Supporting Restrictions on Carbon Dioxide Emissions in the United States

Introduction

Global warming has long been a center of political debate in both world and American politics, and many questions surround global warming: What is causing global warming? What effects does global warming have on us? Is global warming a man-made phenomenon or a natural occurrence? Whose responsibility is it to address climate change? There are countless opinions as to how the issue should be addressed. While there is much debate in political and social spheres about how valid and urgent of an issue global warming is, there is an almost complete consensus among climatologists that global warming will reach critical levels in the coming decades, and that this will have devastating impacts on our planet, endangering our way of life.

Problem Definition

Health Impacts:

Global warming has major impacts on the environment, and these in turn have already begun affecting humans negatively. In some regions, like Southern California and Alaska, wildfires are bigger and more frequent than ever before. These wildfires burn down towns and endanger lives, in addition to creating terrible air quality for the entire West Coast. The East Coast and the Gulf of Mexico are being ravaged by hurricanes and tropical storms that are more powerful than ever. High winds and flooding from rain and storm surges destroy whole cities overnight. As a result of the 14 most damaging weather events in the U.S. in 2018, 247 people died (NOAA).

According to the Natural Resources Defense Council, there are several long-term and wide-spread health effects of climate change, including: heat stroke from more heat waves;

asthma attacks and respiratory illness from increased ground-level ozone and smog; worsening allergies due to prolonged pollen seasons; spread of mosquito and tick-borne illnesses due to population increases of both species; spread of water-borne illnesses due to flooding; and starvation and dehydration caused by threats to food and water supplies (Knowlton, 2011).

Economic Impacts:

Global warming has already had huge impacts on the world in facets ranging from economics to health problems. On the economic end, a climate change report issued on behalf of 13 federal agencies estimated that global warming has cost the US economy $400 billion from 2015 to the time of the report's publication in November of 2018 (NOAA). Economic impacts come in several forms. Storms and wildfires cause high levels of damage to personal property, businesses, and public infrastructure. In 2018, the U.S. experienced 14 climate-related events that each caused over $1 billion. The total cost of all of the billion-dollar storms in 2018 was $91 billion. These storms have been occurring more frequently in the past decade; the four years with the most billion-dollar disaster events are 2017, 2011, 2016, and 2018 (NOAA). Also, the four costliest years in terms of totaled costs of billion-dollar storms – 2018, 2017, 2005, and 2012 – were mostly within the past decade (NOAA).

The frequency and cost of billion-dollar storms has increased dramatically in the past decade:

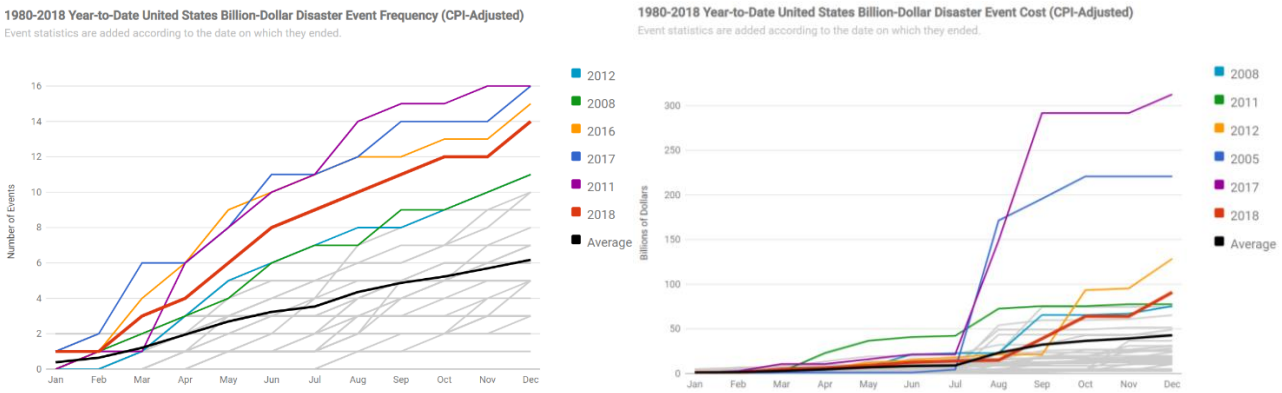

Figure A and B
NOAA National Centers for Environmental Information (NCEI). See work cited for full citation.

