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Beyond Cap & Trade: A Framework for Driving Sustainable Reductions in Greenhouse Gas Emissions

Rhonda L. Ross

Beyond Cap & Trade: A Framework for Driving Sustainable Reductions in Greenhouse Gas Emissions

Rhonda L. Ross[†]

Although a "cap-and-trade" (C&T) program for reducing greenhouse gas (GHG) emissions has long been discussed by environmentalists and policy-makers as a viable program for the United States, the gridlock in Congress makes it highly unlikely that any such program will be adopted in the near future. However, President Obama and the Environmental Protection Agency (EPA) have been successful to date in bypassing Congress and promulgating limited regulations designed to reduce GHGs such as reducing GHG emissions from motor vehicles as well as some of the larger emitters such as coal-fired electric generating systems and refineries.[1]

However, achieving sustainable worldwide reductions necessary to mitigate the dangers of climate change and to protect public health would likely require new domestic legislation as well as the ratification of an international treaty agreement. Any such new program should involve all the major sources of GHGs worldwide. In addition, the program should also be designed so as to promote the development of new and innovative energy related technologies so that existing and emerging economies can continue to grow using sustainable approaches to natural resource management.

As a model, the framework of the Montreal Protocol for reducing emissions of Ozone Depleting Substances (ODS) could form the basis for both a domestic and international program. The Montreal Protocol was a market-based approach that relied on supply and demand, i.e., the program called for reductions in the supply of

† Rhonda Ross currently teaches Business Law at Michigan State University's Broad College of Business. She is also part-time graduate faculty at Wayne State University's College of Engineering program in Chemical Engineering and Alternate Energy Technology. A practicing attorney, she has over 25 years of experience as an environmental engineer and environmental attorney.

1. Amy Harder & Clare Foran, *Clean Energy Experts to Offer Obama a Path Forward Without Congress*, NAT'L J. (January 20, 2014), http://www.nationaljournal.com/energy/what-obama-can-do-on-climate-change-without-congress-20140120.

ODS as well as an increased cost. The cost increase was controlled through the imposition of a phased-in tax on the raw materials. The result was technological innovations which resulted in dramatically lower demand for ODS materials. Although it would be far more complicated to regulate (and effectively ration) the supply of fossil fuels, the basic framework of controlling the cost of fossil fuels through the imposition of a predictable and phased-in cost increase would give companies and consumers time to a switch to more renewable sources of energy.

This approach would also serve the important function of driving innovation in alternate energy sources as the increasing costs of fossil fuel based energy would shrink the current cost gap between non-renewable energy and renewable sources thereby making wind, solar, and geothermal energy much more economically viable. Indeed, the most difficult aspect of developing even a domestic program based on this framework well turn out not to be due to technological feasibility, but instead the highest hurdle may be overcoming the enormous political opposition in the U.S. Congress. Even Ronald Reagan supported this international market-based approach to environmental protection when he signed the Montreal Protocol

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I. INTRODUCTION

Unlike many other industrial nations, the United States has not adopted legislation specifically aimed at reducing emissions of Greenhouse Gases (GHGs). Indeed, the United States has refused to ratify any international treaties that impose legally binding reductions in emissions of GHGs.[2]Although a "Cap-and-Trade"(C&T) market-based program for reducing GHGs has been adopted by the European Union[3] (EU), and has been considered in the past by numerous congressional committees in, the United States, the Republican leadership in the current Congress has announced C&T to be a "dead" issue.[4]This failure to enact legislation to reduce emissions of GHGs is largely political and unlikely to change during the current Congressional session.[5]

Quietly, and without Congressional approval, President Obama and the U.S. Environmental Protection Agency (EPA) have been proposing and promulgating regulations to reduce emissions of GHGs under the

2. R. Daniel Kelemen & David Vogel, *Trading Places: The Role of the United States and the European Union in International Environmental Politics*, 43 COMP. POL. STUD. 427, 435 (2010), *available at* http://fas-polisci.rutgers.edu/dkelemen/research/Kelemen_Vogel_TradingPlaces.pdf .

3. *Emissions Trading in the European Union: Its Brief History*, PEW CENTER ON GLOBAL CLIMATE CHANGE (March 2009), http://www.hss.caltech.edu/~pbs/ec131/EUCapTrade.pdf (last visited April 27, 2014).

4. John M. Broder & Clifford Krauss, *Advocates of Climate Bill Scale Down Their Goals*, N.Y. TIMES (Jan. 27, 2010), http://www.nytimes.com/2010/01/27/science/earth/27climate.html.

5. *See* Joshua K. Westmoreland, *Global Warming and Originalism: The Role of the EPA in the Obama Administration*, 37 B.C. ENVTL. AFF. L. REV. 225, 253-255 (2010); *see also* Kim Chipman, *House Panel Approves Measure to Block EPA Carbon Rules*, BLOOMBERG (Mar. 10, 2011), http://www.bloomberg.com/news/2011-03-10/house-panel-approves-republican-measure-to-block-u-s-epa-s-carbon-rules.html.

existing authority of the Clean Air Act (CAA).[6] In fact, the combination of the 2007 United States Supreme Court case, *Massachusetts v. EPA*, and the EPA's December 2009 finding that six GHGs were endangering public health and welfare (Endangerment Finding) has effectively imposed a legal obligation on the EPA to proceed with GHG regulations under the current Clean Air Act. [7]

Although a C&T framework has long been the focus for reducing GHGs in the United States, such a single-minded approach may not provide the sustainable, long-term, broad-based GHG emission reductions necessary at this time. Evidence from the CAA Acid Rain program indicates that C&T is an effective tool for reducing emissions, but there is no evidence that such a program will drive long-term and sustainable reductions in the use of fossil-fuel based energy or, perhaps more importantly, that such a program would drive technological innovation into new and alternate sources of energy and electricity.

Assuming the goal of any GHG policy is to not only immediately reduce emissions of greenhouse gases, but to drive a long term shift away from near total reliance on combustion of fossil-fuels, then a more comprehensive framework for reducing greenhouse gas emissions will be necessary. Such a framework should include incentives to reduce energy consumption and methods to implement energy conservation programs, mitigate energy waste, and increase the availability and affordability of alternate energy sources. The framework should be structured such that underlying policies drive sustainable reductions in the use of fossil fuels for energy generation as well as increase the use of renewable energy sources by closing the cost gap between energy generated from fossil-fuels and by lowering the costs of energy generated from alternate and renewable sources.

To date, many of the largest emitters of GHGs are the coal fired electric power generating facilities and typically, when required to reduce emissions due to CAA programs or permit requirements, they have generally accomplished reductions through the adding on of

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6. *EPA to Set Modest Pace* for Greenhouse Gas Standards / Agency Stresses Flexibility and Public Input in Developing Cost-Effective and Protective GHG Standards for Largest Emitters, U.S. ENVTL. PROT. AGENCY (Dec. 23, 2010), http://yosemite.epa.gov/opa/admpress.nsf/6424ac1caa800aab85257359003f5337/d2f038e9daed78de8525780200568bec!OpenDocument; 42 U.S.C. § 7401 *et seq*. (2006).

7. *See* Massachusetts v. E.P.A., 549 U.S. 497 (2007); *Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/climatechange/endangerment/#content (last visited Apr. 27, 2014) [hereinafter *Endangerment and Cause*].

emission control technology or switching from coal to natural gas. Natural gas may be a better choice than coal from an overall emissions perspective, but such substitutions will not drive innovation or technological change. The collateral environmental damage from hydraulic fracturing (also known as "fracking") used to obtain much of the current supply of natural gas could overshadow any environmental benefits of using it as a substitute for coal. Driving societal and economic changes towards more renewable energy generation will require a broader regulatory framework that would provide incentives for companies and individuals to make changes in their choice of energy source as well as the quantity and efficiency of energy use which is more than a C&T program could provide.

