compared to the period after the crisis. A surprising effect of the recession was that the low carbon price during the recession actually increased emissions by 30 Mts more compared to the counterfactual, where the price was 25 euros per Mt of CO2 (Declercq, 2011). While the findings of Declercq may still lack a solid foundation due to the use of and difficulty constructing a counterfactual, another later study commissioned by the UK's Climate Change Committee seems to support the findings of Declercq (Cambridge Econometrics, 2009). It appears that both 2009 and 2008 would have been net short years in terms of EUA's, if it were not for the global recession, which would have resulted in allowances being borrowed from future years within phase 2 or the incurrence of the penalty price (Declercq, 2011). This would have been the perfect time for the EU ETS to show its strength after the terrible performance of phase 1 if it were not for the impact of the recession.

Other estimates of abatement using econometric modeling estimate that there was abatement to the tune of 28 Mts of CO2 in 2008; however, whether or not this was due to the EU ETS is debatable (Lewis, 2010). Another study using anecdotal evidence revealed 60% of sectors reported either emissions abatement or planned abatement in 2009 or 2008, which is to be expected given the decline in demand due to the recession (Point Carbon, 2009). Total emissions during this time within the EU28 decreased by 13.64% between 2004 and 2012, with 76% of the reduction taking place during the global recession and the other 24% coming from reductions between 2004 through 2008 (Sanoussi, 2018). Overall, these studies indicate the possibility that reductions throughout phases 1 and 2 of the EU ETS could be attributed to the economic recession and an over-allocation of allowances in phase 1. The shrinking of the economy during that time had a considerable impact and shows that while emissions abatement via market-based interventions, such as the EU ETS, pale in comparison to the effect of shrinking the economy or a slowed growth rate. Unfortunately, the bad news surrounding this phase of the program continued with the finding that there was once again windfall profits.

As in phase 1, there exists empirical evidence of windfall profits in part due to the cap set and the economic recession that took place during this phase of the program. Estimates vary on what precisely the windfall profits were; however, Maxwell shows that the UK power sector collected possible windfall profits to the tune of £1 billion a year within phase 2 (Maxwell, 2011). When an assumption of emissions allowances within the range of 21-32 euros per Mt of emission, it is estimated that the UK power sector saw 6-15 billion euros in windfall profit, and German power sectors saw between 24-34 billion euros in profit (Point Carbon, 2008). When looking at the EU 20's power sector and an assumption of 20 euros per Mt of CO2, Lise estimates that there were windfall profits to the tune of 35 billion euros (Lise, 2010). While estimates of windfall profits vary, what rings true is that once again, the polluter did not pay for their pollution; however, one would hope that these sectors would use these profits to invest in low carbon innovation or perhaps efficiency improvements to prepare for the future.

Unfortunately, a large number of companies reported that the EU ETS and climate policy, in general, are still less critical elements in their decision-making process compared to return on investment (Neuff, 2011). One possible reason for this would be the relative lack of strictness from the EU ETS in that during phase 1, there was an over-allocation of allowances, and during phase two, the economic crisis all but assured that a large number of sectors would be under their estimated emission. Another possible reason for the lack of investment in low carbon innovation or the funding of efficiency increases would be the lack of outside competition. The competitiveness of EU sectors has been a concern since the inception of the scheme as well as the possibility of carbon leakage. An example of carbon leakage would be a high carbon-intensive business leaving the participating EU ETS nations in order to produce their product elsewhere, thereby letting carbon leak outside of the scheme's border. A study done by Branger in 2016 finds that the over-allocation of allowances in phase 1 and the low price of EUA in phase 2, being below 30 euros per Mt, indicates that there was no operational carbon leakage or reduction in businesses competitiveness (Branger, 2016). This, combined with the fact that some sectors experienced windfall profit in both phases, would seem to indicate that competitiveness, profitability, and carbon leakage are currently non-issues. If they were or became issues in the future, however, those same companies would hopefully seek efficiency gains in production in order to remain competitive. This idea coincides with a study conducted by Neuff, which finds that sectors with high expectations regarding the strictness of future permit allocation reported that they were more likely to pursue such investment in low carbon projects (Neuff, 2011). This period also saw the introduction of guidelines that would decide the path for the future of the EU ETS.

During this period, the EU laid out their future climate goals with the 2050 roadmap plan. The EU's roadmap to 2050 plan outlines the future of the EU's climate goals with the goal of reducing emissions by 80-95% below 1990 levels by the year 2050 with interim goals of 20% by 2020, 40% by 2030, and 60% by 2040 (Sanoussi, 2018). The 2050 roadmap ensures that there are hard goals for the EU to aim for beyond the scope of the Kyoto Protocol. Another promising sign of things to come came one year into the second phase with the end of the NAP process. The EU ETS participant states agreed to abandon the NAP and agreed to a program-wide cap declining at 1.74% per year that would go into effect in 2013 for the power sectors and phased in for the remaining sectors by 2027 (Ellerman, 2016). These changes were a promising sign for the program as the NAP process had many flaws and illustrated one lesson learned by the EU ETS in a long list of lessons yet to be learned by the program's failures.

Overall, phase 2 of the scheme benefited from the fact that emissions data from phase 1 participants was now available, so a lower amount of allowances were introduced based on participants' actual emissions, which saw a 5% reduction from the phase before (European Commission, 2020). Despite this, price volatility was again extremely present within this phase with the price for allowances rising to 30 euros per Mt in July of 2008; however, the price did not hold for long as it took a drastic dip to the tune of a 50% drop in late 2008 due to the economic crisis (Grubb & Laing, 2012). The price during this phase would change regularly with it being stable somewhat in early 2009 and experiencing a small two year period of stability with a price of around 15 euros per Mt of CO_2 (Ellerman, 2016). This was before it fell once again in the summer of 2011 down to 7 euros before it dropped down to 4 euros right before phase 3 due to fears of an accumulation of surplus allowances in the industrial sectors (Delarue, 2008) (Ellerman, 2016) (Elsworth, 2011). Later on, it was revealed that the worldwide economic downturn of late 2008 and 2009 had cut emissions so much for the participants that there was an estimated surplus of allowances equivalent to 1.5 to 2 billion Mts of emissions (Ghoulder, 2013). Unfortunately, the excess of allowances in phase two could now be banked into phase 3 and beyond, creating the opportunity for more price volatility. Overall, this phase improved upon the failure of the previous phase; however, the cap and trade framework proved itself somewhat susceptible to influence from the trends of the world market, thus putting the emissions reductions needed to address climate stabilization at risk.

A review of phase 2 shows that emissions within the EU28 decreased by 13.64% between 2004 and 2012, with 76% of the reduction taking place during the global recession and the other 24% coming from reductions between 2004 through 2008 (Sanoussi, 2018). As can be seen, economic trends have a substantial impact on the levels of emissions, with the recession being responsible for a drastic cut in emissions. In terms of abatement within these two phases, the EU ETS succeeded in that there was never an observed movement above the caps that were put in place. However, during the first two phases, emission allowances were oversupplied, and emissions-cutting during the second phase was greatly attributed to the recession of 2008 and 2009. In total, it was estimated that between 2008 and 2009 that electricity demand dropped by nearly 5%, showing that if one wishes to impact climate change, one of the quickest solutions is a change in consumer behavior (Grubb & Laing, 2012). Overall, this phase was a failure in that there was once again extreme price volatility, some, if not all, of the emissions abatement during this phase is attributed to the recession, windfall profits persisted, and the governing entity did not take any actions to stabilize the market during the recession. While the preservation of business competitiveness was positive, there was yet another net positive in this phase with indications that low carbon investment may increase. At the end of phase 2 and heading into phase 3, low carbon investment was looking more promising with 10% of businesses, up from 4% in phase 2, reporting that they expected changes in both their investment decisions and their general operations to change due to their expectation of increased stringency of the EU ETS in phase 3 (Neuff, 2011). At the end of this phase, new changes would hopefully increase businesses' perception of the stringency of the EU ETS heading into phase 3.

Before the initiation of phase 3, the auction method introduced in phase two was strengthened to a greater extent in order to help address the issues of the previous phases. Rough estimates indicate that 40% of the allowances would be distributed through auctioning during phase 3, while the rest would be allocated freely (European Commission, 2020). Due to the impact of the financial recession, the revenue that was supposed to be earned from the auctions was significantly stunted, which proved the promise of investment in clean energy infrastructure after nearly ten years a falsehood

(Grubb, 2012) (EU Commission, 2020). This move to auctioning follows the principle of cap and trade theory in that the polluter should pay for their emissions directly rather than being allocated a significant degree of allowances for free. Revenues from these auctions would be disbursed to each of the EU ETS member states through a formula that is roughly based on their per capita income (Ellerman, 2010). In 2013, another promising change was instituted with free allocation ending for the power sectors while the industrial sectors were allowed to phase out of free allocation over time, starting at 80 % in 2013, 30% in 2020, and entirely by 2027 in order to protect their competitiveness (Ellerman, 2016). Before the third phase, yet another encouraging change was made with 900 million allowances being moved into a reserve to be backloaded later in 2019-2020 as a way to stabilize the price level now heading into phase 3 (ICAP, 2019). This was done in order to bring a more excellent equilibrium to the market by managing the price of emissions through supply and demand, as well as signaling that the governing entity had the ability to reduce price volatility and potential shocks in the market if need be.

