CSB/SJU

The Optimal Global Climate Change Policy Today: An International Carbon Tax vs. an International Cap and Trade System

Final Draft

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Senior Thesis
January 25, 2010

Table of Contents:

Introduction

According to Gerry Meehl of the National Center for Atmospheric Research in Boulder, Colorado, "right now, given our accumulation of greenhouse gases, we are inevitably committed to a certain amount of climate change even if we stabilized emissions today"[1]. Given the trend of emissions today, continued unregulated emissions would double greenhouse gases by 2100 [see Figure 2 in appendix]. Since the onset of the Industrial Revolution about two centuries ago, the growth of emissions from human activities has resulted in rising atmospheric concentrations of greenhouse gases, other gases, and aerosols. The accumulation of greenhouse gases and other warming substances has been the dominant influence contributing to climate change[2]. This accumulation of greenhouse gases is caused by human and natural activities all over the world, which makes climate change a global issue that affects the entire planet. According to the Intergovernmental Panel on Climate Change (or IPCC) report on climate change, climate change has many effects on the physical environment, biological systems, and humans[3]. Several of these impacts on the physical environment include changes in temperature [see Figure 1 in appendix], precipitation, ocean currents, sea level, and ocean acidification[4]. These changes in the physical environment will not only affect natural systems, but humans as well. These changes in the physical environment will also affect humans because humans rely on natural systems for resources and existence value. Existence value is the "value that humans hold for certain ecosystems and species by knowing that an ecosystem or species still exists"[5]. After looking over the IPCC report, it becomes evident that climate change is definitely a problem for humans and ecosystems around the world, and that it is an issue that

[1] Dan Vergano, "Sea Change Coming for Everglades", *USA Today*, June 5, 2006.

[2] U.S. Congress, Senate, Senate Committee on Energy and Natural Resources, *Potential Impacts of Climate Change in the United States*, Congressional Budget Office, May 2009, 111th Cong.

[3] Intergovernmental Panel on Climate Change. *Climate Change 2007: Synthesis Report.* Fourth Assessment Report of IPCC, Geneva; Cambridge University Press, 2007.

[4] Ibid.

[5] David Pearce. *The Economic Value of Biodiversity*. Gland: World Conservation Union, 1994.

needs to be addressed on a global level. To properly address climate change, emissions from human activities must be significantly reduced, and this will need to be done by implementing a policy that will regulate greenhouse gas emissions.

The research of this thesis will focus on this question: what would be the optimal global policy solution to address climate change: an international carbon tax or an international cap and trade system? To address this question, several different steps will be taken. The first step will be to analyze policy responses that have attempted to properly address climate change to date. Identifying the successes and failures of these responses, and identifying what will be required aspects of future policy will be important. Two major pieces of legislation, the Kyoto Protocol and the European Union Emissions Trading System, have paved the road for policy responses to climate change, so these two should be examined. To analyze these policy responses, I will use the framework of Eban Goodstein. Goodstein was a professor of Economics at Lewis and Clark, and started the campaign "Focus the Nation" to get college students and professors a like to think about climate change as a national and international issue. Goodstein uses a "Bare Bones"[6] ranking system to establish the effectiveness of a policy to address climate change on a global scale. These bare bones highlight the necessary structure that he believes necessary for an international policy to contain. These include "1) a numerical emissions target; 2) allowing trade between developing and developed countries; 3) a necessary enforcement and monitoring system"[7]. Another potential way to answer this question is to identify policies that have been implemented, possibly to address certain types of emissions, which found success and to identify what aspects of these policies could be integrated into future policy. Another necessary step will be an independent study, looking at the advantages and drawbacks of both a carbon tax and a cap and trade system, and discovering which one would follow Goodstein's framework the closest and discovering which would be the optimal global climate change policy given all the above steps. The last step will be

[6]Eban Goodstein. *Economics and the Environment.* New Jersey: John Wiley and Sons INC, 2008.

[7] Ibid.

to identify potential barriers to global climate change policy and specific barriers to a carbon tax or cap and trade system, and to identify which policy will more likely meet success in today's society based on these barriers. Following these steps, research indicates that either a well-designed international carbon tax or a well-designed international cap and trade system has the potential to be the optimal climate change policy because both have attributes that follow Goodstein's framework closely, both have the potential of fulfilling the needs of what past responses to climate change have shown us as necessary for future climate policy. However, when the barriers to global climate change policy are revealed, it becomes evident that one policy is significantly more plausible in today's society. An international carbon tax is the optimal global climate change policy solution in today's society because it follows Goodstein's framework closely, it has the potential of fulfilling the successes of past policy responses to climate change, it has many advantages over a cap and trade system in theory, and because it has the potential to overcome many of the social, political, and economic barriers associated with policy implementation.

Past Policy Responses to Climate Change

The first step to identifying the optimal climate change policy is to analyze past responses. The effects of climate change are already being observed globally, and these have resulted in attempts to regulate climate change threats. Learning from these attempts may be useful in identifying the optimal global policy solution to climate change. Two specific policy responses will be assessed, as these policies may prove useful for adapting future global policy. To analyze these policy responses, I will use the framework of Eban Goodstein. Goodstein was a professor of Economics at Lewis and Clark, and started the campaign "Focus the Nation" to get college students and professors a like to think about climate change as a national and international issue. Goodstein uses a "Bare Bones"[8] ranking system to establish the effectiveness of a policy to address climate change on a global scale. These bare bones highlight the necessary structure that he believes necessary for an international policy to contain. These include "1) a

[8] Ibid.

numerical emissions target; 2) allowing trade between developing and developed countries; 3) a necessary enforcement and monitoring system"[9].

One major piece of legislation, the Kyoto Protocol, was an attempt to get nations across the globe to think about climate change regulation. The Kyoto Protocol was developed from the United Nations Framework Convention on Climate Change. The convention was initiated to "combat global warming"[10]. The Protocol was developed following this convention as a treaty to attempt to get developed countries to reduce greenhouse gas emissions. The goal of the convention, and the purpose for the development of the protocol, was the "stabilization of greenhouse gas concentrations at a level that would prevent dangerous anthropocentric interference with the climate system"[11]. The protocol set binding targets for 37 industrialized countries for reducing greenhouse gas emissions. These targets are reducing 1990 levels of CO2 for these countries "five percent in the 5 year period of 2008 to 2012"[12]. The concentration of this protocol is on developed countries because the protocol states that developed countries are to blame for the majority of greenhouse gas emissions, therefore developed countries should contribute the most to reductions. To fulfill the trade requirement of the system, the Kyoto Protocol installed "flexible mechanisms"[13] that allowed countries who developed more efficient technology and infrastructure to buy carbon credits from countries that had excess carbon credits. This mechanism was set up to include only those countries participating in the protocol, but it did provide incentives for other countries to join in order to obtain carbon credits; this encouraged sustainable development. What was good about these flexible mechanisms was that it allowed nations a great deal of flexibility to meet their emissions targets however they wanted. According to Robert N. Stavins and Joseph E. Aldy's novel, *Post-Kyoto*

[9] Ibid

[10] United Nations Framework Convention on Climate Change, Kyoto Protocol, UNFCCC Daily E-Newsletter, http://unfccc.int/kyotoprotocol/items/2830.php (accessed October 26, 2009).

[11] Ibid.

[12] United Nations Framework Convention on Climate Change, Kyoto Protocol, UNFCCC Daily E-Newsletter, http://unfccc.int/kyotoprotocol/items/2830.php (accessed October 26, 2009).

[13] Ibid.

International Climate Policy, the flexibility of the mechanisms installed with Kyoto made it possible for a "large number of nations to reach agreement on emissions requirements" and that the "political importance of this provision should not be underestimated"[14].

Although the Kyoto Protocol was a fairly basic international agreement, with flexible mechanism that were indeed flexible because it was uncertain how well any treaty would work on an international basis, it did have some successes. Despite the flexibility provided by the mechanisms to meet emissions targets, it actually had few other successes. At this point in time it is hard to find many people in the world who support the Kyoto Protocol anymore, but it is necessary to look at what it did policymakers. The most important thing that the protocol did was that negotiations on the protocol were actually completed and a treaty was designed. The successful implementation of the protocol is in itself a feat. It was the first piece of legislation of its kind, and it showed that the world really does care about climate change. Although the protocol was drenched with flaws, it did none the less complete the drafting stages. The initiation of the protocol has helped to trigger a debate of what policies should be implemented for the future, and it has sparked a trend of discussion on international climate change policy. The protocol was a large step in the right direction, and it has provided a starting block for policymakers to follow. Another success, according to Eban Goodstein's framework, was the establishment of numerical emissions targets. Whether or not these targets are reasonable is up for debate, but the protocol did actually set a cap for emissions. A cap for emissions reductions is essential for any cap and trade system, and in the urgent time to limit our role on climate change by reducing emissions, reaching an agreement for a cap is a good sign for the future. The protocol showed us the necessity of a numerical emissions target to follow, and it gives us an outline for how to agree upon a cap in the future.

In looking at Goodstein's framework, there are several flaws in the Kyoto Protocol. The biggest flaw was that it didn't include China, India, or the U.S. To significantly alter emissions on a global basis,

[14] Aldy, Joseph E., and Stavins, Robert N. *Post-Kyoto International Climate Policy: Summary for Policymakers*. New York: Cambridge University Press, 2009.

these countries must be included in the policy. "The real action for climate change in the next decade lies in China"[15]. This is the case because China is the largest consumer of coal in the world, and is reaching higher economic growth rates than any other rates in history. If China continues to grow at the rate it is today, it is estimated that "China will build more coal-fired power-plants in the next two decades than the United States and Europe put together"[16]. China and India have a solid reason to not sign the protocol. Why should they sign when America and other developed nations have been using coal to industrialize for over 100 years? In the grand scheme of things, total emissions in China over history are a "magnitude less than those in America and Europe"[17]. Agreeing to the targets set up by the protocol seems impractical for these countries, especially when it calls for countries like China and India to stop using coal. In essence, the idea of setting up a cap is good, but the reality is that agreeing upon a national quantifiable target that countries like China and the U.S. will agree upon is extremely difficult. Although it is a challenge to do, by not including China in reductions, it is likely that any policy would be met with failure in regards to meeting specific reduction amounts. The U.S. also did not sign the protocol, which is another symptom of the weakness of the act. The reason for the U.S. not signing reveals another flaw in the protocol.