There are many other long-term costs associated with climate change. Rising sea levels endanger thousands of miles of developed coastlines. Reductions in species of wildlife decrease the profits of industries ranging from ecotourism to fishing. Agricultural lands face destruction as well as changes in water supply and temperature, costing farmers money as they are forced to retool their equipment, install new irrigation, or abandon their land entirely. Healthcare providers must treat more victims of climate change events – both from short-term catastrophes and long-term illnesses and conditions – than ever before. While most of these effects impact specific stakeholders first, their losses will quickly be felt by the whole US economy, causing hardship for everyone. The NRDC predicts that the total costs to the U.S. of unabated climate change will be $3.9 trillion (Ackerman, 2008).

Human Responsibility:

The recent climate change report by 13 federal agencies said that more than 90% of the current global warming is being caused by humans, saying that "there are no credible alternative human or natural explanations supported by the observational evidence." (USGCRP, 2018, p. 40)

Effects of Carbon Dioxide for Global Warming:

Almost all global warming is caused by an increase in the amount of greenhouse gases present in our atmosphere, and humans are almost entirely responsible for this increase. There are many types of greenhouse gases. Nitrous oxide, N_2O, is the most powerful greenhouse gas but there is not much of it in the atmosphere. Methane, CH_4, is a less powerful greenhouse gas but it is more abundant than nitrous oxide. Carbon dioxide, CO_2, is the weakest greenhouse gas but it is by far the most abundant in Earth's atmosphere. All of these greenhouse gases function in the same way: They deflect the sun's light beams that reflect off of the Earth's surface, bouncing them back down to Earth, ostensibly trapping the heat energy in our atmosphere. The

higher the amount of greenhouse gases that is present in the atmosphere, the more heat energy that is trapped in the atmosphere. To study the effects of all greenhouse gases would be too much for this report, so we will focus on carbon dioxide only. The main reason for this is that carbon dioxide is by far the most abundant anthropogenic greenhouse gas. By weight, 76% of anthropogenic greenhouse gas emissions are carbon dioxide (IPCC, 2014, p. 6). Carbon dioxide levels in Earth's atmosphere have risen from 280 parts per million to 400 ppm in the last 150 years ("Climate change causes", 2019).

Carbon Dioxide makes up most of the world's anthropogenic greenhouse gas emissions:

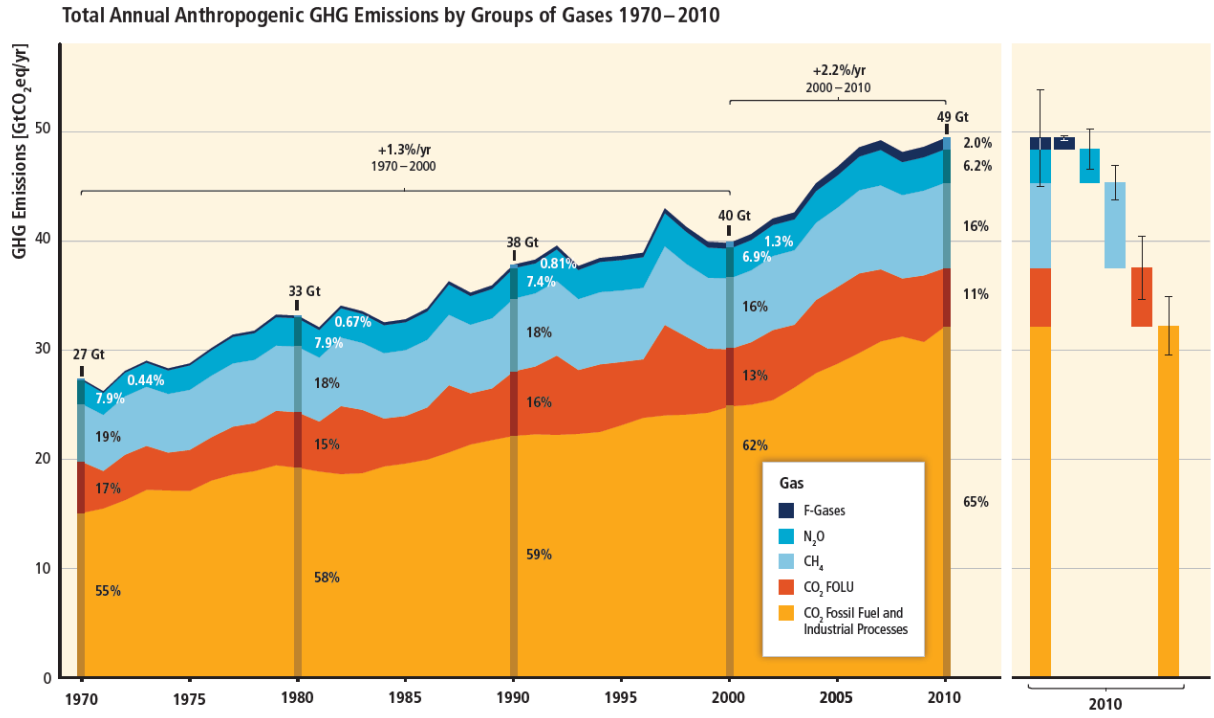

Figure C
Source: IPCC, 2014: Summary for Policymakers. See work cited for full citation.

Goals

The rates of increase of carbon dioxide in Earth's atmosphere need to be addressed immediately and thoroughly. To do anything less would be to endanger human lives in the US and American society's ways of life. Current policies addressing increasing atmospheric carbon

dioxide levels do far too little to stop the increase. The success of these policies could be measured by testing samples of Earth's atmosphere to ensure that CO_2 levels stop increasing annually. An effective policy need not reduce CO_2 emissions to zero. Instead, *net* emissions of CO_2 must be equal to zero. The success of a policy must not be measured by ensuring zero emissions, but rather by ensuring a stagnation of atmospheric levels of CO_2. Following this standard of measurement, a policy needs to be implemented that will reduce net CO_2 emissions in the US to zero.

Role for Government

Government intervention is the only way to effectively deal with the problem of global warming caused by the release of anthropogenic carbon dioxide into the Earth's atmosphere. There is a fundamental market failure with any kind of pollution, including carbon dioxide. Those who release this CO_2 pollution into the air create a large cost to society, but this cost is never applied directly to those who create the pollution. To put it in economic terms, the CO_2 emissions associated with the production or consumption of goods and services has a high social cost in the form of the negative health and economic effects of global warming. However, this social cost does not translate into a private cost for the producer or consumer who creates those CO_2 emissions. Since CO_2 emissions do not naturally pose private costs, they do not affect producer or consumer behavior, despite their harmful affect to society. In this case, a truly free market creates an inefficient equilibrium since the social costs are internalized in neither the consumer's nor the producer's marginal cost curves. Governments intervention could create a more efficient equilibrium in several ways. Common methods include: taxes on producers or consumers who release CO_2 that equal the social cost of that amount of CO_2 emission; government regulations that directly limit CO_2 emission; or cap-and-trade, a practice that makes

CO_2 emission more expensive over time as firms compete for pollution licenses. Regardless, governments are the only method by which pollution will be accounted for.

Criteria for Alternative Evaluation

Policy alternatives considered in this brief will be evaluated under three criteria: effectiveness, equity, and political feasibility. Effectiveness refers to how well the policy achieves its goals of reducing net carbon emissions. The most effective policies will reduce net carbon emissions to zero. Equity refers to the fairness of the distribution of the policy's outcomes. The most equitable policies will not cost a few firms or people significantly more than most. Political feasibility refers to the likelihood of the policy becoming real law. The most politically feasible policies will be most likely to be implemented as laws in the near future.

