Climate Change Economics and a Minnesota Context

Overview and Policy Analysis

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Introduction

Economics might not be the first thing to come to mind when one thinks about climate change, global warming, or our environment, but it needs to become a larger part of the conversation. A recent study reported that if global temperatures increase more than 2.8° C, 22 different sectors of the U.S. economy could be heavily impacted. This could potentially cost the U.S. \$520 billion annually (about 2.5% of annual GDP), which would heavily weigh on the efficiency of the U.S. economy (Cho). North America has already had to pay more than \$415 billion over the past three years due to climate change damages from hurricanes and wildfires (Cho). Economics is a crucial part of measuring the impacts of climate change and also an additional motivation for mitigation, even if it does not always seem like it. In general, "the economic theory of monetary valuation provides a way, albeit an imperfect one, of performing this aggregation and supporting associated policy-making processes" (Kolstad, 243). Policymakers need a reason to implement new mitigation policies, and economic justification can be very persuasive. Over \$2.1 trillion could be generated from potential projects associated with mitigation, according to research conducted with 225 of the world's 500 biggest companies and their plans for future projects (Cho). Economic analysis is crucial in understanding the future well-being of society in terms of the effects of climate change on our Earth, both good and bad.

Some economists argue that the consequences of climate change will occur so far into the future that only minimal investments need to be made in the present. These are the economists who view the world in terms of current dollars, ones that do not see past the calculations and humanize the consequences of climate change (Serakos). To change their minds, and more importantly, the minds of policymakers who listen to these economists, we need to understand the functions of the economy. Climate change mitigation is possible without completely sacrificing the integrity of local or global economies. Learning about economics and its contribution to adaptation and mitigation can help increase the efficiency of integrating climate change into our policies now instead of in the future.

This paper will give an overview of central economic concepts, such as the Free-Rider problem, international relations, discount rates, and price signals, and how they relate to climate change. The paper will then transition and analyze Minnesota's climate change policy and its economic effects on energy, transportation, land, and the built environment. This paper aims to provide a starting point for people to learn about a new approach to mitigation, using economics as a tool. This is just a start, as there is so much more to learn about climate change economics.

Limitations

Before understanding the ins and outs of economic theory to assess policy, it is valuable to understand that economics has its own set of limitations and flaws. To analyze and discuss economic theories, we must make ethical assumptions (Kolstad, 213).¹ For example, one of the most commonly used metrics, Gross Domestic Product² (GDP), can not fully represent changes in welfare. It fails to capture environmental degradation, income inequality, free services, general happiness, and the well-being of individuals. It represents such little of the actual inner workings of a nation that some countries like India are developing new metrics such as an Ease of Living Index³ (Kapoor). The problem is that methods of economics "are suited to measuring and aggregating the wellbeing of humans, but not to taking account of justice and rights" (Kolstad, 224). It is imperative to keep this in mind when using any economic metric in an evaluation. It does not mean that all of these methods should be discarded, but understanding their limitations can make them that much more efficient when using them as tools of evaluation.

GDP represents an issue with economic metrics in general, but there are also five specific limitations to climate change economics considered in this paper. First, the field of economics is best suited for analyzing marginal changes even though mitigation efforts are not marginal.⁴ This means that economic metrics look at the costs or benefits of an additional unit added or taken away from the economy, but mitigation efforts do not fit into this classification of economic change. Second, climate change occurs over the long run, and to evaluate the costs of climate change we need to use a discount rate which is highly debated within the discipline. Discount rates can be a difficult concept to grasp as well and are defined further in the next section. The third limitation deals with wealth disparities. Massive income gaps within different economies and across borders make economic analysis difficult to generalize without additional assumptions. It then becomes difficult to apply climate change policy to areas and expect it to

¹ Kolstad is one of many authors who contributed to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Full source on the work cited page)

² "The global measure of economic markets is gross domestic product (GDP), a measure of the total value of goods and services produced within the borders of a nation." GDP = consumer spending + industry investments + government spending + (exports – imports) (Current Dovetail Report, 2021)

³ "The Ministry of Housing and Urban Affairs has developed the Ease of Living Index to measure quality of life of its citizens across Indian cities, as well as economic ability and sustainability... We believe that this more holistic measure will provide more accurate insights into the state of development of the Indian economy."