3.4 Phase 3 2013-2020

In November 2012, the EU Commission published a report, titled "State of the Carbon Market," which laid out some proposed changes to the program that would be crucial in phase 3. Most notably among these changes was the introduction of a discretionary price management mechanism and the reduction of the EU-wide cap from 1.74% annually to 2.2% in phase 4 (Ellerman, 2016). This reserve would come to be known as the Market Stability Reserve, and its primary function would be the supply and withdrawal of EUA's (EU Commission, 2020). These changes would be adopted in 2014 with the Market Stability Reserve and the cap to be adopted later in 2015 and begin operation in 2019 (Ellerman, 2016). However, according to some research, the program will sadly not see any positive results from the reserve until 2025; however, additional changes to the program were made to address other criticisms (Spinelli, 2016). In order to address criticisms surrounding the lack of innovation in the scheme, 300 million allowances were set aside to fund low carbon innovation in the NER 300 program; (EU Commission, 2020). Some of the EU member states were already making progress on this, including Spain and Germany, who have already developed their own incentives encouraging the development of both solar and wind energy, and it shows with wind and solar making up 24% and 16% of energy production in Spain and Germany respectively in 2014 (Ellerman, 2016). The changes to the program within phase 3, like the inclusion of new chemical emissions and a newly introduced lower cap, represent positive change within the program's structure.

At the start of phase 3, the EU ETS saw the introduction of petrochemicals, gypsum, and ammonia added to the covered emissions (ICAP, 2019). The EU-wide cap for phase 3 was set at 2,084,301,856, with a linear reduction of 38,264,246 allowances each year with 40% of the capped allowances being auctioned in 2013 (EU Commission, 2020). Over the course of phase 3, 57% of allowances were auctioned, 100% of EUA's were auctioned within the power sector, and free allocation continued in industrial sectors (ICAP, 2019). Sectors within the EU ETS that face internal competitive threats due to the program will receive a full free allocation of their allowances at their benchmark levels (Ellerman, 2016). Businesses who are not at risk will see their free allocation phased out from 80% of their benchmark in 2013 down to 30% in 2020 (ICAP, 2019). These positive changes, in addition to a higher number of participating businesses and expanded coverage for more chemical emissions, were indicative of a more robust EU ETS in phase 3.

Within phase 3, the program covered 13,500 businesses in both the industrial and power sectors, covering 4% of global GHG emissions, all domestic airline emissions within all EU member states were covered, and saw the inclusion of Liechtenstein, Norway, and Iceland in the EU ETS program (Ellerman, 2016). In the newly included aviation sector, 85% of allowances were allocated for free in 2012 while in phase 3, 82% were given freely, 15% of allowances were auctioned, and the remaining 3% added to the reserve to new entrants into the market (ICAP, 2019). While the relatively lax restrictions on the aviation sector are a small negative, the inclusion of the sector and the reduced use of carbon offsets were promising signs for phase 3. The use of carbon offset credits in phase 3 was restricted to an additional 300 credits over the 1.3 billion limit put in place during phase 2 (Ellerman, 2016). While that number is still rather large, there would be new restrictions placed on these offsets. Later carbon offset credits that were created before the first KP phase would not be accepted past March 31, 2015, and credits involving the destruction of N2O and HFC23 would no longer be accepted (ICAP, 2019). This was due to a circular market that emerged whereby more products containing these chemicals were made only to be retired later on in order to gain credits very cheaply. The auction process within this phase proved slightly better than phase 2 due to the degree of allowances auctioned.

In terms of auctioning from 2013 through 2016, the mechanism generated 15.8 billion euros, 50 billion since 2005 and 14.65 billion in 2019, with more than 80% of the revenue from these auctions earmarked for energy or climate-related purposes in addition to plans to use at least 50% of future auction revenue for the same purpose (EU Commission, 2020) (ICAP, 2020). The increase in auction revenue on top of increased funding for the program within phase 3 is setting up phase 4 for a productive start, especially in terms of emissions abatement. Emissions within the EU ETS have declined by 4.1% through 2017-2018, while overall emissions have declined by 29% from 2005-2018; unfortunately, though, emissions are set to slow in the coming years with ten nations reporting increasing emission until 2030 (EU Environmental Agency, 2019). All of the changes within this phase were improvements over the two previous phases and were signs of lessons being learned.

After over ten years, the EU ETS is finally making changes to the program in order to accomplish the original goals of the scheme. This can be reflected by the fact that the EU is on track to meet most of its climate goals per the 20-20-20 guidelines (Spinelli, 2016). Unfortunately, there is doubt surrounding the 2050 roadmap goals with projections showing a reduction of 36% achieved in 2030 compared to 2005 emissions levels, which is not in line to meet the 43% reduced emissions goal set in 2030 (EU Environmental

Agency, 2019). The system as a whole has fallen short of the hopeful expectations that initially surrounded the program due in part to windfall profits and a low or volatile carbon price. Some nations have taken note of this negative public perception and have put in place policies to support the EU ETS within their borders, with the UK being one such nation. In April 2013, the UK enacted a carbon price floor through a carbon tax placed on fossil fuel producers, set so that the price of EUAs will be 19 euros per Mt in 2013 and grow to 35 euros per Mt in 2020 (Ellerman, 2016). This carbon tax, or price floor, will act as a price stabilizer for EUAs in the UK, in addition to both decreasing demand for fossil fuels and increasing the demand for allowances. This price floor seems necessary considering a price for allowances of 5.8 euros per Mt in 2017 and a higher, but still relatively low, price of 15.5 euros per Mt in 2018 (EU Environmental Agency, 2019). Despite this progress from the UK in taking their own measures to encourage the success of the program and a rise in the price for allowances between 2017 and 2018, some pessimism persists.

This pessimism revolves not around the positive changes to the program, the past performance of the program, the future expectations and performance for the scheme, or even what could possibly be low to moderate emissions abatement from the duration of the scheme. The pessimism that surrounds the EU ETS is due to the programs inability to address its issues in a permanent and immediate way. These issues have persisted and have not been addressed entirely or permanently, but rather have seen relative improvements at the cost of the environment. These issues include windfall profits, pass-through costs, over-allocation of allowances in phases 1 and 2, and the free allocation of allowances to a large number of businesses under the guise of protecting EU competitiveness.

In particular, the pass-through of EUA costs onto consumers, in addition to the windfall profits, have given rise to questions over whether or not the polluter is actually paying or whether the consumer is bearing the entire cost. If the consumer is bearing the cost of an, at best, debatable reduction in emissions, the EU ETS is failing at making the polluter pay while those same polluters gain excessive revenue from the program without making improvements. If the EU wishes to give money to businesses in order to grow the economy, by all means, go ahead, but do not do so under the guise of reducing emissions while asking the consumer to pay for it. Furthermore, the continued free allocation of allowances to protect EU businesses from international competitiveness and prevent possible carbon leakage illustrates that what really matters is the economy and not the environment. The EU ETS's primary goal is to reduce emissions at a balanced cost, but the issue with this is that the scale has always been more substantial on the side of economic progress. The environment and the natural world have been used to advance the worldwide economy for a very long time, and, as such, the balance is not equal. It took years to set up the EU ETS and then took 2 phases, or nearly a decade, to make moderate improvements to the program. While the complete end of free allocation may not be realistic as an immediate goal, there most certainly exist others that are and would provide a greater balance to the scales. These changes include a stable price range for allowances, no pass-through costs, no over-allocation of allowances, more publically available data, and more significant emissions abatement. These changes can be accomplished currently and in a permanent way without tipping the scales too far in favor of the environment.

While it is somewhat unfair for the EU as a whole to bear the burden of the entire world's emissions, the EU also makes up the most extensive grouping of industrialized countries and is often held up as the leader of positive environmental change. To put it quite simply, there will never be any large scale positive change in terms of combatting emissions until one nation, or nations, take both the economic and environmental burden onto themselves. This burden will quite possibly open up said nation or nations to a weaker economic position; however, no change will take place so long as every nation defects in this worldwide assurance game. Within this worldwide assurance game, the EU has demonstrated the willingness to cooperate in order to arrive at the mutually advantageous position where emissions return to lower levels, and some nations have even indicated the same willingness. With the introduction of emission trading programs in China and South Korea, there is indeed willingness for the entire world to arrive at said mutually advantageous position; however, many industrialized nations still choose to free-ride within this grand game (ICAP, 2019). Even though emissions trading schemes have their flaws and potentially do not represent the most optimal choice in terms of emissions abatement, they can still be a strict improvement over no effort, which is what phase 3 and the program overall seemingly represents.