II. BACKGROUND ON GREENHOUSE GAS REGULATION IN THE UNITED STATES

A. Greenhouse Gas Law and Regulation in the United States: Current Status

The current Congress announced early in their session that they would not take up C&T legislation, and in fact several members openly discussed attempting to block the EPA's regulatory efforts to regulate GHGs.[8] However, the EPA is legally obligated by the CAA to regulate those GHGs pollutants the Agency has determined are endangering "the public health and the public welfare of current and future generations." More specifically, in December 2009, the EPA announced that the Agency determined that six GHGs were endangering public health and welfare.[9] In a final rule, that has become commonly referred to as EPA's "Endangerment Finding." the EPA stated:[10]

> Pursuant to CAA section 202(a), the Administrator finds that greenhouse gases in the atmosphere may reasonably be anticipated both to endanger public health and to endanger public welfare. Specifically, the Administrator is defining the ''air pollution'' referred to in CAA section 202(a) to be the mix of six long-lived and directly-emitted greenhouse gases: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6).[11]

8. Chipman, *supra* note 5.

9. *Endangerment and Cause*, *supra* note 7.

10. *Id.*

11. Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66496 (Dec. 15, 2009) (codified at 40 C.F.R. ch. I).

This Endangerment Finding specifically states that GHGs not only pose a danger to "public health and welfare" but by operation of law under the CAA. This determination triggers extensive requirements and time frames under which the EPA must act to regulate any pollutant identified as posing a danger to "public health and welfare." [12] As noted in a recent Congressional Research Service (CRS) Report to Congress, the EPA has developed GHG regulations using its existing Clean Air Act authority over the last two years:

> On December 15, 2009, the agency finalized an "endangerment finding" under Section 202 of the act, which requires it to regulate pollutants for their effect as greenhouse gases for the first time. Relying on this finding, EPA finalized GHG emission standards for cars and light trucks on April 1, 2010. *The implementation of these standards, in turn, triggered permitting and Best Available Control Technology requirements for new major stationary sources of GHGs as of January 2, 2011*.[13]

In particular, Section 165 of the CAA mandates that once a pollutant is identified as "subject to regulation," then the pre-construction permitting requirements and associated emission control technology provisions of the CAA are automatically triggered.[14] The EPA has clearly recognized that designing and implementing a new regulatory program for GHGs, particularly for Carbon Dioxide (CO_2), a product of combustion from any organic material, is a major task that will take years of enormous efforts by both regulatory agencies and the companies that emit CO_2.

In an attempt to prioritize GHG regulation, the EPA started by promulgating the "tailoring rule" that sets forth the criteria and timeframes under which emission sources of GHGs, particularly CO_2, will be regulated.[15] The EPA plans to start by regulating GHG emissions from the largest sources of emissions including the tailpipes of

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12. Clean Air Act, 42 U.S.C. § 7401, *et seq*., (2006). *See also* Patricia Ross McCubbin, *EPA's Endangerment Finding for Greenhouse Gases and the Potential Duty to Adopt National Ambient Air Quality Standards to Address Global Climate Change*, 33 S. ILL. U. L.J., 437, 439 (2009) ("In particular, debate rages on whether issuance of the final endangerment finding will obligate EPA and the states to regulate greenhouse gases from nearly every sector of the economy with "national ambient air quality standards," the central program of the Clean Air Act that addresses air pollution all across the country. [42 U.S.C. § 7410] Such standards, designed to protect the public by limiting the overall concentration of greenhouse gases in the air, could force all 50 states to consider regulating everything from home furnaces, lawn mowers and outboard motors, to hospitals, apartment buildings, and other commercial and industrial enterprises.").

13. James E. McCarthy, *Clean Air Issues in the 112th Congress*, CONGRESSIONAL RESEARCH SERVICE 3 (Dec. 31, 2012), https://www.fas.org/sgp/crs/misc/R41563.pdf (emphasis added).

14. *Id.*

15. 40 C.F.R. § 52 (2013).

automobiles and light-duty trucks as well as stationary sources such as oil refineries and coal-fired electrical generating power plants.[16]

Although EPA's GHG rulemakings were challenged in Court by various industry interests, the U.S. Circuit Court of Appeals for the District of Columbia recently upheld all of EPA's GHG related rulemakings including the tailoring rule, GHG emission standards on automobiles and light-duty trucks, and the endangerment finding.[17]

B. EPA's Regulatory Toolkit For Reducing GHG Emissions

Although C&T seems to be the most often mentioned form of regulating GHG emissions, the EPA has experience with a broad spectrum of regulatory tools under the CAA and the Agency has numerous options for regulating GHG emissions under their current legal authority. The tools in the EPA's regulatory toolkit include very prescriptive "command and control" approaches such as the New Source Review (NSR) and Prevention of Significant Deterioration (PSD) programs which impose legally binding emission limitations on regulated pollutants at new and modified major sources.[18]

Market-based approaches such as C&T do have some advantages in that instead of imposing a 'one size fits all' approach to emission control, programs such as C&T allow companies to over-control those emissions where it is most cost-effective while potentially under-controlling the

16. Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule, 75 Fed. Reg. 31514-01 (2010) (codified at 40 C.F.R. Parts 51, 52, 70, and 71).

17. *Hearing on EPA Regulation of Greenhouse Gases Before the S. Comm. on Energy and Power and H. Comm. on Energy and Commerce*, U.S. House of Representatives (June 29, 2012) (opening statement of Regina McCarthy, Assistant Administrator for Air and Radiation, U.S. EPA), *available at* http://www.epa.gov/ocir/hearings/pdf/2012_GHG_testimony_final.pdf; *see also* Coal. For Responsible Regulation, Inc. v. Envtl. Prot. Agency, 684 F.3d 102, 121 (D.C. Cir. 2012).

18. 'Command and Control' is a term used to describe the highly regulated and prescriptive approaches to reducing air pollution under the traditional programs of the Clean Air Act. *Command and Control*, U.S. ENVTL. PROT. AGENCY, http://yosemite.epa.gov/ee/epa/eed.nsf/fa6512c6e51c4a20852576620063 9df2/9b6ed59f910a89ea85257746000aff58 (last visited Apr. 28, 2014). NSR is the framework used by the CAA to give the EPA and state air pollution control agencies the authority to review the emissions of air pollutants proposed to be emitted by new and modified major stationary sources (e.g., manufacturing facilities, utilities, etc.). *New Source Review: Basic Information*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/nsr/info.html (last visited Apr. 28, 2014). Additionally, NSR is often the term used to describe permits for stationary sources that are seeking to emit pollutants for which the area is not in attainment with the National Ambient Air Quality Standards (NAAQS) that the EPA establishes in accordance with Section 109(b)(1) of the CAA. 42 U.S.C. 7409(b)(1) (2014). Stationary sources that elect to locate a new source or expand an existing source in an area which is in non-attainment with the NAAQS are required by the CAA to not significantly degrade the air quality in such 'clean air' areas and thus are subject to stringent pre-construction permit and emission control restrictions under the Prevention of Significant Deterioration Program (PSD). *See* 40 C.F.R. § 51.165-66.

emissions that are more costly to reduce or purchase credits on the market in place of making costly reductions. As described by the EPA, C&T is a system whereby "total emissions are limited by an overall ceiling that is designed to achieve health or environmental goals, and allowances are allocated to sources in quantities consistent with this ceiling."[19] However, as noted above, such a program would require Congressional authorization, and given the negative connotations frequently associated with C&T, such authorization is unlikely in the near future. In addition, as discussed below, there are some flaws in the C&T program in that it focuses on major sources and in the long run has not been shown to reduce reliance on fossil fuels.

