

EFFICACY OF CARBON TAXES AND RECOMMENDATIONS FOR CUTTING CARBON EMISSIONS

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I. SCOPE OF THE PAPER

Climatologists have recently observed an increase in average temperatures across the globe.¹ This phenomenon can be called global warming; however, climatologists often refer to this phenomenon as climate change, because the term climate change has broader meaning, encompassing other effects besides simply rising temperatures.² Whatever the terminology, the problem is becoming clear, human influence is very likely causing an increase in average global temperatures through the release of greenhouse gas emissions, such as carbon-based emissions.³

This paper is an attempt to pick one aspect of the overall problem posed by increasing temperatures and analyze the effectiveness of a proposed solution through carbon taxation.⁴ The ultimate goal is to repurpose, reduce, recapture, and perhaps eliminate carbon-based emissions into the atmosphere to stop, reverse, or slow the climate-change process.⁵ Any effective solution must produce these results, otherwise it can hardly be termed effective. Whatever the “vehicle” or means a society chooses to obtain these results is only effective insofar as the means are working toward accomplishing the ends of slowing or stopping the negative effects of the climate-change process.

In order to further understand why it is imperative that we act now to slow this process, we must first understand the nature of the problem.

1. See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE [IPCC], *Climate Change 2013, Summary for Policymakers* (Thomas F. Stocker et al. eds., 2013); see National Aeronautics and Space Administration, <http://climate.nasa.gov/scientific-consensus#ft1> (last visited Jan. 14, 2015).

2. See UNDERSTANDING AND RESPONDING TO CLIMATE CHANGE: HIGHLIGHTS OF NATIONAL ACADEMIES REPORTS 2 (National Academies Brochure, 2008).

3. IPCC 2013, *supra* note 1, at 12.

4. Various other means for controlling carbon emissions, such as command and control regulation, cap and trade systems, and systems other than carbon taxation will be only briefly considered in this paper, and only to the extent necessary to “frame” the context of the carbon tax debate. The efficacy of systems other than carbon taxation is beyond the scope of this paper.

5. There is some disagreement about whether the responsibility should fall on the current generation. The benefits of the change in climate policy will likely not occur until much further into the future, but the burdens of such change in climate policy will be realized much earlier. SHI-LING HSU, *THE CASE FOR A CARBON TAX 1* (Island Press, 1st ed. 2011). This argument is unpersuasive however, because the current generation has already enjoyed the “benefits” of over-consumption of carbon intensive products (such as cars, and other petroleum based products), and would merely have to pay for those benefits already consumed by accepting the change in climate policy that should follow the recognition that humans have significantly contributed to the climate change problem.

II. DEFINING THE PROBLEM: THE SCIENCE BEHIND CLIMATE CHANGE⁶

A. *Defining Climate and the Greenhouse Effect*

According to one source, climate is defined as “the average of the weather conditions described through variability in temperature, precipitation, and wind over a period of time.”⁷ Greenhouse gases work in a similar manner to greenhouses—where plants are raised—via the “greenhouse effect.”⁸ In a greenhouse the sunlight will shine through the glass of the greenhouse and onto the ground, but when the light hits the ground it is radiated back (transformed) into heat.⁹ In a similar manner to greenhouse gases, the glass will trap the radiated heat keeping the heat near the surface and inside the greenhouse.¹⁰

B. *The Meaning of Global Warming or Climate Change*

“The phrase global warming refers to a phenomenon in which the Earth’s surface temperature increases from its long-term averages generally because of an atmospheric blanket of greenhouse gases [“GHGs”](primarily carbon dioxide; methane; and chlorofluorocarbons) that serve to trap reradiated solar energy from escaping into space.”¹¹ Similar to the idea that the greenhouse effect supports plant life in an actual greenhouse, the same effect supports all life on a larger scale.¹² “This blanket of greenhouse gases is responsible for providing Earth a generally temperate, stable, and life-sustaining climate.”¹³

C. *The Basic Reason Why Climate Scientists Know Climate Change is Occurring*

Climatologists can study the composition of ice at the polar regions to get a baseline record of temperatures throughout

6. Volumes of literature could be written, and have been written about the climate change issue. This section of the paper is merely intended to provide the reader with a very short summary of the current state of the issue.

7. GREEN ENERGY: AN A-TO-Z GUIDE 72 (Dustin Mulvaney & Paul Robbins eds., 2011).

8. *Id.* at 73.

9. *Id.*

10. *Id.* Also, similarly, the greenhouse allows for plant life to live and thrive in an environment it otherwise might not. *See infra.* Why this greenhouse effect is similar or analogous will become clear in the next section.

11. Green Energy: An A-to-Z Guide, *supra* note 7, at 201.

12. *Id.*

13. *Id.*

time.¹⁴ The scientists are able to gather this data using correlation methods to show climate change throughout time.¹⁵ Climate scientists also use data collected at weather stations set up at various points throughout the world¹⁶ and use computer simulations to compare the data with future projections.¹⁷ With those data sets in hand, climatologists and other scientists are able to compare temperature changes, and after correcting for natural variability in weather patterns, climatologists are now saying global warming is occurring.¹⁸

D. *The Reason for the Focus Specifically on Carbon Emissions and Potential for Expanding Legislation to Encompass Other GHGs*

Carbon Dioxide, methane, and chlorofluorocarbons are just a few of the many known greenhouse gases (GHGs).¹⁹ One reason for such a focus specifically on carbon dioxide is that scientists can calculate the climate forcing effects of various GHGs and determine the ones having the greatest climate forcing effects.²⁰ Carbon dioxide has greater climate forcing capacity than some other GHGs such as methane.²¹ Climatologists also have

14. *Id.* at 202; A significant portion of climate data comes from testing polar and glacial ice cores. *See id.*

15. Green Energy: An A-to-Z Guide, *supra* note 7, at 202 (“By testing polar and glacial ice cores at continuously increasing depths, scientists can determine the composition of Earth’s atmosphere as a function of time. For example, an Arctic ice sample will contain minute pockets containing a small amount of air—and its constituent gases—that were trapped at the time the ice froze. Ice samples taken from deeper cores were formed earlier in time. Using these historic data, modern computer models of Earth’s climate systems are able to calculate Earth’s surface temperature over time.”). In the mid-1800s scientists were beginning to realize that “changes in the concentrations of some atmospheric gases could result in changes to Earth’s climate.” *Id.* Later, scientists began to understand that the “amount of carbon dioxide in Earth’s atmosphere would significantly affect its surface temperature.” *Id.* More recently scientists have used correlation models to determine that Antarctic air temperatures correlate strongly with atmospheric greenhouse gas concentrations. *See id.* Using these data as a baseline, scientists can compute radiative forcing—or the ability of a greenhouse gas to affect climate—and average temperatures. *Id.* at 202-203.

16. *See generally* IPCC, *supra* note 1.

17. Green Energy: An A-to-Z Guide, *supra* note 7, at 204 (“Analysis of atmospheric greenhouse gas concentrations and computer modeling of interacting land, ocean, and atmospheric systems has led scientists to conclude beyond any reasonable doubt that greenhouse gas emissions from human activity are the primary drivers in this dramatic increase in global warming.”).

18. *Id.*

19. *Id.* at 201.

20. *Id.* at 214. Forcing is “[t]he degree to which an agent can cause atmospheric changes (e.g., warming). . .” *Id.*

21. *Id.* at 214. (“Even though it is approximately 20 times as potent as carbon dioxide as a greenhouse gas (as a function of emission quantity), methane has

scientific tools to calculate climate forcing capacity.²²

Ideally, although perhaps somewhat unrealistically, we can reach a global result of carbon neutrality—meaning “the conditions at which a net zero carbon emission is reached.”²³

III. OBJECTIONS TO THE SCIENCE OF CLIMATE CHANGE

A. Overview

Advocates opposed to the idea that climate change is occurring have sometimes confused the climate change issue by referring to claims made by “climate science” and by claiming that climate science is uncertain.²⁴ The popular media has also contributed to much of the confusion about climate science.²⁵ Nevertheless, with the current available science, there is a near 97 percent agreement among climatologists—those who devote their available time to studying climate science issues—that the earth, *on average*, is getting warmer and that this increased temperature is “very likely due to human activities”.²⁶

approximately a third of the climate forcing effect as does carbon dioxide.”)

