THE NEW CLIMATE WORLD: ACHIEVING ECONOMIC EFFICIENCY IN A FEDERAL SYSTEM FOR GREENHOUSE GAS CONTROL THROUGH STATE PLANNING COMBINED WITH FEDERAL PROGRAMS

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"The maximum range of anatomical possibilities arises with the first rush of diversification. Later history is a tale of restriction, as most of these early experiments succumb and life settles down to generating endless variants upon a few surviving models."[1]

1 STEPHEN JAY GOULD, WONDERFUL LIFE: THE BURGESS SHALE AND THE NATURE OF HISTORY 47 (1989).

I. Introduction

A strong federal response to global climate change by the United States is now assured, with key elements in progress. In response to the Supreme Court's mandate in *Massachusetts v. EPA*,[2] the new Administration's Environmental Protection Agency (EPA) will make a finding that emissions of greenhouse gases (GHGs) cause or contribute to pollution that can reasonably be anticipated to endanger health or welfare. This will trigger requirements to regulate those emissions under many sections of

2 *See* Mass. v. EPA, 549 U.S. 497 (2007) (ruling that Congress had not denied the EPA the authority to regulate greenhouse gases).

the existing federal Clean Air Act,[3] as outlined in the EPA's Advance Notice of Proposed Rulemaking on Regulating Greenhouse Gas Emissions Under the Clean Air Act (ANPR).[4] The new Administration is committed to use the existing law and to seek new legislative authority to address the issue with a suite of both traditional regulatory tools, other sector-based policy instruments, and market-based mechanisms such as cap-and-trade.[5]

There is no doubt that a strong federal response is necessary and that this response must be effective in both the short and long term. In order to stabilize global levels of GHGs at a range that will limit global average increases in average temperature to 2º C and thereby prevent dangerous anthropogenic interference with the climate system as required by the United Nations Framework Convention on Climate Change (UNFCCC),[6] the Intergovernmental Panel on Climate Change (IPCC) estimates that global GHG emissions will need to be reduced between fifty and eighty percentfrom 2000 levels by the year 2050.[7] Because the

3 Clean Air Act, 42 U.S.C. §§ 7401-7671q (2006).

4 Advance Notice of Proposed Rulemaking: Regulating Greenhouse Gas Emissions Under the Clean Air Act*,* 73 Fed. Reg. 44354 (proposed July 30, 2008) (to be codified at 40 C.F.R. chpt. 1), *available at* http://edocket.access.gpo.gov/2008/pdf/E8-16432.pdf [hereinafter ANPR].

5 *See* Barackobama.com, Barack Obama and Joe Biden: New Energy for America 2-3, http://www.barackobama.com/pdf/factsheet_energy_speech_080308.pdf (last visited Mar. 26, 2009). Specifically, the new administration plans to implement an economy-wide cap-and-trade system to reduce greenhouse gas emissions by 80% of their 1990 levels by 2050, as well as support the utilization of renewable energy in the private sphere. *Id.*

6 United Nations Framework Convention on Climate Change, Apr. 30-May 9, 1992, art. 2, U.N. Doc. A/AC.237/18 (Part II)/Add. 1 (1992) *available at* http://www.un.org/documents/ga/ac237/ac237-18pt2add1 [hereinafter UNFCCC].

7 INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: SYNTHESIS REPORT, SUMMARY FOR POLICYMAKERS 20 (2007), *available at* http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf [hereinafter 4TH IPCC SUMMARY FOR POL'YMAKERS]. James Hansen et al. have summarized the state of the scientific knowledge regarding final goal setting as follows:

> "The Intergovernmental Panel on Climate Change and others used several 'reasons for concern' to estimate that global warming of more than 2-3°C may be dangerous. The European Union adopted 2°C above preindustrial global temperature as a goal to limit human-made warming." Further, they "argued for a limit of 1°C global warming (relative to 2000, 1.7°C relative to preindustrial time), aiming to avoid

United States is responsible for almost 15% percent of world emissions with only approximately 4.5% of the world's population, significantly greater emissions reductions will be required in the United States.[8]

The nature of GHGs also make long-term planning and long-term goal setting a crucial part of any effective policy. Because GHGs have a long residence time, their impacts are delayed,[9] and they are generated by infrastructure that has both a long lifetime and requires long lead times for financing and construction, planning and implementation of control measures must begin many decades before significant problems manifest themselves,