Another market-based option would be to adopt an approach similar to the phase-out of supply/products and fee-based approach used under the Montreal Protocol and Title VI of the Clean Air Act Amendments of 1990 (1990 CAAA) to mitigate emissions of Ozone Depleting Substances (ODS). In addition to being a market-based approach, another aspect of the Montreal Protocol is that it was developed as a market-based approach to environmental regulation. Perhaps knowing that the Montreal Protocol was an international treaty that was signed into law by President Ronald Reagan may assuage some concerns of politicians who prefer market-based approaches rather than prescriptive government regulations.[20]

III. THE CAP-AND-TRADE FLAW: REDUCES EMISSIONS WITHOUT DRIVING SUSTAINABLE REDUCTIONS FROM FOSSIL-FUEL BASED ENERGY GENERATION OR USE

B. Overview of Cap and Trade

One of the regulatory tools frequently discussed for addressing emissions of GHGs within the United States has been a C&T program. A C&T program is a market-based program where the EPA identifies a group of sources that are to be regulated, establishes a cap on the total quantity of emissions of one or more air pollutant(s) from those sources, and then allocates allowances to each of the regulated sources. The allowances represent some quantity of emissions each source is allowed to emit. Regulated sources that emit less than their allowance can sell

19. *The United States Experience with Economic Incentives for Protecting the Environment*, U.S. ENVTL. PROT. AGENCY 68 (Jan. 2001), http://yosemite.epa.gov/ee/epa/eerm.nsf/vwAN/EE-0216B-13.pdf/$file/EE-0216B-13.pdf.

20. President Reagan on Montreal Protocol Ratification, U.S. ENVTL. PROT. AGENCY (Dec. 21, 1987), http://www2.epa.gov/aboutepa/president-reagan-montreal-protocol-ratification.

their extra allowances to companies that emit more than they are allocated. This allows companies to decide whether it is more cost-effective to reduce emissions or purchase allowances from other companies.

However, as noted by the EPA, C&T is not the only tool in the Agency's regulatory toolkit.[21] Indeed, the EPA has recognized that C&T programs tend to be best suited to controlling emissions that have large-scale impacts from sources that have extensive monitoring systems, and where the cost of controlling such emissions varies widely from source to source.[22] For example, C&T was a remarkably successful program for reducing emissions of pollutants that were leading to Acid Rain. Title IV of the Clean Air Act Amendments of 1990 ("1990 CAAA") mandated a C&T program that proved successful at reducing emissions of sulfur dioxide and oxides of nitrogen.[23] However, implementation of that C&T program did not drive reductions in energy consumption, nor did it result in an increase in use or demand for renewable energy. In short, C&T did not foster technological innovation in the area of generating electricity without fossil fuels. Instead, many of the facilities that reduced emissions under C&T did so by switching from coal to natural gas. Perhaps more importantly, C&T also did not drive any behavioral or cultural changes in energy use.

If the long term policy goal is to reduce emissions of greenhouse gases and to shift away from combustion of fossil-fuels and dependence on foreign oil, then a more comprehensive framework for reducing greenhouse gas emissions must include incentives for reducing consumption and increasing the availability and affordability of alternate energy sources. This would entail a comprehensive framework that would not only reduce emissions of GHGs, but would also drive sustainable reductions in the use of fossil fuels for energy generation as well as increase the use of renewable energy sources by closing the cost gap between energy generated from fossil-fuels and by lowering the costs of energy generated from alternate and renewable sources.

Although a C&T program may well reduce emissions of greenhouse gases (GHGs) from a limited number of sources nationwide, there is no evidence that a C&T program alone is sufficient to drive sustainable and broad-based reductions in the use of fossil-fuels, and therefore a C&T program alone will not drive overall long-term reductions in

21. *When Cap and Trade is Appropriate*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/capandtrade/appropriate.html (last visited April 28, 2014).

22. *Id.*

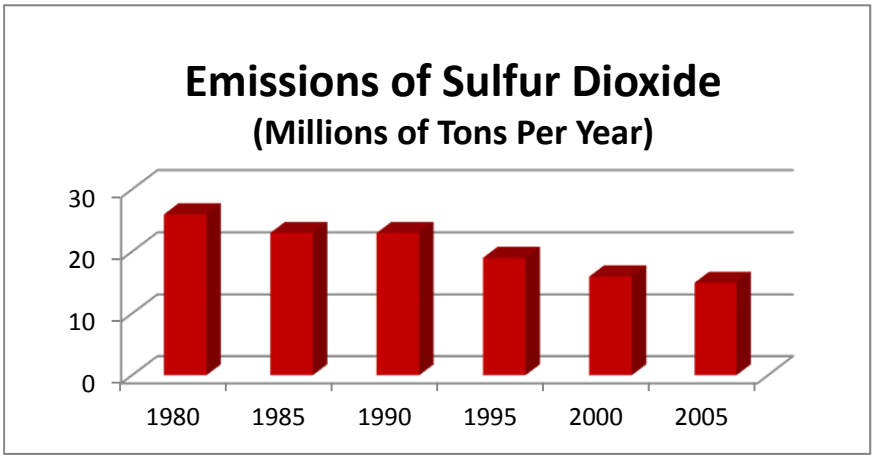
23. *See* 42 U.S.C. §§ 7651-7651o (2012).

GHGs.[24]Other regulatory approaches would likely be necessary in order to achieve broad-based and sustainable reductions in GHGs in the United States

B. Cap-and-Trade Effectively Reduced Emissions of Acid Rain Pollutants

Although the C&T program does not drive increasing reductions in fossil based energy, nor drive innovation in renewable energy, it has been used effectively under the federal Clean Air Act to reduce emissions of pollutants that contribute to acid rain. The C&T approach under the Acid Rain Program (ARP) has resulted in dramatic reductions in air emissions of sulfur dioxide (SO_2) and nitrogen oxide (NOx).[25] EPA reports that between 1990 and 2009, SO_2 emissions have dropped by 61 percent, while NOx emissions decreased 44 percent.[26] Figure 1 illustrates the dramatic reduction in SO_2 between 1980 and 2009. Figure 2 shows the reduction in NOx during the same time-frame.

Figure 1: Emissions of Sulfur Dioxide 1980 – 2009 (Millions of Tons per Year) [27]



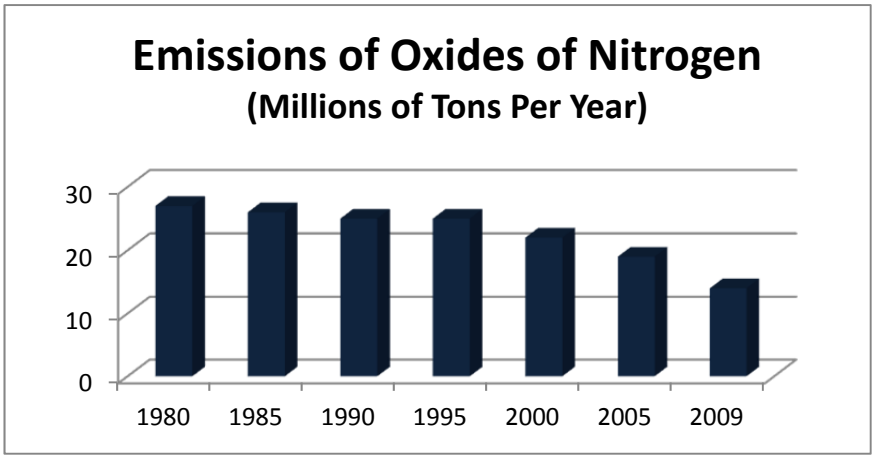
24. The scope of this paper is limited to reducing GHGs in the United States. To date, the United States has declined to participate in any international program that imposes legally binding reductions of GHGs. Rather than attempt to address the implications and complexities of international law and politics, this paper is limited in scope to considering the form of a GHG program at the national level.