22. *Id.* at 48–51. For example, another tool in the climatologists’ toolbox is to calculate carbon emission factors (CEF). *Id.* “The CEF is used to relate the relative intensity of an activity (e.g., the amount of coal burned) to emission values of carbon dioxide equivalence (CO_{2e}), a quantity that indicates global warming potential of each greenhouse gas (GHG) using carbon dioxide as the GHG standard.” *Id.* at 49–52. In this way, each GHG has a scale with carbon dioxide as the baseline measurement point; thus, even though the focus here is on carbon emissions specifically, legislation could be expanded in a similar manner to cover all GHG emissions based on the relative intensity of the emission. *Id.* at 49–50.

23. *Id.* at 52–53.

24. *See generally* NONGOVERNMENTAL INTERNATIONAL PANEL ON CLIMATE CHANGE [NIPCC], *CLIMATE CHANGE RECONSIDERED: SUMMARY FOR POLICYMAKERS* 3 (Idso, C.D., R.M. Carter, F. Singer (et al. eds. 2013). According to one source, supporting the idea of global climate change,

[t]he world’s political process has been slow to react to the serious, and potentially catastrophic, consequences for life on our planet that flow from the burning of fossil fuel. In one sense, this is understandable: turning around the global energy base is not a simple task. In another sense, it is inexcusable: a myopic failure to act in the face of clear scientific evidence.

Peter E. Roderick, *Foreward in* ADJUDICATING CLIMATE CHANGE vii, vii (William C. G. Burns & Hart M. Osofsky eds., 2009).

25. *See, e.g.*, FOX NEWS, ‘Bad, Bad Science’: Weather Channel Founder Says Climate Change Is a Myth, insider.foxnews.com/2014/10/27/weather-channel-co-founder-john-coleman-climate-change-myth (Oct. 27, 2014). Unfortunately, media sources still air stories that create confusion about climate change.

26. NASA, *supra* note 1. As one source correctly states the beginning point of the scientific method is the “null hypothesis”. NIPCC, *supra* note 24 at 3.

“Regarding global warming, the null hypothesis is that *currently observed changes in global climate indices and the physical environment, as well as current changes*

B. *Objection—There Are Unexplained Patterns of Cooling*

The IPCC, in its newest report, actually addresses this issue.²⁷

The observed reduction in surface warming trend over the period 1998 to 2012 as compared to the period 1951 to 2012, is due in roughly equal measure to a reduced trend in radiative forcing and a cooling contribution from natural internal variability, which includes a possible redistribution of heat within the ocean (*medium confidence*). The reduced trend in radiative forcing is primarily due to volcanic eruptions and the timing of the downward phase of the 11-year solar cycle.²⁸

So, here the IPCC is demonstrating that it is taking into account *factors other than GHG emissions* in particular cooling cycles, i.e. natural variability.²⁹

C. *Objection—It is Not Certain that Human Factors are the Cause of the Problem*

The idea behind this objection is that if climate scientists are uncertain of whether human factors are the cause of the climate change issue, then it is likely that they will also be uncertain of whether humans can influence the climate system at all, thus interfering with our capability of discovering a solution.

in animal and plant characteristics are the result of natural variability.” *Id.* at 3. With a careful method, this assumption of the null hypothesis should prevail unless “direct evidence of human causation is . . . adduced.” *Id.* at 3. According to the IPCC’s definition of climate change, which adds indirect evidence as a possibility for overcoming this assumption of natural variability, climate change is “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.” United Nations Framework Convention on Climate Change, May 9, 1992, 1771 U.N.T.S. 107, available at: http://unfccc.int/essential_background/convention/background/items/2536.php.

27. IPCC, *supra* note 1, at 13.

28. *Id.* Radioactive forcing means “the change in the amount of energy per unit of time flowing into or out of the Earth’s climate system.” Green Energy: An A-to-Z Guide, *supra* note 7, at 377.

29. See *infra* note 34. A related argument denies that there is an ice-cap-melting phenomena occurring. According to one source, “scientists have measured increased rates of glacial melt in the Arctic, on Greenland, and on Antarctica. In 2008, the area of the Arctic ice cap was at an all-time recorded low . . .” Green Energy: An A-to-Z Guide, *supra* note 7, at 205. The same source relates that melting of the ice caps could result in a large release of methane gas, a known GHG, into the atmosphere. *Id.* at 207. If this happens, there could be a dramatic increase in the “greenhouse effect and global mean temperatures.” *Id.* The point is that the ice-cap melting phenomena is confirmed by observation and documented in the IPCC report. IPCC, *supra* note 1 at 2, 7.

There are a number of reasons that this objection is not persuasive. First, as the precautionary principle advises we ought to act, even if we aren't the cause of the problem and even in the face of some uncertainty.³⁰ Second, as the evidence has already shown, an overwhelming majority of climate scientists believe the source of the problem to be human activities,³¹ thus giving us hope that at least by reducing those activities we can make a difference. Third, scientific certainty is never a guarantee, in fact the best available report we have from the IPCC only gives ranges or degrees of certainty based on the quantity and the quality of the evidence available.³² Fourth, by waiting we may reach the "tipping point" of rising temperatures.³³

D. *What We Know Today about Climate Change*

The intellectual rigor of the climate change debate has all but come to an end, being frustrated by the availability of 'hard data.'³⁴ The Intergovernmental Panel on Climate Change (IPCC), formed by the United Nations and the World Meteorological Organization, is a body of hundreds of scientists from around the world contributing to the current state of knowledge in climate science.³⁵ The IPCC, along with other respected organizations and scientists, using the scientific method and correcting for possible errors, have come to the conclusion that climate change is a legitimate issue.³⁶ If these climate scientists are to be

30. UNITED NATIONS CONFERENCE ON ENVIRONMENT AND DEVELOPMENT, Rio de Janeiro, Braz., June 3-14, 1992), *Rio Declaration on Environment and Development*, U.N. Doc. A/CONF.151/26(Vol. I), (Aug. 12, 1992). "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." *Id.*

31. NASA, *supra* note 1.

32. IPCC, *supra* note 1, at 2.

33. "Of particular concern is the possibility that these feedback mechanisms will drive our climate processes to a tipping point at which [point] they will shift rapidly to a new—and unpredictable—equilibrium that is far less conducive to supporting ecological systems as we have come to know them." GREEN ENERGY: AN A-TO-Z GUIDE, *supra* note 7, at 207.

34. *See generally* IPCC, *supra* note 1. According to the IPCC's most recent report "Summary for Policymakers," "[w]arming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased." *Id.* at 2.

35. GREEN ENERGY: AN A-TO-Z GUIDE, *supra* note 7, at 258.

36. *See, e.g.*, IPCC, *supra* note 1, at 2. There are those who claim that climate change is not really occurring or, at least, that humans are not the cause of the climate change problem. Some of those who make such claims appear in the popular media. *See, e.g.*, FOX NEWS, 'Bad, Bad Science': Weather Channel Founder Says Climate Change Is a Myth (Oct. 27, 2014, 10:45 PM), insider.foxnews.com/2014/10/27/weather-channel-co

believed, then it is imperative that we act accordingly and do something now to reverse this destructive trend.

IV. OVERVIEW OF EFFECTIVE CLIMATE-CHANGE SOLUTIONS FROM A SCIENTIFIC PERSPECTIVE: WHAT SHOULD BE DONE TO DECREASE CARBON EMISSIONS?