⁴ Marginal costs or marginal revenues can be calculated in economics based on business functions. They are a known amount. Climate change cannot fit into these same equations as too much of it is unknown. We don't have a way to calculate how much change will occur in our environment due to a specific increase in emissions.

have the same effect across various stakeholders. The fourth limitation recognizes it is very difficult to measure factors that do not possess market value, such as the existence of species, natural environments, and cultures. The final limitation addresses uncertainty of climate change. There is a small possibility of catastrophe, a high likelihood of irreversible changes, and the potential for effects on a variety of spectrums (Kolstad, 224-225). Ultimately, calculating climate change for economic analysis involves multiple barriers— but it does not mean we should not try.

Explanation of Climate Change Economics

Before examining policies and the application of economic theory, it is valuable to have a grasp of some general economic concepts. A few of these concepts include the Free-Rider problem, international relations, discount rates, and price signaling tools. Understanding some of this terminology will allow for a more in-depth discussion around policy analysis and its implications.

Free-Rider Problem

To begin, we will start on a global scale and analyze how the Free-Rider problem has affected mitigation efforts. Climate change is a consequence of an economic concept known as 'The Tragedy of the Commons' (Kolstad, 211). This refers to our overconsumption of the natural resources that our earth provides. We have been gifted with a certain amount of resources and the fear is that other stakeholders⁵ will take more than their fair share, so one must take what they can before the other groups have that chance. The classic example is a large pond with lots of fish and two fishermen. If each person catches one fish a day, there are enough left to continue to reproduce and continuously provide fish. However, if one person takes two fish, then there will not be enough for both of them over time. The fear that the other might take an additional fish is what motivates you to take more than your fair share so that if the pond were to run out of fish you got what you could. This results in scarce sources of raw materials. Climate change is one of the main consequences of this. Fresh air, clean water, and an atmosphere with minimal emissions are all resources that are freely accessible and can be abused by certain actors for economic gain, just like the fish in the pond.

At least that is the common understanding of what is going on, but there is always more to the story. Hardin, who was the theorist who developed the Tragedy of the Commons, was not even an economist, he was a biologist. He applied survival of the fittest to behavioral economics to help promote the need for privatisation. This concept has been used to justify the stealing of resources and lands, oppression of people, and extreme privatization of the economy. Communities around the world have proven that the rational decision is not to abuse resources for the individual. That tends to be irrational, that is how you run out of fish. Communities have

⁵ Stakeholders refers to any individual or group that could be affected by the actions of the situation or has any reason to be involved in the situation. This typically includes individuals, companies, markets, or governments.

been known to set their own protectionist regulations to common resources, and everyone abides by them for the benefit of the whole, not the individual. Fishermen will put quotas on fishing limits, and stick to them without the threat of penalty (Villiers). There are always enough fish in the pond. Climate change has come from our abuse of our natural resources, but if the Tragedy of the Commons was not a fallacy, mitigation would not exist, and there might be nothing left of our natural environment. The international community would not have come together and tried to work on global mitigation.

This does not mean that the solution to climate change suddenly becomes easy because, "for an individual or firm, mitigation involves real costs, while the benefits to themselves of their mitigation efforts are small and intangible. This reduces the incentives for individuals or countries to unilaterally reduce emissions; free-riding on the actions of others is a dominant strategy" (Kolstad, 213). This is where the Free-Rider problem⁶ comes into play. The solution needs to be international, to prevent some individuals from polluting at high levels while others attempt mitigation. The Free-Rider problem is when one individual piggybacks off of the progress that other stakeholders are making without the same level of effort contributed. Greenhouse gasses are the major driver of climate change, and every country emits them at different levels and different rates. While it is in every country's interests to decrease emissions, if there are no incentives, no one will do it of their own accord because of the Free-Rider problem. We must not act independently with our interests in mind, but as a planet with a global perspective to decrease future climate change (Kolstad, 214). While this seems easy, it has proven to be very difficult to achieve; the goal is to not have each country act in its self-interests for the maximum economic gain.

International Relations

Climate change mitigation does not look the same for each country, nor should it. Mitigation can be difficult because "prioritizing action on climate change over other significant social goals with more near-term payoffs is particularly difficult in developing countries" (Kolstad, 213). There are wealth disparities, geography implications, politics, and so many more factors that require different approaches to mitigation for each country. Should less developed countries be held to any standards of mitigation? Should more developed nations mitigate even more to take that burden off of other countries? Could this be considered an obligation or a form of reparations and taking responsibility of certain nations for their abuse of these less developed countries? There are so many ethical questions to be considered when discussing the burden each country faces when deciding what to do about climate change.