Along with not including developing countries or the U.S. in the protocol, the protocol also had flawed emissions targets. Although setting a numerical emissions target is a feat for the protocol, the target itself is based on flawed numbers. There was reason for selecting 1990 as the base year for emissions reductions. Europe pretty much handled the Kyoto Protocol discussion, and had a large input on the targets set up by the protocol. The U.S. was essentially "out-negotiated"[18] by Europe due to the

[15] Richard Cooper. "Alternatives to Kyoto: The Case for a Carbon Tax". Working Paper, Boston: Harvard University Economics Department, 2006.

[16] Ibid.

[17] James Hansen. *Storms of My Grandchildren: The Truth About the Coming Climate Catastrophe And Our Last Chance To Save Humanity.* New York: Bloomsbury USA, 2009.

[18] Richard Cooper. "Alternatives to Kyoto: The Case for a Carbon Tax". Working Paper, Boston: Harvard University Economics Department, 2006.

slow economic growth of many European countries in the 1990s. With the cap based on 1990 levels of emissions for participating countries, the burden lay more heavily upon the U.S. and Australia, who had a relatively high economic growth rate compared to Europe in the 1990s. Since 1990 was chosen as the base year, and because Europe dominated negotiations of reductions targets, the U.S. opted out of signing the protocol. These targets favored Europe, and created an unreasonable demand for reductions in the U.S., Australia, Japan, and other developed countries with higher growth rates in 1990. For example, the reductions required for the U.S., Japan, Canada, and Australia was all 25 percent or greater by 2010. In comparison, the targets only required a 12 percent reduction for most countries in Western Europe[19]. To think that these targets would be supported by the U.S. when Europe countries have to reduce less than half of what the U.S. is absurd. Along with not including China and other developing nations, these flawed emissions targets caused the protocol to meet failure. This shows policymakers the difficulty of agreeing upon a national quantitative target, and how difficult it will be for nations to agree upon a cap under an international cap and trade system. Overall, the Kyoto Protocol was saturated with flaws, but it did provide policymakers with a basic outline for future cap and trade systems to follow.

The European Union offers another example of an attempt to address climate change. The Emissions Trading System; which was inspired by the Kyoto Protocol, was set up by the European Union in 2005. The system is a classic cap and trade that originally dealt exclusively with CO2 emissions (there have been proposed amendments to monitor other emissions, which are not likely to be considered until 2013). The basic features of this system are: "1) Over 12,000 facilities located in the European Union have been given an absolute quantity limit on CO2 emissions, 2) A tradable allowance distributed to each facility that is equal to the cap, and 3) Each facility must measure and report their CO2 emissions and subsequently surrender an allowance for every ton of CO2 they emit annually"[20]. The system has

[19] Ibid.

[20] Denny A. Ellerman. *The European Union's Emissions Trading System in Perspective*. Washington D.C.: Massachusetts Institute of Technology, 2008.

generated relatively good success, being that the first period was only three years. The total number of allowances in the first trading period (which was a three year period) was 6.55 billion, or about 2.18 billion per year. This success came from only the trial period, and proper changes to this system will be made based on results from this trial period. The ETS trial period also presented a transparent price for trading carbon credits. This piece is essential for a cap and trade system; as a transparent price will be a base price for industries to follow and it makes costs easier to understand [costs of these credits are shown in figure 3 in appendix]. The trial period was set up to discover the best policy solution for the EU, not to reduce GHG in a short three year period. In doing this, the trial period revealed options for policy, and it revealed what effective policy will be in reducing GHG in the future; which is the ultimate goal of the Emissions Trading System. This trial period created a market in allowances, the trading infrastructure for markets, reporting and monitoring, and many of the European industries are implementing the price of CO2 emissions (a transparent price arose from the short trial period for CO2 emissions) in every day production. The most important piece of information that the first period, or trial period, of the ETS cap and trade system revealed was that climate change programs like this don't need to be perfect right from the beginning. The optimal policy solution will result from years and years of implementation, and it will continue to grow with the proper monitoring system. With this in mind, the ETS may prove to be a helpful and useful program for future global policymakers to follow.

A Policy Success Story: Learning from the Montreal Protocol

The Montreal Protocol was signed in 1987 as a response to a new problem facing the modern world. This was the realization that ecological dangers can imperil the security of all people. Dangers such as ozone depletion, climate change, toxic wastes and destruction of rain forests were starting to become a reality[21]. The Montreal Protocol was drafted as a response mainly to ozone depletion, which presented many challenges. The uncertainty surrounding the extent to which the stratosphere would be

[21] Richard E. Benedick. *Ozone Diplomacy: New Directions in Safeguarding the Planet.* Boston: Harvard University Press, 1991.

changed complicated the drafting process because protecting the stratosphere could not be solved by the usual resolutions (i.e. military strength and economic power were virtually useless). So, with the protection of the ozone layer as the main objective, the protocol was set up to eliminate the use of substances that deplete the ozone layer. Scientific theory suggests that chlorofluorocarbons or CFC's, halons, carbon tetrachloride, and methyl chloroform significantly reduce the ozone layer. In accordance with scientific theory, the protocol stipulated that these compounds were to be phased out by the year 2000[22]. To effectively phase out these compounds, the protocol developed a system of control measures, data reporting, methods to ensure that compliance was met, and methods to encourage compliance.

The control measures were at the heart of the Montreal Protocol because these measures imposed restrictions on the production and consumption of ozone-depleting substances (or ODS). The production of these substances, defined in the previous paragraph, can be defined as the total amount of controlled substances produced and consumption can be defined as the production plus imports minus exports[23]. Each substance is given an ozone-depleting potential, or ODP. The consumption and production targets are based on the ODP of each substance. To encourage developing nations to meet these targets, developed countries are permitted to exceed their control targets by a specified percentage to allow for the "basic domestic needs" of developing nations to be met[24]. Parties involved with the protocol are obligated to report data to the Ozone Secretariat in Kenya. Within three months of becoming a party, or participating in the protocol, each country must provide data on production, imports, and exports of ODS for the base year of each category of ODS. This data provides the reference points against which production and consumption targets are calculated for each country. After these initial calculations are provided, each country then provides annual data of total production, imports, exports, so production and consumption calculations can be made for each year. Developing countries have slightly more lenient

[22] Ibid

[23] Duncan Brack. "Monitoring the Montreal Protocol". *Verification Yearbook 2000*, The Verification Research, Training and Information Centre, London, 2000, pp. 133–149.

[24] Ibid.

rules and targets to follow because they are given longer phase-out periods for each ODS to ensure that targets are met each year. The overall success rate of data reporting by parties was 85% in 2001[25].

To ensure that parties comply with the control measure and data reporting requirements, the protocol set up strong monitoring mechanisms. Compliance mechanisms are defined in Article eight of the protocol; which states that "the Parties shall consider and approve procedures and institutional mechanisms for determining non-compliance with the provisions of the Protocol and for treatment of the Parties found to be in non-compliance"[26]. In essence, non-compliance measures are determined by the parties themselves. Parties are to meet about twice a year with the Implementation Committee of the Montreal Protocol, which consists of two members of each of the UN's five geographical areas[27]. In these meetings, the committee and the parties receive data about the parties from the Ozone Secretariat, and the list of measures to be taken based on non-compliance defined by the parties is modified to fit the data. The committee provides recommendations for parties on how they can meet their production and consumption targets based on reported data. The committee also helps parties identify why non-compliance has occurred, and provides means by which parties can meet their compliance obligations. The sheer number of developing countries creating parties has expanded the work of these committees, but the growing number of developing countries also highlights the success of the protocol. The Implementation Committee is a highly effective monitoring mechanism set up by the protocol, and is one of the most important parts of the protocol in ensuring that developing countries are meeting their targets. This committee's success should be understood by future policymakers for climate change, as monitoring mechanisms will be extremely important for the success of any policy.

[25] Ibid.

[26] Ozone Secretariat. *Montreal Protocol on Substances that Deplete the Ozone Layer.* Montreal Protocol, Nairobi: Nairobi: United Nations Environment Programme, 2000.

[27] Duncan Brack. "Monitoring the Montreal Protocol". *Verification Yearbook 2000,* The Verification Research, Training and Information Centre, London, 2000, pp. 133–149.

In order to encourage parties to comply with the protocol, trade restrictions on products are put on parties that show non-compliance. In addition, the protocol encourages the creation of new parties by putting trade restrictions on non-parties. This prevented the trade between parties and non-parties. The aim of these trade restrictions was to maximize the participation in the protocol, and to prevent industries from migrating to non-parties to escape phase-out schedules. In practice, the trade restrictions have not needed to be applied too strictly because now every major producer and consumer is now a party member to the protocol.

Another way the protocol encourages compliance is through a multilateral fund. The multilateral fund created by the protocol, as defined by Article ten of the protocol, is "the financial mechanism developed to help developing countries meet the cost of fulfilling the control measures identified by the protocol"[28]. The fund is managed by an Executive Committee, made up of representatives from seven developing and seven developed parties. The Executive Committee sets up funding standards for each year, based on the needs of developing countries to meet control targets. Industrialized countries are given the responsibility of replenishing this fund each year. Incentives to replenish this fund are provided by the UN assessment scale; which usually becomes part of the procedure for each party's non-compliance definition. Each developing state chooses one of four agencies: the United Nations Environment Programme, United Nations Development Programme, United Nations Industrial Development Organization, or the World Bank to work closely with to ensure that control measures are met and that the proper funding is provided to these parties. "The Country Program", developed by each developing nation and one of these agencies, is approved by the Executive Committee[29]. The multilateral fund has taken over the function in Article ten of the protocol that states that parties are to transfer "the best available, environmentally safe substitutes and related technology to developing countries"[30]. This function was

[28] Ozone Secretariat. *Montreal Protocol on Substances that Deplete the Ozone Layer.* Montreal Protocol, Nairobi: United Nations Environment Programme, 2000.

[29] Ibid.