A. Carbon Sequestration

Natural carbon sequestration already occurs, but there are some things we can do to help this process along, or at least avoiding hindering the process.³⁷ Through deforestation the problem of overproduction and release of carbon into the atmosphere becomes worse, as natural defenses to overproduction are being removed from the system.³⁸ Even though stopping deforestation is one method that can be used to restore the natural balance, it can at most help offset about 20 percent of the total emissions overall.³⁹

B. Carbon Capture and Storage

Another way to offset emissions might be to deliberately capture the greenhouse gases such as carbon dioxide and store them underground. This method is called carbon capture and sequestration.⁴⁰ It is important to note, when considering this option, that CCS is often suggested in the context of “enhanced oil recovery”, thus the net effect due to burning of the oil may be

founder-john-coleman-climate-change-myth. Others who make such a claim appear through organizations espousing their own legitimacy. *See, e.g.*, NIPCC, *supra* note 24. In response, the reader should consider the motives and sources of funding these organizations and politically-charged media might receive and how receipt of that funding might affect what they say. The IPCC, by contrast, is a collection of scientists from all over the world working on the climate change issue. *See generally* IPCC, www.ipcc.ch/organization/organization.shtml (last visited Jan. 14, 2014). While it might be true that the IPCC and climate scientists could be wrong and biases are certainly possible, it is likely that those most concerned about finding out the truth about climate science and claims about global warming are those who have been specifically trained for the job.

37. GREEN ENERGY: AN A-TO-Z GUIDE, *supra* note 7, at 54 (“Carbon sequestration is the process through which carbon dioxide (CO₂) from the atmosphere is absorbed by trees, plants, and crops through photosynthesis and stored as carbon in biomass (tree trunks, branches, foliage, and roots) and soils or aquatic vegetation.”).

38. *Id.* at 54. In fact, “[t]ropical deforestation is responsible for about 20 percent of the world’s annual CO₂ emissions.” *Id.*

39. *Id.*

40. *Id.* at 77. Carbon capture and sequestration, or carbon capture and storage (“CCS”), is “where carbon emissions from the burning of fossil fuels are captured and sequestered deep underground in stable geological formations.” *Id.*

an increase in carbon emissions.⁴¹ Also, if large amounts of carbon are sequestered, “shifts in geology that could release large amounts of carbon dioxide at some point in the future” is worthy of consideration.⁴²

C. *Other Suggestions by the IPCC for Reducing Atmospheric Carbon*

The IPCC discusses the efficacy of attempting to alter the climate system through geoengineering methods.⁴³ From the report,

Methods that aim to deliberately alter the climate system to counter climate change, termed geoengineering, have been proposed. Limited evidence precludes a comprehensive quantitative assessment of both Solar Radiation Management (“SRM”) and Carbon Dioxide Removal (“CDR”) and their impact on the climate system. CDR methods have biogeochemical and technological limitations to their potential on a global scale. There is insufficient knowledge to quantify how much CO₂ emissions could be partially offset by CDR on a century timescale. Modelling indicates that SRM methods, if realizable, have the potential to substantially offset a global temperature rise, but they would also modify the global water cycle, and would not reduce ocean acidification. If SRM were terminated for any reason, there is *high confidence* that global surface temperatures would rise very rapidly to values consistent with the greenhouse gas forcing. CDR and SRM methods carry side effects and long-term consequences.⁴⁴

D. *Combining Methods is the Likely the Scientific Solution*

It is likely that a combination of the above methods and a reduction in carbon emissions overall is the only way to reverse the global warming trend. The choice of instrument used, whether cap-and-trade, command and control regulation, or carbon taxation, must be implemented with an eye toward bringing about one or a combination of these solutions. In other

41. *Id.*

42. *Id.*

43. IPCC, *supra* note 1, at 27.

44. *Id.*

words, the law has to support the industry solution toward reduction in carbon emissions, and laws regarding such emissions that do not meet this standard ought to be repealed in favor of a more effective law.

V. EFFECTIVE CLIMATE-CHANGE SOLUTIONS FROM A POLICY PERSPECTIVE: WHAT SHOULD BE DONE TO DECREASE CARBON EMISSIONS?

A. *The Problem of Leakage and the Need for a Global Response*

Increasing atmospheric carbon emissions has been known by some to potentially cause climate change issues since “at least the 1970s.”⁴⁵ Prior to that some believed that increasing temperatures from excessive carbon emissions could produce positive results such as improved agricultural yield.⁴⁶ The solution to the problem of rapidly increasing carbon emissions will “in all likelihood require a global response, and will require the engagement of the vast majority of countries.”⁴⁷ “[U]nilateral action by one or a few countries is likely to be ineffective.”⁴⁸

The issue appears to be well-known in international discussion regarding possible solutions to the carbon emissions problem and is called leakage.⁴⁹ The problem of leakage is the problem that one country drastically reducing the carbon emissions within its own borders is likely to cause other countries to increase their own carbon emissions, and perhaps less efficiently, due to the price drop created by the participating country’s efforts.⁵⁰ And further, “[t]he nature of the leakage problem is that the greater the efforts to reduce greenhouse gas emissions, the greater the leakage.”⁵¹ That is, the fossil fuels, such as carbon, that are reduced as a result of a participating country’s efforts will mean that the non-participating country will benefit from those efforts by being able to buy cheaper fossil fuels.⁵²

45. HSU, *supra* note 5, at 1.

46. *Id.*

47. *Id.* at 2-3.

48. *Id.* at 3.

49. *Id.*

50. *See id.*

51. *Id.* at 4.

52. *Id.*

B. *Why there is resistance to global response to reducing carbon emissions*

Already developed countries evolved in a manner that uses fossil fuels to grow their economy.⁵³ The ultimate goal is to disassociate economic growth with resource depletion and environmental impact to the greatest extent possible and eventually lead to a sustainable future both economically and environmentally.⁵⁴

Absent a technological solution currently which allows for the production of sustainable and environmentally friendly resource uses, but will still allow countries to remain competitive economically, it seems that we are somehow in an environmentally destructive 'arms-race.' Each country seems to be unwilling to budge for fear that the other country will take undue advantage because of the leakage problem.⁵⁵

C. *In Spite of the Leakage Problem it is Important that Countries Still Act to Reduce Carbon Emissions*

According to one author, "while it is still possible that the developing nations could undo reduction efforts, for developed nations doing something still seems preferable to doing nothing."⁵⁶ It is true that developed countries who choose to participate in a global attempt to reduce carbon emissions could be falling behind other countries economically who don't impose those same restrictions on their own country, but it may still be preferable to act in light of: higher potential future costs from having to respond later, uncertain economic consequences (i.e. a country imposing those restrictions may develop better technology when it is 'necessary' to stay competitive), and developed countries probably should lead the way in environmental response due to those countries creating the issue in the first place.

There could also be a potential security threat to countries capitalizing on the low cost of carbon-intensive resources to try to

53. ENVIRONMENTAL TAX REFORM (ETR): A POLICY FOR GREEN GROWTH 03-04 (Paul Elkins & Stefan Speck eds., 2011) ("Throughout industrial history, economic growth has been associated with increased uses of energy and materials.").

54. *Id.* at 3.

55. HSU, *supra* note 5, at 3. (Considering the moral and political problems that "[d]eveloping countries, having benefitted little from the past combustion of fossil fuels, do not wish to commit to limiting their greenhouse gas emissions, as that would mean they would refrain from doing that which developed countries have already done.").

56. *Id.* at 5.

secure their own wealth.⁵⁷ Regardless of which country decides to reduce carbon emissions first by acting now to stop or reverse the coming effects of climate change, eventually every country must participate.⁵⁸

D. *A State or Local Response Can Still Be Effective*

Just because a global response is needed *eventually* does not mean that a state response to the issues posed by climate change is ineffective.⁵⁹ One source even argues that even if the regulation doesn't actually burden the "in-state" business interests it can still be effective — calling such efforts "symbolic".⁶⁰

The idea is that state support of regulation can overcome the leakage issue mentioned earlier. States may be reluctant to regulate carbon emissions within the states' own borders for fear the state will fall behind other states economically. Thus, even if the legislation that passed has no 'visible' effect initially, the fact that the state is willing to impose such legislation may send a 'signal' to the federal government to act to impose legislation regarding carbon emissions on a national scale.