Overall, it seems as though phase 3 of the program shows some success in areas including a reduced use of carbon offset credits, a lower cap on emissions, the introduction of the MSR, the NER 300 program, increase in the share of allowances auctioned, and the inclusion of new nations. Phase 3 also saw the coverage of additional chemical emissions, increased stringency overall, efforts to encourage investment in low carbon innovation, and many other minor improvements. Estimating emissions abatement during this phase remains a relative unknown, with some claims of total emissions declining by 4.1 % from 2017 to 2018 and projections of possibly meeting 2020 goals; however, there are no readily available numbers of just phase 3 (EU Environmental Agency, 2019). As such, the evaluation of phase 3 will be based on the positive, although small changes made to the program during this phase, which tentatively qualify this phase as a success with the understanding that there are more improvements to be made.

3.5 Phase 4 2021-2030

There can be no assessment of phase 4 due to the timing of this paper; however, a thorough review of the details of this phase and the changes to the program leading up to phase 4 will be put forth in order to observe what lies in store for the EU ETS. What follows is no more than a review of what information is available pertaining to phase 4.

The revised EU directive, which went into force in April 2018, included strengthening changes such as a reduction in the annually declining cap from 1.74% up to 2.2% and changes to the MSR (ICAP, 2019). The Market Stability Reserve was also strengthened through 2019-2023 with the number of allowances feeding into it doubled to

24% until 2024 with any allowances within the reserve exceeding the previous year's auction allocation being retired (EU Commission, 2020). If the number of allowances within the market goes higher than 883 million, then 12%, up to a total of 24%, of allowances will be taken out away from future auctions up to 2023 and placed into the MSR over 12 months, while 100 million allowances will be introduced into the market if the number of allowances in the market goes below 400 million (ICAP, 2019). As of May 19th, 2020, it was determined by the EU Commission that a total of 397 million allowances would enter the MSR from September 2019 through August 2020 (EU Environmental Agency, 2020). Another change includes a number of allowances being set aside for new and growing businesses, with that number of allowances being made up of the number of free allowances that were not dispersed by the end of the third phase and an additional 200 million from the Market Stability Reserve (EU Commission, 2020). However, another favorable modification was made to the program on January 1st, 2020, when a linking agreement between the EU ETS members and Switzerland's own emissions trading scheme became a reality (ICAP, 2020). With this link and many other changes, phase 4 aspires to be the most promising phase to date.

As of phase 4, the EU ETS covers 45% of the EU's GHG emissions, 28 EU states, Norway, Iceland, Liechtenstein, 13,500 businesses within the EU, and all flights within the European Economic Union until 2024 when it will cover international flights as well (EU Commission, 2020). In order to safeguard industrial sectors within the EU ETS from international competition, a buffer was established whereby over 450 million EUA, which were set to be auctioned, will be made available to industrial sectors if the 6 billion free EUA amount is fully absorbed (ICAP, 2019). On the topic of free allocations, these will continue for one decade, and those sectors that are at high risk of relocating will receive 100% of their EUA for free, while sectors less at risk will see their free EUAs phased down to 30% by 2026 and down to 0% by the end of phase 4 (EU Commission, 2020). By putting a concrete end on free allocations, the EU ETS is making strides in the right direction even if these strides are slow ones. Individual businesses that receive free allocations may see their allocation amounts adjusted annually with a maximum of 15% change annually in order to prevent the existence of windfall profits (ICAP, 2019). Furthermore, a list of all installations that receive free allowances will be updated every five years, and the benchmark values for those businesses will be updated twice in the fourth phase in order to prevent windfall profits and illustrate any technological changes made since 2008 (EU Commission, 2020) (ICAP, 2019). With these changes surrounding and impacting windfall profits, these profits will hopefully no longer persist within the program.

In 2020, the sectors covered in the EU ETS emissions levels will be 21% lower compared to 2005, with the program mostly on the way to complete this goal, in addition to a future goal of cutting emissions by 43% in 2030 compared to 2005 levels (EU Commission, 2020). Within phase 4, there are also improvements surrounding the use of carbon offsets. The use of carbon offsets is not imagined to be a significant contributing element, meaning there are no projections where these are used, making this phase a drastic departure from the previous phases (ICAP, 2019). At this point within the EU ETS, the system covers carbon dioxide from commercial aviation, heat generation, power generation, oil refineries, iron production, aluminum production, cement, glass, pulp, cardboard, glass, metals, steelworks, lime, acids, and ceramics; nitrous oxide from the production of, glyoxal, nitric acids, adipic, and glyoxylic acids; and perfluorocarbons resulting from aluminum production (EU Commission, 2020). While the sectors that produce these chemicals as emissions are covered in the EU ETS depending on their size and emission footprint, they may be exempt or be regulated by their national government (EU Commission, 2020).

Within this phase, 90% of the allowances that are to be auctioned will be distributed in the same way as phase 3, with the remaining 10% being given to those member states that are the least wealthy in order to provide them a means of fostering both economic and green investment (EU Commission, 2020). Additionally, new rules regarding the aviation sector within this phase will see their allowances decrease by the same 2.2% annually starting in 2021 with the goal of emissions from the aviation sector to be 21% lower compared to 2005 levels (EU Commission, 2020). Finally, during the fourth phase, two new funds will be created whose purpose will be to fund energy sector modernization through the Modernization Fund and low carbon innovation through the Innovation Fund (ICAP, 2019). The Innovation fund will support low carbon innovation and carbon capture technology with the funding of the program being the current value of at minimum 450 million emission allowances and the remaining NER 300 program budget

(ICAP, 2020). The Modernization fund will support the modernization of the EU's power and wind energy sectors through gains in efficiency and a transition away from carbon dependency in the ten most low income and carbon dependent nations (EU Commission, 2020). With the many changes to phase 4, and the changes that will most assuredly occur during this phase, it may prove to be not only the most interesting to observe but perhaps the best phase yet in terms of meeting the goals first set in 2005.

3.6 Overall Evaluation of the EU ETS

The overall evaluation of the effectiveness of the EU ETS, and to a more significant degree the EU carbon market, via a determination of whether the EU ETS has allowed for emissions reductions in line with the goal for climate stabilization set by the EU, whether emission reductions in line with the climate stabilization goals set by the scientific community were achieved or projected to be achieved, and a determination of the success of phase 1 of the EU ETS will now be put forth. The first phase of the EU ETS was considered a success by the EU Commission in that the first phase succeeded in establishing a price for carbon, facilitated free trade of the EUA throughout the EU, and established the needed infrastructure to verify, monitor, and report emissions from the sectors covered (EU Commission, 2020). The program was further characterized as a success, although not looking at the price of allowances, which ranged from below 1 euro to 30, but by a change in thinking (Delarue, 2008). There were perhaps changes in thinking and decision making due to the fact that emissions have a price and are therefore taken into account more readily in the investment and production processes (Ellerman, 2010). While the trial phase of the program was viewed as a success by the EU Commission, the first phase is, and should be characterized, as an overwhelming failure; due to the pervasive flaws and failures present.

The flaws and failures present within phase 1 of the EU ETS range from issues with the National Allocation Program, the price volatility, the overallocation of allowances, massive windfall profits, and no noticeable change in low carbon investment. Overall, if the goal was to make polluting industries a significant degree of profit while producing little to no discernable emissions abatement or improvement in low carbon investment, then phase 1 of the EU ETS could very well be considered a success by that criteria. Despite the failure of phase 1 of the program and the issues within the further phases, the EU does look on track to meet its goals per the 20-20-20 guidelines (Spinelli, 2016). Unfortunately, there is doubt surrounding the 2050 roadmap goals with projections showing a reduction of 36% achieved in 2030 compared to 2005 emissions levels, which is not in line to meet the 43% reduced emissions goal in 2030 (EU Environmental Agency, 2019).