Alternatives

Cap and trade of CO_2 emissions

One possible way of reducing net carbon emissions to zero is to institute a cap-and-trade program. The government would first set a limit on the total amount of emissions allowed across an entire industry, and then issue a set number of permits to produce CO_2 emissions. These permits could be initially distributed either by allocating them to specific business or by an auction. Once they have the permits, businesses could then trade or sell these permits. This would create a market for the rights to produce CO_2, and CO_2 production would have a monetary cost associated with it. The economic cost of producing CO_2 would affect business behavior since producing this pollution would no longer be free, and they may move to less-polluting production techniques that are now cheaper than paying for the permit. Businesses that continue to produce CO_2 pollution would now include the cost of paying for permits in the price of their

product, and consumers would then also be discouraged from buying those goods, reducing CO_2 production.

A cap-and-trade program would be very effective at the goal of reducing net CO_2 emissions. The main reason is that it sets a hard limit on the total amount of emissions released, so the policy almost automatically achieves the goal of net-zero carbon emissions, or any other level of emissions reductions that the policy implements. A similar program for reducing SO_2 emissions has proven quite effective in recent decades. The Acid Rain Program, or ARP, was implemented under Title IV of the 1990 Clean Air Act Amendments. It set a cap on the total amount of SO_2 emissions from power plants nation-wide to 8.95 million tons, and then allocated permits that allowed for one ton of SO_2 emissions per year. The program succeeded at its goal of reducing SO_2 emissions to less than half of initial levels ("Acid Rain Program", 2018). Its greatest strength is that it is very easy to control how much emissions are allowed without having to estimate how much producers value that privilege. Since a cap-and-trade program for CO_2 emissions would be very similar to this national program, it is likely that a CO_2 cap-and-trade program would be effective at reducing CO_2 emissions.

Some state programs within the U.S. have already demonstrated effectiveness in lowering carbon emissions. The Regional Greenhouse Gas Initiative, or RGGI, has lowered covered carbon emissions in the program's 11 states by over half since 2005 (Market-Based State Policy, 2017). A similar policy implemented on a national level could reasonably be expected to be just as effective. A carbon cap-and-trade program as large as an American one would be has already been implemented in Europe. The European Union Emissions Trading System, or EU ETS, was implemented in 2005. It has already achieved its goal of reducing European carbon emissions to 80% of 1990 levels before 2020 ("EU", 2018, pg. 1).

EU carbon emissions have dropped to 20% below 1990 levels while GDP has continued to increase:

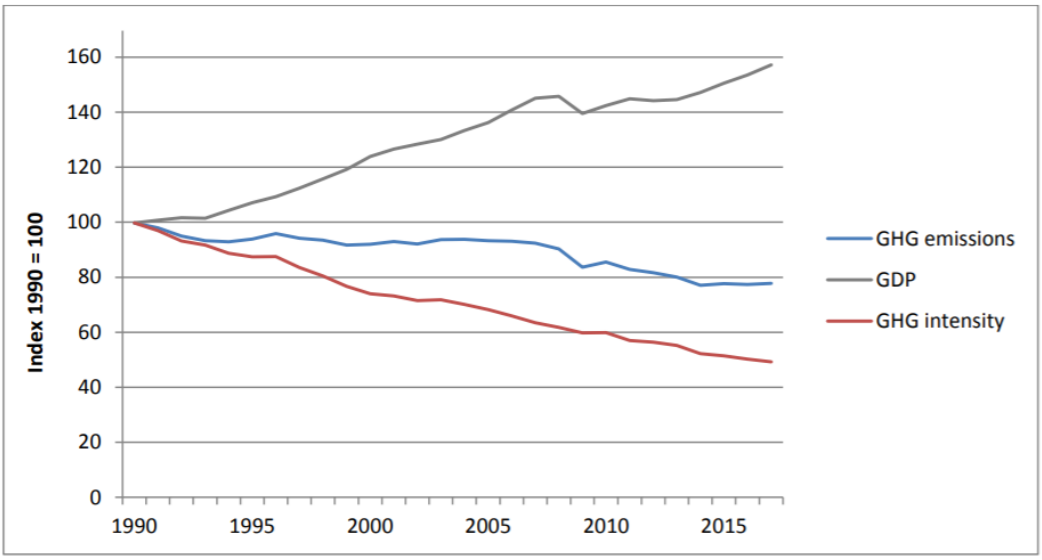

Figure 2: The EU's GHG emissions, real GDP and GHG emission intensity (1990 = 100).[2]

Figure D
Source: "EU", 2018. See work cited for full citation.