⁶ Public goods like a street light are a good example of a Free-Rider. If I were to sell light from my street lights, I wouldn't have any customers because as long as they line the street people can use them without needing to purchase the service. These people then become Free-Riders. The same goes for climate change, if one person is paying for mitigation, therefore a cleaner environment, their neighbor can pay nothing and still enjoy the new cleaner environment.

Less developed countries usually face larger impacts than more developed nations from climate change, as shown in the box below, "Real-World Consequences". "Their vulnerability is due to multiple factors that can limit their ability to prevent and respond to the impacts of climate change. Climate change has the potential to reverse significant development gains made in these countries" (Canada). One example of differentiating impacts has to do with women's rights and the weight they bear from these consequences across different countries. It can threaten their healthcare opportunities, chances at education, and economic well-being. Their rights should not be pushed under the rug, but when a country is dealing with the impacts of climate change and does not have the capacity to juggle these tasks, it is forgotten about. "While they are the most vulnerable, women and girls are also powerful agents of change to advance action on climate change, pollution and other environmental concerns" (Canada). This sentiment parallels the economic gain of a country as well. Their development is limited when women can not contribute. Overall, less developed countries have limitations when women are not at the table, and climate change is one factor keeping them away. This is just one of many moral dilemmas that are associated with the costs of climate change.

Real-World Consequences: Lagos, Haiti, Kiribati, and Manila

The city of Lagos could potentially be submerged underwater, and if it is, Nigeria will lose one-third of its GDP. The Republic of Kiribati has purchased over 5,000 acres of land in Fiji for when their island becomes uninhabitable. The recovery cost of the earthquake in Haiti alone was over \$8 billion which is larger than the entire country's GDP. A total of 80% of the area of the city of Manila in the Philippines was submerged underwater in 2009 and has not been fully rebuilt yet (Law). These cities and countries, and many more, face costs that are already so out of control they can not fathom fully recovering, especially as the consequences from global warming rapidly increase. The costs of rebuilding or mitigating future effects do not even encompass the full picture. How much monetary value can society place on the culture, the resources, the memories, the land, and the spirit of Kiribati if its citizens must emigrate to Fiji? Or that of Lagos, Manila, or Haiti if they are ever fully underwater. The oceans could vanquish entire countries, and we fail to imagine what we might lose, and how to regain what is gone forever. The truth is, ice caps are melting, the sea level is rising, the globe's average temperature is increasing, and natural disasters are becoming more impactful. We need a way to evaluate all this, and to start moving in a direction that will prevent the losses mentioned above from being our reality. One way to do this is through economic policy and through correcting the market failure that is global warming (Schwartz).

Despite all of the ethical dilemmas, many nations are aware that actions need to be taken quickly. A binding agreement between nations failed with the conference in Rio de Janeiro, Berlin, Kyoto, Bonn, Copenhagen, and Durban because, as mentioned before, there are more incentives to keep polluting than there are to mitigate. After these conferences, the idea of 'peer pressure' began being tossed around. Each country would set its standards and promise to meet those limits. Other countries would then feel pressured to outdo others, therefore creating a social incentive. This would also allow more developed countries to take on higher burdens as they would have a higher capacity and drive to do so. This was the premise that the twenty-first Conference of the Parties was built off in Paris (Harris, 48). This still is not perfect and has flaws, but we are learning from past mistakes. The important question though is are we learning quickly enough? The policy section further elaborates on local appeals to try and reach mitigation goals by certain dates. While international cooperation is crucial, it is just as important to turn inwards and make sure that mitigation within our borders is also being fully maximized.

Discount Rates

As mentioned above, each country is trying to reach individual domestic goals set for certain levels of mitigation. An important part of setting these goals is determining the discount rate. Discounting is the act of comparing costs in the present day to benefits that we would only experience with time. This is very important in regard to climate change because the cost of mitigation has few present-day effects and therefore needs to be compared to the future intended benefits of the investment. The discount rate gives us a numeric prediction of the cost-to-benefit analysis. A common discount rate seen across certain models tends to be between 2 and 7 percent (Newell). This range is very large and highly disputed, but "even with disagreement on the level of the discount rate, a consensus favors using declining risk-free discount rates over longer time horizons" (Kolstad, 211). The lower the discount rate, the less we value present-day benefits over future benefits, which will lead to more mitigation. If the discount rate is higher, closer to seven, then that means we value present-day benefits significantly more than future ones and will mitigate less. A discount rate of zero means that we value present and future benefits equally, and we must mitigate to the fullest capacity for the welfare of both present and future society. While the application of a discount rate is heavily agreed upon, actually deciding the rate is very difficult. The reason for this is because the benefits from mitigation do not appear until the future while the costs are realized in the present. The discount rate is used to bridge this gap (Kolstad, 228). Some economists believe that the discount rate should be zero, which would force the current generation to fully recognize the long-term environmental effects in today's economic decision-making. While this argument is more ethically compelling, "the existence of inflation, time preference, and the opportunity cost of capital suggests that a positive discount rate better reflects societal preferences" ("Discounting and Time Preference"). Discount rates⁷ are continuously argued over and will continue to fluctuate depending on people's social intent. They play a very important role in policy decision-making and supporting action towards mitigation and economic preservation.