25. *Acid Rain and Related Programs: 2009 Environmental Results*, U.S. ENVTL. PROT. AGENCY 1(Oct. 2010), http://www.epa.gov/airmarkt/progress/ARP09_downloads/ARP2009Results.pdf.

26. *Air Quality Trends*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/airtrends/aqtrends.html#comparison (last visited Apr. 28, 2014).

27. *Id.*

Figure 2: Emissions of Oxides of Nitrogen 1980 – 2009 (Millions of Tons per Year)[28]



Admittedly, the reductions in SO_2 were considerably greater than the reductions of NOx during identical time-frames.[29] However, it is important to note that the vast majority of the emissions of SO_2 are the result of coal-combustion, much of which takes place in large Electric Generating Units (EGUs). There are far more emission sources of NOx than there are of SO_2.[30] As a pollutant, NOx is generated from a wide variety of combustion sources and fuels. Whereas SO_2 comes primarily from the combustion of coal (and to some extent the combustion of high sulfur oil). NOx is generated not just from the combustion of coal and oil, but from any combustion of nearly any fuel source (e.g., natural gas, gasoline, kerosene, biofuels, biomass, etc.) simply due to the fact that the oxygen for the combustion comes from ambient air which is about 79 percent nitrogen (N_2). To achieve greater reductions in NOx, the program would have to expand to include more than utility coal-fired boilers and include emission reductions from sources such as automobiles and commercial/industrial natural gas fired boilers and similar operations.

28. *Id.*

29. U.S. ENVTL. PROT. AGENCY, *supra* note 25.

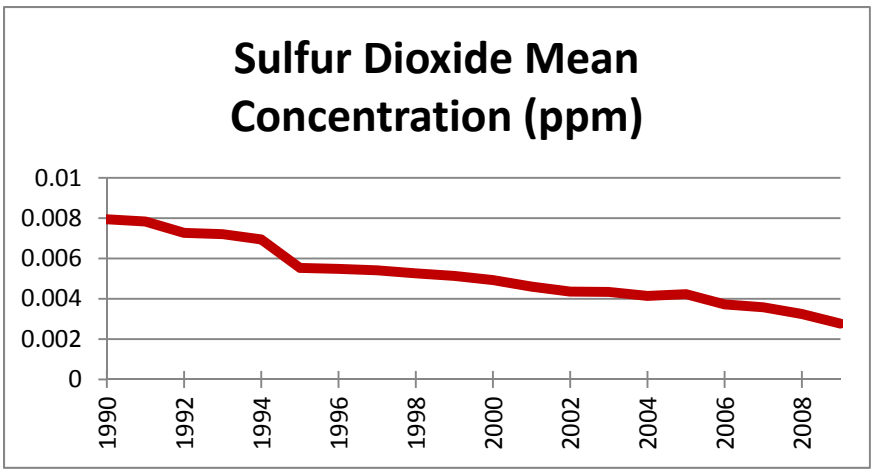
30. *What is Acid Rain?*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/acidrain/what/index.html (last visited Apr. 28 2014).

C. The Acid Rain Cap-and-Trade Program Improved Ambient Air Quality

The Acid Rain C&T program not only resulted in significant reductions in emissions of SO_2 and NOx from regulated sources, but those reductions appear to reflect a dramatic improvement in ambient air quality as well as reductions in acid deposition into lakes and waterways.[31] For example, according to EPA, the nearly 99 percent of SO_2 emissions that were regulated under the Acid Rain Program were from coal-fired Electric Generating Units (EGUs).[32]

The reduction in SO_2 emissions under the ARP resulted in dramatic reductions in ambient concentrations of SO_2 (as illustrated in Figure 3). In other words, ambient air quality improved between 1990 and 2009, as demonstrated by the fact that the mean ambient concentration of SO_2 dropped from 0.0079 parts per million (ppm) in 1990 down to 0.0028 ppm in 2009.[33]

Figure 3: Mean SO2 Concentrations in Ambient Air 1990 – 2009 (ppm)[34]



31. Sam Napolitano et al., *The U.S. Acid Rain Program: Key Insights from the Design, Operation, and Assessment of a Cap-and-Trade Program*, 20 ELECTRICITY J. 47, 47-48 (2007); *see also* Kristin Waller & Charles Driscoll, *Long-Term Recovery of Lakes in the Adirondack Region of New York to Decreases in Acidic Deposition*,46 ATMOSPHERIC ENV'T 56 (2012).

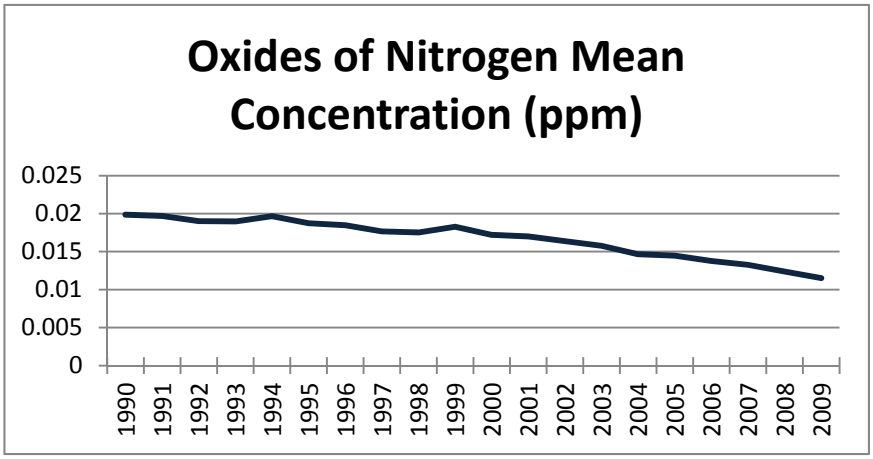
32. U.S. ENVTL. PROT. AGENCY, *supra* note 25.

33. *Air Trends: Sulfur Dioxide*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/airtrends/sulfur.html (last visited Apr. 28, 2014).

34. *Id.*

Similarly, Figure 4 illustrates the reduction in NOx over the same time-frame. In 1990, the mean ambient concentration of NOx was 0.0198 ppm.[35] The mean ambient concentration of NOx dropped by 42% to 0.0115 ppm by 2009.[36]

Figure 4: Mean NOx Concentrations in Ambient Air 1990 – 2009 (ppm)



D. Failure of Cap-and-Trade to Drive Sustainable Reductions in Fossil Fuel-Based Energy Generation or Use

Although the C&T provisions of the Acid Rain Program drove large reductions in emissions of targeted pollutants, the program did not appear to drive any sustainable reductions in overall electricity generation or use. The program also did not drive innovation or adoption of renewable energy—the majority of coal-fired units were merely converted to natural gas units.