> practically irreversible ice sheet and species loss. This 1°C limit, with nominal climate sensitivity of 3/4°C per W/m2 and plausible control of other GHGs, implies maximum CO_2 ~ 450 ppm.
>
> [The] current analysis suggests that humanity must aim for an even lower level of GHGs. Paleoclimate data and ongoing global changes indicate that 'slow' climate feedback processes not included in most climate models, such as ice sheet disintegration, vegetation migration, and GHG release from soils, tundra or ocean sediments, may begin to come into play on time scales as short as centuries or less. Rapid on-going climate changes and realization that Earth is out of energy balance, implying that more warming is 'in the pipeline', add urgency to investigation of the dangerous level of GHGs.
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> A probabilistic analysis concluded that the long-term CO_2 limit is in the range 300-500 ppm for 25 percent risk tolerance, depending on climate sensitivity and non-CO_2 forcings. Stabilizing atmospheric CO_2 and climate requires that net CO_2 emissions approach zero, because of the long lifetime of CO_2.

James Hansen et al., *Target Atmospheric CO_2: Where Should Humanity Aim?*, 2 OPEN ATMOSPHERIC SCI. J. 217, 217-231 (2008), *available at* http://www.bentham-open.org/pages/content.php?TOASCJ/2008/00000002/00000001/217TOASCJ.SGM (follow "Download" hyperlink) (citations omitted). The authors argue for a lower target level. *Id.*

8 The United States emitted 7.078 gigatons of GHGs in 2004 CO_2e, *see* ANPR, *supra* note 4, at 44402 fig.III-I, or 14.4% of the world emissions of 49.0 gigatons, *see* 4TH IPCC SUMMARY FOR POL'YMAKERS, *supra* note 7, at 5. The U.S. population on January 4, 2009 was 305,548,018, *see* U.S. Census Bureau, U.S. POPClock Projection, http://www.census.gov/population/www/popclockus.html (last visited Mar. 26, 2009), as compared to a world population on January 1, 2009 of 6,750,819,383, *see* U.S. Census Bureau, World POPClock Projection, http://www.census.gov/ipc/www/popclockworld.html (last visited Mar. 26, 2009); thus, the United States only comprises 4.5% of the world's population.

9 *See* Hansen et al., *supra* note 7, at 219.

and must continue over decades.[10] Moreover, given the fact that there is still scientific uncertainty regarding the sensitivity of the climate system to various levels of GHGs, there must be sufficient flexibility built into the system to allow goals to be adjusted, upwards or downwards, as new scientific evidence becomes available.[11] However, there must be sufficient certainty regarding demand for low carbon fuels and electricity to provide certainty regarding returns to capital markets.

We will argue that for this federal response to be effective in either the short run or the long-term, it must include several important elements. First, it must involve very long-term as well as short-term goal setting with sufficient flexibility to allow changes that reflect improvements in both science and technology. Second, it must engage the existing state, local, and regional programs to address climate change that have developed over the last eight years while the federal government dawdled. Incorporation of existing and planned state programs[12] is not only desirable in that they can provide a jump start for federal implementation, but necessary, since states exercise primary authority over many areas that will be crucial for an effective response and for removal of market barriers–areas such as land use, building codes and standards, utility regulation, water supply, transportation planning, municipal waste, agriculture and forestry.[13] Third, an effective federal program must incorporate sector-based climate policy planning at the state level to allow the full range of tools to be brought to bear on the problem and coordinated to produce the most cost effective approach to GHG emissions reduction. The scale up of the results of twenty state-level climate planning processes presented in this article[14] show

10 *Id.* at 228-29.

11 *See* Hansen et al., *supra* note 7 *passim*; *see also* ANPR*, supra* note 4, at 44400-08.

12 By referring to state programs in this article, we will intend to incorporate references to regional and local programs, which are the creations of the states.

13 *See* EPA, Action Policy Glossary, http://www.epa.gov/climatechange/wycd/stateandlocalgov/state.html (follow "State Climate Plans Action Database" hyperlink; then follow "Glossary of State Policy Recommendations" hyperlink) (setting out descriptions of state policy recommendations for climate control in various state controlled sectors) (last visited Mar. 26, 2009).