⁷ If you would like a more in depth conversation on discount rates in this context, view this article: https://grist.org/article/discount-rates-a-boring-thing-you-should-know-about-with-otters/

Price Signals

The government has a lot of policy options when it comes to climate change mitigation. The goal of these policies is often to alter the price of goods and services to change the behavior of consumers and suppliers in certain markets (Kolstad, 239). The intent would be to make certain products cheaper if they have positive externalities on the environment and make other products more expensive if they have negative externalities on the environment. An example of government intervention with positive externalities would be vaccines. The government bears a lot of the costs to make them virtually free, like with the COVID-19 vaccine. The intention of government intervention is to have as many people consume products with positive externalities for the well-being of all stakeholders. The opposite example, with negative externalities, would be cigarettes. The government has taxed them as well as required anti-smoking advertisements to help decrease the consumption of this product. It hurts both the smoker and people around them when consumed, which is why it has a negative externality. Governments have a variety of policy options to address different concerns and potential outcomes. They can apply taxes, tradable permits, and subsidy policies as a form of economic incentives (see the following text box for further discussion). Another option includes direct regulatory approaches, such as technology advancements or setting performance standards. The least direct approach a government can take has to do with information programs addressing government provisions of technologies or products and voluntary actions (Kolstad, 239). Governments need to use a variety of these market instruments to manipulate consumption behavior and decrease aggregate emissions within their borders (Kolstad, 234).

Tradable Permits, Taxes, and Subsidies

There is not a straightforward answer as to which policy a government should implement over another option, creating a large debate over all of these market tools as to which one is the most effective. Tradable permits and taxes sit in the center of the dispute as they both target specific types of emission contributions at any level in the supply chain. However, they have many differences which allow each country to pick the policy that best fits their industry needs. To begin, one of the biggest differences is that *taxes* allow the industry to know the price while the quantity of the good might fluctuate and therefore the emissions, while *tradable permits* do the opposite by allowing the government to set an exact level of emissions which sets a market quantity but leaves very volatile prices of the products and permits. One of the biggest pros of taxes is that it allows the government to earn revenue. Traditionally, permits do not produce revenue, but it does not mean they can not, it would just require additional infrastructure to auction off the permits for a price. If the government does not choose to auction off the permits, they can choose to distribute them strategically to address the unequal costs that burden some firms and industries over others. The additional costs associated with implementing any kind of tradable permit system make it significantly less appealing to certain countries, especially less developed ones that rely on their tax system. It is suggested that countries try and create hybrid policies to strike a balance between the two systems and try to

reap as many of the benefits from the two as possible. Even with their flaws, they are both more efficient than traditional technological regulations as they allow for the most flexibility in a market (Parry).

On the other side of climate change policy, there are subsidies. These promote good environmental behaviors and consumption patterns versus negating away from high emitting ones. Subsidies are less appealing to governments; instead of gaining revenue they have to pay companies for their actions. Subsidies decrease the cost of production and therefore decrease the price. This signals to consumers that this is a good or service that they should be purchasing. The opposite happens with the other two policies, they increase the prices; therefore, signaling that those goods should not be consumed as much. Even though subsidies can be costly, they are a very useful tool for correcting market failures caused by high emitting markets. They can also support the development of new technologies at lower costs. Currently, some countries have some subsidies supporting fossil fuel reliant markets, and removing them would be the ideal first step towards good mitigation policies (Kolstad). Overall, citizens need to start pushing their governments towards these policy options to see real impacts on economic behavior across the board.