The goal of the 2050 roadmap is the reduction of emissions by 80-95% below 1990 levels by the year 2050 (Sansoussil, 2018). The 2050 roadmap serves as the current climate stabilization and emissions reduction goal set by the EU, and as it does not appear that the EU is currently on track to reach that goal, through reductions in emissions via EU ETS and the carbon market it has constructed, it must be considered a failure. Unfortunately in terms of reductions in emissions in line with goals set by the scientific community, it appears that the 2030 goal of a reduction in emissions by 40% is not sufficient with the current climate stabilization goal set by the scientific community of warming well below 1.5°C and the Paris Agreement of 1.5°C warming (Tracker, 2020). Additionally, it appears that the goal set by the 2050 roadmap is insufficient to meet the reductions in line with the climate stabilization goals set by the scientific community of warming below 1.5°C, the 2009 Copenhagen 2°C goal, and the 1.5°C limit put in place at the Paris Agreement (Tracker, 2020). Because the EU ETS did not allow for emissions reductions in line with the goal for climate stabilization set by the EU, did not see emission reductions in line with the climate stabilization goals set by the scientific community, and with the crucial starting phase of the EU ETS considered a failure both the EU ETS, and to a greater extent the carbon market it constructed, must be considered an overall failure.

Chapter 4: Lessons Learned & More

The European Union's Emission Trading Scheme is by far the most extensive and longest-running ETS in the world, and regardless of whether or not the program can overall be considered a success or a failure, there remains a number of lessons, insights, and information that can be taken away from it. As such, the most important lessons learned from within the EU ETS will be reviewed in addition to the limitations of cap and trade; and, to a greater extent, carbon markets. Solutions to ongoing challenges within the EU ETS will be reviewed as well as proposed alternatives to achieve climate stabilization within the neoclassical economic toolkit, and options to achieve climate stability outside of said neoclassical economic framework. The most important lessons learned from within the EU ETS will be reviewed briefly from phase 1 through phase 3 and focus on the lessons the program learned from its own mistakes. At this point, the limitations of the cap and trade theory will be put forth; so that there may be a greater understanding of the pitfalls inherent within the EU ETS and carbon markets as a whole. This will lead to an examination of the possible solutions that could be put in place within the program in order to help the EU ETS prosper. Finally, a review of the alternative options to achieve climate stabilization, besides a pure cap and trade program, will be discussed. At the start, these alternatives will focus on neoclassical economic solutions, then lead into an analysis of the inherent weaknesses of such solutions, and finally conclude with a review of the options to achieve climate stability outside the neoclassical economic framework.

A number of the topics covered within this chapter are or can be broadly overlapping, with this especially ringing true with the solutions for the issues within the EU ETS and the alternative options to achieve climate stabilization. Due to this fact, a number of topics may not be discussed within one section but instead reviewed in another in order to give greater weight and depth to specific topics.

4.1 Lessons Learned from within the EU ETS

Phase 1 of the EU ETS was filled with a wealth of lessons to be learned due to issues with an over-allocation of allowances, a low price of carbon, and a low level of emissions abatement. One particular lesson to be learned within phase 1 would prove to be the most important by far. That lesson was the National Allocation Program, which proved to be the culprit behind many of the issues within both phases 1 and 2. The national allocation program was rushed and saw each specific nation, virtually determining the cap for the covered sectors based on each business's self-reported historical emission levels. The benchmarks to be set for these businesses under the NAP were determined by the "average emissions rate per unit of output for those installations in each ETS sector constituting the 10% with the lowest CO2 emission rate in 2005" (Ellerman, 2016). This essentially amounted to historical emissions reports from said sectors being the standard benchmark, and even though these benchmarks focused on the lowest 10% of emitters in a given sector, they were still too high. Unfortunately, this lesson was not learned until the end of phase 2, at which point the NAP was scrapped in favor of an EU-wide cap. The NAP was directly linked to the over-allocation of allowances due to the rushed nature of the process, the fact that a number of NAP's did not get approved until months into phase 1, and the biased nature of the NAPs that were submitted, which also caused competitive distortions (EU Commission, 2020) (Ellerman, 2016) (Calder, 2009).

A clear link between the NAP and a number of issues within phase 1 can be established in that the NAPs were directly linked to the over-allocation of allowances with some countries. The over-allocation of allowances resulted in a low price for carbon, which most likely did not help to encourage an increase of investment in low emissions technology. The over-allocation of allowances did not encourage a significant degree of emissions abatement due to the low price of allowances on the market and the future low demand from the over-allocation of EUAs. The lesson involving the NAP was learned over time and did much damage to the early phases, which made it clear that if an emissions trading scheme is to cover numerous nations, the cap needs to be set in an overarching manner and not through a series of smaller national linkages. To be clear, the linking of emissions trading schemes is not the issue in this case but rather the lack of coordination and equity between these nationally linking programs.

Unlike phase 1, phase 2 of the EU ETS had by far the most issues within the scheme to date with a continuation of problems from phase 1 into phase 2 and the recession whose impacts were felt from 2008 through 2009. Because of the large number of issues within phase 2, there are also a large number of lessons to be learned, mainly revolving around low carbon investment, windfall profits, the oversupply of allowances, and the price volatility which defined phase 2. The price volatility within phase 2 was caused primarily by the economic recession which saw the price swing between 30 euros per Mt in July of 2008 and 4 euros right before phase 3 due to fears of an accumulation of surplus allowances in the industrial sectors (Grubb & Laing, 2012) (Ellerman, 2016) (Elsworth, 2011). The lesson to be learned from the price volatility within phase 2 was the need for a price stabilization mechanism executed through the management of the supply of allowances on the market.

The establishment of this price mechanism started with the movement of 900 million allowances into a reserve to be backloaded later in 2019-2020 as a way to stabilize the price level, now heading into phase 3 (ICAP, 2019). Those 900 million allowances would eventually be folded into the newly established Market Stability Reserve, whose main objective was the management of the supply of allowances currently in the market. Through this mechanism, the EU ETS could more easily ensure a less volatile price for emissions in the future. This lesson, which was learned in phase 2, is one of the most important as the price volatility within phases 1 and 2 did not encourage faith in the EU ETS as an effective market for emission, which was the main goal of the EU ETS. It also signaled that if there were indeed another recession or other instabilities within the market, the EU ETS would ensure that a reasonable price for carbon was maintained, which would, in theory, ensure that emissions abatement in times of economic downturn would continue. The establishment of this price management mechanism is also linked to other lessons that were learned within this phase revolving around low carbon investment, windfall profits, and an excess of allowances in the market.

The establishment of the MSR signaled to participating sectors and investors that the EU ETS was being strengthened and, as such, would not be as susceptible to future instability due to outside shocks or an oversupply of allowances. Another important lesson in regards to the oversupply of allowances and price instability was learned in phase 2 with the move to auction 40% of the allowances in phase 3, with the rest being allocated freely (European Commission, 2020). This move toward a higher number of allowances being auctioned follows the principle of cap and trade theory in that the polluter should pay for their emissions directly; rather than being allocated a significant degree of allowances for free. The implication that this lesson was learned was only amplified when in phase 3, free allocation ended for the power sector while the industrial sector was allowed to phase out of free allocation over time (Ellerman, 2016). The move toward auctioning and away from free allocation helped encourage a higher price for allowances, less of a possibility for windfall profits to occur due to a decrease in free allowances, and hold the potential for an increase in low carbon investment due to increased revenue for the member states.

Indeed, the lessons learned within phase 2 surrounding price volatility and an oversupply of allowances within the market lead to a different view of the EU ETS as a program that would indeed not succumb to instability. The increased auctioning of allowances, the move away from free allocation, and the establishment of a price management mechanism can all be connected to the lesson involving windfall profits learned within this phase. Windfall profits were a significant issue within both phases 1 and 2, with some estimates indicating that the UK power sector collected possible windfall profits to the tune of £1 billion a year within phase 2 (Maxwell, 2011). When looking at the broader picture through examining the EU 20's power sectors with an assumption of 20 euros per Mt of CO2, some estimates show that there were windfall profits to the tune of 35 billion euros (Lise, 2010). These windfall profits were able to occur in part due to the light hand of the EU ETS, which did not have enough restrictions and or support around the price of carbon. Other drivers were high-cost pass-through rates, the over-allocation of allowances, and massive profits from the sale of said overallocated allowances. As mentioned before, this was partially resolved with the introduction of the MSR, the move toward auctioning, and the move away from free allocation, which would all increase the perceived stringency of the program. This perceived increase in stringency is also indicative of a lesson learned regarding low carbon investment.