14 The twenty states and the sources of data are: **Arkansas,** ARKANSAS GOVERNOR'S COMMISSION ON GLOBAL WARMING, FINAL REPORT (2008), *available at*

http://www.arclimatechange.us/ewebeditpro/items/O94F20338.pdf; **Arizona,** Arizona Climate Change Advisory Group, Climate Change Action Plan (2006), *available at* http://www.azclimatechange.gov/download/O40F9347.pdf; **California,** California Air Resources Board, Climate Change Draft Scoping Plan (2008), *available at* http://www.arb.ca.gov/cc/scopingplan/document/draftscopingplan.pdf; **Colorado,** Climate Action Panel, Final Report (2007), *available at* http://www.coloradoclimate.org/ewebeditpro/items/O14F13892.pdf; **Connecticut**, Connecticut Governor's Steering Committee on Climate Change, 2005 CT Climate Change Action Plan (2005), *available at* http://www.ctclimatechange.com/StateActionPlan.html; **Florida,** Florida Governor's Action Team on Energy and Climate Change, Florida's Energy and Climate Change Action Plan (2008), *available at* http://www.flclimatechange.us/ewebeditpro/items/O12F20128.PDF; **Iowa,** Iowa Climate Change Advisory Council, Final ICCAC Report (2008), *available at* http://www.iaclimatechange.us/capag.cfm (last visited Mar. 25, 2009); **Maine,** Maine Department of Environmental Protection, Final Maine Climate Action Plan 2004 (2004), *available at* http://www.maine.gov/dep/air/greenhouse/ (last visited Mar. 25, 2009); **Maryland**, Maryland Commission on Climate Change, Climate Action Plan (2008), *available at* http://www.mde.state.md.us/Air/climatechange/index.asp (last visited Feb. 9, 2009); **Michigan**, Michigan Climate Action Council, Climate Action Plan (2009), *available at* http://www.miclimatechange.us/stakeholder.cfm (last visited Mar. 25, 2009); **Minnesota**, Minnesota Climate Change Advisory Group, Minnesota Climate Change Advisory Group Final Report (2008), *available at* http://www.mnclimatechange.us/MCCAG.cfm; **Montana,** Montana Climate Change Advisory Committee, Montana Climate Change Action Plan (2007), *available at* http://www.mtclimatechange.us/CCAC.cfm (last visited Feb. 9, 2009); **North Carolina,** North Carolina Climate Action Plan Advisory Group, Capag Final Report (2008), *available at* http://www.ncclimatechange.us/capag.cfm (last visited Mar. 25, 2009); **New Mexico,** New Mexico Climate Change Advisory Group, NM Climate Change Action Plan (2006), *available at* http://www.nmclimatechange.us/ (last visited Feb. 9, 2009); **New York,** Center for Clean Air Policy and New York GHG Task Force, Recommendations to Governor Pataki for Reducing New York State Greenhouse Gas Emissions (2003), *available at* http://www.epa.gov/climatechange/wycd/stateandlocalgov/states/ny.html (follow hyperlinks under "Climate Change Action Plan") (last visited Feb. 9, 2009); **Rhode Island,** Rhode Island Greenhouse Gas Process, Rhode Island Greenhouse Gas Action Plan (2002), *available at* http://righg.raabassociates.org/ (last visited Feb. 9, 2009); **South Carolina,** South Carolina Climate, Energy and Commerce Committee, South Carolina CECAC Final Report (2008), *available at* http://www.scclimatechange.us/plenarygroup.cfm (last visited Feb. 9, 2009); **Utah,** Howard Geller, Sarah Baldwin, Patti Case, Kevin Emerson, Therese Langer, & Sarah Wright, Utah Energy Efficiency Strategy: Policy Options (2007), *available at* http://www.swenergy.org/pubs/UT_Energy_Efficiency_Strategy.pdf; **Vermont,** Vermont Governor's Commission on Climate Change, Final Report and Recommendations of the Governor's Commission on Climate Change (2007), *available at* http://www.anr.state.vt.us/air/Planning/htm/ccvtactions.htm (last visited Feb. 9, 2009); and **Washington,** Washington Climate Advisory Team, Leading the Way: A Comprehensive Approach to Reducing Greenhouse Gases in Washington State (2008), *available at* http://www.ecy.wa.gov/climatechange/2008CATdocs/ltw_app_v2.pdf.