Minnesota Policy Analysis

Communities around the world face catastrophic climate change events every day like discussed with Nigeria, Kiribati, Haiti, and Manila. To help decrease the impact on these places, we need to change what is in our control, and that begins with addressing local policy. It is important to have a global perspective, but it is also important to narrow the lens and look at smaller pieces of the world. Minnesota has a very special environment that the state realizes it needs to protect. Their wildlife and nature are one of a kind, and seeing what we can do at a policy level to help it thrive as well as protect our future generations is what I want to focus on. Minnesota has set emission goals, with the intention to reach specific mitigation levels by certain dates. To achieve these goals, "a stable and predictable policy framework is required" (Kolstad, 242). Minnesota's Climate Action Plan set a goal so that by 2030, we would see a 45% decrease in greenhouse gas emissions. This target would put the state on the right track to be completely carbon neutral by 2050. The Climate Action Plan emphasizes four main economic sectors: energy, transportation, lands, and the built environment, as ways to reach these emission goals (Acomb). Ideally, the policies aimed at these sectors would be rapid in their application, efficient in nature, and affordable for the state. Sadly, Minnesota failed to reach its first progress goal (15% reduction by 2015), making it that much more difficult to be carbon neutral by 2050, but it does not mean they are not trying. Below are policies that are currently being put into action in the state targeted towards these four sectors.

Energy

The State of Minnesota has set a goal to have all energy consumption be 100% clean energy, and these tasks have been set on an accelerated timeline. The state wants to move towards wind and solar energy so that they can match demand on a large scale. The goal is to

make sure that the state's citizens are reaping the benefits from an economy that supports clean energy (Acomb). To achieve this goal, Minnesota has created policies that target investment opportunities and funding. They have required that the companies that run the electric and natural gas utilities invest in this project. At least 1.5% of their gross operating revenues must go to the Conservation Improvement Programs (CIP) every year. This has proved to have a multiplying effect on the initial investment in the clean energy industry. For every dollar that the gas and electric companies invest in the CIP, there is a return of \$4 to \$4.30. These returns on investments are shown through decreased costs in energy, benefits from a better environment, and increased economic activity through the processes. Proof of these benefits can be found in a report published in 2020 analyzing the changes created by the policy from the years 2017 to 2018. Between these two observed years, 15.2 trillion-Btus of energy⁸ were saved and there was a reduction of 1.79 million tons of carbon emissions⁹. People in Minnesota paying energy bills have saved \$279 million in energy costs. Other than personal savings, the policy has also been supportive of over 47,000 jobs relating to energy efficiency, which is the state's largest sector of clean energy employment ("Mandate Details."). All of these numbers have increased from the report published one year early, focusing on the years 2016-2017. These policies are having an obvious impact on the energy sector in the state.

There are two main ways in which the economy will be improved by these investments. The first has to do with the increase in jobs. New contractors, suppliers, and laborers will be required for the expansion of a new industry. The second impacts the consumer side. If the costs of an average consumer's utility bill can be decreased, then the difference can be spent in other markets, boosting economic activity in other sectors ("Efficiency"). This policy example is just one of many that are in place moving the state towards clean energy while also increasing economic development. Due to a combination of state policy and targeted private investment, the state of Minnesota has decreased its emissions in the energy sector by 30%; this is a good start, but the state still has a long way to go ("Driving Minnesota Forward").

The positive economic effects from these policy changes could in fact be the behavioral motivator that incentivizes other states to follow suit instead of just being observers. Theory suggests that without incentives, other states would free-ride, however, there are significant results from these policy implementations. It could actually drain other states resources if Minnesota's clean energy sector continues to grow and needs additional labor, research, money, and capital. Competing with Minnesota would allow other states to continue to match their clean energy growth instead of falling behind the curve. This theory would counteract the Free-Rider problem, which is our goal in terms of successful mitigation policies.

⁸ This is "enough energy to heat, cool and power more than 160,000 Minnesota homes for a year" ("Mandate Details.") ⁹ This is "equivalent to removing over 350,000 vehicles from the road for one year" ("Mandate Details.")