[30] Ibid.

taken over to help provide the best available means to ensure control measures are met in developing nations. The multilateral fund has also helped developing countries, through the assistance of these four agencies, by initiating new action plans for compliance for non-compliance countries. Overall, the implementation of the multilateral fund has been one major reason for the success of the Montreal Protocol at involving developing countries. The lesson provided to policymakers of climate change on the multilateral fund should also be understood, as a fund like this can help ensure that developing countries get involved in the next policy for climate change.

According to Duncan Brack, Head of the Sustainable Development Programme at the Royal Institute of International Affairs in London, the Montreal Protocol is "one of the most, if not the most, successful conventions in existence"[31]. The Montreal Protocol was so effective that in industrialized countries, consumption of CFC's was completely phased out by the year 1996[32] [fact is also reinforced by figure 4 in appendix]. Looking at the Montreal Protocol, the success of the protocol can be attributed to two elements that were incorporated into the drafting stages of the protocol, along with the strong monitoring and compliance mechanisms. One of these elements was the strong role of science. The Montreal Protocol had an inherent ability to adapt to new scientific knowledge and technological developments. The cooperative effort of the scientists involved in this treaty created an effective environment for negotiations. "The close collaboration of scientists, and the specific knowledge that each scientist brought to the negotiations allowed for the best science to be applied to policy"[33]. The role of science in the success of the protocol is indisputable. Another element that made this protocol successful was the public opinion. In this instance, the public was well-informed because the findings of the scientist's were easily accessible for the public. In other words, science did not become a secret that only

[31] Duncan Brack. "Monitoring the Montreal Protocol". *Verification Yearbook 2000*, The Verification Research, Training and Information Centre, London, 2000, pp. 133–149.

[32] Ibid

[33] Richard E. Benedick. *Ozone Diplomacy: New Directions in Safeguarding the Planet.* Boston: Harvard University Press, 1991.

a handful of people had access to. A well-informed public is a prerequisite to changing the political will of governments and to weakening industry's resolve to defending the chemicals they emit. Along with these two elements, the effective control measures and data reporting mechanisms, the initiation of the Implementation Committee as a monitoring mechanism, the trade restrictions, and the implementation of the multilateral fund have also contributed to the success achieved by the Montreal Protocol. By taking on these characteristics of the Montreal Protocol, policy starts to look more promising. These are the lessons learned from the Montreal Protocol, and this protocol should be well understood by policymakers wishing to set up the optimal global climate change policy.

Implementing a More Effective Policy: An International Carbon Tax vs. an International Cap and Trade System

Before discussing which global climate change policy is best, it is important to recognize how challenging the implementation of any policy will be. Despite finding the optimal policy, this policy will have a large amount of challenges associated with it. Policymakers must understand this, as the implementation of global climate change policy is one of the most challenging ideas of our time. Despite the policy implemented, private companies, governments and the public alike will have to sacrifice regardless. The success of any policy will require the understanding that lifestyles will have to change, and means of production will have to change. The public, companies and governments must understand this aspect, and they must realize that sustaining the future will require some immediate sacrifices. This being said, global climate change policy has the potential to be one of the most important changes in our generation, and to sustaining future generations. Understanding the challenges of implementing policy such as this and the other barriers mentioned, and having the will and determination to overcome these challenges is the first step for any successful policy. The barriers associated with climate change implementation will be the next step to addressing the question surrounding the thesis, but for now let's focus on the advantages and drawbacks of the two proposed policies.

Following the lessons learned from past examples, the next step to finding the optimal global climate change policy is to analyze two potential candidates for the job. In researching global climate change policy, two proposals for an optimal policy have taken the reins in specifically addressing climate change. These proposals include an international carbon tax and an international cap and trade system. Although there are many other policy proposals, these two proposals show the greatest potential for meeting success, and are the two major proposals being discussed as possibilities for the future. To analyze each of these proposals, I will use the framework of Eban Goodstein. A reminder of this framework is that an international policy should include 1) a numerical emissions target, 2) trade among developing and developed countries or incentives for developing countries to participate, and 3) a strong monitoring and compliance mechanism[34]. Goodstein's framework provides a solid backbone for any international policy, and it will be useful for analyzing the two proposed solutions. Other important aspects of a policy, which we have learned from the Montreal Protocol, Kyoto Protocol and The EU Emissions Trading, will be: effective control and data reporting mechanisms, the ability to provide allowances for carbon offsets in a cap and trade system, keeping the public well-informed through easily accessible information, and additional funding to help developing countries get involved. Following Goodstein's framework, and what we have learned from past responses to climate change, the proper policy for climate change can be developed.

Advantages and Disadvantages of an International Carbon Tax

An international carbon tax is one possibility for an international climate change policy. A carbon tax is a tax on "the carbon content of fuels"[35]. A carbon tax, therefore, would be a tax on the use of fossil fuels. Most fuel consumed "emits carbon dioxide in a direct proportion to its carbon content"[36]. In theory,

[34] Eban Goodstein. *Economics and the Environment.* New Jersey: John Wiley and Sons INC, 2008

[35] Charles Komanhoff. Pricing Carbon Efficiently and Equitably. Carbon Tax Center. http://www.carbontax.org/introduction/ (accessed January 15, 2010).

[36] Janet Milne. *Critical Issues in Environmental Taxation: Volume 1: International and Comparative Perspectives*. USA: Oxford University Press, 2008.

a carbon tax would be fairly simple for this reason. Since emissions of carbon are directly related to the carbon content of fuel, it would seem fairly easy to set up a tax that would match the carbon content of the fuel being regulated. In the case with greenhouse gas emissions, "85 percent of total emissions come from carbon dioxide"[37]. In theory, the carbon tax would reflect the carbon content of the fuel being used. The simplicity of placing a tax on carbon, in theory, is efficient. Since the carbon content of fossil fuels is known and because of the "simple correlation between the input of fuel and output of carbon dioxide"[38] placing a price and covering the carbon dioxide emissions from the fuel use seems fairly simple. This is efficient from a market point of view because the users of the fuel, under a carbon tax, will know exactly how much carbon dioxide they will be emitting, and they then can plan production accordingly. A carbon tax can also be efficient because by knowing how much carbon they are emitting, a user of fossil fuel will know the tax set upon them. The cost of carbon will be a "tax rate"[39], which means the tax will reflect how much fuel is being used, and it will be easily identifiable for users of fossil fuel because of the strong correlation between the amount of fuel used and carbon emitted. Another aspect of a carbon tax is the idea of a "uniform fee"[40]. This would be a fee that nations agreed upon, as a price for carbon, and would increase as the use of fossil fuels increased. The fee would be placed domestically, but the fee would be the same for all nations. It is likely that developing countries will need more leeway then developed countries, and this should be taken into account when a uniform fee is discussed. Although a carbon tax looks simple and efficient in theory, will it possess the proper aspects to be a successful international policy for climate change?

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[37] Ibid.

[38] David Weisbach. Carbon Tax vs. Cap and Trade. Bulletin of the Atomic Scientists. http://www.thebulletin.org/web-edition/roundtables/carbon-tax-vs-cap-and-trade (accessed January 10, 2010)

[39] Janet Milne. *Critical Issues in Environmental Taxation: Volume 1: International and Comparative Perspectives*. USA: Oxford University Press, 2008.

[40] Richard Cooper. "Alternatives to Kyoto: The Case for a Carbon Tax". Working Paper, Boston: Harvard University Economics Department, 2006.

Using Goodstein's framework for a successful international policy, a well-designed carbon tax possess many characteristics that would match this framework. According to Jeffrey D. Sachs, the director of the Earth Institute at Columbia University, a carbon tax has many advantages over a cap and trade system. One of these advantages is that a carbon tax can be "levied upstream at a few dozen places"[41]; as opposed to a cap and trade that involves thousands of businesses. This means that a fee would be collected at the port of entry for the fossil fuel. Another advantage of a carbon tax is the ability to place a uniform fee for all nations to follow. A uniform fee could be used, based on dollars per ton of carbon used, at each point of entry. James Hansen, director of NASA's Goddard Institute, also agrees with this uniform fee. Hansen refers to a "fee and dividend" as a carbon tax, which means that the companies using the fossil fuels will be charged based on how much fossil fuel is used. The more a company uses fossil fuels in production, the more the fee will increase. According to Hansen, this system would not "require the public to pay directly for the tax, but the price of the products they purchase depends on the amount of fossil fuel used for production"[42]. This is a great aspect of a carbon tax, if designed as Hansen lays it out, because the public would benefit from such a policy. The public would benefit from such a tax because revenues produced from the tax in countries that implement this tax could be used to lower other taxes. Providing a monetary award for abiding by the tax, i.e. switching to more efficient practices has the potential to keep the public in support of such a policy. As we have learned from the Montreal Protocol, keeping the public informed and happy is one of the recipes for success for a climate change policy.

For such a fee to be successful, leeway must be given to nations that are still in need of industrialization, and a new fee could be agreed upon by developed nations as a starting point. A uniform tax rate can also be agreed upon with the help of import and export duties. Import and export duties are

[41] Jeffrey D. Sachs. Putting a Price on Carbon: An Emissions Cap or a Tax?. Yale Environment 360: Opinion, Analysis, Reporting, and Debate. **http://e360.yale.edu/content/feature.msp?id=2148** (accessed January 10, 2010).

[42] James Hansen. *Storms of My Grandchildren: The Truth About the Coming Climate Catastrophe And Our Last Chance To Save Humanity*. New York: Bloomsbury USA, 2009.

already applied to existing international agreements, and the calculation of these duties could be "based on standard estimates of the amount of fossil fuels that goes into the production of import production"[43]. The import duty would be an effective way to promote other countries to use a tax because countries would collect money from countries that didn't implement a tax. By not implementing a tax, countries would become a target for countries that have implemented a tax because they would receive a duty from the export country. In this sense, export countries would have an incentive to impose their own carbon tax so they could keep the money for themselves. Import and export duties, therefore, would provide incentives for developing countries to set up a domestic carbon tax so they could keep the revenues from imported and exported products for themselves. This would follow Goodstein's second piece of his framework, which calls for incentives to include developing countries.