The price volatility, the oversupply of allowances, and the occurrence of windfall profits within both phase 1 and 2 did not indicate to the market that a functioning price for emissions was established. The fact that the EU ETS was perceived as a light-handed program with an on average low price for emissions did not send the signal that investors and businesses should look into low carbon investments in the form of efficiency upgrades or low carbon energy generation. However, at the end of phase 2, there were indications that low carbon investment may increase. At the end of phase 2 and heading into phase 3, low carbon investment was looking more promising, with 10% of businesses, up from 4% in phase 2, reporting that they expected changes in both their investment decisions and their general operations to change due to their expectation of increased stringency of the EU ETS in phase 3 (Neuff, 2011). While this increase in consideration of low carbon investment may simply be a side effect of the other lessons, it is so vital that it is worthy of being a lesson learned from this phase. Very little within phase 1 and 2 was done to encourage low carbon investment, and this change in expected decision making is the first indication of progress in terms of one of the main goals of the EU ETS. It also shows that if an emissions trading scheme hopes to encourage increases in efficiency, innovation, invention, and investment, then the program needs to operate in a practical, strict, and precise manner. The predicted increase in stringency within phase 3 most certainly occurred and is illustrated by the many changes before, during, and after phase 3, including the changes to the use of carbon offsets.

As phase 3 comes to a close, there are a number of valuable lessons to take away including the increase in the number of allowances auctioned, the strengthening of the MSR, and many more essential lessons; however, one of the more minor lessons will be focused on due to its lack of attention as of yet. As phase 3 ends and the program moves onto phase 4, it is projected that carbon offsets are not foreseen to be a significant contributing element to the phase, meaning there are no current projections where these offsets are used (ICAP, 2019). While this might not seem like a relatively significant change, compared to many other possible lessons that could be taken away from phase 3, it is a drastic departure for the program in that the use of carbon offsets in the form of CDM and JI credits has persisted throughout each phase. From the beginning of the EU ETS, these credits have been used as an alternative means to fulfill businesses' emissions abatement requirements, and while these carbon offset programs are well intended, they have often been criticized for a number of significant reasons. Before these reasons are revealed, an explanation of what these credits are will be reviewed.

Carbon offset projects are alternatives to reducing emissions for polluters and often are undertaken when polluters either do not have the needed number of allowances or find it more cost-efficient to pursue carbon offset projects. Some examples of carbon offset projects are renewable energy projects, reforestation, or funding efficiency upgrades for other businesses. Reforestation and renewable energy projects are a few examples of Clean Development projects, while the funding of efficiency gains in businesses to reduce pollution is one example of what can be done through Joint Implementation projects. Joint Implementation projects generally occur in other industrialized and wealthy nations through a process where businesses can purchase these credits to fund projects to reduce emissions in another country. Clean Development Mechanism projects, per the Kyoto Protocol, have to occur in pre-approved, less industrialized nations not currently signed onto the Kyoto Protocol. While these programs sound great to start with, especially in regards to the CDM, which has the potential to encourage low emissions economic development, there are issues with them, namely regarding price and equity.

These credits are usually purchased when the cost of allowances on the market exceeds the cost of carbon offset credits, and while it makes economic sense to fund reductions in emissions through the most affordable means, this mechanism can be overexploited. It is possible for purchasers to reduce emissions in another sector within a KP signed-on nation, through JI, or in a nation that is not as developed; however, this avoids making the needed changes in the given local sector. It also does not provide the possible spillover benefits for the local community where the businesses who purchase these credits; these spillover benefits could include air quality improvements. Additionally, the funding of innovation or new inventions to reduce emissions in sectors where it is difficult to reduce emissions, like the power sector, will not occur if these sectors are able to purchase carbon offsets in both other nations and sectors. The most significant concern and the reason this is the lesson to take away from the end of phase 3, and the beginning of phase 4 is equity. While the concerns surrounding carbon offset credits funding cheaper, less viable projects through CDM's are well placed, there are also issues of equity in that many of the nations that these cheaper projects take part in are less industrialized (Johnson, 2008).

While the idea that these projects could encourage reforestation or clean energy projects in developing countries is a positive one, there are also issues of equity. Simply put, placing the burden of sequestering carbon, or reducing emissions, onto a less developed nation while the burden is that of a coal power plant in the UK is, to say the least, inequitable. Even reforestation projects which offer plenty of feel-good emotions are essentially taking away how that nation decides to use their capacity and land both presently and in the future. Not to mention the often cheaper forestation projects do not offer the reduction in emissions levels that the world so desperately needs, especially if that same forest is then harvested in the future or is disturbed by some coincidence. While the idea of forestation is excellent, it has been shown that tree plantations like the kind often funded through carbon offset projects can encourage streamflow loss, increased acidification, and increased soil salinization (Johnson, 2008). These carbon offset projects do not address the issue of equitability or accountability, even when the projects are of the highest tier.

The projects that are funded through the purchase of CDM and JI credits are independently verified and have to meet a high standard, with that standard being higher for more expensive projects such as renewable energy projects. Despite the high standards present for these projects and the independent third-party verification that occurs, these projects have been continuously playing a smaller role within the EU ETS over the first 3 phases due to concerns regarding equitability, viability, and accountability. The projection that carbon offsets are not foreseen to be a contributing element in phase 4 is a massive change and indicative of a lesson learned (ICAP, 2019). While CDM and JI credits being incorporated into the EU ETS seemed like a good idea at the time, their continued use in the future would indicate that this was not a good idea due to concerns surrounding accountability, equity, and viability.

4.2 Limitations of Cap & Trade Theory

The limitations of cap and trade theory and the limitations of the EU ETS broadly overlap in a number of ways, with the most overlap coinciding with their own inability to solve particular problems. These problems can also be broadly linked together due to the interdependence present within the cap and trade framework. Perhaps one of the most significant limitations within cap and trade theory is the amount of time and information that such an essential and complex program requires in order to function correctly. The benefit of a cap and trade program compared to a carbon or emissions tax is that the cap and trade program can set a definite cap on the level of emissions within the sectors covered; however, that cap requires a tremendous amount of time and information to be set correctly.

The cap within a cap and trade program, if set too high, could result in an increase in the level of emissions, a low price for allowances, or price volatility once it is discovered the cap is too high. If, at one point within this hypothetical program, it was discovered that the cap was too high, it would then take until the next phase or beyond in order to correct this issue. If this issue is discovered, it would then be necessary to collect information and determine a cap more in line with the objective of reducing emissions, which could take an extended amount of time depending on the scale of the program. This would also give rise to concerns of just how low the cap would then be adjusted, which, in a market-based approach to emissions reductions, can impact the participants' expectations about the future and hence, the market. Overall, a cap and trade program requires a significant degree of time and information in order for the program to work effectively and for the cap to be set appropriately. The time and information necessary to set a cap, correct a cap in either direction, or in general to correct an issue with a cap and trade program is a limitation depending on how the program is rolled out. The determination of the cap in a cap and trade program will impact many things but mainly the participation rate.

A cap and trade program can be a useful tool to reduce emissions when operated effectively; however, the program is no good if the participation rate is low. The benefit of setting the cap knowingly or unknowingly too high is the possible increase in the participation rate. Furthermore, if the cap and trade program has a low participation rate overall or within specific sectors of the economy, it can cause competitive distortions for businesses, resulting in an extreme level of competition for some businesses or sectors. While it is possible with a cap and trade program that is operated at the national level to attempt to force businesses to participate in the program, there could be potential legal issues in addition to putting the country at a competitive international economic disadvantage. This competitive economic disadvantage would occur due to increases in the cost of production or possibly from the passing on of the increased costs of production to the consumer. This may shift the consumption of individual products to imported goods, which may have a new price advantage. While this could attempt to be solved through potential tariffs or through other means within a nation's economic toolkit, it is definitely a limitation within the cap and trade framework.

Unlike competitive distortions, the price volatility within the pure cap and trade framework cannot as quickly be addressed, on top of the fact that addressing the issue of price volatility within a pure cap and trade framework is nearly impossible. What makes addressing price volatility in a pure cap and trade framework nearly impossible is the intrinsic market-based nature of the theory. Both a pure cap and trade framework and a hybrid or mixed model is susceptible to market forces outside the control of the program, with this clearly being exhibited by the drop in the price for allowances during the global recessions within the EU ETS (Ellerman, 2016). While it may be possible to address these problems slightly within a hybrid or mixed cap and trade framework through a price floor, an auction reserve, or other economic interventions, this issue is not as simple to solve in a pure cap and trade framework. Additionally, even if the issue of price volatility was solved through a price floor, an auction reserve, or through the management of the supply of allowances within the market, these interventions can have unintended consequences. A price floor could establish too high of a price for allowances, resulting in issues such as competitive distortions, the closure of businesses who cannot afford said allowances, or a decrease in the participation rate of the program. The inability of a pure, or even a mixed, cap and trade program to manage the price of allowances is a significant limitation and requires a high degree of flexibility, time, and information in order to ensure a stable price.

While price volatility and many other issues within the cap and trade framework represent limitations, by far, the most limiting is the inability to address cost pass-through. Through the cap and trade framework, a price is established for emissions, and that price is rightfully placed onto the producer who is directly responsible for the production of emissions. The fact that the polluter pays the price for their emissions is an essential and positive aspect of cap and trade theory; however, those same producers passing along this cost to the consumer is not. If the polluter can continue to pollute, despite the price of carbon rising over time, by passing along the cost to the consumer, the polluter is no longer paying for the pollution they are responsible for. The issue of costs being passed onto consumers brings up a whole other number of issues, namely these producers' continued response to rising emissions prices.