Transportation

Eventually, all citizens should have access to a form of transportation--whether it is their vehicle or public transit--that should be completely electric. Minnesota seeks to reduce the number of cars on the roads by making public transportation much more accessible (Acomb). The state has taken to focusing its attention on the accessibility of electric vehicles. The state claims that "ensuring that all Minnesotans have access to the cleanest vehicles available is a simple common-sense approach to reducing carbon pollution in our state and helping us get back on track to meet our Next Generation Energy Act goals" ("Driving Minnesota Forward"). The state has implemented The Clean Car Rule. They do not want to force residents into cars that do not fit their lifestyle, so they have targeted the supply side of the market. This new rule will increase the number of electric vehicles in the state's market, therefore providing a larger selection and variety for consumers to choose from. Because electric vehicles cost less to operate, "clean car standards have saved drivers in other states over \$88 billion and counting" ("Driving Minnesota Forward"). Gas reliant cars are currently one of the main sources of air pollution in the state, so over time, there will be a large push from the state to move away from the consumption of these cars due to their negative externalities. The state is targeting transportation in many different ways, it will continue to push for electric vehicles statewide, but also has funds allocated towards public transportation in major metropolitan areas. Hopefully, effects from changes in transportation will begin to show just as much as the effects in the energy sector.

Transportation policies can be very difficult to implement on a local level due to the international supply chain. Cars are made all around the world, and the price of gas is influenced daily by international markets. These two goods are complementary goods, which means their prices change how consumers purchase each one. If oil prices plummet, electric cars will become harder to sell as people are not incentivised by high gas prices to switch over. Local governments are heavily influenced by these global decisions and market fluctuations. The transportation market is worth trillions of dollars, and therefore it is difficult to change current consumption habits¹⁰. Minnesota is doing what it can to face these international relationships, but it will still take continuous fighting to see significantly more change.

Lands

Minnesota is very proud of its local environment and land. The state has realized that it should be doing even more with the management of its natural resources. Some of their goals include bettering the health of the soil for the farmers, improving the food systems in the state, and increasing natural carbon sequestration. The way the state hopes to achieve this last point is by "enhancing native prairies and forest ecosystems and including carbon sequestration as a

¹⁰ There is a documentary called "Who Killed the Electric Car?", that discusses how this technology should have been developed years ago but was stunted by oil companies, gas car companies, the US government, local state governments, and additional stakeholders. Money has high market influence and can create or destroy change.

management goal for public lands" (Acomb). Minnesota has its land managers and experts in the field of forestry researching new ways to sequester carbon from the atmosphere. They are specifically looking for ways to incentivize landowners to alter their practices so that their forests have the maximum capacity for this task. The Blandin Paper Company in Minnesota is a prime example of large-scale sequestration of carbon¹¹. This company owns about 175,000 acres of forest near Grand Rapids and manages the land by selectively cutting trees and then replanting a mix of tree species. By not clear-cutting the trees, they are storing more carbon on their land. Blandin is on a 20-year timeline, and within that time, they will have been able to sequester about 3.6 million tons of carbon dioxide. That is the same as if we were able to stop 760,000 cars from driving for an entire year (Kraker). While this has obvious positive effects on the environment, one of the reasons more landowners are not doing this practice is that it is very expensive.

Blandin pays for this form of forestry management by utilizing the carbon offset market (Kraker). Companies that want to meet voluntary or regulatory emissions reductions can pay landowners who are sequestering carbon a certain amount of money for their practices; offsetting the net carbon emissions of a company. This could be a voluntary act of a company or a compliance-driven motivation by a tradable permit system. The landowner is paid to manage their woodlands in an environmentally friendly way from the private sector. The government can also participate in motivating landowners to sequester carbon by providing incentive-based payments through property taxes or cost-share assistance methods (Russell). The carbon offset market is very popular in other states, but still being developed in Minnesota. Some Indigenous groups are looking into the possible benefits of this market and are seeking the opportunity to get their land reviewed for the process. Two of these groups include the Fond du Lac and Leech Lake Bands. If landowners¹² can start making even small changes "in the ways they manage their forests, they can store more carbon, earn more money and build up the additional ecosystem benefits that healthy forests provide, like clean water and wildlife habitat" (Kraker). Minnesota has such beautiful and unique ecosystems that need to be protected and policy is one way to do this.

One connection to the economic concepts above is that the carbon market is a counter market to the cap and trade system. Governments tend to place maximums on net carbon. This means that a company can produce more than their cap, as long as they are sequestering enough carbon to bring them back under that initial number. These policy tools create behavioral changes in the way companies and consumers make decisions, and the carbon market is just one of these examples.

¹¹ This information is from a report published in 2019.

¹² Chris Wright, an ecologist with the University of Minnesota Duluth's Natural Resources Research Institute, is trying to motivate other businesses to engage in the process, and he is developing a website to make it easier for people to start moving towards these practices.