E. *Possible Solutions to the Global Carbon Emissions Problem — Command-and-Control Regulations*

Command-and-control regulations, in their earliest forms in the United States, were about getting polluters to adopt state-of-the-art technology so that "less of the targeted pollutant was emitted."⁶¹ For instance, in dealing with sulfur dioxide, the environmental toxin now known to cause acid rain, the regulatory answer was "to require coal-fired power plants to

57. *See id.* at 5.

58. *See id.* at 5. ("Because of the leakage problem, global engagement with the reduction of greenhouse gases is absolutely necessary, and almost every country, developed or not, has to be a party.")

59. *See* Stephanie Stern, *State Action as Political Voice in Climate Change Policy: A Case Study of the Minnesota Environmental Cost Valuation Regulation* in ADJUDICATING CLIMATE CHANGE 31, 31 (William C. G. Burns & Hart M. Osofsky eds., 2009).

60. *Id.* at 31 (Such weak or 'symbolic' regulation nonetheless plays an important role in the global climate change debate by fostering political voice, creating a threat of future regulatory action, and legitimating climate change as a legally redressable harm. An individual state cannot make a significant impact on atmospheric carbon dioxide levels or arrest global warming. However, carbon dioxide regulation by states can make a strong statement about the political will to address global warming — a statement that has grown louder as individual state legislation encourages other states to act and in turn brings pressure to bear upon the federal government.)

61. HSU, *supra* note 5, at 17.

install scrubbers.”⁶² A potential drawback of this form of command-and-control regulation is that there may be an even better technology not being developed or pursued for controlling sulfur emissions than the one currently mandated by the command-and-control regulations.

Command-and-control regulations are currently actually more sophisticated.⁶³ The regulations will now often require a “minimum level of performance in pollution abatement.”⁶⁴ This deals more with the rate at which the emissions are released in comparison with the level of performance achieved.⁶⁵ Note that this is also a potential answer to the problem discussed above in that, with this type of regulation, *any* technology can be pursued, not simply the one mandated by the command-and-control regulation.

Command-and-control regulation has inefficiencies and can sometimes lack effectiveness. According to one source, “[t]he distinguishing feature of command-and-control systems... is that compliance is largely an administrative matter”, which can allow parties potential redress through an administrative hearing or through the courts.⁶⁶ Command-and-control regulations, because of their strictness in terms of compliance, will often lead to litigation over “inevitable ambiguities.”⁶⁷

Command-and-control regulations sometimes incorporate flexibility into the regulation. Even in this case the regulation “still requires the identification of the regulated entities, some administrative determination of how those entities ought to best reduce pollution, and perhaps most vexing of all, what compliance means.”⁶⁸ The administrative determination has an administrative process which is generally costly and lawyers can force the agencies to abide by its own mandate procedures; thus, agencies have to take great care to follow those procedures including responding to interested parties’ comments. Research may have to be done in order to determine what standard should be set which is also costly. Even with a flexible standard, there is still ambiguity, which inevitably will have litigation costs associated with the ambiguity.

62. *Id.* at 18.

63. *See id.* at 18-19.

64. *Id.* at 18.

65. *See id.*

66. *Id.* at 19-20.

67. *Id.* at 19.

68. *Id.* at 84.

F. *Possible Solutions to the Global Carbon Emissions Problem — Cap-and-Trade*

Cap-and-trade systems can be compared to command-and-control systems in that the latter sets administrative standards whereas the former involves issuing “allowances to polluters that permit them to emit a quantity of pollution.”⁶⁹ Also, rather than compliance being determined by comparison with an inevitably vague legal standard, “[c]ompliance is determined solely by whether the emitter has enough allowances to cover its quantity of emissions.”⁷⁰ Another potential advantage of a cap-and-trade system is that allowances may be traded among the polluters.⁷¹

Finally, cap-and-trade systems can be less costly for the government because the government doesn’t necessarily need as intensive of research procedures to figure out the proper standard to set (as in command-and-control) but still needs to determine the overall ‘cap’ or maximum emissions allowable for each specific region. The ‘policing’ of a cap-and-trade system, after it is initially set up, is more up to the emitters themselves and the market forces than the government entity.⁷²

The cap-and-trade system for sulfur dioxide in the United States has been successful in reducing overall sulfur dioxide emissions.⁷³ The Kyoto Protocol was, in part, an attempt to extend the cap-and-trade system internationally.⁷⁴ Cap-and-trade systems can also incorporate flexibility in setting different trading values for “allowances for different greenhouse gases” since some greenhouse gases are actually far more effective at trapping heat than carbon dioxide (although they typically don’t linger in the atmosphere quite as long).⁷⁵

69. *Id.* at 20.

70. *Id.* at 20. The terms emissions permit and allowances have similar meanings. The permits or allowances create an economic market that allows trading to occur. *Id.* This system can have advantages in allowing the polluter flexibility because the polluter does not have to get permission from a court or a regulatory body to emit a higher amount of pollution. See *Id.* If the polluter needs to emit more pollution, the polluter simply purchases or trades permits or allowances from other polluters in the market who have excess. See *Id.* The regulatory body will merely inspect each polluters aggregate pollution, and provided the pollution does not exceed a polluters allowance, emissions should be in compliance. *Id.* The regulation may, of course, require polluters to meet other conditions for compliance. *Id.*

71. *Id.* at 20.

72. See *id.* at 20.

73. *Id.* at 20.

74. *Id.* at 20-21.

75. *Id.* at 21. For example, methane, which is “twenty-five times more powerful at trapping heat than carbon dioxide, would be worth twenty-five carbon dioxide allowances.” *Id.*

One criticism of a cap-and-trade program is actually its potential lack of flexibility in dealing with a market crisis regarding that particular “capped” pollutant. A cap-and-trade system will often magnify market effects because when emitters need more allowances quickly — for instance, to respond to a market crisis — this will often cause the price for the allowances to rise due to the increased demand. Because there is already (theoretically) a demand for the product causing the pollutants’ release, a cap-and-trade system will magnify or enlarge the effects of that demand causing prices to rise even further than the prices otherwise would (without cap-and-trade). This objection can be overcome by not using a pure form of cap-and-trade program, which involves “a relatively hard ‘cap’ on total emissions.”⁷⁶ In fact, the Kyoto Protocol allows for “the potential to raise the cap by means of ‘offsets’—credits that can substitute for allowances—awarded for projects that do not necessarily reduce existing emissions, but reduce or ‘offset’ emissions that *would otherwise occur*.”⁷⁷

Other variations of a cap-and-trade system with the attempt to remove the hard cap have been attempted to “reduce not the absolute amount of greenhouse gases but greenhouse gas ‘intensity.’”⁷⁸ Greenhouse gas intensity has to deal with the “*ratio* of carbon emissions to productivity.”⁷⁹ The problem with this approach is that it essentially functions as a government subsidy, and actually “creates economic inefficiency by encouraging overproduction.”⁸⁰

The main difficulty with cap-and-trade programs is allocating the emissions allowances.⁸¹ “The most efficient way of allocating allowances is to auction them, and allow low emitters to bid for the right to emit.”⁸² In this way, the polluter bears the initial cost of setting up the cap-and-trade system, rather than the taxpayer.⁸³ Cap-and-trade systems are not free from potential for corruption, however.⁸⁴ This possibility exists because the allowances have economic value similar to a stock holding.

76. *Id.*

77. *Id.*

78. *Id.*

79. *Id.* at 21-22.

80. *Id.* at 22.

81. *See id.*

82. *Id.*

83. *Id.*

84. *Id.* at 62 (“The problem with cap-and-trade programs is that the allocation of valuable allowances is really a vehicle for *government subsidization* of politically favored groups.”).

Companies will often slightly overbuy emissions allowances to make sure they do not emit pollutants above their available allowances.