Some companies may choose not to pass along the cost of emissions in order to gain a competitive edge in the market at a lower price point. If this scenario continued for a prolonged amount of time, the market for specific products would shrink. This would be due to large corporations being better able to absorb the rising cost of emissions until they push their competitors out of the market, at which point they would be free to pass on the previously absorbed cost of emissions. In a similar manner, large corporations may choose to either coordinate their price point either directly or indirectly, which would once again see the market shrink over time or see the coordinated pass-through of costs. If these businesses chose not to absorb any of the cost of emissions and instead pass them onto the consumer while simultaneously being allocated allowances for free, this then opens up the possibility for windfall profits. In this way, a pure cap and trade framework cannot deal with the issue of pass-through costs, and even if the framework were more suited to this issue, it would still represent a limitation that could not easily be overcome. Overall, both a pure cap and trade program and a more flexible cap and trade program have a number of limitations due to issues that can either not be solved easily or cannot be solved at all within the framework. The limitations of a pure cap and trade program are numerous, and while a hybrid model offers more flexibility to overcome these limitations, both are still susceptible to market forces for better or worse. The very fact that cap and trade theory and carbon markets as a whole are market-based interventions will always limit their impact.

4.3 Solutions to the Ongoing Challenges within the EU ETS

Just as there are a number of ongoing challenges within the EU ETS, there are also a number of solutions. The solutions to the challenges that will be reviewed are the main criticisms of the EU ETS, which include windfall profits, price volatility, and a low level of low carbon investment. The solutions to the challenge of low emissions abatement will not be reviewed as this requires both a much more complex and alternative approach, which is not to say the solutions presented below are not applicable to low emissions abatement. The solutions to the challenges within the program that will be discussed will focus on solutions that can either be easily applied within the cap and trade framework or slightly outside the scope of said framework. The reason for the limiting of the scope of the proposed solutions is to not take away from the possible solutions that exist much more outside of the traditional cap and trade framework. The first of such issues to be discussed will be the perpetual issue of windfall profits.

Windfall profits were present in both phases 1 and 2 of the EU ETS and drew much criticism with some estimates indicating that businesses pulled in large profits during this time. The drivers of these profits were an over-allocation of allowances, the economic recession, the sale of over-allocated allowances, and high-cost pass-through rates. One example of this was an estimation by Maxwell that shows the UK power sector collected possible windfall profits to the tune of £1 billion a year within phase 2 (Maxwell, 2011). Looking at the EU 20's power sector and an assumption of 20 euros per Mt of CO2, Lise estimates that there were windfall profits to the tune of 35 billion euros (Lise, 2010). Windfall profits are a significant issue within the EU ETS and violate the principle of the polluter paying for their pollution. The existence of windfall profits can be combated through the elimination of outside cheaper options, besides allowances, in the form of carbon offset credits, the elimination of price volatility, and the end of free allocation.

By far, the easiest way to combat windfall profits while staying within the cap and trade framework is the ending of free allowance allocation and the frequent re-verification of emissions levels on a site by site level. The frequent re-verification, every year, of emission levels on the individual business level would then be followed up by the option to adjust the specific cap on emissions for that business within a certain tolerance range. These two solutions combined would help to eliminate the issue of windfall profits; however, they would not completely address the issue. This is in part due to the complex nature of the EU ETS, the fact that the program is a market-based intervention, and the fact that windfall profits by their very nature can occur unexpectedly. An intrinsic part of the EU ETS is that it establishes a market and that market is complex, open to influences beyond the governing entities control, and has the ability for participants to make a profit from said market. Just as there are no perfect solutions for the existence of windfall profits within the EU ETS, there are also no perfect solutions for price volatility.

However, just because there are no perfect solutions for price volatility does not mean that potential solutions should not be put in place in order to prevent as much of a possibility for the issues as imaginable. One such solution that exists relatively within the cap and trade framework would be the full auctioning of allowances in addition to the introduction of an auction reserve. This auction reserve would go a long way toward countering price volatility while directly avoiding the introduction of other less popular measures such an emissions tax or a price floor. While it is possible that some would insist that this auction reserve is essentially a tax or price floor with a different name or methodological approach, the EU ETS is not far away from needing those outright additions. The price volatility that was present within phase 1 and 2 of the program enabled windfall profits to accrue, a lackluster reduction in emissions, and an inability to fund low carbon investment. An auction reserve price would go a long way toward accomplishing the bare minimum of a cap and trade program by putting a reasonable price on emissions and establishing an adequate market for emissions. The solutions presented so far would also go a long way toward solving the lackluster level of investment in low carbon technology.

By far, the solutions presented, including a more stringent and frequent emissions verification process and an auction reserve, would also assist in increasing investment in low carbon technology. Low carbon technology could be the funding of efficiency upgrades to existing facilities, the invention of new technology, encouraging innovations in current technology, or the construction of low carbon energy sources. While the goal of increasing low carbon investment is one of the minor goals of the EU ETS, the lack of progress on this goal is an issue. While not perfect, the introduction of the previous solutions would help in this respect, but it may be possible for the EU Commission or the relevant national entities to establish other mechanisms to accomplish this goal. This could be accomplished through a grant application process open to businesses, inventors, or innovators who would put forward their proposals, which would have to meet specific criteria or focus on a particular topic such as clean energy. While this solution is but a small one, it would be a strong financial incentive for creative thinkers and businesses who do not have the capital to fund upgrades to their facilities

4.4 Neoclassical Economic Alternatives for Climate Stability

Within the pantheon of mainstream neoclassical economics, there exist many options to combat climate change besides a pure cap and trade theory, which, as can be seen by the EU ETS, can have a number of significant issues. The options that will be reviewed include the varying forms of an emissions tax, a cap and trade program with a price floor and or ceiling, and a hybrid model that incorporates multiple aspects. Another review of the emissions tax will be undertaken due to the theory's ability to impact pollution on many levels, its ability to be incorporated into other solutions, and its ability to avoid price volatility slightly better than a cap and trade program. The possibility for the cap and trade model to be improved upon by a price floor and or ceiling would open up the possibility to improve upon the already established EU ETS, and it is for this reason that it will be explored as an alternative option. Finally, a hybrid model that incorporates multiple elements within these alternatives will be discussed due to such programs increased flexibility.

In terms of the options for incorporating carbon into the market, a pure emissions tax may prove more effective at reducing emissions than the cap and trade model. A pure carbon tax model would strictly define the cost of pollution at a socially acceptable rate, would not have issues such as windfall profits, and would benefit from the fact that allowances would not exist. The simple act of not distributing allowances for free would encourage the idea that all emissions should be taxed towards the source of pollution instead of the burden of those emissions being placed onto society at large. Furthermore, the many constant revisions associated with the cap and trade framework have undoubtedly incurred a degree of administrative costs where a carbon tax could provide the opportunity for a decrease in overhead (Goulder, 2013). This decrease in overhead could be prevalent for many developing nations and would be a great way of cutting costs even if an emissions tax does require some overhead. The carbon tax model has none of the price volatility, high overhead costs, and takes into account accountability to a higher degree, given that the polluter will always pay the full amount for their emissions and will not have the option to purchase the ability to pollute. Furthermore, if the tax rate is guaranteed for a specific time period, it allows businesses and consumers to plan for the future and adjust their expectations to the tax ahead of time, which would provide some security for individuals. There are also certain design elements that are particularly attractive to an emissions tax like the placement of such tax, the possibility of a dividend, and the shift in consumer behavior.

One such positive design element is the ability to allocate the tax revenue from the emissions tax to lower other taxes, such as social security taxes, thus possibly making it a more tax-neutral policy. Another idea along a similar vein is to have an emissions tax with a dividend, in that the tax revenue would be distributed to those individuals who are most impacted by the tax. This would ideally see those individuals with lower income receive support from the dividend in order to alleviate some of the tax burden that would inevitably be passed onto the consumer from the producers. It is important to note that an emissions tax should not be placed directly on the consumer, but rather on producers and those who are extracting fossil fuels; this is known as an upstream tax (Harris, 2018). Because these producers and extractors will likely choose to pass on the price of the emissions tax, a dividend sort of system or a tax cut on another tax is needed in order to prevent some consumers from bearing an undue burden. Admittedly, some of the burden being passed on to the consumer is an essential part of an emissions tax, as it can shift consumption behavior; however, that burden should be equitable and manageable.