Built Environment

In terms of Minnesota's built environment in 2021, the state government is currently working on a bill that will address building codes. This would change the regulations around construction for commercial and multifamily apartment buildings. If the bill goes through, "the measure would set Minnesota on a course to require developers to construct only net-zero buildings after 2036" (Jossi). Instead of codes changing every six years, the bill would cut this in half, and energy codes for statewide commercial buildings would change every three years. The purpose of this would be to require Minnesota to construct energy codes that would require buildings to have net-zero carbon emissions. The reason this is so important is that 39% of carbon emissions in Minnesota's big cities come from this built environment of commercial buildings. While it might be costly to begin with, eventually the investment will pay for itself as building owners will save greatly on their long-term utility bills. The trick is actually getting the bill passed. In times of social unrest, reports like this have taken a back seat, despite the need for a faster timeline on policy like this. "Emissions are the problem, and better buildings can be part of the solution" (Jossi).

Currently this bill is stuck in committee, but it does have both a part in the House¹³ with four representatives' names on it and a part in the Senate¹⁴ with one member listed. The built environment is a good sector to apply the discount rate to. One study researched the value of the discount rate in reference to building energy efficiency codes. Their conclusion was that it was one of the most prominent (if not the most important) factors when determining codes for building energy (Copiello). It can help us determine how strict the codes need to be for the most efficient welfare combination of current and future generations. The built environment landscape is changing daily, and we need our policy to keep up with these changes, and this bill is working on doing exactly that.

Conclusion

Economics might have it's limitations, but it provides an abundance of helpful analysis when it comes to creating mitigation policy. Learning about concepts such as the Free-Rider problem, international relations, the discount rate, and price signals are just the beginning. Economics assumes that people are rational, but they are just the opposite. This is what makes looking into the future and predicting what might happen so difficult. These tools are used to look into the past and make the best forecast for events to come. Our mitigation policies rely on this kind of analysis, otherwise it would be a complete shot in the dark. This paper focused on Minnesota, and discussed their mitigation goals and the policies they have implemented to get there. The state targeted four major sectors (Energy, Transportation, Lands, and the Built Environment) that create an abundance of emissions. They designed creative policies to target the state's needs in a variety of ways. They balanced the consumer's needs with those of the

¹³ House Bill Information: https://www.revisor.mn.gov/bills/bill.php?f=SF2077&y=2021&ssn=0&b=senate

¹⁴ Senate Bill Information: https://www.revisor.mn.gov/bills/status_search.php?body=House&search=basic&session=0912019

supply chain and the economic growth of the state while also pushing to meet extreme mitigation goals. It is not impossible to face climate change head on and still be economically conscious.

Minnesota is just one small pocket of the world. Starting analysis at a small level is good to understand the basics, but it leaves the big questions unanswered. What about the countries and communities around the world that are not as developed as Minnesota and therefore not in a financially sound place to mitigate to the same level? Economics is very quantitative, and in cases like this needs an injection of ethical consideration to be more qualitative in it's analysis. Think about how we keep moving forward. Think locally and globally. Never shut out information and always be asking questions. That is how we move closer to a solution that best fits our future that at this moment is still so unknown. Using climate change economics is just one of many tools. We can not disregard anything in the fight against climate change. It is a market failure that we created and one that is our responsibility to correct.