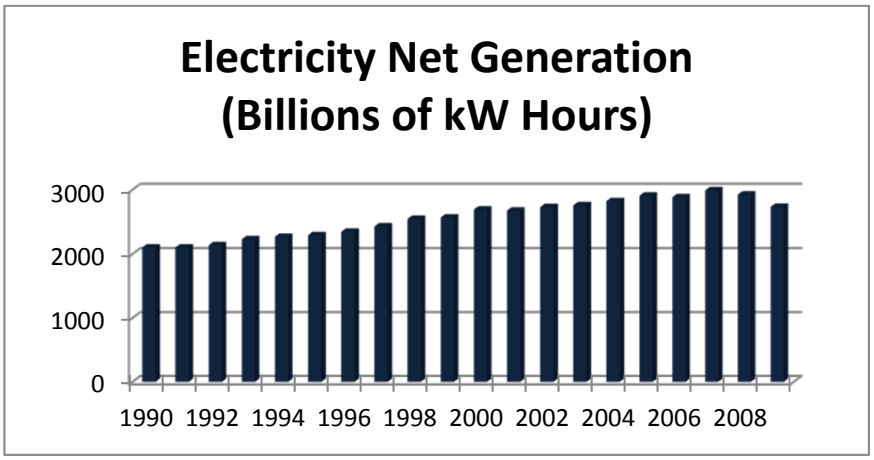
Figure 5 illustrates how electrical generation from fossil fuels increased between 1990 and 2009, even though emissions of acid rain pollutants were reduced during that same period. In short, the ARP forced electric generating units to emit less acid rain pollutants, but ARP did not stop the rapid growth of fossil-fuel based electricity generation.[37]

35. *Air Trends: Nitrogen Dioxide*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/airtrends/nitrogen.html (last visited Apr. 28, 2014).

36. *Id.*

37. There was a small drop in electricity generation in 2008 and 2009 that was due to the severe economic slowdown in the global economy.

Figure 5: Fossil-Fuel Based Electricity Net Generation (Billions of Kilowatt Hours)[38]



1. A Cap-and-Trade Program Would Only Apply to Major Sources of GHGs

The Acid Rain Program only covered a limited number and type of air pollution sources. In particular, it primarily targeted utility coal-fired EGUs. As with the Acid Rain program, a GHG C&T program would likely only regulate emissions from large emitters.[39] C&T programs are too costly and cumbersome to apply to smaller sources. Not only would the administrative requirements of monitoring, recordkeeping, and reporting likely be cost prohibitive to sources, the regulatory agencies are also not (currently) staffed appropriately to monitor compliance by thousands of smaller sources.[40]

Unlike emissions of SO2, which are emitted primarily from large coal-combustion sources, emissions of GHGs come from any source that combusts organic (i.e., carbon-based) matter. For example, in a manufacturing operation where surface coatings are applied (to vehicles, appliances, laptops, etc.), newly coated product must pass through an oven to heat the raw surface coating material to a temperature where it

38. *Annual Energy Review 2009*, U.S. ENERGY INFO. ADMIN. 227 (August 2010), http://www.eia.gov/totalenergy/data/annual/archive/038409.pdf.

39. Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule, *supra* note 16.

40. Lesley K. McAllister, *The Enforcement Challenge of Cap-and-Trade Regulation*, 40 ENVTL. L. 1195, 1196 (2010).

will crosslink and adhere to the product while forming a smooth and often glossy appearance. As a result of the heating, vapors from volatile organic compounds (VOC) are released into the atmosphere. Many air pollution laws require that these VOC vapors be combusted prior to releasing them into the atmosphere. Because the surface coating contains organic carbon, heating and combustion releases CO2.[41]

2. Cap-and-Trade Alone Would Not Drive Sustainable Reductions in Fossil Fuel Use in the Transportation Sector

Approximately one-third of carbon dioxide ("CO_2") emissions are emitted, not from stationary sources, but from mobile sources in the transportation sector.[42] A C&T program would not drive any sustainable reductions in CO_2 emissions from the transportation sector, because simply, the program is not designed to cover mobile sources of CO_2—at least not to the level of individual vehicles. Fortunately, the EPA recognizes this issue and is addressing GHGs, particularly CO_2, and emissions from the transportation sector in other rulemakings.[43]

For purposes of reducing both fossil fuel consumption and emissions of GHG by motor vehicles, the EPA coordinated two rulemakings with the National Highway Transportation Safety Agency (NHTSA).[44]According to the joint Regulatory Announcement by EPA and NHTSA:

> EPA and NHTSA's April 1, 2010 final rule set the first-ever harmonized GHG and fuel economy standards for light-duty vehicles for model years 2012 through 2016–a historic first step in addressing the transportation segment's largest contributor to oil consumption and GHG emissions. Light-duty vehicles are responsible for about 60 percent of United States transportation GHG emissions.[45]

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41. *Reducing Acid Rain*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/air/peg/acidrain.html (last visited Apr. 28, 2014).

42. STACY C. DAVIS, SUSAN W. DIEGEL, & ROBERT G. BOUNDY, TRANSPORTATION ENERGY DATA BOOK 11-6 (Oak Ridge National Laboratory eds., 29th ed. 2010), *available at* http://info.ornl.gov/sites/publications/files/pub24318.pdf.

43. U.S. ENVTL. PROT. AGENCY & THE NAT'L HIGHWAY TRANSP. SAFETY AGENCY, EPA-420-F-10-038, REGULATORY ANNOUNCEMENT: EPA AND NHTSA TO PROPOSE GREENHOUSE GAS AND FUEL EFFICIENCY STANDARDS FOR HEAVY-DUTY TRUCKS; BEGIN PROCESS FOR FURTHER LIGHT-DUTY STANDARDS (2010).

44. *Id.* EPA and NHTSA will initiate two joint rulemakings, one to improve fuel efficiency and reduce GHG emissions for commercial trucks, and another to adopt the second-phase of GHG and fuel economy standards for light-duty vehicles. *Id.*

45. *Id.*

Though initially designed to increase fuel economy of automobiles in the United States, a side benefit of the Corporate Average Fuel Economy (CAFE) standards has been to also reduce emissions of air pollutants as well. The increase in CAFE standards represents a significant opportunity to reduce GHGs from the transportation sector, which is important for at least two reasons. First, these sources are significant contributors to GHG in that they "emitted 28 percent of all United States' GHG emissions in 2007 and have been the fastest-growing source of United States' GHG emissions since 1990 . . . Light-duty vehicles and heavy-duty vehicles accounted for 23 percent of all United States GHG emissions in 2007."[46] Second, not only are transportation sources significant emitters of GHGs, but by including transportation sources, the Obama Administration is bringing average Americans closer to the table in the sense that consumers will have the opportunity to use the marketplace to drive demand for more fuel-efficient and lower GHG emitting vehicles. This is evidenced by the apparent increase in consumer market demand for more fuel-efficient vehicles. Ford Motor Company recently reported that "US sales rose 16% as customers increasingly sought fuel-efficient vehicles such as the [Ford] Escape. This helped total vehicle sales hit 1.4 million units, up by 150,000 units."[47]

IV. A "MONTREAL PROTOCOL" TYPE REGULATION WOULD ACCELERATE GHG EMISSION REDUCTIONS AND DRIVE SUSTAINABLE CHANGES IN ENERGY GENERATION AND USE

The 1987 Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol) has been widely acclaimed as one of, if not the, most successful international environmental agreements. The key goal of the Montreal Protocol was to reduce ozone-depleting substances, preventing them from depleting the layer of ozone in the troposphere where that layer helps prevent dangerous UV radiation from the sun from reaching the planet.[48] It has been hailed as "a resounding success" by scientists at the National Aeronautic and Space Administration

46. *Id.*

47. Andrew Trotman, *Ford Profits Soar on Hybrid Demand*, TELEGRAPH (Apr. 26, 2011, 1:24 PM), http://www.telegraph.co.uk/finance/newsbysector/transport/8474068/Ford-profits-soar-on-hybrid-demand.html.