G. *Possible Solutions to the Global Carbon Emissions Problem — Government Subsidies*

In the context of carbon emissions, a subsidy would seek to lower the price of things that emit less carbon.⁸⁵ There is an inherent definitional boundary problem in actually defining and restricting the universe of technologies that emit less carbon than the government ought to subsidize. A government subsidy program targeting carbon emissions, however, has a similar goal to the cap-and-trade and command-and-control programs already discussed: to reduce externalities caused by carbon emissions.⁸⁶ Arguably, if such externalities could be internalized to the polluter, then the price would rise to such a point that, provided the polluter is a rational economic actor, the polluter would only emit to the point of economic sustainability. That is, it would not be profitable for a polluter to emit beyond the point of economic sustainability because the environmental costs of emitting more would exceed the marginal cost of producing the product that would cause such emission.⁸⁷

Subsidies can actually be divided into two different kinds of government subsidies: “price-oriented subsidies and research and development funding.”⁸⁸ Here the definitional problem, mentioned earlier, is implicated again. A definition of “renewable energy” is required, which can prove to be quite problematic.⁸⁹ This problem can be partly solved by simply creating a list of approved renewable energy generators.⁹⁰

The government can also subsidize research and development into cleaner fuels.⁹¹ The attempt here might be to subsidize such technology as carbon capture and sequestration (CCS). Carbon capture and sequestration contains within it two

85. *Id.* at 23.

86. *See id.*

87. Anil Markandya, *Environmental Taxation: What Have We Learnt in the Last 30 Years?* in ENVIRONMENTAL TAXES AND FISCAL REFORM 9, 14 graph 1 (Laura Castellucci & Anil Markandya, eds., 2013).

88. HSU, *supra* note 5, at 23. As an example of price-oriented subsidies, “[c]ertain specific renewable energies to enjoy the benefit of a payment for every kilowatt hour of electricity generated.” *Id.*

89. *See id.* 23-24.

90. *See id.*

91. *See id.* at 24.

distinct concepts.⁹² Thus, carbon sequestration can occur naturally. The idea of CCS, however, is to sequester the carbon through means beyond merely planting more trees and other natural means.⁹³ Thus, the other distinct concept is how to go about actually capturing the carbon emitted. Each part of this process is fraught with potential problems such as the cost and availability of the technology needed to capture the carbon.⁹⁴ Thus, CCS may not be the most effective solution to reducing atmospheric carbon.

Polluters will most often produce products using the cheapest available method. Without a means of increasing the price of carbon-intensive production methods or decreasing the price of less carbon-intensive production methods through subsidies, polluters will have little incentive to switch to more environmentally friendly production methods. In this way, current markets don't really "reward the development of low-carbon technologies."⁹⁵

Suggestions for targets of subsidies in the past have included "insulation retrofits for residential and commercial buildings [. . .], switching residential lighting from incandescent bulbs to LEDs (light-emitting diodes), and capturing methane escaping from landfills to generate electricity."⁹⁶ Ironically, if prices for renewable energy sources are lowered then demand for fossil fuels might lower which would encourage increased use of the now cheaper fossil fuels.⁹⁷

It might be the case that actually identifying the "best"

92. See Green Energy: An A-to-Z Guide, *supra* note 7, at 54 ("Carbon sequestration is the process through which carbon dioxide (CO₂) from the atmosphere is absorbed by trees, plants and crops through photosynthesis and stored as carbon in biomass (tree trunks, branches, foliage, and roots) and soils or aquatic vegetation.").

93. See HSU, *supra* note 5, at 24 (Explaining that CCS technology actually "seeks to suck out the carbon dioxide from fossil fuel combustion (mostly coal) at some stage, and store it in leakproof containers or underground caverns. . .").

94. According to one source,

[t]he United States currently emits around 1.5 billion tons per year of carbon from coal-fired power plants, and the world's largest sequestration project, at the Sleipner gas field in the North Sea, is sequestering 1 million tons a year of carbon dioxide, or about 0.06 percent of United States emissions. If carbon capture and storage were to capture all of the carbon dioxide from US coal-fired power plants, the total weight that would need to be transported would equal three times the annual volume of natural gas transported in the United States by pipeline.

Id. at 57.

95. HSU, *supra* note 5, at 24.

96. *Id.* at 36.

97. *Id.*

renewable energy is prohibitively costly or even impossible.⁹⁸ Government subsidies do have the benefit of not having litigation as a form of redress because Congress decides which entity to give the subsidy to.⁹⁹ However, a subsidy is really a way of disadvantaging competitors who are not taking advantage of the particular subsidized technology subsidized.¹⁰⁰ This can mean the competitor may actually be disincentivized from switching more promising alternatives because these alternatives become more costly than pursuing a subsidized technology.

H. *A Carbon Tax is Likely the Most Effective System to Reduce Carbon Emissions*

1. Establishing a Carbon Tax — Determining the Price

In order to reduce carbon emissions it is argued that a price must first be placed on carbon emissions.¹⁰¹ This price, or tax in this context, is called a Pigouvian tax.¹⁰² The tax should be “set at a level equal to the marginal damages of the emissions of a ton of carbon or carbon dioxide.”¹⁰³ As discussed earlier, this would mean that the marginal damage caused by the polluter would be charged to the polluter in such a manner that it would no longer be profitable for the polluter to manufacture beyond a certain point. If the price is set correctly, then the “*right* amount” of carbon emissions would be reduced because “[f]urther reductions would cost too much (more than would be saved in terms of environmental damages), and lesser reductions would be too environmentally harmful (more costly than further reductions would cost).”¹⁰⁴

A great deal of controversy surrounds where to set this price point for carbon dioxide emissions. A big source of the controversy has to do with the proper marginal damage estimates.¹⁰⁵ Disputes between researchers regarding how exactly to factor in the costs of catastrophic risks and the likelihood of those risks occurring make estimation very

98. *Id.* at 37.

99. *Id.* at 35.

100. *See id.* at 35.

101. *Id.* at 25. The purpose of a price is to make the polluter pay for the “externalities caused by its emissions.” *Id.* at 27.

102. *Id.*

103. *Id.*

104. *Id.*

105. *See id.*

difficult.¹⁰⁶ Those costs must also be discounted back to present value, and setting the discount rate is controversial.¹⁰⁷ There is some controversy about whether these types of models are meaningful at all, because nearly any significant probability of catastrophic consequence occurring may imply that emissions need to be below a certain point regardless of the cost merely to prevent the catastrophe.¹⁰⁸ Perhaps the right thing to do is to simply set the price in spite of the small likelihood of a catastrophic consequence, simply because it achieves some reduction in carbon emissions.¹⁰⁹

2. Establishing a Carbon Tax — How the Price Affects Goods Automatically

With a carbon tax, the price of goods fluctuates with the market and carbon taxation follows the market; that is, if more of a certain carbon-intensive good is being used, then more carbon taxes are collected.¹¹⁰ Carbon taxation doesn't require spending on market studies to determine the appropriate "cap" the way a cap-and-trade system does; carbon taxation needs no such model.¹¹¹

A carbon taxation system is superior to other systems because it creates less interference overall with the market. "Government policy can and should correct market failures, but should do so by sending simple price signals, not by trying to simulate an efficient economy through governmental policy and expenditures."¹¹²

3. Using Carbon Taxation to Tax the "Bads"¹¹³

It has been seemingly presumed, as evidenced by the provisions of the tax code, that "*physical* capital in the form of

106. *See id.* at 28.

107. *See id.*

108. *Id.* at 29.

109. *Id.*

110. *Id.* at 32. ("The simple genius of a carbon tax is that it aggregates disparate pieces of information, transmitting a price signal at every stage in which there is fossil fuel usage, and transmitting it in proportion to the carbon emissions of the production process.")

111. *Id.*

112. *Id.* at 40.