While a cap and trade model with a price floor and or ceiling may not be able to address questions of equity in the same way that a tax on emissions can, it can most certainly address the issue of price volatility, one of the main benefits to an emissions tax. A cap and trade program with a price floor, price ceiling, or both could very well stabilize the volatility of such a market. A price ceiling would put a limit on how high the price of allowances can go, while a price floor sets a minimum value for allowances at all times. To construct a functioning price ceiling, the governing body could introduce reserved allowances whenever the price rises to a particular benchmark or allow participants to pollute by paying a substantial set fee after the price ceiling is reached (Goulder, 2009). This would help ensure that the competitiveness of businesses are protected and would produce more revenue for the investment in low carbon energy infrastructure; however, it would also hinder the reduction of emissions. A price floor, on the other hand, could see the governing body keeping allowances out of circulation unless the participants are willing to pay the floor price (Newell, 2013). The price floor would ensure that polluters are indeed being held responsible for their emissions at a socially responsible price. The benefits of a hybrid cap and trade program are substantial, and these fixes in the mixed model could easily be applied to the EU ETS, but so could the beneficial elements of an emissions tax.

The best elements of the hybrid cap and trade program, in the form of a price floor and or ceiling, can be combined with an emissions tax in order to incorporate the best of both options into a mixed model. This mixed model could be similar to the emissions tax introduced in the UK in 2013. In April 2013, the UK enacted a carbon price floor through a carbon tax placed on fossil fuel producers, set so that the price of EUA will be 19 euros per Mt in 2013 and grow to 35 euros per Mt in 2020 (Ellerman, 2016). This carbon tax, or price floor, will act as a price stabilizer for EUA in the UK in addition to both decreasing demand for fossil fuels and increasing the demand for allowances. A similar solution, such as the one practiced in the UK, could be placed overall EU ETS participating nations in order to bring more price stability to the market. There is also the option for the emissions tax to be placed in a different way in that there is a ceiling and a floor, but when the ceiling is reached, polluters pay the carbon tax rate. With the existence of an outside price in general, the price volatility of a pure cap and trade model could be avoided to some degree and minimize the cost of policy errors within the program. Of the options presented, a mixed model that incorporates a price floor and ceiling, an emissions tax placed upstream, a dividend from said tax, and a clause that prevents double taxing participants is one of the more promising options. This type of mixed program would admittedly be more complex and would have to ensure that there was not a double tax incidence; however, it has the ability to insulate the EU ETS more from outside market forces. This type of mixed model would offer more of a range of options to ensure price stability, increases in low carbon investment through a stable price for allowances, and combat pass-through costs. Unfortunately, this type of mixed model is still a market-based approach, and no matter how insulated it may be, it is still susceptible to outside market forces that can render it useless or, at worse, provide windfall profits to polluters as they continue to pollute.

4.5 Non-Neoclassical Economic Climate Stabilization Options

One of the main issues with climate stabilization options within neoclassical economics and neoclassical based environmental economics is the belief in market-based approaches. Market-based approaches, even under the best of assumptions and regulations, are still market-based approaches and, as such, are susceptible to the whims of the market. If those who take place in the market decide that their profit imperative is stronger than the market mechanisms put in place to reduce emissions, they will find a way to ensure that they do not reduce emissions and protect their profits. Even worse is the case when market-based interventions such as the EU ETS result in large windfall profits for the polluters, which violates the entire principle of the cap and trade theory. Because of the belief in markets and their ability to accurately select the best outcome, market-based approaches will always be susceptible to failure. The only way in which market-based approaches are practical is if they have a high level of oversight and a complex web of supports put in place in order to ensure that the outcome is a reduction in emissions in line with what is needed for climate stabilization. Even when these market-based approaches have such supports in the form of a mixed or hybrid cap and trade model, the very fact that they require such oversight and complex supports illustrates that market-based approaches are not enough.

The market-based approaches discussed within this paper should either be replaced or supplemented with alternative non-market based options to reduce emissions and achieve climate stabilization. One of the most effective means to do this is through a reduction in the use of fossil fuels. This initiative should be pursued through policies instituted in an equitable manner, with wealthier countries supporting less wealthy countries' movement away from carbon-intensive energy sources, toward cleaner sources such as solar, wind, and hydroelectric energy. Assuming that there are remaining stocks of fossil fuels left in the ground, they can be preserved indefinitely or used sparingly in a way that supports select areas of the world where access to renewable energies is currently impossible or unfeasible. Along with the reduction in the use of fossil fuels, there needs to be social change and a move away from overconsumption.

This kind of social change would look like using electronic products for much more extended periods of time instead of opting for a new device, repairing old and or damaged products for further use, traveling in a sustainable way via public transportation options, and not consuming food in excess or wasting it. These are only some of the small ways changes can be made in order to decrease emissions levels. On a larger scale, this would look more like a movement toward relative or absolute decoupling, with a reduction in the extraction of natural capital and the overexploitation of the natural world in order to drive economic growth. The focus of the world economy should be reducing poverty, improving global health standards, increasing education levels, preserving the natural world for future generations, and increasing overall human wellbeing. These objectives could be accomplished through policy initiatives encouraging a foundational reshaping of the worldwide economy through decoupling, which is broken down into absolute and relative decoupling.

Relative decoupling is severing the connection between increases in economic activity and increases in environmental effects. Relative decoupling is a moderate position, while that of absolute decoupling would see an increase in economic growth being linked to a decrease in environmental effects. While the position of absolute decoupling would be preferred, either of these initiatives pursued through both policy initiatives and social change would be improvements to market-based solutions. In a perfect world, the re-centering of the economy around the natural world and gains in human wellbeing would be accomplished through policy in a short time span; however, that is not possible given the economic cost. This is why the end goal of absolute decoupling should be pursued through policy and social change in addition to market-based interventions. This multifaceted approach toward accomplishing the goal of absolute decoupling should be pursued due to the short term economic consequences that absolute decoupling would inflict. These short term economic consequences would, at a minimum, include frictional unemployment for the lucky, and structural unemployment for the unlucky. While these consequences are a necessity in order to make an immediate change to avoid the substantial harmful impacts of climate change, the term short is used with the understanding that the long term could very well be hundreds of years. Because of the substantial shift that is necessary within the world economy to achieve absolute decoupling, any measures that can address climate change with any degree of impact immediately should be pursued. This immediate impact is best achieved through a mixed cap and trade model, policy initiatives, and social change in order to both pursue immediate "balanced" emissions reductions and long term structural changes to the world economy.

Chapter 5: Conclusion

The European Union's Emission Trading Scheme attempted to create an effective means by which to incorporate emissions into the market in order to make strides in emissions reductions in a "balanced" manner. The effectiveness of the overall program was evaluated via a determination of whether the EU ETS, and to a greater extent the EU carbon market, has allowed for emissions reductions in line with the goal for climate stabilization set by the EU, whether emission reductions in line with the climate stabilization goals set by the scientific community were achieved, and a determination of the success of phase 1 of the EU ETS. The first phase of the program that was examined started in 2005 and was aimed at 10,500 businesses, from power plants to energy-intensive industries, who produced the most substantial carbon dioxide emissions within the EU (Calder, 2009). Phase 1 of the program was generally considered a learning by doing phase, which would lead to the second phase, where the program would need to function effectively (EU commission 2020).