48. Guus J. M. Velders et al., *Preserving Montreal Protocol Climate benefits by Limiting HFCs*, 335 SCI. MAG. 922, 922 (2012), *available at* http://igsd.org/documents/Science-2012-Velders-922-3.pdf.

(NASA)[49]; "a landmark agreement" by scientists writing in the Proceedings of the National Academy of Sciences[50]; and "The Most Successful Multilateral Environmental Agreements to Date" by the National Oceanic and Atmospheric Administration (NOAA).[51] The Montreal Protocol was adopted to phase out the production, use, and release of Ozone Depleting Substances (ODS), including chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), and Halons.[52] According to the EPA,

> Tropospheric concentrations of total ozone depleting substances have been slowly declining. Between 1995 and 2006, total ozone-depleting substances in the troposphere have declined 12 percent, and this decline has contributed to the recent recovery in stratospheric ozone levels. [53] The trends for individual ozone-depleting substances vary. Tropospheric concentrations of many ozone-depleting substances have declined since the early 1990s, but concentrations of halons (fire extinguishing agents) and hydrochlorofluorocarbons (HCFCs), a class of chemicals being used to replace CFCs, increased.[54]

The 1990 CAAA included an entirely new section, Title VI, which placed into federal law the United States program to implement the Montreal Protocol, including a phased-in tax on ODS.[55] As illustrated in Figure 6, the excise tax was $1.37 per pound of ODS beginning in January 1990. The tax increased gradually until it hit $5.35 per pound in 1995 and it has continued to increase by $0.45 per pound of ODS every year since.[56] According to EPA, the phased-in tax "clearly accelerated the rate at which CFC uses are being substituted for, and the rate at which CFCs are being recovered for reuse."[57] The EPA also noted that

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49. Tabatha Thompson, *NASA Keeps Eye on Ozone Layer Amid Montreal Protocol's Success,* NASA (Sept. 13, 2007), http://www.nasa.gov/home/hqnews/2007/sep/HQ_07192_montreal_protocol.html.

50. Guus J. M. Velders et al., *The Importance of the Montreal Protocol in Protecting Climate*, 104 PROC. NAT'L ACAD. SCI. 4814, 4814 (Mar. 20, 2007), *available at* http://www.pnas.org/content/104/12/4814.full.pdf+html.

51. *NOAA Observes 20th Anniversary of the Montreal Protocol*, NOAA EARTH SYSTEM RESEARCH LIBRARY (Sept. 16, 2007), http://www.esrl.noaa.gov/news/2007/montrealprotocol.html.

52. U.S. ENVTL. PROT. AGENCY, EE-0216B-02, THE UNITED STATES EXPERIENCE WITH ECONOMIC INCENTIVES FOR PROTECTING THE ENVIRONMENT (2001).

53. U.S. ENVTL. PROT. AGENCY, EPA-260-R-08-002, EPA'S 2008 REPORT ON THE ENVIRONMENT: HIGHLIGHTS OF NATIONAL TRENDS (2008).

54. *Id.*

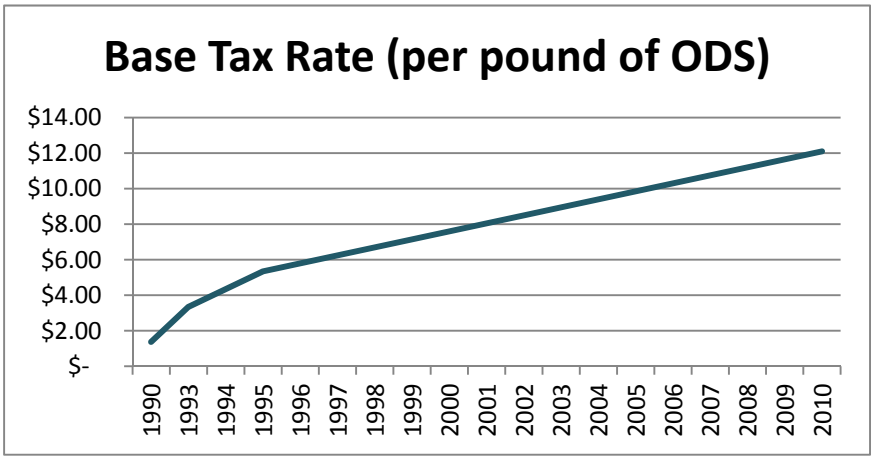
55. U.S. ENVTL. PROT. AGENCY, *supra* note 53.

56. *Excise Tax – Ozone Depleting Chemicals: Audit Techniques Guide (ATG)*, INTERNAL REVENUE SERVICES (Sept. 2007), http://www.irs.gov/pub/irs-mssp/ozone_depleting_chemicals.pdf.

57. U.S. ENVTL. PROT. AGENCY, *supra* note 53.

the tax went into effect in 1990, reducing consumption dropped 318,000 metric tons to 200,000 metric tons during the first year the tax was imposed.[58]

Figure 6: 1990 CAAA Phased-In Base Tax Rate (Per Pound of ODS)[59]



Not only has the Montreal Protocol resulted in decreased concentrations of ODS in the stratosphere, but because it also regulates GHGs, NOAA estimates that the reduction in GHGs due to the Montreal Protocol have helped to mitigate global warming.[60] The Montreal Protocol was not only an effective program for reducing emissions of regulated pollutants in the short-term but, perhaps more importantly, the Protocol drove sustainable changes in the use of the regulated materials.

A. The Key to the Success of the Montreal Protocol: Driving Technological Innovation

The United Nations (UN) worked with the EPA and other corresponding agencies in other industrialized countries to develop the Montreal Protocol. Key industries that produced the regulated ODS, as well as the industries that used the ODS in their products (e.g.,

58. *Id.*

59. *Id. See also* INTERNAL REVENUE SERVICES, *supra* note 56.

60. *Protecting Earth's Ozone Layer Also Helped Slow Climate Change*, NOAA EARTH SYSTEM RESEARCH LIBRARY (Mar. 9, 2007), http://www.esrl.noaa.gov/news/2007/ozone/index.html (The GHG reductions resulting from the Montreal Protocol have"helped to slow global warming by an amount equivalent to seven to 12 years of rise in carbon dioxide in the atmosphere.").

refrigeration and air conditioning companies, automobile manufacturers, pharmaceutical companies, cosmetic manufacturers, etc.), were also actively engaged in the development of the Montreal Protocol. Negotiations included detailed discussions regarding the time-frames under which the supply of the ODS materials would be reduced as well as how the tax increases would be phased in. Having industry involved in the negotiations helped assure that practical and feasible time frames would be established in the Protocol that would allow for the rapid reduction of ODS materials while giving various industries enough lead time to develop alternate materials and processes.

Time frames were not only key to allowing manufacturers to develop alternate products and processes, but also helped companies develop business plans to meet key deliverables in the most timely and cost-effective manner for their operations. Knowing the time frame for how the materials would be phased out, as well as how that reduction in supply combined with the phasing in of the excise taxes would affect the business model, was an invaluable element. In short, although there were no readily available off-the-shelf technologies available for full scale implementation on the day the Montreal Protocol was signed, by giving the industry notice of the reduction in supply of materials and the increase in cost, the Montreal Protocol drove numerous technological innovations as manufacturers raced to find alternatives to the use of ODS materials.