Looking at Goodstein's framework again, the rising price of carbon based on fossil fuel would also be a fairly simple monitoring and compliance mechanism. Simply put, as the production of fossil fuel use increases, the price of carbon will increase proportionately. This affects companies and consumers, because the price of production will increase for companies as the use of fossil fuels increases, and the products that consumers are using will also increase if the demand for products that require fossil fuel use in production increase. In theory, monitoring would also be fairly simple because there are fewer places to enforce a tax then a cap and trade. The uniform fee would make monitoring simple, as a uniform fee could be "levied upstream on the major sources of emissions of carbon dioxide"[44]. Just as Sachs mentioned above, the upstream collection of the fee would involve less industries then a cap and trade system. The rising carbon price would promote clean technology and more efficient products. As the price for carbon increases, so would the incentives for consumers to consume more efficient products. Indirectly, this promotes reduced carbon emissions.

[43] Ibid.

[44] Richard Cooper. "Alternatives to Kyoto: The Case for a Carbon Tax". Working Paper, Boston: Harvard University Economics Department, 2006.

Although a carbon tax presents many great aspects for an international climate change policy, it also has a few drawbacks. One potential drawback to a carbon tax is that a carbon tax is susceptible to having weak environmental effectiveness. Environmental effectiveness refers to how much the policy is able to prevent drastic changes to the environment. This is reinforced by Robert N. Stavins, an Albert Pratt Professor of Business and Government at Harvard University, who states that under a carbon tax, there is "no guarantee for the amount of emission reductions"[45]. With no clear cap on emissions, there is no guarantee for a certain level of emission reduction. Using Goodstein's framework, the carbon tax can be criticized on the first guideline, which is that an international policy should set a numerical emission reduction target. There is no numerical emissions target for reduction, only estimates for how much emissions will be reduced. In our current position in regards to the severity of climate change, we can't afford to be unsure of how much we are reducing. Given the temperature rises estimated by the IPCC report, which is "3 to 7 degrees Fahrenheit by the end of the 21st"[46], we can't afford to have anything less than a guaranteed amount of carbon emissions reductions. Under a carbon tax the amount of emission reduction from the tax "may not be sufficient enough to change the course of global warming"[47]. Adapting to meet a reduction target would also present a great challenge, as it would be hard to predict which tax rate would bring about a certain reduction in emissions. Without a quantifiable impact, it will be hard to meet proposed targets for safe carbon dioxide levels. This fact is reiterated by Fred Krupp, president of the Environmental Defense Fund. In the same debate between Sachs, Stavins, Beinecke and several other experts, Krupp reinforces Beinecke in that he believes a carbon tax will not put a "legal limit on pollution"[48]. A climate change policy must have an environmental goal, not a fiscal goal, guiding the

[45] Robert N Stavins. Putting a Price on Carbon: An Emissions Cap or a Tax?. Yale Environment 360: Opinion, Analysis, Reporting, and Debate. **http://e360.yale.edu/content/feature.msp?id=2148** (accessed January 10, 2010).

[46] Intergovernmental Panel on Climate Change. *Climate Change 2007: Synthesis Report.* Fourth Assessment Report of IPCC, Geneva; Cambridge University Press, 2007.

[47]Frances Beinecke. Putting a Price on Carbon: An Emissions Cap or a Tax?. Yale Environment 360: Opinion, Analysis, Reporting, and Debate. **http://e360.yale.edu/content/feature.msp?id=2148** (accessed January 10, 2010).

[48] Fred Krupp. Putting a Price on Carbon: An Emissions Cap or a Tax?. Yale Environment 360: Opinion, Analysis, Reporting, and Debate. **http://e360.yale.edu/content/feature.msp?id=2148** (accessed January 10, 2010).

process. In a time that requires a great reduction in carbon dioxide to limit climate change, a policy with an environmental goal is vital. In terms of meeting an environmental goal, i.e. strong emissions reduction targets, a carbon tax simply does not cut it.

Frances Beinecke, president of the Natural Resources Defense Council, also presents another drawback to a carbon tax. According to Beinecke, a tax would be susceptible to many loopholes. She uses the BTU tax as an example of this. In 1993, the "BTU tax was killed" after successful lobby attempts by industries using BTU were produced[49]. Although it is impossible to predict how successful lobbyist will be under a carbon tax, it is important to think about possible loopholes in a carbon tax. To prevent lobbying, an internationally agreed upon fee for carbon is essential. This will prevent industries from moving business to other countries that have lower prices for carbon, and it will prevent poor regulation enforcement in these countries. The greatest single barrier to an international carbon tax is the tax name itself. The word tax has a bad reputation, and the word usually makes the average person cringe. A tax or the "T-word"[50] has a large hate-base. How accepting will the public be of another domestic tax? In may take several years of implementation for the public to accept such a tax, but initially such a tax will likely be met with wide criticism, as are all other taxes. Producing revenue for the public and using the revenue to lower other tax rates is one potential way a carbon tax could reduce this bad reputation. Depending on the design of a tax, a carbon tax as the potential to be strong candidate for optimal global climate change policy.

The findings from international carbon tax research seem to indicate that a well-designed carbon tax would: be set up domestically by an individual country, and the fee would be a uniform fee agreed upon on an international level. This fee would be applied to all major emitters of carbon dioxide at the point of entry, and the fee would be collected at these points. This fee would allow leeway for developing

[49]Frances Beinecke. Putting a Price on Carbon: An Emissions Cap or a Tax?. Yale Environment 360: Opinion, Analysis, Reporting, and Debate. **http://e360.yale.edu/content/feature.msp?id=2148** (accessed January 10, 2010).

[50] Jeffrey D. Sachs. Putting a Price on Carbon: An Emissions Cap or a Tax?. Yale Environment 360: Opinion, Analysis, Reporting, and Debate. **http://e360.yale.edu/content/feature.msp?id=2148** (accessed January 10, 2010).

countries, to allow developing countries more freedom to emit to industrialize. This tax would also implement a monitoring mechanism that would allow for the proper changes to the tax rate, based on increases or decreases in fossil fuel use. The revenue from the tax would be equally shared among the public, in the form of lower taxes for other aspects of life. Lastly, existing import and export duties would be applied to countries that do not set up a domestic carbon tax, and this would provide incentives to create a tax so revenue could be kept domestically.

Advantages and Disadvantages of an International Cap and Trade System

The alternative to an international carbon tax is an international cap and trade system. As highlighted by Kyoto and the Montreal Protocol, the basic principle of a cap and trade system is to provide a clear cap for emissions, and to generate trade of carbon credits to allow countries to meet this cap. A cap would be agreed upon, like what occurred in Kyoto, for countries to follow by a set date. To meet this cap, in theory, a cap and trade system would "create a new market" for trading emissions credits[51]. This market would set a specific number of allowances for a country. Allowances can't exceed the cap set up by the system. If a country needed to purchase more allowances, or if they were not meeting the cap, they would have to buy allowances from countries that were emitting less than the emissions cap provided. In essence, a cap and trade system would reward countries for emitting less, as they would have the ability to sell caps. Although Kyoto ultimately failed, it was a good first step for cap and trade supporters to follow. The ability to trade allowances with other countries that are in need of carbon credits to meet their cap was one mechanism of a cap and trade. Eban Goodstein is one strong supporter of an international cap and trade system. He concludes that an international marketable permit system would efficiently meet the framework he has identified.

[51] Bracken Hendricks and Benjamin Goldstein. "Rebuilding America: A National Policy Framework for Investment in Energy Efficiency Retrofits". *Center for American Progress*. (August 2009). 1-56.

An international cap and trade system has many advantages. Using Goodstein's framework again, we can find advantages and drawbacks to an international cap and trade system. Supporters of a cap and trade system believe that first off, pollution permits or quotas could be issued based on the target level of emission established[52]. What a cap and trade does that a carbon tax is unable to do is put a cap on emissions. According to Krupp, an international cap and trade system would "set a clear goal for emission reductions"[53]. The IPCC report provides us with a target, which is "50 to 80 percent reductions from the 2000 levels by 2050"[54]. Under a cap and trade system, these levels could be used as the target emission numbers. Limiting climate change is an urgent issue, and climate change presents one of the greatest threats to humans of all time; therefore an environmental goal of limiting climate change must be the backbone of any international climate change policy. The ability to create a clear cap for emissions, and mimic the levels of emissions provided by the IPCC, is a potential environmental goal that could be followed under a cap and trade system. Using a cap will ensure that the environment, not money, is at the center of the policy. Putting a numerical emissions target on a cap and trade system would follow the first piece of the framework identified by Goodstein.

An international cap and trade system would follow Goodstein's second aspect of his framework because the system could use a trade system of permits that would allow poor countries to sell unused permits to developed countries for technology. A permit system would create a market that was not established by Kyoto, and give the owners of permits a valuable commodity. Not only would this be important for handling emissions, it would give developing countries more power. As we have learned from the Montreal Protocol, allowing tradable allowances for carbon credits between developing and developed countries is essential for an international cap and trade system to be successful. The ability to

[52] J.M. Tomkins and J. Twomey, International Pollution Control: a Review of Marketable Permits, Journal of Environmental Management 41, no. 1 (May): 39-47, http://www.sciencedirect.com/science (accessed October 26, 2009).

[53] Fred Krupp. Putting a Price on Carbon: An Emissions Cap or a Tax?. Yale Environment 360: Opinion, Analysis, Reporting, and Debate. **http://e360.yale.edu/content/feature.msp?id=2148** (accessed January 10, 2010).

[54] Kenneth Richards. Carbon Tax vs. Cap and Trade. Bulletin of the Atomic Scientists. http://www.thebulletin.org/web-edition/roundtables/carbon-tax-vs-cap-and-trade (accessed January 10, 2010)

trade their excess permits would allow these countries to build more technology and infrastructure to allow them to develop. At the same time, the system would control what type of energy and technology is used by developing countries because of the numerical emissions target and monitoring system. In this competitive market, the countries involved would attempt to avoid the cost of purchasing permits, and the system would give countries an "incentive to adopt cleaner technologies because of the high cost of permits"[55]. The creation of a new market has the potential to also provide new jobs.