Work Cited

- Acomb, Patty. "House Climate Action Caucus Introduces Climate Action Plan." Rep. Patty Acomb - House Climate Action Caucus Introduces Climate Action Plan, 27 Oct. 2020, www.house.leg.state.mn.us/members/profile/news/15513/30573#:~:text=The%20main% 20goal%20of%20the,climate%20resilience%20across%20the%20state.
- Canada, Global Affairs. "Climate Change in Developing Countries." GAC, 23 June 2020, www.international.gc.ca/world-monde/issues_development-enjeux_developpement/envir onmental_protection-protection_environnement/climate-climatiques.aspx?lang=eng.
- Cho, Renee. "How Climate Change Impacts the Economy." State of the Planet, Columbia Climate School, 20 June 2019, news.climate.columbia.edu/2019/06/20/climate-change-economy-impacts/.
- "Climate Solutions and Economic Opportunities." Edited by Amanda Jarrett Smith, Leg.mn, Environmental Quality Board, July 2016, www.leg.mn.gov/docs/2016/other/160864.pdf.
- Copiello, Sergio. "Economic Viability of Building Energy Efficiency Measures: A Review on the Discount Rate." AIMS Energy, 23 Feb. 2021, www.aimspress.com/article/doi/10.3934/energy.2021014?viewType=HTML.
- "Discounting and Time Preference." Coastal Services Center, National Oceanic and Atmospheric Administration, www.sfu.ca/~heaps/483/discounting.htm.
- "Driving Minnesota Forward with Cleaner Vehicles." Our Minnesota Climate, Minnesota Pollution Control Agency, climate.state.mn.us/driving-minnesota-forward-cleaner-vehicles.
- "Efficiency." Minnesota.gov, Commerce Departement, 25 Oct. 2019, mn.gov/commerce/industries/energy/efficiency/.
- Hargreaves, Steve, and Dominic V Aratari. "How the Twin Cities Got Transit Right." CNNMoney, Cable News Network, money.cnn.com/interactive/technology/minneapolis-light-rail/index.html.
- Harris, Jonathan M., et al. Global Development and Environment Institute, 2017, pp. 1–67, The Economics of Global Climate Change.
- Jossi, Frank. "Sustainable: Bill Hastens Net-Zero Commercial Development." Finance & amp; Commerce, BridgeTowerMedia, 2 Feb. 2021, finance-commerce.com/2021/02/sustainable-bill-hastens-net-zero-commercial-developm ent/.

Kapoor, Amit, and Bibek Debroy. "GDP Is Not a Measure of Human Well-Being." Harvard

Business Review, 4 Oct. 2019, hbr.org/2019/10/gdp-is-not-a-measure-of-human-well-being.

- Kolstad C., K. Urama, J. Broome, A. Bruvoll, M. Cariño Olvera, D. Fullerton, C. Gollier, W.M. Hanemann, R. Hassan, F. Jotzo, M.R. Khan, L. Meyer, and L. Mundaca, 2014: Social, Economic and Ethical Concepts and Methods. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Kraker, Dan. "In Minnesota, a New Push to Fight Climate Change and Make Money from Forests." MPR News, MPR News, 10 Oct. 2019, www.mprnews.org/story/2019/10/10/climate-change-carbon-sequestration-forests.
- Law, Tara. "These Six Places Will Face Extreme Climate Change Threats." Time, Time, 30 Sept. 2019, time.com/5687470/cities-countries-most-affected-by-climate-change/.
- "Mandate Details." Mandate Detail Minnesota Legislative Reference Library, Dec. 2020, www.lrl.mn.gov/mndocs/mandates_detail?orderid=1613.

Newell, Richard, and William Pizer. "Discounting the Benefits of Climate Change Mitigation: How Much Do Uncertain Rates Increase Valuations?" Center for Climate and Energy Solutions, 4 Feb. 2020, www.c2es.org/document/discounting-the-benefits-of-climate-change-mitigation-how-mu ch-do-uncertain-rates-increase-valuations/#:~:text=The%20discount%20rate%20tells%20 us,justify%20spending%20a%20dollar%20today.&text=Using%20an%20integrated %20assessment%20model,the%20initial%20rate%20one%20chooses.

- Parry, Ian W.H., and William A. Pizer. "Emissions Trading versus CO2 Taxes versus Standards." Resources for the Future, 14 Nov. 2007, www.rff.org/publications/issue-briefs/emissions-trading-versus-co2-taxes-versus-standar ds/.
- Russell, Matthew. "Carbon in Minnesota Trees and Woodlands." UMN Extension, University of Minnesota, 2020, extension.umn.edu/managing-different-forest-types/carbon-minnesota-trees-and-woodlan ds.

Schwartz, Pedro. "Climate Change: A Tragedy of the Commons?" Econlib, The Library of Economics and Liberty, 6 Apr. 2020, www.econlib.org/library/Columns/y2020/Schwartzclimatechange.html#:~:text=A%20gro wing%20number%20of%20people,an%20unstructured%20group%20of%20people.&am p;text=One%20of%20the%20earliest%20climate,market%20failure%20of%20all%20tim e'.

- Serakos. "Understanding the Role and Findings of the Ipcc." Dovetail Partners, May 2014, dovetailinc.org/portfoliodetail.php?id=5e2f0b57ac3a3.
- Villiers, Marq de. "The Fallacy of the Tragedy of the Commons." Center for the Advancement of the Steady State Economy, Brian Czech /Wp-Content/Uploads/Logo.svg, 22 Jan. 2019, steadystate.org/the-fallacy-of-the-tragedy-of-the-commons/.