The planned price increases (through predictable and phased in taxes) were very effective incentives for manufacturers. For example, in May 1993, Chrysler reported that by January 1994 they would no longer be using Freon-12, a regulated CFC, in their vehicles.[61] They redesigned their air conditioning systems to operate on HFC-134a. Similarly, General Motors Corporation was targeting fall 1994 (model year 1995) vehicles as their deadline for a full conversion over to systems operating on HFC-134a. [62]

Switching from Freon-12 to HFC-134a was no small task for automobile manufacturers. HFC-134a was significantly less efficient than Freon-12 and thus, the compressor for an HFC- 134a based system had to be larger in order to achieve the same level of cooling.[63] There

61. Casey Bukro, *Out with Freon, In with HFC-134a in Automobiles*, CHI. TRIB. (May 29, 1993), http://articles.chicagotribune.com/1993-05-23/travel/9305230146_1_air-conditioners-freon-auto-air.

62. *Id.*

63. *Choosing and Using Alternative Refrigerants for Motor Vehicle Air Conditioning*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/ozone/snap/refrigerants/macssubs.html (last visited Apr. 29, 2014).

were also differences between the hoses and the permeability of the coolants. Additional engineering concerns included changes to fittings and having to install high-temperature switches to prevent venting coolant.[64] Also, in addition to changing over their new product lines to the new coolant, automobile manufacturers also had to be able to provide repairs for existing customers whose vehicles were still using Freon-12.[65] Similar issues had to be faced by manufacturers of stationary industrial, commercial, and residential cooling systems.

Another example of the success of the Montreal Protocol can be measured by the dramatic reductions in industrial use of 1-trichloroethane (TCA). A ubiquitous solvent, TCA was widely used as a degreasing agent by thousands of general manufacturers. However, once it was listed as an ODS, manufacturers had to begin to seek alternative materials and processes for degreasing operations, thereby creating a new market. In short, the increase in cost of TCA opened up a new market for alternatives—a market that would not exist without the Montreal Protocol.[66] The Montreal Protocol demonstrates that regulatory programs can not only succeed in the basic goal of reducing emissions, but it also shows that well-crafted public policy can change behavior and drive market demand for innovative technology.[67]

It is important to note that one of the key provisions of the international aspects of the Montreal Protocol was that developing countries would be placed on a different schedule than more industrialized nations.[68] The issue of how an international treaty, such as the Kyoto Protocol, would apply to GHG emissions from rapidly developing economies such as China and India has been one of the biggest barriers to widespread adoption of the program.[69] The United

64. *Id.*

65. Bukro, *supra* note 61; U.S. ENVTL. PROT. AGENCY, *supra* note 63.

66. Stephen R. Seidel & Daniel P. Blank, *The Montreal Protocol: Pollution Prevention on a Global Scale*, 19 AMBIO 301, 303-304 (1990).

67. Paul Shrivastava, *Environmental technologies and competitive advantage*, 16 STRATEGIC MGMT. J. (Special Issue) 183, 185-186 (1995).

68. 2 DARREL STALEY, UNITED NATIONS ENVIRONMENT PROGRAMME 8 (Geoffrey Bird ed., 2001) *available at* http://www.unep.fr/ozonaction/information/mmcfiles/2334-e.pdf.

69. It was clear by the mid 1980's that anthropogenic CO2 was leading to global warming. The UN created the Intergovernmental Panel on Climate Change (IPCC) in 1988. *See* Robert Townsend, *Revisiting the Kyoto Protocol: Reducing CO2 to Prevent Climate Change Disasters*, OLD DOMINION UNIV. MODEL UNITED NATIONS SOC'Y (2013), http://al.odu.edu/mun/conference/2014_issue_briefs/WCRevisitingtheKyotoProtocolReducingCO2toPreventClimateChangeDisasters.pdf. The threat from global warming became the prime topic of the UN's 1992 Framework Convention on Climate Change (UNFCCC) held in Rio de Janeiro. *Id.* This meeting became known as the "Rio Earth Summit" and eventually led to an international agreement in Kyoto in 1997 that climate change was an imminent threat. The international agreement is called the "Kyoto Protocol." *Id.* Although many

States has indicated they will not ratify the country unless it also imposes emission limitations on China and India. The United States fears that the developing nations will get an unfair economic advantage if they are not required to reduce GHG emissions. [70] Whereas China and India contend, as developing countries, they are merely trying to catch up to the technology and quality of life in most westernized nations, and it would unfairly inhibit and restrain their economic growth if they had to implement costly emission reduction programs. [71]

V. COMPLEMENTARY REGULATORY TOOLS TO ASSIST IN DRIVING TECHNOLOGICAL INNOVATION

Although a Montreal Protocol type framework of artificially increasing the cost of fossil fuels through a progressively phased in tax may be a good framework for reducing emissions of GHGs, it would likely not be any easier to get the current Congress to adopt a new tax than it would be to get them to enact C&T legislation. However, there has been recent speculation that Congress is so desperate to reduce the deficit and national debt, progress may be made in seeking new sources of tax revenue.[72] For instance, the conservative American Enterprise Institute held a conference in November 2012 titled, "The Economics of Carbon Taxes," and a spokesman for Exxon indicated that of the options for regulating GHGs, the company would prefer a carbon tax.[73] Specifically, Exxon's Vice President of Public and Government Affairs is quoted as saying:

> If policymakers are going to adopt a measure, a regime to affect or put in place a cost on the use of carbon across the economy, then as we look at the range of options, our economists and most economists would support a revenue-neutral, economy-wide carbon tax as

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countries adopted voluntary goals for reducing emissions, the United States never ratified the treaty nor did the United States ever agree to enforceable reductions in GHGs. *Id.*

70. Ewa Krukowska & Allessandro Vitelli, *Japan Aims to Push China, U.S. on Pollution without Kyoto*, BLOOMBERG (Dec. 2, 2012, 6:33 AM), http://www.bloomberg.com/news/2012-12-02/japan-aims-to-push-china-u-s-on-pollution-without-kyoto.html.

71. Alex Morales, *China Rules Out New Climate 'Regime,' Setting Up U.S. Conflict*, BLOOMBERG (Nov. 20, 2012, 10:59 AM), http://www.bloomberg.com/news/2012-11-20/china-sets-up-u-s-conflict-by-ruling-out-new-climate-regime-.html.

72. Mark Drajem, *Carbon Fee From Obama Seen Viable With Backing from Exxon*, BLOOMBERG (NOV. 16, 2012, 9:26 AM), http://www.bloomberg.com/news/2012-11-15/carbon-fee-from-obama-seen-viable-with-backing-from-exxon.html.

73. Ben German, *Exxon isn't Pushing for Carbon Tax*, THE HILL (Dec. 11, 2012, 4:44 PM), http://thehill.com/blogs/e2-wire/e2-wire/272201-exxon-exec-were-not-seeking-carbon-tax

> the most transparent and efficient way of putting in place a cost on the use of carbon.[74]

An alternative to a direct carbon tax would be to implement a form of feed-in tariff. The feed-in tariff is a mandate that a regulatory body imposes on a utility to purchase renewable energy at a price set to level the economic playing field between the less expensive electricity generated by fossil fuels and the generally more expensive electricity generated from renewable sources. The use of feed-in tariffs to promote renewable energy has been particularly effective. For example, feed-in tariffs in Germany increased the generation of renewable energy by over 20 percent between 1991 and 2002.