A carbon cap-and-trade program has some issues with equity. The initial distribution of the pollution permits is an important problem. One method – that of allocating the permits to specific businesses – brings about the most equity concerns. ARP initially allocated these permits based upon pre-cap emission levels, but only to large companies that served generators over 25 megawatts ("Acid Rain Program", 2018). This seems to unfairly harm small businesses who did not receive the permit. A tax may be a more equitable form of carbon pricing since it would charge producers for exactly as much as they pollute and not a penny more. Another major equity issue is that the program will inevitably raise the price of goods and services for all consumers, including low-income consumers. These people have to pay more for these carbon-friendly goods – something they may not be able to afford. Additionally, the program may cause workers in some industries to be laid off as their companies' business becomes less profitable. In addition to paying for the increased prices of goods and services like all consumers, these people pay by losing their jobs and source of income – far more than their fair share of the burden

(Carbon Pricing 101). The program could compensate these people in various ways – including providing job retraining or unemployment benefits – using the revenue generated from the permits if they are initially auctioned, but there will be no revenue with which to offer compensation if they are initially allocated instead. If they are auctioned or sold, there could be enough revenue to pay for these compensations. For example, the RGGI has generated over $3 billion since 2005 (Market-Based State Policy, 2017).

A cap-and-trade system is politically feasible in the U.S., a nation that has shown a preference for market-based solutions to economic problems. Congress has passed several other laws that included cap-and-trade programs for SO_2 and NO_x, including: the NO_x Budget Trading Program; the Clean Air Interstate Rule, or CAIR; the Cross-State Air Pollution Rule, or CSAPR; and the CSAPR Update ("Clean Air Markets", 2018). Cap-and-trade programs for carbon have even been implemented in 11 states, including California, Washington, and the nine northeastern states in the RGGI (Market-Based State Policy, 2017). These programs have been successful at reducing emissions and have generated large amounts of revenue, making bills like them even more likely to get voted into federal law.

Pigouvian tax on CO_2 emissions

The government could also achieve nationwide net-zero carbon emissions by instituting a Pigouvian tax. The government would first set a target level of carbon emissions and compare it to the current rate of emissions. It would then create a tax on the emissions that it estimates will incentivize businesses to cut their emissions to socially optimal levels. Unlike the cap-and-trade program, the Pigouvian tax would not set a hard limit on the total amount of carbon that could be released into the air, but it does still cause carbon emissions to have a monetary cost that affect business decisions.

A Pigouvian tax has some issues with effectiveness. The main issue is that it does not set a hard limit on the amount of emissions that can be released. The process is essentially the inverse of the cap-and-trade, where the government sets a price for carbon emissions and then companies react by determining their outputs of carbon emissions. This means that the government has to make an educated guess as to how businesses will choose to react to the tax, which is not as effective as mandating a level of emissions like the cap-and-trade. The government runs the risk of either underestimating or overestimating how high the tax should be. If it is underestimated, then there will still be too much carbon emissions. However, if it is done correctly, a carbon tax is rather effective at reducing carbon emissions. The UK implemented a carbon tax in 2013, and carbon emissions have dropped steadily since then. Carbon emissions in 2016 were 7.4% lower than those in 2015 ("2016 UK", 2017, pg. 3).