Another aspect of an international policy is that it must create jobs, especially in a time of economic crisis like today. In an international cap and trade system, there is a potential for "sustained investment in job creation"[56]. This is the case because under a cap and trade system, private sector businesses would be involved. In order to meet the regulations set up by the cap, private businesses would need to become more efficient and switch to more efficient production methods. This would require the creation of new, green jobs including consulting, engineering, marketing and many other jobs. Not only would this occur at the private level, it would also occur on the government level. There would be a new desire for green, more efficient jobs to meet the cap set up by the system. This would create new jobs, and this may prove to help relieve the economic crisis the world is facing today. In essence, an international cap and trade system would cause businesses to invest in sustained job creation, and this would be with the creation of jobs that made the company more efficient with energy use.

Following the third piece of the bare bones, the system could use trade sanctions and a chain monitoring system to monitor and enforce the system. Trade sanctions would restrict trade in permits to countries who are either exceeding permit emission requirements or violating term agreements. The "chain monitoring system would rank the CO_2 emitters" by who emits the most and would provide

[55] J.M. Tomkins and J. Twomey, International Pollution Control: a Review of Marketable Permits, Journal of Environmental Management 41, no. 1 (May): 39-47, http://www.sciencedirect.com/science (accessed October 26, 2009).

[56] Fred Krupp. Putting a Price on Carbon: An Emissions Cap or a Tax?. Yale Environment 360: Opinion, Analysis, Reporting, and Debate. **http://e360.yale.edu/content/feature.msp?id=2148** (accessed January 10, 2010).

incentives for the biggest competitors to comply with the treaty[57]. This would require the biggest emitters to limit their emissions in order to meet the permit requirements in case they emit more than the numerical emissions target highlighted by the new system. This international market permit system proposed by Goodstein bears many similarities to the Montreal Protocol, which at this point in time, is the best piece of legislation for any global policy solution for climate change to follow.

One addition to the international market system that would make this system more similar to Montreal is the addition of a fund, similar to the multilateral fund in the Montreal Protocol. The implementation of such a fund would help involve developing countries by providing a more plausible ability to get involved with permits. Another similarity to the Montreal Protocol with this international market permit system is the trade sanctions. The trade restrictions set up by the Montreal Protocol effectively limited the amount of parties who did not comply, and the restrictions also limited trade between parties and non parties. The proper implementation of trade sanctions in the international market permit system would act in the same fashion, restricting the trading of permits for parties who do not comply with the system, and by restricting trade between participating nations and those nations not participating. With the lessons learned by the Montreal Protocol on successful policy mechanisms, implementing similar mechanisms for carbon dioxide would allow the international market permit system to closely match the Montreal Protocol. The implementation of a fund, trade sanctions, and the chain monitoring system would also likely create new jobs. These jobs would be environmental consultants for business, environmental engineers, and many other jobs related to more efficient energy use

An international cap and trade system also bears some criticism. One source of this criticism stems from an enforcement point of view. There is a strong potential for corrupt governments, particularly developed country governments, in an international cap and trade system. There are incentives to cheat the system if reductions targets are not being met. Governments have the potential to sell permits to

[57] Eban Goodstein, *Economics and the Environment*, New Jersey: John Wiley and Sons INC, 2008.

foreign entities in order to meet reduction targets, and then "not enforce regulations at these local industries in foreign countries"[58]. The buying and selling of these permits becomes quite complicated, and involves many governments from various countries settled in one country. The vast amount of countries and industries involved in the cap and trade would make monitoring quite complicated, even with trade sanctions and chain monitoring systems. The ability to sell these permits, and give enforcement of the new industries to local governments has the potential to cause the system to fail, or in other words, not meet emission reduction targets. One further drawback of a cap and trade system is the cost of creating a new market. In a time of recession, it is hard for governments around the world to think about spending money on a new market. It is estimated that an "economy-wide cap and trade program for greenhouse gases would cost around $100 billion in 2012"[59]. Will governments around the world be willing to spend this much money for a program that is not guaranteed success? While cost of such a program is a large barrier for a cap and trade system, the result of such a policy may help our economic crisis in the long run by creating new jobs.

Another drawback to a cap and trade system is involving certain countries, such as the U.S. and China. Under the Kyoto Protocol, neither the U.S. nor China signed. If any policy is to succeed, it must include the U.S. and China. The cooperation of these two countries is "absolutely essential if greenhouse gases are to be seriously limited"[60]. The reason for this is that these two countries provide a large percentage of total emissions, and not including these two countries would hardly make a dent in total emissions reductions. One of the major flaws of the Kyoto Protocol was that it didn't get U.S. and China to sign. Since the Kyoto Protocol was a cap and trade system, this means that future cap and trade systems have the potential to run into this same problem. One of the largest challenges facing a cap and trade is

[58] David Weisbach. Carbon Tax vs. Cap and Trade. Bulletin of the Atomic Scientists. http://www.thebulletin.org/web-edition/roundtables/carbon-tax-vs-cap-and-trade (accessed January 10, 2010)

[59] Janet Milne. *Critical Issues in Environmental Taxation: Volume 1: International and Comparative Perspectives*. USA: Oxford University Press, 2008.

[60] Richard Cooper. "Alternatives to Kyoto: The Case for a Carbon Tax*"*. Working Paper, Boston: Harvard University Economics Department, 2006.

settling on an international cap, and creating a cap for developing countries. Why would developing countries like China and India "accept a cap when their per-capita emissions are an order of magnitude less then America and Europe?"[61] If we focus on Goodstein's framework, it appears that an international cap and trade system will have trouble providing enough incentives for developing countries, such as China and India, to participate. China and India are examples of countries that are experiencing an economic boom, especially China, and are requiring large amounts of fossil fuel to do so. These countries are using coal factories and large industries to create the cheapest form of expansion, much like the U.S. did during the U.S. Although China may be hesitant to getting rid of these coal plants, in part because the U.S. used coal powered plants to industrialize, it will be important for policy to encourage more efficient energy use none the less. Providing China with more efficient alternatives to coal, while at the same time providing more jobs for people, will be the best option for a country dependent on coal. A well-designed international cap and trade system has the potential of doing this by creating a new, green market that rewards efficient energy use.

After researching an international cap and trade system, it appears that a well-designed cap and trade system would suffice as a global climate change policy. A well-designed international cap and trade system would have the following attributes: a clear cap for emissions reductions as the environmental goal of the system, perhaps the levels indicated by the IPCC by the year 2050. The system should also create a market for carbon credits; this market would reward energy efficiency and create new jobs to meet the emissions reduction demands. The system should also allow trade between developing and developed countries. This can be done by allowing developed countries access to permits in developing countries, and in turn trading these permits for technology to be given to developing countries. A well-designed international cap and trade system would also create a fund, much like the Montreal Protocol's multilateral fund, to allow more access to money for developing countries. Trade sanctions and chain marketing systems could also be implemented to restrict trade of permits in countries not meeting their

[61] James Hansen. *Storms of My Grandchildren: The Truth About the Coming Climate Catastrophe And Our Last Chance To Save Humanity.* New York: Bloomsbury USA, 2009.

reductions. Lastly, a well-designed cap and trade system would include U.S. in China, and it would provide incentives for these two countries to sign on through the rewards created by the new carbon credits market. It is also important to remember that any system is better than no system at this point.

Al Gore's novel, "Earth in the Balance", he strongly argues for a carbon tax. In this novel, he also states, "energy efficiency will be the single best way to reduce human's impact on climate change"[62]. After looking at both proposals, it seems energy efficiency can be promoted by both, despite Gore's argument for a carbon tax. We are in an urgent situation to limit greenhouse gases, and we are in need of a policy to limit these gases. The one true success of the Kyoto Protocol was that it got politicians and the public thinking about climate change. It was a big first step, and it was a step that needed to be taken. Since the protocol failed, people have been debating alternatives to the protocol. This is important because this requires people to think about climate change policy, and it requires people to do research. Whether an international carbon tax is initiated, or whether an international cap and trade system is initiated, it will be another large step regardless. A well-designed system, as we have seen, has the potential to help limit human's role on climate change. Upon initiation of either policy, a great amount of patience and determination will be required in order for either of the policies to reap any major results.

Barriers to Implementing Policy Today

In Stavins' and Aldy's novel, Post-Kyoto International Climate Policy, they come to the conclusion that the greatest challenge in addressing risks of climate change is "designing an international policy that will guide most, if not all, countries" to participate[63]. This is the case because of the large amount of barriers associated with climate change policy. Although both an international carbon tax and an international cap and trade may in fact suffice at being a usable climate change policy given all the steps taken this far in the thesis, it is important to figure out which of these is more likely to succeed in

[62] Al Gore. *Earth in the Balance: Ecology and the Human Spirit*. New York: Plume, 1993.

[63] Aldy, Joseph E., and Stavins, Robert N. *Post-Kyoto International Climate Policy: Summary for Policymakers*. New York: Cambridge University Press, 2009.

today's society. Following Goodstein's framework, and the examples set by previous responses to climate change in Kyoto and the Emissions Trading System in the EU, it is evident that both would be good climate change policies. However, this is not enough for a policy to just be okay, it must be able to find success given the barriers involved with implementing policy. To figure out which policy is a better solution, given the barriers, the different barriers of implementation for both a carbon tax and a cap and trade must be addressed. The optimal global climate change policy will be the policy that has fewer barriers to overcome, and which policy has easier barriers to overcome as well.