Another way to drive the market towards innovation and to increase the deployment of alternative energy technology would be to adopt renewable portfolio standards (RPS). The RPS is essentially a goal set by state utility regulatory boards that mandate utilities obtain some given percentage of their capacity or electrical generation through renewable energy sources.[75] Therefore, instead of setting a price (feed-in tariff), the governing body establishes a quantity of renewable energy that the utility must purchase. These RPSs have been adopted by law or policy in twenty-nine states, yet many state programs differs in the percent of energy required to be generated by renewables. [76] For example, on the low side, Michigan has a goal of 10 percent renewable energy by 2015, whereas New York has a goal of 29 percent by 2015.[77] Hawaii and California have set the highest RPS at 40 percent by 2030 and 33 percent by 2020.[78]These RPS programs have proven to be effective at increasing the supply of electricity generated by renewable sources while only slightly increasing consumer costs by 0.4 to 0.5 percent.[79]

VI. CONCLUSIONS AND RECOMMENDATIONS

A C&T program for emissions of greenhouse gases may well result in reductions of greenhouse gases from the limited number and type of

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74. *Id.* (internal citation omitted).

75. Timothy P. Duane, *Greening the Grid: Implementing Climate Change Policy Through Energy Efficiency, Renewable Portfolio Standards, and Strategic Transmission System Investments*, 34 VT. L. R. 711, 759-766 (2010).

76. *Database of State Incentives for Renewables and Efficiency: Renewable Portfolio Standard Policies*, U.S. DEPT. ENERGY (Nov. 2012), http://www.dsireusa.org/documents/summarymaps/RPS_map.pdf.

77. *Id.*

78. *Id.*

79. *Impacts of a 15-Percent Renewable Portfolio Standard*, U.S. ENERGY INFO. ADMIN. (June 2007), http://www.eia.gov/oiaf/servicerpt/prps/rps.html.

major sources that would be regulated by such a program, but it would not necessarily lead to sustainable reductions in the use of fossil fuels or overall energy use in the United States. The C&T approach under the Acid Rain Program demonstrated that reductions in emissions occurred during the same period when the number of kilowatt hours increased. That increase in efficiency and control is good, but insufficient to address current the current climate change scenario. It is necessary to develop a comprehensive program for reducing emissions of GHGs that will not only result in direct reductions in emissions, but also drive sustainable decreases in fossil-fuel based energy generation while increasing new and alternative renewable energy generation.

Thus, if the long term policy goal is to reduce emissions of greenhouse gases and to shift away from combustion of fossil-fuels and dependence on foreign oil, then a more comprehensive framework for reducing greenhouse gas emissions must include incentives for reducing consumption and increasing the availability and affordability of alternate energy sources. Such a comprehensive framework would require closing the cost gap between energy generated from fossil-fuels and energy generated from alternate and renewable sources. The phased-in aspects of the Montreal Protocol excise tax may work well as a complementary approach to simply imposing a C&T program—the excise tax could be applied to far more sources than a C&T program alone would cover. For example, the described approach should reduce the supply of GHG emitting fuels, resulting in increased costs through a progressive and phased-in federal excise tax, and therefore drive more sustainable changes in carbon-based energy generation and use.

With regard to the automobile industry, the excise tax could be imposed in a manner that would gradually, but predictably increase the cost of gasoline.[80] Consumers interested in spending less on gasoline would drive market-demand for more fuel efficient vehicles. As the price of gasoline continued to increase, both the quantity of consumers seeking more fuel efficient vehicles and the level of fuel efficiency they would be seeking (i.e., higher miles per gallon) could reasonably be expected to have a technology-forcing effect. Automakers have long argued that they are manufacturing the product lines that their consumer base demands. In

80. Funds raised by the excise tax could be used to fund innovative renewable energy technologies which would further drive advances in technology. Some funds should be set aside to compensate those who least can afford higher energy prices, such as lower income families, senior citizens, etc. Also, the tax should be structured to keep gasoline prices predictable while fairly compensating oil companies without handing them windfall profits.

the United States, that tends to be low mileage Sport Utility Vehicles (SUVs) and light-duty trucks or sedans.

In addition to driving technological changes in motor vehicles, an excise tax on fossil-fuels would also serve as an incentive to reduce the use of fossil-fuels in both manufacturing and electricity generation. If structured properly, such a tax could help close the price gap between electricity generated from fossil-fuels and electricity generated through innovative and renewable technologies.

Germany has had apparent success incentivizing renewable energy through a combination of funds, subsidies, and tax policies.[81] Germany's 1999 Ecological Tax Reform program imposed progressive taxes on fossil-fuels and appears to have driven use of biofuels.[82] Germany's electricity rate structure appears designed to offset the otherwise higher cost of renewable energy in that utilities are required to pay a higher price to renewable energy-based generators such as solar plants and they pay a lower rate to non-renewable electricity generators.[83] Effectively, these "feed-in" tariffs on the fossil-fuel based energy generators are subsidizing the cost of renewable energy, and it appears to be working. As of 2006, approximately 50 percent of the solar electricity generated in the world was generated in Germany.[84] As of 2007, out of "the 20 biggest photovoltaic plants, 15 are in Germany."[85]

Though there may not be enough political will in Congress to tackle the imposing and imminent problems posed by climate change, there is still hope that the Obama Administration will implement an effective program to reduce emissions of GHGs in the United States.[86] The President has the authority, and indeed the legal obligation, to implement such a program under the CAA. The EPA appears to be taking cautious but positive steps towards developing a regulatory program to address emissions of GHGs. Given the bitter and often antagonistic relationship between the White House and the Republicans, it is very likely that the EPA will face numerous difficult, costly, and time-consuming efforts to

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81. University of Maryland, *Renewable Energy Policy in Germany*, JOINT GLOBAL RES. INST., *available at* http://www.globalchange.umd.edu/energytrends/germany/3/ (last visited Apr. 29, 2014).

82. *Id.*

83. Craig Whitlock, *Cloudy Germany a Powerhouse in Solar Energy*, WASH. POST (May 5, 2007), http://www.washingtonpost.com/wp-dyn/content/article/2007/05/04/AR2007050402466.html.

84. *Id.*

85. *Id.*

86. The scope of this paper has been limited to the United States. Without the political will in the Senate, the United States will not engage in any meaningful way in an international agreement to reduce GHGs and any such treaty would need to be ratified by the Senate. U.S. CONST. art. III § 2.

tie the Agency's hands and restrict the Agency's efforts through some form of Congressional "oversight."

Success stories—such as the sustainable changes implemented through the Montreal Protocol, or Germany's efforts to expand renewable energy—demonstrate the capacity of society to tackle large and complex problems. The real issue with addressing climate change in the United States is not that it cannot be accomplished; it is that it is not a politically attractive option. Unless there is a strong swing back to an overwhelming Democratic majority (assuming the Democrats are friendlier in Congress), the most viable national approach will be to address reductions of GHG emissions through the EPA's regulatory programs. Although the United States cannot ratify any international treaties without the "advice and consent" of the Senate, the Obama Administration can go a long way towards using the administrative process to drive sustainable GHG emission reductions, as well as advance technological innovations with a well-structured regulatory program. The quantity of reduction in GHG emissions and the structured pricing program could be developed based on the current ambient concentrations, projected future emissions, and the ambient concentration desired.

Alternatively, there may also be an opportunity to drive sustainable reductions in the use of fossil fuels for electricity generation at the state level. State utility regulatory boards have the authority to adopt RPS or feed-in tariff programs to encourage the generation and consumption of electricity created through renewable sources. As more and more renewable energy comes online at the utility level, the economics of scale should result in lower and more competitive prices.

In addition, educational programs could be initiated to better inform consumers that their activities and their product choices have an impact on GHG emissions. The Department of Energy, Environmental Protection Agency, and other Executive agencies could establish grants for Universities to train the next generation of professionals. Universities could also develop training materials for primary and secondary schools to use in the classroom. This would not only help children understand the importance of taking action to mitigate climate change, it could also be a tool to help inspire more interest in science, technology, engineering, and mathematics.