113. "Bads" is a term referring to anything generally agreed upon by taxpayers as having significant negative societal consequences, and thus, worthy of imposing taxation. Examples include "sin taxes" on products like alcohol, cigarettes, and gambling. The idea of taxing such things can be extended to taxing other "bads" such as greenhouse gas emissions.

buildings, facilities, and structures is an unambiguous good.”¹¹⁴ Favorable tax treatment given through the Internal Revenue Code is a form of a subsidy. Perhaps the recent climate change debate has caused at least some people to question the logic of encouraging economic growth in this manner. According to the Stern Review, “[c]limate change is the greatest market failure the world has ever seen.”¹¹⁵

Carbon taxation provides an answer to the market failure problem. Taxing the “bads” is superior to subsidizing goods because the “bads” or causes of the climate change problem are easier to identify than the proper solutions.¹¹⁶ Also, what we think today might be the correct solution might change at some point in the future when better solutions are found.¹¹⁷ Finally, “carbon tax is capital neutral: it does not encourage the formation of expensive physical capital that would inhibit future changes in production.”¹¹⁸

4. Use of a Carbon Tax is Not Exclusive and Can Combine Well With Other Solutions If Necessary

Choosing to implement a carbon tax system does not necessarily preclude implementing other effective solutions. “A carbon tax could coexist with all of the . . . alternative policy measures considered. . . (though implementing the others may undermine the efficiency benefits of the carbon tax).”¹¹⁹

5. Carbon Taxation is a More Efficient Solution from the Government’s Standpoint and May Be More Efficient Overall

The Government should allow the private market to make market decisions as much as possible while identifying sources of market failure and determining how to correct those market failures in the *least disruptive manner possible*. Carbon taxation does this better than any of the previously described methods.¹²⁰ The Government should not make decisions about particular carbon-reducing technologies, because “[i]t is important that

114. *Id.* at 41.

115. Nicholas Stern, *The Economics of Climate Change*, 98 AM. ECON. REV. 1, 1 (2008).

116. *See generally* HSU, *supra* note 5, at 44, 53-64.

117. *See generally id.* at 43.

118. *Id.* at 45.

119. *Id.* at 46.

120. *Id.* at 58 (“Indeed, if the goal is to reduce greenhouse gas emissions, then a policy instrument should draw on what government does well—tax—rather than on what it does poorly—make strategic market decisions.”).

climate policy remain ‘technology-neutral’—that it not push vast economies and governments toward any particular technology, no matter how attractive.”¹²¹

When the Government sets the incentives through a Pigouvian tax system, the polluters generally respond to those incentives by reducing their emissions. Using the optimal solution may differ depending upon the industry. For instance, “[a] polluter could find a way of running low-NO_x burners more efficiently that costs more, but that improves emissions rate and reduces pollution. If the pollution savings offset the extra cost, the polluter would pursue it under a Pigouvian tax system”¹²²

6. Carbon Taxation May Be a Better System for Encouraging Innovation

Innovation and economic development may be more enhanced when the correct price signals are sent.¹²³ Examples of the effectiveness of carbon taxation include the Swedish NO_x tax. This tax actually pays the proceeds of the tax back to the polluters “*in proportion to the amount of electricity generated.*”¹²⁴ If the Swedish polluters can efficiently produce electricity without producing excess NO_x emissions, then they will be paying less in taxes and receiving the benefits of their own innovation.¹²⁵

A proper carbon tax may be better at encouraging innovation than cap-and-trade because the price signal is steadier.¹²⁶ Risk-averse investors will be more cautious about investing when the prices are volatile and will generally demand a higher rate of return.¹²⁷

Another reason that carbon taxation is superior in spurring innovation over a cap-and-trade program is because innovation will actually reduce the value of the allowances held under a cap-and-trade program.¹²⁸ This is so because if polluters can produce

121. *Id.* at 59.

122. *Id.* at 66.

123. *Id.* at 66. (“The evidence is somewhat mixed, but this bit of economic doctrine—that market-based instruments deliver more innovation than traditional command-and-control regulation—is largely accurate.”).

124. *Id.* at 67.

125. *See id.*

126. *See id.* at 70 (“[A] cap-and-trade program presents one extra source of price volatility: the fact that it is regulating a quantity, and not a price.”).

127. *Id.* at 70. Furthermore, “with price volatility in cap-and-trade programs, risk-averse emitters may hedge by purchasing more allowances, which is much easier than innovating.” *Id.* at 71.

128. Hsu, *supra* note 5, at 72.

goods more efficiently, i.e. with less pollution, then those polluters will need fewer allowances to produce the goods driving the price of the allowance down.¹²⁹ Thus, under a cap-and-trade system it is possible for innovation to actually be discouraged.¹³⁰

I. *Arguments Against Imposing a Carbon Tax to Reduce Carbon Emissions*

1. Argument Against Carbon Taxation—Pay to Pollute

One argument against allowing a price to be set for carbon emissions is that this essentially allows polluters to pay to pollute.¹³¹ If polluters can make an economic calculation in their decisions to pollute the environment, then the environment will become that much more polluted provided the polluter has the ability to pay the cost.¹³² The degradation of the environment will occur regardless of the economics or the reasons behind the pollution.¹³³ Markets are not necessarily static, and sometimes polluters can still make a profit beyond a theoretically set price point (at least for a little while) simply because the polluter has found a way to develop a particular carbon-intensive product much more cheaply than their competitors.¹³⁴ Environmental degradation occurs while the competitors and the market are still lagging behind what the competitive price of the good should be.¹³⁵ As a response, it is important to note that this objection is really an objection against all price-based systems, including cap-and-trade.¹³⁶ The alternatives, such as government subsidies, command-and-control, and the alternative of doing nothing seem worse.¹³⁷ At least if a “price signal” is sent to the polluter, then *something* is being done to reduce carbon emissions.¹³⁸ The claim is not that carbon taxation has no flaws, but that carbon taxation is simply a better system for controlling carbon emissions than any other.¹³⁹

129. *See id.*

130. *Id.*

131. *See id.* at 71.

132. *See id.* at 72 – 73.

133. *See id.* at 10.

134. *See generally id.* at 128 – 130.

135. *See id.* at 10.

136. *See id.* at 66.

137. *See generally id.* at 65 – 67.

138. *See id.* at 44 - 45.

139. *See id.* at 146.

2. Argument Against Carbon Taxation—Other Systems Can Set Price on Carbon Also

Another argument against a carbon tax system is that the other systems can give the price signals in a similar manner to the way a carbon tax system does.¹⁴⁰ Cap-and-trade programs use allowances creating a price; government subsidies lower the price of non-carbon emitting technologies; while command-and-control systems typically have administrative penalties for non-compliance.¹⁴¹ However, under command-and-control, administrative prices are set and do not necessarily track market prices; this can lead to situations of over-abatement and sometimes (oppositely) not enough abatement.¹⁴² Government subsidies imply that the government must determine what to subsidize by spending funding on research, which arguably is less efficient than when the carbon reduction processes are discovered by the industry.¹⁴³ According to one source “carbon taxes are *generally* more comprehensive than cap-and-trade programs, and therefore more efficient.”¹⁴⁴

3. Carbon Taxation Systems are Subject to the Same Corruption Influences as Cap-and-Trade Systems

Cap-and-Trade systems can become a way for the politically favored to gain special treatment, for example, through increased emissions allowances.¹⁴⁵ Carbon Taxation is not free from the same types of political favors, for instance, exempting certain categories from the tax.¹⁴⁶ Carbon taxation is better at managing certain incentives than other systems because “the carbon tax. . . preserves the incentive to change behavior at the margins.”¹⁴⁷

4. Carbon Taxation is Not a Politically Popular Idea

This is not an argument against carbon taxation per se, merely an argument against it ever becoming implemented. Carbon taxes have already been implemented in “British Columbia, Sweden, Norway, Finland, Denmark, and the United

140. *See id.* at 33.

141. *See id.*

142. *See id.* at 33-34.

143. *See id.* at 34 – 35.

144. *Id.* at 38.

145. *See id.* at 86-87.