General Barriers to Climate Change Policy Implementation

The first area to focus on is what barriers both policies will run into, or the general barriers to climate change policy. One of the most significant barriers to climate change policy today involves the values that many countries around the world hold. Other than certain universal values held by all countries, social values are not typically the same between developed and developing countries. The diverse value base will be a tricky barrier to overcome, as it will be hard for climate change policy to meet the values of all countries involved in the policy. For example, policy will need to be able to provide new jobs for developed countries, and at the same time provide incentives for developing country's citizens to be more efficient in food production and energy use. How can policy remake the food production of countries who have limited food access? On top of this, many of these values conflict with environmental concerns, and have the ability to stall taking action for environmental concerns such as climate change. One specific value, which is more of a developed country value, is personal control over the environment. According to Wesley Schultz, a professor of Psychology at California State University, the value of personal control over the environment is based on the value that "first and foremost, each individual should look out for his or her self-interests by controlling nature and one's environment"[64]. A value such as this directly conflicts with interests in protecting the environment. Another value that

[64]Wesley Schultz, and Lynnette Zelezny. "Reframing Environmental Messages to be Congruent with American Values". *Human Ecology Review 10*, no. 2 (2003): 126-133.

conflicts with climate change policy is competition. Competition is what makes capitalism work, and it provides incentives to work hard and encourages innovation. The problem with competition, particularly in a free enterprise system that awards competition, is that people "value competition and not cooperation to achieve one's personal best"[65]. The successful implementation "of a comprehensive adaption strategy" to climate change will require coordination and cooperation across all institutions[66]. With a new climate change policy, competition as we know it today would be altered. Production would change, marketing would change, and this may be something that the public would be unwilling to accept immediately. Other values held by developed countries in particular include wealth, time, individualism, and quality.

Along with diverse social values conflicting with environmental concerns, there are several political barriers interfering with policy implementation. One significant barrier is the cost of implementation of a policy coupled with the lack of understanding about climate change. There is limited understanding of the risks associated with climate change, and this is due to the complexity of the climate system. According to Michael Oppenheimer, a professor of geosciences at Princeton University, "the effects of climate change cannot be predicted with certainty because future emissions trajectories are not known and our understanding of the climate system is limited"[67]. Due to this lack of understanding, politicians are skeptical to support new policies that address climate change. This, coupled with the cost of implementation, becomes a serious drawback for any climate change policy to overcome. It is estimated that a climate change policy would cost an estimated "one to two percent of national income in the U.S."[68]. While this cost doesn't take into account the benefits reaped from the policy, or money produced from the policy, it is still a large initiation cost. In the current state of our economy, with

[65]Ibid.

[66] Neil Leary. *Climate Change and Adaptation*. London: Earthscan, 2008.

[67]Michael Oppenheimer. "Understanding the Causes and Implications of Climate Change". Working paper, New Jersey: Princeton University, 2009.

[68] Joseph E. Aldy, and William A. Pizer. "Issues in Designing U.S. Climate Change Policy". *Resources for the Future* (June 2008).

reduced budgets, this is a hefty price for one policy. Given the uncertainty surrounding future projections of climate change, and the cost of implementing a policy, why would a politician support a policy that addresses such unknown risks? It seems that before politicians will be ready to support climate change policy, the monetary benefits of such a policy must be realized, and the impacts of future emission rates on the climate system must also be realized. Another political barrier surrounding climate change policy implementation is special interest groups. Special interest groups, especially auto, coal and mining groups, have a "substantial influence over the political system"[69]. Given the large profit these companies make, which is mainly due to a reliance on oil around the world, these companies have a large influence on people with power, i.e. presidents, congress, etc… These industries have the ability to "stall" the policy making process, and call for "more time for research"[70]. Before any policy will meet success, these interest groups must lose some of their power over the political system.

Lack of technology and the restricted access to technology today create another significant barrier for policy to overcome. More so in developing countries, technology is extremely limited. This is the case because, in general, developing countries have a more limited supply of scientists, resources, and information that will help them improve their technology. With the implementation of a policy, developing countries would be at a distinct disadvantage because of their limited access and supply of technology. The transfer of technology from developed to developing countries is poor because there is a small incentive for developed countries to do this. A great example of the restricted trade is provided by emerging Asian countries, NAFTA, and the European Union [see figure 5 in appendix]. According to the figure, only 8.2 percent of total trade in the EU, which includes technology, is exported to Asia; only 6.1 percent for emerging Asia. Compared to the 59.2 percent of total trade which goes back to other EU countries, this is a tiny percentage. The conclusion of this figure is that more trade is completed within a country, and less is exported out to other countries. It will be important for climate change policy to even

[69] Max Bazerman. "Barriers to Acting in Time on Energy and Strategies for Overcoming Them". Working Paper, Boston: Harvard Business School, 2008.

[70] Ibid.

out domestic trade and international trade, specifically for technology, in order to level out the playing field of energy efficiency once a policy is implemented. A better technology transfer system will be needed, and restricted access to technology must be eliminated. It would be interesting to see how these percentages change if developed countries were given more incentives to trade, i.e. through taxation or trade allowances.

Another significant barrier that will need to be overcome is the prevalence of other issues taking the spotlight away from climate change. Other issues such as health care, poverty, war tactics, military spending, and economic development take priority over climate change in politicians minds. Due to the lack of certainty surrounding the risks of climate change, politicians will set their sights on issues with more seen and known risks, such as economic development. Getting climate change off the backburner of global issues represents a large barrier for policy implementation, and it is likely that something drastic will need to happen before policy can meet success. A good example of how other issues take the limelight is in China. Due to its large population, and the quickly growing industries, China has required a large amount of coal. Coal is a fossil fuel, which means that by using coal, carbon dioxide is emitted. China is both the largest producer and consumer of coal in the world. In 2008, China "consumed over 3 billion tons of coal, representing nearly 40 percent of the world total consumption, and 129 percent increase from consumption in 2000"[71]. Coal consumption is highly correlated to industrialization and economic development. Due to this large coal consumption, China has become one of the fastest countries to industrialize in history. Economic development is one of the main focuses for China's leader, and furthering China's economy with coal consumption seems to be the way to do it. With a policy implemented to address climate change, China's coal consumption would have to be drastically reduced to meet the demands of the policy. With China's recent economic success, it is unlikely that China would be willing to accept anything that would require them to change their consumption habits. China is not the

[71] U.S. Energy Information System. China: Coal. Country Analysis Briefs. http://www.eia.doe.gov/emeu/cabs/China/Coal.html (accessed January 15, 2009)

only country in the world to have sharp increases in coal consumption. India, for example, is the third largest coal consumer in the world, with coal accounting for "67 percent of total energy consumption in the country"[72]. With countries like China and India depending on coal for economic growth, it will be difficult to get them to stop using coal. Policy, therefore, will need to be able to promote economic growth, while at the same time it will need to promote energy efficiency. Policy will need to provide incentives for countries like China and India to take part in the policy because the participation of China, India and other quickly growing nations is vital to the success of any policy. In other words, China and India will not be willing to sacrifice economic development for the energy efficiency promoted by policy. So policy will need to promote economic development and the creation of new jobs through energy efficiency to meet success within these developing countries.

Specific Barriers for an International Carbon Tax

Compared to an international cap and trade system, an international carbon tax has two different barriers that the cap and trade system would not encounter. These two barriers include the reputation of a tax, and a heavier burden placed on those at the lower end of the economic spectrum. In researching an international carbon tax, it becomes clear that the most significant barrier to a carbon tax is the word tax itself. The "T-word"[73], as Sachs calls it, has a large cultural aversion attached to it. Not only does the general public cringe at the thought of a tax, but politicians are equally skeptical at supporting new taxes. The word tax is actually a primary reason for the political support of a cap and trade. Since a cap and trade system "isn't called a tax"[74], it receives more popularity from politicians. Having the word tax in the name, a carbon tax has one more barrier that a cap and trade system does not. This aspect of a carbon tax

[72] Author N.A. Coal Industry. diehardindian.com. http://www.diehardindian.com/infra/coal.htm (accessed January 15, 2009).

[73] Jeffrey D. Sachs. Putting a Price on Carbon: An Emissions Cap or a Tax?. Yale Environment 360: Opinion, Analysis, Reporting, and Debate. **http://e360.yale.edu/content/feature.msp?id=2148** (accessed January 10, 2010).

[74] James Hansen. *Storms of My Grandchildren: The Truth About the Coming Climate Catastrophe And Our Last Chance To Save Humanity*. New York: Bloomsbury USA, 2009.

will create another political barrier for a carbon tax implementation, as politicians will be skeptical to create a new tax in a world that despises taxes. Conquering this barrier will require a system that will give back to the public, so the system will reward those who abide by the tax. It would be more feasible for a politician to support a tax if it were to give back to the public, as this would give a politician more support. Another significant barrier to a tax implementation is the potential for a heavier burden placed on those with lower incomes. This is the case because a carbon tax is a consumption tax, which is a tax on the consumption of goods and services[75]. A consumption tax has the ability to be regressive and impact those at the lower end of the economic spectrum. This occurs because as wealth increases, the ratio of spending money on consumables compared to annual income decreases[76]. Those who make less money annually will need to spend more of their income on consumables, and with the implementation of a carbon tax, the same story would apply. A carbon tax would favor those who make more money. A carbon tax would need to incorporate a system that would relieve this tax burden to level the playing field.

Specific Barriers to an International Cap and Trade System

Compared to an international carbon tax, a cap and trade system has two distinct barriers that a carbon tax would not run into. Along with the general barriers of policy implementation, an international cap and trade system would struggle to find an agreeable cap for emissions, and the cost of implementation is estimated to be much greater then a carbon tax. As we have learned from the Kyoto Protocol, and the drawbacks of a cap and trade system from the section above, it is a significant challenge to find a cap that nations around the world will agree upon. As we saw in Kyoto, the agreed cap favored European countries, which controlled the negotiations of the cap. This led the U.S. to not sign the protocol, which is a necessary for any policy to succeed. A cap and trade policy is thus susceptible to

[75] Roberta F. Mann. "The Case for the Carbon Tax: How to Overcome Politics and Find Our Green Destiny". *Environmental Law Institute 39* (2009): 10118-10127.

[76]Gilbert E. Metcalf. The National Sales Tax: Who Bears the Burden?. CATO Institute. http://www.cato.org/pubs/pas/pa-289.html (accessed January 15, 2010).

flawed emissions targets, as was the case with Kyoto. Along with including developing countries in the policy, a cap and trade system must create a cap that each individual country will agree upon. This cap should favor developing countries and give more leeway to developing countries because they will require more carbon emissions to industrialize. Another significant barrier to a cap and trade is the large cost of implementation. According to Janet E. Milne, author of the book "Critical Issues in Environmental Taxation: International and Comparative Perspectives", a cap and trade program on an economy-wide basis "would create a market at an estimated cost of $100 billion in 2012"[77]. Not only is this a large cost, but this creates complexity issues. Considering the immense number of industries and countries involved in this program, "who will pay the costs and how much will each pay?"[78] Given the uncertainty surrounding the future of climate change and the unknown risks of climate change, should politicians be willing to support such a complex and costly system? Cost and complexity barriers surround the cap and trade system, and the uncertainty of climate change risks certainly hinders the ability for an international climate system to overcome these barriers.