Overall, phase 1 of the EU ETS was a learning phase, but it was also a failure. This failure was in part due to the accumulation of windfall profits to the tune of £800million a year for the UK power sector, and when combining power sectors in DE, UK, FR, BE and NL at 20 euros per Mt of CO2 there was windfall profits to the tune €5.3-7 billion per year (Grubb, 2012). These windfall profits were driven by an over-allocation of allowances, high-cost pass-through rates, and revenue from selling excess allowances. The existence of profits resulting from the EU ETS is not necessarily an issue, but what is an issue is the fact that it appears as if the participating sectors may not taking on any of the cost of their pollution. There were also issues with price volatility and an over-allocation of allowances. In April 2006, the price for allowances dropped dramatically from nearly 30 euros per Mt of CO2 down to 13, due to the release of reports which showed that a number of member states and regions were below their expected emissions levels (Ellerman & Buchner, 2008) (Ghoulder, 2013). There was a small revival before prices inevitably spiraled down below 1 euro per Mt of CO2 in May of 2007 for phase 1 allowances (Delarue, 2008). Due to the over-allocation of allowances, windfall profits, and price volatility, participants suffered little to no loss of competitiveness or profitability (Newell, 2013). Fortunately, the power sectors in the Netherlands and the UK during this phase were not only able to accrue windfall profits; there were also able to pass through 60 to 100% of the cost of allowances (Grubb, 2012). This cost pass-through rate, along with evidence by Branger, clearly indicates that there was no loss of competitiveness or profitability during the phase (Bringer, 2016). Emissions abatement during this phase was unfortunately low if at all present, with figures ranging between 120 and 300 Mts of CO2 (Ellerman & Buchner, 2008). Despite the terrible performance of the EU ETS during this phase, some considered it a win for investment due to the fact that emissions have a price and are therefore taken into account more readily in the investment and production processes (Ellerman, 2010). While phase one of the EU ETS was a failure overall, it was in phase 2 that the scheme would have to prove itself, and it most certainly did; as a failure yet again. During this phase, the global recession would have the most profound effect on the program resulting in price volatility, an almost indeterminable level of abatement, and no gains in investment. At the beginning of phase 2, the price for allowances nearly rose to 30 euros per Mt in July of 2008; however, the price took a drastic dip to the tune of a 50% drop in late 2008 due to the economic crisis (Grubb & Laing, 2012). The price would stabilize in early 2009 and experience a small two year period of stability until it fell once again in the summer of 2011 down to 7 euros, before it dropped down to 4 euros right before phase 3 due to fears of an accumulation of surplus allowances being banked into phase 3. In terms of investment during this phase, a large number of companies reported that the EU ETS and climate policy, in general, are still less important in the decision-making process compared to return on investment (Neuff, 2011). Business competitiveness was well preserved within phase 2 due to the low price of allowances (Branger, 2016). The determination of emissions abatement during this phase would prove to be difficult to estimate; however, it appears some abatement took place; however, not at a significant level (Ellerman, 2016). Emissions levels in Germany, the UK, France, and Spain decreased both during the economic growth period taking place after 2009 by 80 MtCO2, and the economic crisis period of 2008 and 2009 by 175 Mt CO2 (Sansoussi, 2018).

With phase 2 generally considered a failure due to price volatility, the low level of emissions abatement, and no definite change in investment decisions, the hopes were high for phase 3 to be a course-correcting phase. In some ways, phase 3 was indeed a course-correcting phase in that emissions abatement certainly took place at a low to moderate level; there were positive changes regarding investment and no discernable impacts on competitiveness as of the time of writing. Emissions within the EU ETS have declined by 4.1% through 2017-2018, with overall emissions have declined by 29% from 2005-2018, unfortunately, though emissions are set to slow in the coming years, with ten nations reporting increasing emission until 2030 (EU Environmental Agency, 2019). Finally, in phase 3, there were net positives surrounding low carbon investment with 10% of businesses, up from 4% in phase 2, reporting that they expected changes in both their investment decisions and their general operations to change due to their expectation of increased stringency of the EU ETS in phase 3 (Neuff, 2011). Phase 3 also saw the movement of 300 million allowances into the NER 300 program whose aim was too fun low carbon innovation (EU Commission, 2020). The positive changes surrounding low carbon investment during phase 3 were substantial with more than 80% of the revenue from auctions in phase 3 earmarked for energy or climate-related purposes; in addition to plans to use at least 50% of future auction revenue for the same purpose (EU Commission, 2020) (ICAP, 2020). While there is still more insights to be gleaned from future studies on phase 3 it appears that this phase was at minimum a vast improvement over the other two and due to that fact it could be considered a success; when the bar was already set so low by phase 1 and 2.

Despite the failure of phases 1 & 2 and the issues present in phase 3, the EU does look on track to meet it is goals per the 20-20-20 guidelines (Spinelli, 2016).

Unfortunately, there is doubt surrounding the 2050 roadmap goals with projections showing a reduction of 36% achieved in 2030 compared to 2005 emissions levels, which is not in line to meet the 43% reduced emissions goal in 2030 (EU Environmental Agency, 2019). The goal of the 2050 roadmap is the reduction of emissions by 80-95% below 1990 levels by the year 2050 (Sansoussil, 2018). The 2050 roadmap serves as the current climate stabilization and emissions reduction goal set by the EU, and as it does not appear that the EU is currently on track to reach that goal, through reductions in emissions via EU ETS and the carbon market it has constructed, it must be considered a failure.

Unfortunately in terms of reductions in emissions in line with goals set by the scientific community, it appears that the 2030 goal of a reduction in emissions by 40% is not sufficient with the current climate stabilization goal set by the scientific community of warming well below 1.5°C and the Paris Agreement of 1.5°C warming (Tracker, 2020). Additionally, it appears that the goal set by the 2050 roadmap is insufficient to meet the reductions in line with the climate stabilization goals set by the scientific community of warming below 1.5°C, the 2009 Copenhagen 2°C goal, and the 1.5°C limit put in place at the Paris Agreement (Tracker, 2020). Because the EU ETS did not allow for emissions reductions in line with the goal for climate stabilization set by the EU, did not see emission reductions in line with the climate stabilization goals set by the scientific community, and with the crucial starting phase of the EU ETS considered a failure both the EU ETS, and to a greater extent the carbon market it constructed, must be considered a failure.

In conclusion, an overall evaluation on the effectiveness of the EU ETS, and to a more considerable degree the EU carbon market, via a determination of whether it has allowed for emissions reductions in line with the goal for climate stabilization set by the EU, whether emission reductions in line with the climate stabilization goals set by the scientific community were achieved, and a determination of the success of phase 1 of the EU ETS indicate that the EU ETS and the EU carbon market were failures. These conclusions indicate that if the EU ETS and the EU carbon market as a whole are to be the principal instrument for emissions reductions and climate stabilization that there needs to be changes. The fact that the EU ETS is so profoundly influenced by market forces places emissions reductions and climate stabilization as a hopeful goal and by no means a strict one. One positive is that the program did give many lessons of what not to do and provided an excellent example for other countries looking to establish a similar program while avoiding the issues within the EU ETS.

If a nation is considering pursuing a reduction in emissions, toward the goal of climate stabilization, they would be better off pursuing this reduction through a number of different alternatives than a program very similar to the EU ETS. These more appropriate alternative frameworks within neoclassical economics, and neoclassical based environmental economics, include a program with more insulations from market instability such as a mixed cap and trade model with a price floor and or ceiling and an emissions tax with a dividend. A program with these insulations from market forces are the more appropriate measures needed to move the EU ETS and the EU carbon market toward seriously addressing climate change as a whole. The most substantial impact; however, is best achieved through a mixed cap and trade model, the introduction of policies to reduce the use of fossil fuels, and social change aimed toward eventual decoupling in order to both pursue immediate “balanced” cost emissions reductions, and long term structural changes to the world economy through absolute decoupling.

The role of the government in change within the EU ETS, climate stabilization policies, low carbon investment, social change, and absolute decoupling cannot be overstated. While the EU ETS is a program implemented by the EU Commission and pursues the goal of emissions reductions via a market-based intervention, the very weakness of the EU ETS is its susceptibility to market influence. The government as a whole has the ability to pursue reductions in emissions in line with the goals for climate stabilization set by the scientific community because of the unique position it is in. The government, and to a greater extent, the general public, has the ability to fund more risky ventures in low carbon investment that other investors would not take up due to such high risk. The government is able to fund these riskier projects and, in general, a more significant degree of investments and innovative ideas because of the scale of money available, either through current funds or its tax base. The unique position of government as an investor and change-maker in the goal of climate stabilization cannot be understated.

The government, as an entity, also has the ability to put policies in place that guarantee emissions reductions in line with the goals set by the scientific community. While the use of market-based interventions to reduce emissions is commendable, the use of public policy measures is perhaps the most critical element in achieving climate stabilization. Policies which see reductions in the degree of fossil fuels being extracted, increased use and construction of public transit, a shift in the energy sector toward low emissions energy generation, a guaranteed level of emissions reductions in line with the goals of climate stabilization set by the scientific community, and many others are policies that need to be enacted by the government in order to achieve real change. While the number of public policies that the government should put in place to combat climate change are innumerable, the prior list is a small start toward the government taking up its role, through public policy, to combat climate change.

While it is somewhat unfair for the EU as a whole to bear the burden of the entire world's emissions, the EU also makes up the most extensive grouping of industrialized countries and is often held up as the leader of positive environmental change. To put it quite simply, there will never be any large scale positive change in terms of combatting emissions or achieving climate stabilization until one nation, or nations, take both the economic and environmental burden onto themselves. This burden will quite possibly open up said nation or nations to a weaker economic position; however, no change will take place so long as every nation defects in this worldwide assurance game. Within this worldwide assurance game, the EU has demonstrated the willingness to cooperate in order to arrive at the mutually advantageous position where emissions return to lower levels, and some nations have even indicated the same willingness. With the introduction of emission trading programs in China and South Korea, there is indeed a show of willingness for the entire world to arrive at said mutually advantageous position; however, many industrialized nations still choose to free-ride within this grand game (ICAP, 2019). In short, the only way that climate change can be successfully combatted and climate stabilization successfully achieved is through a united global response, and nothing short of that.

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