146. *But see id.* at 63. (“[I]t is also true that carbon taxes can be relatively free of special treatments, as in the case of carbon tax in British Columbia—an export-oriented province with manufacturers exposed to intense trade competition.”).

147. *Id.*

Kingdom.”¹⁴⁸ Even in the U.S. it seems that Americans favor subsidy programs and disfavor carbon taxes.¹⁴⁹ Other countries have implemented carbon taxation systems despite their disfavor, and the idea of carbon taxation seems to have some traction in the academic community; thus, it still seems possible to implement a carbon taxation system even if it is somewhat politically disfavored.¹⁵⁰

5. A Carbon Tax is a Consumption Tax Which is Regressive

One objection to imposing a carbon taxation system is that “[a] carbon tax is considered a form of consumption tax, and without some adjustments or exemptions, consumption taxes tend to disproportionately hurt poorer individuals and households.”¹⁵¹ A carbon tax will affect the price of many goods and services because it affects transportation; those goods and services, if basic goods, could disproportionately hurt the poor.¹⁵² The regressiveness of the carbon tax seems to apply regardless of whether the carbon tax is imposed on individuals (downstream) or at the point of extraction (upstream) and on big businesses.¹⁵³ Corporations will likely pass along the carbon tax onto consumers.¹⁵⁴

A potential counter-argument is that the price of carbon-based activities is currently artificially low, and implementing a carbon tax would merely raise the cost of the goods to their competitive economic price.¹⁵⁵ Societies are likely to have to incur these costs at some point, arguably we should implement those costs now, when we can implement the costs gradually, this way the costs won’t be so prohibitively expensive in the future.

It’s not clear whom—if any party—is truly responsible for

148. *Id.* at 118-19. However, the “latter four countries have carved out significant exceptions for many industries, especially those exposed to international competition.” *Id.* at 119.

149. *See id.* at 121.

150. There is some disagreement as to whether a carbon tax idea is simply proposed to allow the government to profit from global warming. It is difficult to trace the original source of this idea, however much money has been spent trying to disprove the negative effects of climate change in general. The motives behind implementing a carbon taxation system are irrelevant however, as long as it can be demonstrated that a carbon taxation system is an effective step toward environmental sustainability.

151. *Id.* at 124.

152. *See id.* at 124-125.

153. *See id.* at 126.

154. *See id.*

155. *See id.* at 125.

the climate change issue through overuse of carbon.¹⁵⁶ The overuse and over-emitting of carbon-based technologies is likely the responsibility of almost everyone.¹⁵⁷ The poor should not be made to pay a disproportionate share of the costs of any carbon tax. However, it is not clear which costs will be passed down, because this “[w]ould depend on a variety of *elasticities*—the amount of substitution or adjustment that is made in response to a change in price (price-elasticity) or a change in income (income-elasticity).”¹⁵⁸ If the price of luxury goods increases, consumers could simply choose not to buy those goods.¹⁵⁹ However, as mentioned earlier, with a carbon tax it is likely that the price of *everything* will increase.¹⁶⁰

6. The Possibility of a Double Dividend from a Carbon Tax is Dubious

There is some speculation that imposing a carbon tax may allow for a double dividend. A double dividend likely implies a revenue neutral tax, since the money from the tax is being cycled back into the economy by cutting other taxes.¹⁶¹ When carbon emissions taxes were introduced in Denmark the Government had a commission to study various effects on the Denmark economy and its competitiveness.¹⁶² The commission found that in Denmark the taxes were relatively inexpensive to

156. *See id.* at 127.

157. *See id.*

158. *Id.* For example, if the price of goods such as basic foods and needed medicines are increased then the poor—not having substitution options and now needing to spend a greater percentage of their income on those goods—will be disproportionately affected. *See id.*

159. *Id.* at 127.

160. *Id.* Also consider that the poor might be able to make appropriate adjustments (find substitutions). There is at least one study that shows the poor actually can and do make adjustments. *See id.* at 128. “In fact, the poorest quintile of households in the United States make the most substitutions to increases in gasoline prices.” *Id.* at 128.

161. Runar Brännlund & Ing-Marie Gren, *Green Taxes in Sweden: A Partial Equilibrium Analysis of the Carbon Tax and the Tax on Nitrogen in Fertilizers in Green Taxes: Economic Theory and Empirical Evidence From Scandinavia* 109, 109 (Runar Brännlund & Ing-Marie Gren eds., 1999).

For an explanation of what a double dividend is, consider the following:

The idea behind revenue neutral reforms is to use revenues from eco taxes to finance cuts in other taxes which are viewed as distortionary. The belief is then that we will obtain a double dividend. The first dividend is due to the positive environmental effect, and the second dividend is the efficiency gain due to lower distortionary taxes.”

Id.

162. Jorgen Birk Mortensen & Jens Hauch, *Governmental Commissions on Green Taxes in Denmark in Green Taxes: Economic Theory and Empirical Evidence From Scandinavia* 1, 1 (Runar Brännlund & Ing-Marie Gren eds., 1999).

administer.¹⁶³ The Denmark commission was not conclusive as to the existence of a double dividend.¹⁶⁴ However, the studies by the commission generally show that taxes may be a better solution than administrative instruments, provided that the taxes are introduced gradually.¹⁶⁵

It is possible that the idea behind a double dividend is nothing more than an attempt to convince persons to consider a carbon tax. It is better to consider a carbon tax as not revenue neutral but gaining revenue, at least until better technology is developed that uses less carbon. The lack of a double dividend is not a sufficient reason to reject a carbon tax.

7. A Carbon Tax is Simply Ineffective

The point of the carbon tax must always be to reduce carbon emissions in such a significant manner so as to actually slow the climate change process and avert the negative effects of climate change. If the carbon tax instrument does not achieve or even move toward this goal, then the carbon tax should not be implemented. There are people who oppose a carbon tax simply because they fear it will not work effectively or quickly enough.¹⁶⁶

Eventually "a price increase will lead to a decline in consumption."¹⁶⁷ While certain individuals may not change their behavior it is likely that in aggregate a reduction in the use of carbon will occur.¹⁶⁸ "The mistake with arguing that a carbon tax is ineffective is that it confuses individual instances of ineffectiveness with predictions about behavior in the aggregate."¹⁶⁹

163. *Id.*

164. *Id.* at 3-4. (Citing T.M. Andersen, *Miljöprojekter fra et makroperspektiv* in C. HJORT-ANDERSEN (ED.) OKONOMISK VURDERING AV ENERGIPROJEKTER (Copenhagen 1995)). ("The double dividend hypothesis. . . claims that the tax revenues from green taxes can be used to reduce other distortionary taxes and hence improve the efficiency of the rest of the tax system. So green taxes will both improve the environment and reduce distortions of the existing tax system. A positive environmental dividend from a green tax is that it is often taken for granted in the discussion, but there is an ongoing debate, also in Denmark, about the existence of the second dividend of the tax system").

165. *Id.* at 8-11.

166. HSU, *supra* note 5, at 138.

167. *Id.* at 140.

168. *See id.* at 140-142.

169. *Id.* at 142.

VI. INTO THE FUTURE: KEEPING CLIMATE CHANGE
CONSEQUENCES AT BAY WHILE STILL ENJOYING A
REASONABLE STANDARD OF LIVING

The goal of this paper has been to show some of the advantages a carbon tax system enjoys over other systems in dealing with the carbon emissions problem. Because of the leakage issue, it appears that the ultimate solution will have to be implemented at an international level.¹⁷⁰ Nonetheless, we should not discount the advantages of state policy in an overall effective solution to the carbon emissions problem.¹⁷¹

Even though prospects for large scale implementation of a carbon-reduction solution seem distant, it should be clear that the time for implementing such a policy is now.¹⁷² This is the case even though the costs appear to be front-loaded and the benefits appear to be back-loaded.¹⁷³ The issue appears to have been largely caused by the developed countries, and is as described, quite possibly the biggest market failure ever seen.¹⁷⁴ Because the problem is quite likely the result of human activity, largely through the development process of already developed economies, it is hard to argue that those same economies should not be made to bear some of the cost today, even though the benefits appear to only flow to future generations. Also, carbon removal costs today are far more likely to be less expensive than removal costs would be in the future.