The Final Decision: A Carbon Tax or a Cap and Trade

With the general barriers, barriers specific to a carbon tax, and the barriers specific to a cap and trade system, it is time to decide which of the two policies would be more feasible in today's society. Given the urgent, although uncertain, need to reduce emissions, policy will need to find a way to be successful in today's society. Given my analysis of an international carbon tax and an international cap and trade, and taking into account of all the barriers, advantages, and drawbacks of each system, I have come to a final decision on the optimal global climate change policy for today's society. There are two aspects of an international carbon tax that make it a better fit then a cap and trade system. These two aspects, along with the well-designed carbon tax identified from the advantages of a carbon tax, are

[77] Janet Milne. *Critical Issues in Environmental Taxation: Volume 1: International and Comparative Perspectives*. USA: Oxford University Press, 2008.

[78] Roberta F. Mann. "The Case for the Carbon Tax: How to Overcome Politics and Find Our Green Destiny". *Environmental Law Institute 39* (2009): 10118-10127.

revenue recycling and technology transfer. Although the later can be done by a cap and trade system, the former is so promising that it dwarfs anything capable for a cap and trade system. "Revenue recycling" is the idea to "return to households, in aggregate, the extra money they'll pay when carbon prices go up"[79]. Essentially this is returning the revenue produced by the tax to the public equally, in the form of dividends or the lowering of other tax rates. The concept of revenue recycling has the potential to overcome the political barriers and social barriers associated with policy implementation. With the ability to produce revenues, a carbon tax has an attribute that doesn't exist with a cap and trade system. Permit selling, which is the concept behind a cap and trade system, does not "have the ability to raise revenues, so it would cost governments more"[80]. With this in mind, politicians may be more willing to support a policy that gives money back to the government that set up a carbon tax. Along with this, the revenue could be used to lower other tax rates, such as employment taxes or social security taxes. According to Al Gore, revenue from the carbon tax "could be recycled through portions of workers' payroll taxes" and be used to lower employment taxes. Revenue recycling could help overcome the political barriers surrounding policy implementation, but it could also destroy the cultural aversion to taxes. With the ability to reward the public and industries for more efficient energy use, revenue recycling can help the public and industries by allowing them to see a monetary benefit of supporting a tax. Along with lower other tax rates, revenue could also be recycled equally through dividends in order to cover those who don't pay certain taxes. In other words, revenue could be recycled through "equal dividends of all residents"[81] in the areas where a fee is collected from. This would allow for the greatest support from all citizens, not just those who pay taxes. By using dividends for all residents, revenue recycling could also

[79]Peter Barnes. *Climate Solutions: What Works, What Doesn't, and Why*. White River Junction: Chelsea Green Publishing Company, 2008.

[80] Ian W.H. Parry. "Are Tradable Emissions Permits a Good Idea?". *Resources for the Future 02*, no.33 (November 2002) 1-12.

[81] Peter Barnes. *Climate Solutions: What Works, What Doesn't, and Why*. White River Junction: Chelsea Green Publishing Company, 2008.

take the burden off those at the bottom of the economic spectrum. An example of this is the Tax Reform Act of 1986, which succeeded by using revenue recycling to replace the higher tax rates imposed[82].

Another aspect of a carbon tax that has the potential to overcome these barriers is by improving technology transfer between developed and developing countries. As we saw from Asia, the trade between the two is fairly weak. The lack of technology and restricted access to technology is a barrier that must be overcome by policy. Transfer of technology can be improved by "improved regulations to capture full social and environmental costs"[83]. This means that regulations need to make all costs internal, and to ensure that the full cost of using fossil fuels is paid. An international carbon tax would do this by setting up import and export duties. These duties would be applied to countries that do not set up a carbon tax, and these duties would provide incentives for countries to set up a tax so they could keep the revenue produced from the tax for them. Export duties could improve technology through a fund. This fund would be supported by export duties, and it would be a financial resource for countries in need of improved technology. This fund should be available to all developing countries, and it should provide incentives for developed countries to support the fund. With these two aspects of a carbon tax, along with the advantages identified, a carbon tax would overcome many barriers associated with climate change today.

Finally, a well-designed carbon tax would promote energy efficiency. In promoting energy efficiency, a climate change policy will help lift the economic and social barriers surrounding climate change policy. With the implementation of a rising carbon price, applied domestically at the point of entry, industries, the government, and the public will need to use energy more efficiently to meet the demands of the tax. By rewarding them with revenue, there are incentives to do this. In need of more efficient energy, countries will have a new demand for efficiency in all aspects of life. This will create new, green, jobs, and will create a new green market. By promoting energy efficiency, countries will be

[82] Roberta F. Mann. "The Case for the Carbon Tax: How to Overcome Politics and Find Our Green Destiny". *Environmental Law Institute 39* (2009): 10118-10127.

[83]Jayant Sayathe. Climate Change Mitigation: Barriers, Opportunities, and Technology Transfer. Lawrence Berkeley National Laboratory. http://ies.lbl.gov/ppt/ccmbott.pdf (accessed January 15, 2010).

able to continue to grow economically, while at the same time get rid of carbon dependencies. Thus, economic development will be promoted through more efficient energy sources. Values such as wealth in developed countries can also be met, as the new market created by the carbon tax for green jobs will open up new employment opportunities, likely to offer jobs will sufficient income. Energy efficiency should be favorable in China and other rapidly industrializing nations because China is already noticing the impacts on daily life, such as pollution and health, that coal fired power plants are having. New production methods, new energy sources, and new marketing methods will be promoted with a carbon tax, and this will create a brand new market for countries to employ. Economic growth, after the tax, will depend on the countries willingness to be more efficient. Therefore, by choosing to be more efficient, economic development and values stemming from wealth and well-being will be promoted. Although the impacts of the new jobs demanded with a carbon tax are unknown, it should be understood that this time of economic crisis in the world is in need of change and new jobs. By promoting energy efficiency, new jobs will be created by a carbon tax. This has the potential to alleviate some of the employment problems around the world, while at the same time promoting economic development in developed and developing countries.

Conclusion

According to Al Gore, the most important part of any global climate change policy is to "introduce the right incentives for eliminating pollution and becoming more energy efficient"[84]. In researching proposed solutions, it is evident that both an international carbon tax and an international cap and trade would provide incentives to do these two things. In answering the question of "what is the optimal global climate change policy: an international carbon tax or a cap and trade system", and following the five step guide laid out in the introduction, there are many conclusions to be drawn. Following Goodstein's framework, policy responses to climate change to date have been ineffective. With flawed emissions targets, ineffective enforcement mechanisms, and by not including developing countries

[84] Al Gore. *Earth in the Balance: Ecology and the Human Spirit*. New York: Plume, 1993.

or the U.S., the Kyoto Protocol was not successful. The Emissions Trading System actually presented a fairly successful trial period, however this policy showed us that it will be difficult to enforce regulations in a cap and trade on an international level. Overall, past responses to climate change have shown the need for a better, more effective policy. The second step, learning from policy responses, has shown us many ideas that should be implemented in future policy. We have learned that the Montreal Protocol is a high-quality piece of legislation that has met great success in lowering sulfur emissions, and that it should be used as legislation to follow by future policymakers. Specifically the Montreal Protocol has shown us that: a) a policy must reward the public for being more energy efficient and that it must keep the public well-informed, b) a policy must also have a strong monitoring mechanism to ensure compliance and punish those who don't comply with trade restrictions, and c) a policy must incorporate a fund to provide financial resources and incentives for developing countries. In researching the advantages and disadvantages of an international carbon tax and an international cap and trade system, both show promise for being the optimal global climate change policy. Both have attributes that follow Goodstein's framework closely, and both mimic many of the successes of past policy responses to climate change. We can also conclude that either policy is supported by a wide range of sources, and both have the potential to be good policies. In today's society, however, we cannot afford just a good policy. We need a great policy, one that will overcome the barriers associated with policy implementation. With the diverse and conflicting social values, political barriers, economic barriers, other issues taking the limelight, and the individual barriers for each policy, policy implementation presents a large challenge for policymakers in today's society. With all the barriers revealed, and the findings of all the advantages and disadvantages of cap and trade versus a carbon tax, there is one specific policy that has the largest potential of overcoming these barriers. A rising uniform tax fee, agree upon at an international level with more leeway originally given to developing countries, applied at a domestic level across all fossil fuels at the source, with import and export duties to encourage participation, recycled revenue to reduce other tax rates and to reward the public for using more efficient energy sources, and a fund to improve technology transfer and developing country participation through export duties are all aspects of an international carbon tax that should be

applied. With all of these pieces making up a well-designed international carbon tax, a well-designed international carbon tax would be the optimal global climate change policy because it can mimic the successes of the Montreal Protocol, it follows Goodstein's basic framework closely, it has many advantages over a cap and trade system, and it has the potential to eliminate most of the social, political, economic, and specific carbon tax barriers associated with climate change policy today. If energy efficiency is the answer for climate change policy today, as Gore states, than it should be addressed through a well-designed international carbon tax.