The carbon tax in the U.K. has been effective in lowering carbon emissions:

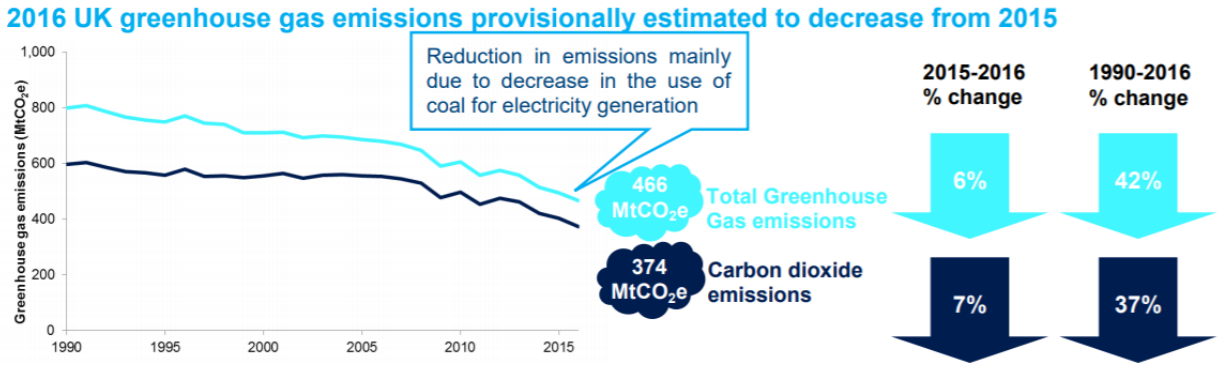

Figure E
Source: "2016 UK", 2017, pg. 4. See work cited for full citation.

A tax creates the opportunity for countless hybrid approaches due to the revenue generated. Money collected annually from a carbon tax could be used for programs ranging from creating carbon sinks by planting forests to conducting research on renewable energy and energy efficient technology. These would improve the effectiveness of a tax by reducing net carbon emissions through more than just changing company behavior.

The Pigouvian tax shares many equity issues with the cap-and-trade program. Both will raise the prices of goods and services for everyone equally, which will most adversely affect low-income consumers. The tax, which would force businesses to change their practices, would inevitably lead to lay-offs of many workers in certain industries. In the UK, the higher costs of carbon emissions have caused many coal power plants to shut down or convert to using other fuels ("2016 UK", 2017, pg. 3). By both paying for the tax and losing the income from their job, these workers pay far more for the tax than it seems like they ought to. The revenue from the tax could be used to compensate these people through job retraining or unemployment benefits, but it is difficult to estimate how much each worker would deserve. Additionally, if the government sets the tax too high, then they will stifle business more than necessary to reach their emissions goal, which may be seen as inequitable.

Taxes have low political feasibility within the U.S. There is currently no carbon tax in the U.S. on a national or state level. Washington is the only state to have proposed a carbon tax, and they have done so several times. However, each one has been rejected by voters by a large margin – the 2016 referendum only got 41% of the vote (Lavelle, 2017). A tax has much lower political feasibility than cap-and-trade.

Regulation of levels of CO_2 emissions

Another possible way for the government to reduce net carbon to zero is to regulate the amount of CO_2 emissions that can be released. In this method, the government mandates that producers cannot emit more than a certain amount of CO_2. These regulations also come in hundreds of other, smaller forms, most of which are targeted at specific sources of CO_2. An example is fuel emissions standards on American cars; these standards indirectly affect how much consumers emit CO_2 by regulating the quality of the products they are able to buy.

Regulations on carbon emissions are less effective at reducing emissions than Pigouvian taxes:

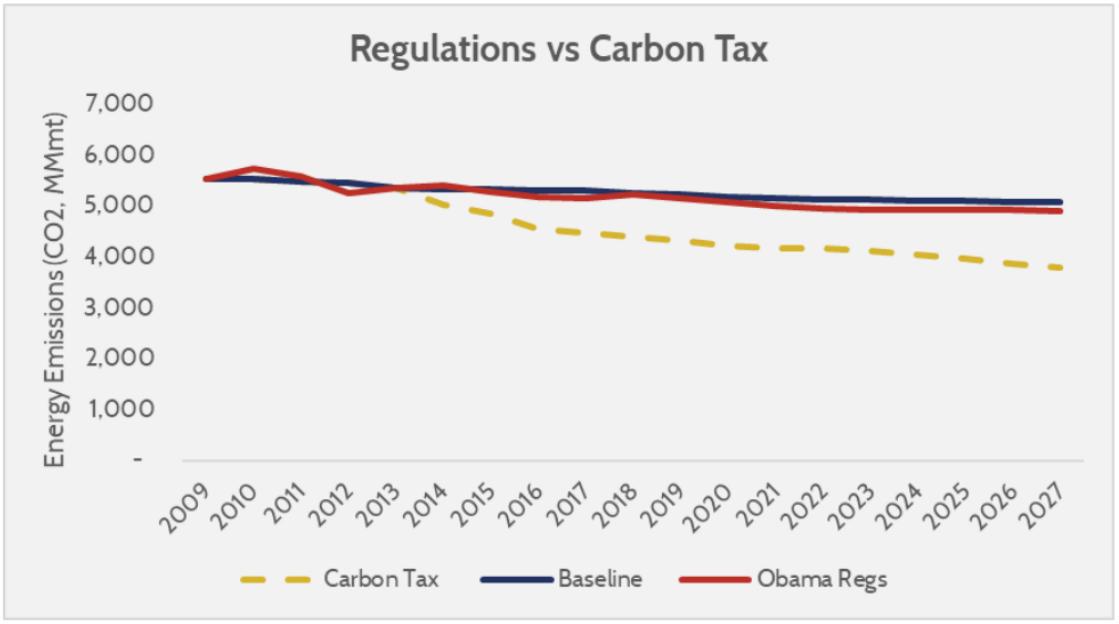

Figure F
Source: Rossetti, P., Bosch, D., & Goldbeck, D. See work cited for full citation.

Regulations are also far less cost-effective than market-based solutions. Regulations on emissions are less effective than market-based solutions. Research indicates that regulations on carbon emissions are less than half as cost-effective as a carbon tax would be (Rossetti, 2018). This conclusion is based only on the economic harms in the form of deadweight loss that both regulations and taxes make. Since a tax generates revenue while a regulation does not, the revenue from taxes could be used to offset the tax's economic inefficiencies, while a regulation could not. This makes the cost-effectiveness of a regulation even lower than half that of a tax (Rossetti, 2018).

Regulations on carbon emissions are far less cost-effective than Pigouvian taxes:

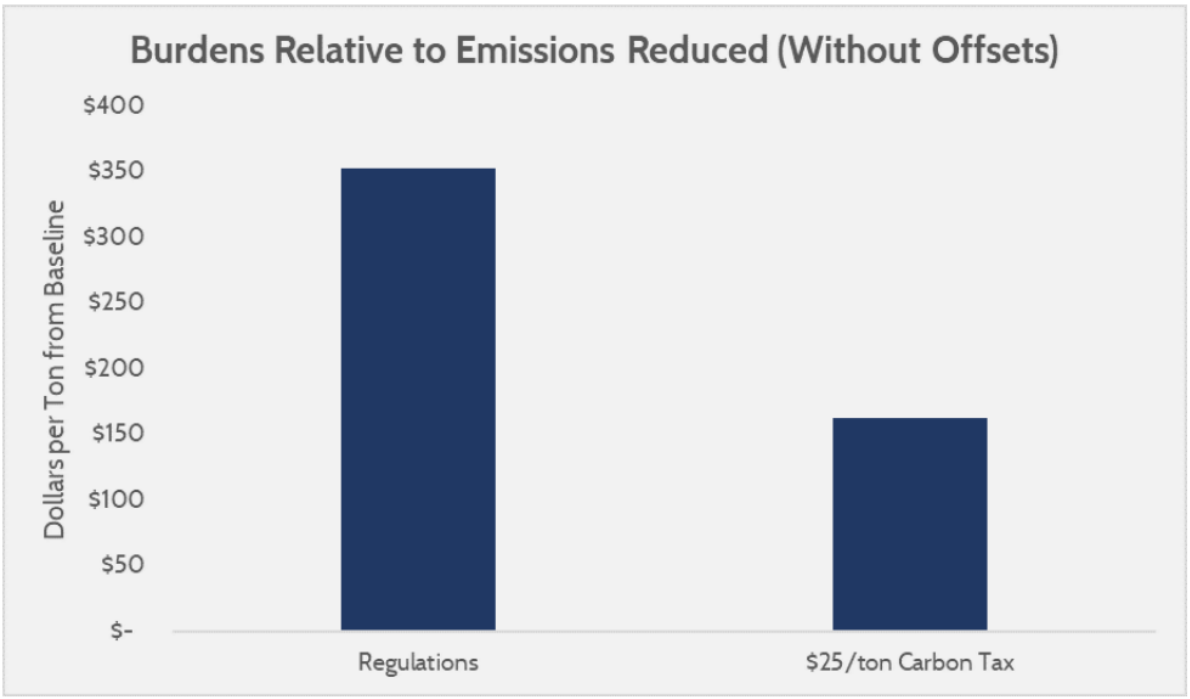

Figure G
Source: Rossetti, P., Bosch, D., & Goldbeck, D. See work cited for full citation.

Regulations on carbon emissions are not very equitable. If a regulation required all power plants to emit zero carbon emissions, then all coal plants would shut down while solar plants would be unaffected. While this is an extreme example, it shows the inequity at the heart of a body of regulations: regulations apply to all equally, but not all who are subject to them can comply as easily. Any regulation on emissions would be harder for some companies to comply with than others, and a high-polluting company that is unable to change to comply with the new rules would not be allowed to operate at all. This may seem less fair than a market-based solution: While high-polluting companies would still find the market-based solution harder to pay for than other companies, a high-polluting company would not have to cease operation entirely, but would only have higher operating costs.

Regulations are not very feasible politically, especially under the Trump Administration. The administration not only has a disdain for making new regulations, but has also set a goal of dismantling existing regulations. Recent actions the administration has taken include: signing an executive order to dismantle the Clean Power Plan and its regulations on CO_2 emissions (Trump, 2017), withdrawing from the regulations of the Paris Climate Agreement (Shear, 2017), ending regulations on toxic air pollutants (Wehrum), ending fuel efficiency requirements (Dennis, 2018), and, most recently, ending many regulations on coal power plants ("EPA Proposes", 2018). These actions clearly demonstrate that the administration does not want to enact any regulations on carbon emissions in the near future. However, they have not dismantled any market-based programs, such as the cap-and-trade programs on many gas emissions.

Recommendations:

A cap-and-trade program for carbon emissions is the most promising policy alternative solution of the three presented. The program is more effective in reducing carbon emissions than regulation, and about equally as effective as a carbon tax. It is also far more politically feasible than a tax or regulation. The program is also relatively equitable.

A strength of the cap-and-trade program is the revenue generated. The revenue from auctioning off permits is large, especially when compared with regulations, which generate no revenue at all. While all three of these solutions create significant deadweight loss, the cap-and-trade program generates revenue that the government can use to offset this. It can be used to address equity issues, such as providing job retraining to workers laid off from high-polluting industries or subsidizing low-income individuals who will struggle to pay for the increased price of goods and services. The revenue from a cap-and-trade program could also make the policy more effective at reducing net carbon emissions if the government invests this revenue into other

methods of reducing net carbon emissions. Revenue could be invested into the creation or maintenance of carbon sinks, such as forests, to reduce atmospheric CO_2, or into the research of more efficient production methods that produce less CO_2 emissions. If the revenue of a cap-and-trade program is reinvested in this way, then the limit on emissions would not have to be set as low. For example: If revenue from the program is invested into carbon sinks, the cap-and-trade program itself would not have to lower initial emissions as much to achieve the same net rate of emissions.

The cap-and-trade program's greatest strength is its political feasibility. Neither a tax nor a regulation is politically feasible in the U.S., but cap-and-trade programs have been implemented many times for emissions. It definitely has the most political support out of all three of the alternatives.

In order for the United States to greatly reduce net carbon emissions, a cap-and-trade program for carbon emissions is the best solution, especially if the revenue generated by it is used for job retraining, technology research, or the creation of carbon sinks.

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