Any program that a society decides to pursue needs to be effective in removing excess carbon from the atmosphere, otherwise the program should not be implemented. It is likely that the program should be mandatory for all nations in order to be effective, unlike the Kyoto Protocol which was voluntary.¹⁷⁵ This is an extremely complex problem, and it will be very difficult to reach agreement on an international scale, but any solution will very likely have to solve the leakage issue.

There are people who still believe that acting now could have costly consequences in deterring a problem—greenhouse gas emissions—that does not exist, or is at least not as severe as some scientists would have us believe. However, the IPCC deals with the issue of climate change by examining various statistical models which incorporated varying degrees of certainty

170. See STERN, *supra* note 59, at 31.

171. See *id.*

172. See Hsu, *supra* note 5, at 6.

173. See *id.* at 1.

174. *Supra* note 115 and accompanying text.

175. HSU, *supra* note 5, at 93.

regarding the global issues that are affected by climate change. Such widespread consensus, including the studies showing that 97% of climate scientists agree that global warming is occurring, is almost unheard of in the scientific community on such issues of controversy.¹⁷⁶ However, the extent of the global warming and climate change issue and the proper and effective means of resolving the issue are still in controversy.¹⁷⁷

It is possible that we should still respond in the face of any remaining uncertainty due to the small, but significant, chance of catastrophic consequences.¹⁷⁸ Even though the likelihood of such consequences are still in dispute, it is probably best to respond to the potential of catastrophic consequences since those consequences render almost any analysis of marginal damages moot.¹⁷⁹

Command-and-control systems have evolved over the years to become a bit more sophisticated in dealing with various other environmental issues. Command-and-control systems have met with limited success in certain circumstances, such as sulfur-dioxide emissions.¹⁸⁰ While those systems may be appropriate in those limited circumstances, they likely are not the best or most effective systems for reducing carbon emissions. Industries are likely to respond to regulations by filing lawsuits and driving up the costs of implementation of the system.¹⁸¹ This result is even more certain with stricter regulations.

Government subsidies are likely the least effective solution to the carbon-emissions issue. Subsidies are also likely to be the most politically popular idea for reducing carbon emissions. The government should not try to pick the most effective solution; this is a job best left to industry and innovation in the private sector.¹⁸² Subsidies are likely to be a waste of government resources, and it is even possible that—due to ambiguity in the laws—the government could wind up subsidizing the over-emission of carbon.¹⁸³

Cap-and-trade programs are more similar to carbon taxation

176. NASA, *supra* note 1.

177. The research put together in this paper demonstrates the controversy over the proper solution to be implemented. I argue here that a carbon tax system is currently the most effective means of resolving the climate change issues.

178. *See supra* note 24.

179. *See* discussion *supra* note 24.

180. *See supra* note 73 and accompanying text (discussing sulfur dioxide emissions).

181. *See* discussion *supra* Part V.E (evaluating command-and-control systems).

182. *See* discussion *supra* Part V.G (assessing government subsidies).

183. *See* SHI-LING HSU, *THE CASE FOR A CARBON TAX 1* (Island Press, 1st ed. 2011; *see generally* discussion *supra* Part V.G (same)).

programs than government subsidies or command-and-control programs are. All programs are essentially intending (or should be intending) to force the polluter to internalize the externalities caused by carbon emissions. If the polluter is forced to pay a cost equal to the damage caused by each unit of carbon released, then the polluter will likely respond by reducing the carbon emissions. Cap-and-trade programs are an attempt to force the polluter to pay for these emissions. Cap-and-trade programs, however, have the very bad side effect of actually discouraging innovation.¹⁸⁴ This is true because the allowances distributed through cap-and-trade programs are actually assets that can be retained by the companies (polluters). Any company having these allowances therefore would likely not want to pursue innovation, because pursuing innovation would mean decreasing the value of the assets owned by the company if the innovation were successful.¹⁸⁵ Cap-and-trade is likely not the best or most effective solution for reducing carbon emissions.

Carbon taxation systems are likely the most effective solution for reducing carbon emissions. It is possible that eventually, if the climate change issues become too severe, we may have to implement a different system to reduce carbon emissions further (such as command-and-control). We are likely not at that point yet. Carbon taxation systems are likely the least invasive government-implemented system that will still be effective at reducing carbon emissions. Assuming the polluter is acting rationally (and other basic free market assumptions), the polluter will reduce carbon emissions to the point where increasing the emissions any further would mean a loss in profitability. This is the point at which the marginal damages (now internalized as cost through the tax system) would be too severe to emit above that level.¹⁸⁶ The issue here is making sure we set the carbon tax at the correct economic point so that the damages are accurately reflected. The proper method for setting the damages is, of course, highly controversial.¹⁸⁷ It is likely we should err on the side of caution—i.e., set the carbon tax a bit higher—because of the possibility of catastrophic

184. See SHI-LING HSU, *THE CASE FOR A CARBON TAX 1* (Island Press, 1st ed. 2011); see generally discussion *supra* Part V.F (explaining how cap-and-trade programs discourage innovations).

185. See SHI-LING HSU, *THE CASE FOR A CARBON TAX 1* (Island Press, 1st ed. 2011); see generally discussion *supra* Part V.F (evaluating cap-and-trade programs).

186. See SHI-LING HSU, *THE CASE FOR A CARBON TAX 1* (Island Press, 1st ed. 2011); see generally discussion *supra* Part V (presenting arguments for and against carbon taxation).

187. See discussion *supra* Part V.H.i–iii (noting controversial price setting in carbon taxation).

consequences.¹⁸⁸ Carbon taxation systems also have the advantage of compatibility with other systems that might be implemented (such as cap-and-trade, or command-and-control).¹⁸⁹

Even though a carbon tax is likely to cause a raise in the price of nearly all goods, it is likely that we have enjoyed an artificially low price of goods because the damages we are causing are not reflected in those prices. This inevitable result likely accounts for the unpopularity of a carbon tax in the political arena. In attempt to soften the negative economic effects of a carbon tax (especially as it relates to the poor), it is often suggested that the carbon tax should be paired with a corresponding subsidy; that is, the money that is collected from the carbon tax could be reinvested into the industry to help with innovation, or perhaps refunded to the poor in the form of tax credits to deal with the inequities potentially created.¹⁹⁰ While this may seem like a good idea, the idea of a double dividend has not necessarily manifested in other countries implementing a carbon tax.¹⁹¹

Climate change caused by overuse and over-emission of carbon dioxide is a multifaceted and complex problem. The solution to such a problem is likely to affect nearly every aspect of our lives (i.e., possible reduction in standard of living). A small reduction in our current standard of living may be the small price we all have to pay in order to have a brighter future. A carbon tax is the first step societies can take in order to ensure the future does not become bleak. If the government can create the conditions within a society that sends the appropriate price signals to industry that change is needed, rather than dictating (command-and-control) that change is needed, then the government can leave the solution to the industry most capable of implementing it. Because a carbon tax creates those conditions and sends the right price signal, it is likely that a carbon tax will push industry toward the much needed technological solution to

188. See SHI-LING HSU, *THE CASE FOR A CARBON TAX 1* (Island Press, 1st ed. 2011); see generally discussion *supra* Part V.H.i (anticipating catastrophic consequences).

189. See discussion *supra* Part V.H.iv (reviewing compatibility of carbon tax with other systems).

190. See HSU, *supra* note 5, at 23; see generally discussion *supra* Part V.H.

191. See HSU, *supra* note 5, at 118-19, see generally discussion *supra* Part V.I (evaluating various international carbon tax regimes).

the carbon emissions problem. Effectively, this means that the same industries responsible for creating the carbon emissions problem will eventually be the industries responsible for implementing the solution leading to a brighter future.

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