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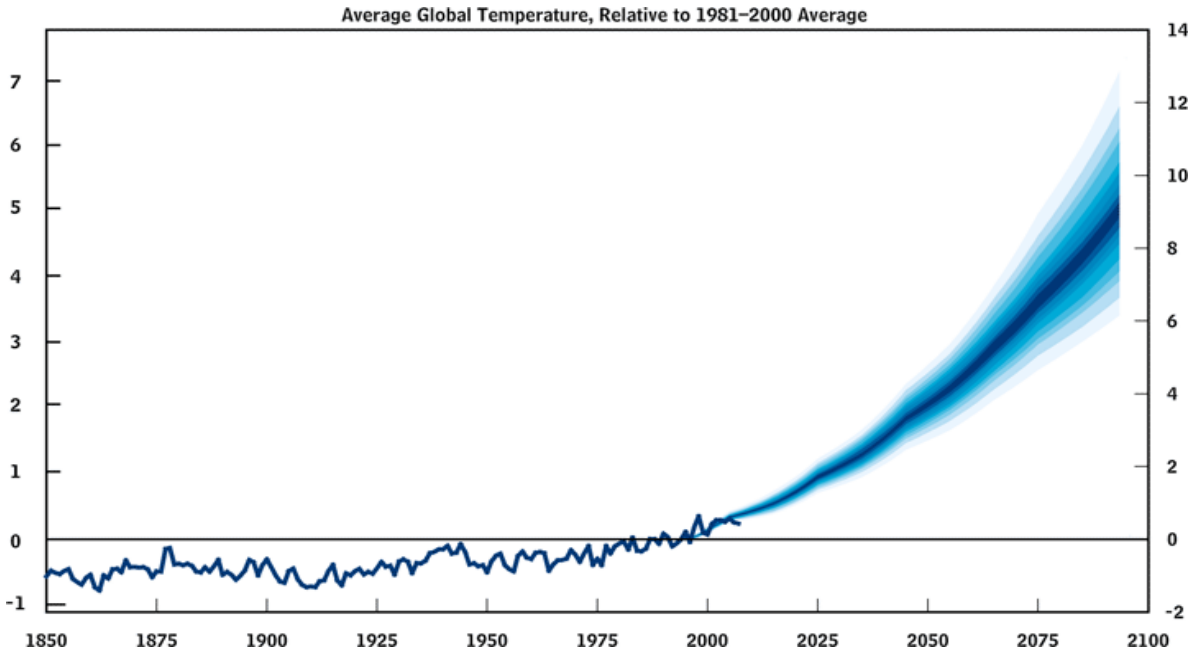
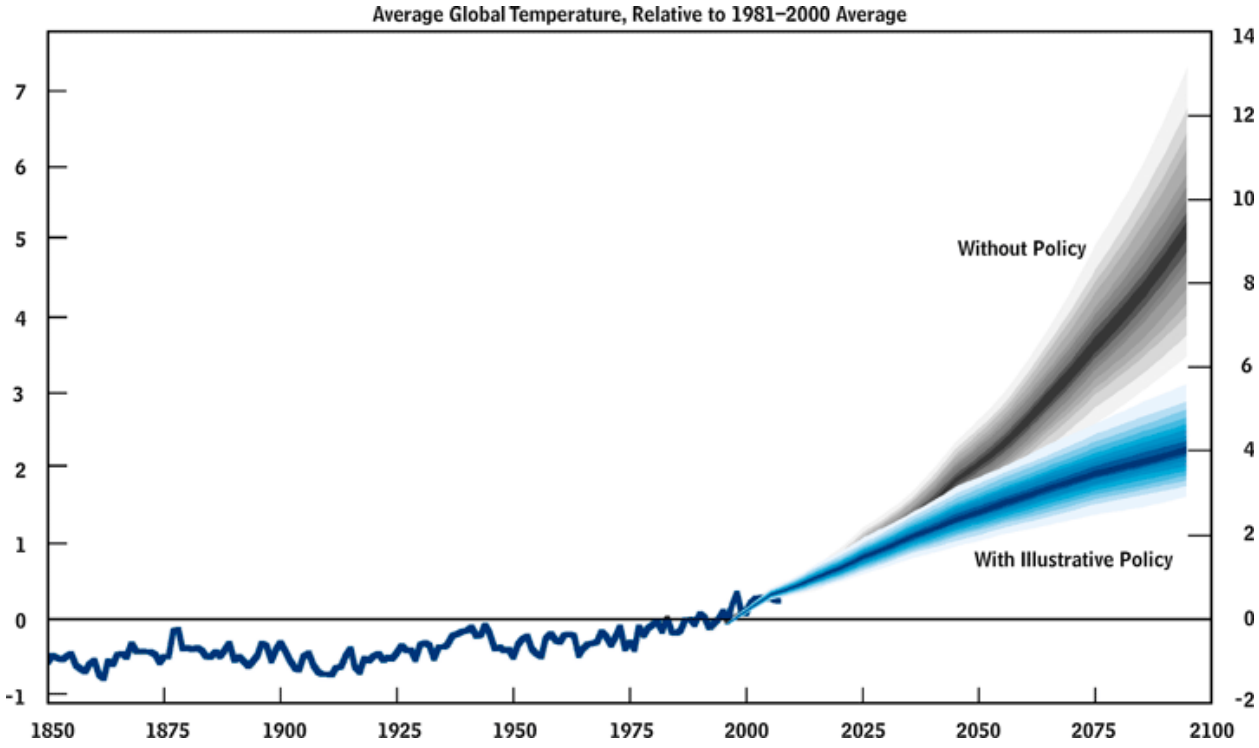
Appendix:

Figure 1:



Source: U.S. Congress. Senate. Senate Committee on Energy and Natural Resources. *Potential Impacts of Climate Change in the United States*. Congressional Budget Office, May 2009. 111th Cong.

Figure 2:

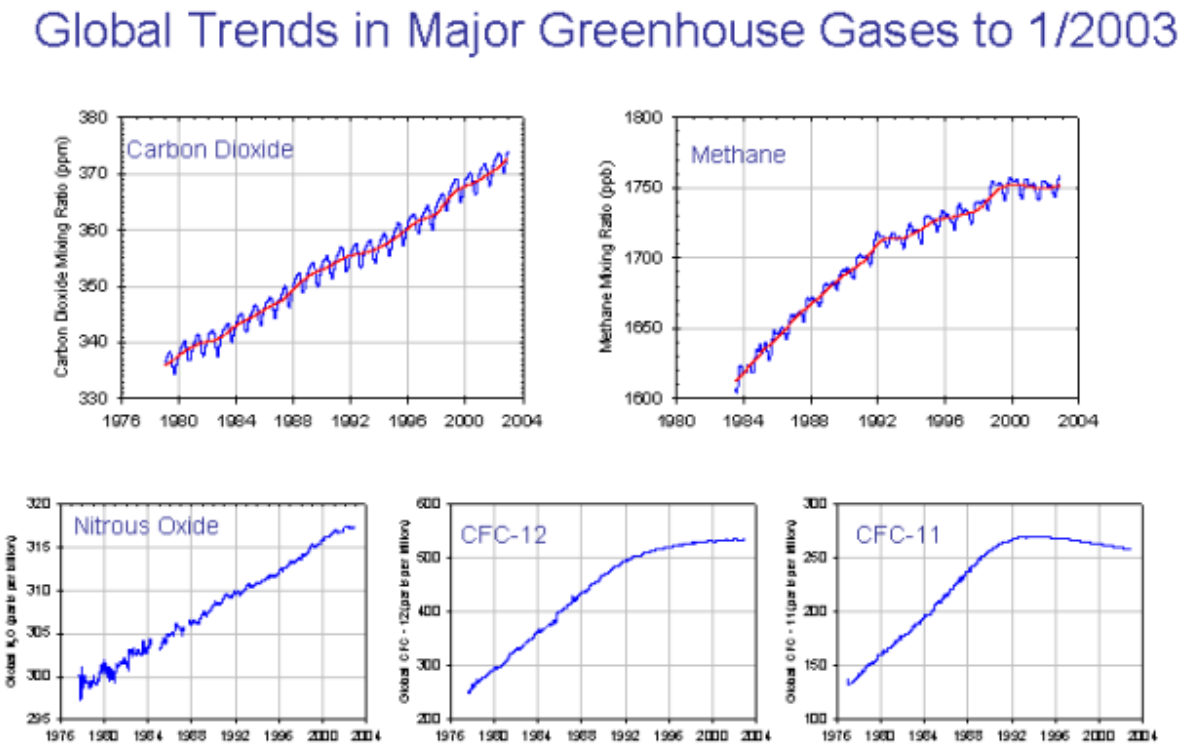


Source: U.S. Congress. Senate. Senate Committee on Energy and Natural Resources. *Potential Impacts of Climate Change in the United States*. Congressional Budget Office, May 2009. 111th Cong.

Figure 3:

Source: The European Union's Emissions Trading System in perspective - http://www.pewclimate.org/eu-ets

Figure 4:



Global trends in major long-lived greenhouse gases through the year 2002. These five gases account for about 97% of the direct climate forcing by long-lived greenhouse gas increases since 1750. The remaining 3% is contributed by an assortment of 10 minor halogen gases, mainly HCFC-22, CFC-113 and CCl_4.

Source: http://www.solarnavigator.net/greenhouse_gases.htm

Figure 5:

Table 1

Asia's booming intra-regional trade

Intra-regional trade now accounts for more than 50 percent of total trade in Asia.

(Share of the direction of exports in 2006 and changes from 1990 in parentheses.)

Exporting Region	Directions: Asia	Emerging Asia	Industrial Asia	NAFTA	EU15	Rest of the World
Asia	**51.9** (9.2)	**42.1** (11.7)	**9.9** (–2.5)	**20.7** (–6.9)	**14.2** (–4.1)	**13.2** (1.9)
Emerging Asia	**51.6** (4.1)	**40.8** (9.8)	**10.8** (–5.7)	**20.1** (–4.6)	**14.6** (–2.2)	**13.6** (2.7)
Industrial Asia	**53.1** (16.2)	**46.5** (16.9)	**6.6** (–0.7)	**22.5** (–8.7)	**12.8** (–7.4)	**11.6** (–0.1)
NAFTA[1]	**19.5** (–5.8)	**13.5** (1.0)	**6.0** (–6.8)	**52.5** (11.9)	**14.6** (–7.4)	**13.4** (1.3)
EU15[2]	8.2 (0.7)	6.1 (1.7)	2.2 (–1.0)	9.6 (1.2)	59.2 (–6.7)	23.0 (4.8)

Source: IMF Direction of Trade Statistics, and staff calculations.
Note: Numbers in the parentheses are changes in the shares from 1990 to 2006.
Shaded cells are those of intra-regional trade flows.
[1]NAFTA = North American Free Trade Agreement.
[2]EU15 = Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom.

Source: http://www.imf.org/external/pubs/ft/survey/so/2008/CAR02608A-1.gif