that, if implemented by all fifty states, GHG emissions reduction plans can achieve their goals cost-effectively.[15] Specifically, this scale-up shows that state climate plans can achieve reductions of GHG emissions to 10% below 1990 levels by the year 2020 at a net economy-wide cost *savings* of $20.8 billion by 2012, net savings of $85.065 billion by 2020, and net cumulative savings of $535.5 billion for the period 2009 to 2020.[16] These reductions, on this timeline, will be consistent with long-term goals intended to stabilize the climate at levels that will prevent dangerous anthropogenic interference with the Earth's climate system.[17]

Establishing and implementing the long-term goals necessary for an effective response to climate change presents significant challenges to our political systems, with two-, four- and six- year term horizons,[18] as well as free market capital systems which look to quarterly returns, with three- and four-year time horizons representing long-term returns. This suggests that dealing with climate change requires legal and policy mechanisms that will establish both long-term multi-decadal goals and short-term goals for GHG emissions based on concentration goals that will send sufficient messages to capital markets, maintain sufficient flexibility to implement adaptive management and adjust the concentration and emission goals as new scientific information and technologies emerge, and tailor means to the real conditions in which decisions are made regarding both capital investments and individual lifestyles.

Legislative models with fixed legislative goals, such as those presented by the Clean Air Act Acid Rain Program,[19] or the

15 *See* THE CTR. FOR CLIMATE STRATEGIES, ECONOMIC STIMULUS, RECOVERY, AND CLIMATE MITIGATION: POLICY AND PROGRAM OPPORTUNITIES FROM THE STATES 2 (2008), http://www.climatestrategies.us/ewebeditpro/items/O25F20666.PDF [hereinafter CTR. FOR CLIMATE STRATEGIES, POL'Y & PROGRAM OPPORTUNITIES]. *See also infra* app. II, p. 36 fig.2, p. 42 fig.5 and p. 43 fig.6.

16 CTR. FOR CLIMATE STRATEGIES, POL'Y & PROGRAM OPPORTUNITIES, *supra* note 15, at 3.

17 *See* UNFCCC, *supra* note 6, at art. 2.

18 *See* U.S. CONST. art. 1, § 2, cl.1 (describing election of House of Representatives); U.S. CONST. art. 1, § 3, cl. 1, *amended by* U.S. CONST. amend. XVII, § 1 (describing election of Senate); U.S. CONST. art. 2, § 1, cl.1 (describing election of President and Vice President).

19 Clean Air Act §§ 401-416, 42 U.S.C. §§ 7651-7651o (2006). Many have looked to the acid rain program as a model for dealing with climate change. However,

detailed requirements incorporated into federal environmental laws in response to the Reagan Administration's attempts to roll back the progress of the 1970s,[20] do not provide the flexibility needed to adjust goals and policies over the long term. For example, while the Clean Air Act Acid Rain Cap-and-Trade Program[21] successfully achieved the reductions called for by the legislation and partially solved the problem of acid rain, acid rain has persisted.[22] The specificity of the legislatively mandated reduction goals has created barriers both to the actions of individual states and to achieving the further reductions necessary to address the continuing problem.[23] Similarly, the New Deal approach of telling the expert agency simply to solve the problem[24] will not give sufficient direction and certainty to guide a multi-decadal federal effort or sufficiently involve the states.

The federal Clean Air Act represents a regulatory model intermediate between these extremes, and also contains the mechanisms and the flexibility to allow the type of long-term adaptive management necessary to meet the challenges presented

significant differences in the nature of the problem make that model less useful. *See* Thomas D. Peterson, Robert B. McKinstry, Jr., & John C. Dernbach, *Developing a Comprehensive Approach to Climate Change Policy in the United States: Integrating Levels of Government and Economic Sectors*, 26 Va. Envtl. L. J. 227, 246-51 (2008) [hereinafter Peterson et al., *Developing a Comprehensive Approach*].

20 *See*, *e.g.*, Hazardous and Solid Waste Amendments of 1984 (HSWA), Pub. L. No. 98-616, 98 Stat. 3224 (Nov. 8, 1984) (re-authorizing the EPA's setting of standards for facilities generating or maintaining hazardous waste as established in 1976); the Superfund Amendments and Reauthorization Act of 1986 (SARA), Pub. L. No. 99-499, 100 Stat. 1613, 1615 (Oct. 17, 1986) (regulating liability and providing funds for disposal of municipal waste).

21 Clean Air Act §§ 401-416. *See also* EPA, Cap and Trade: Acid Rain Program Basics , http://www.epa.gov/airmarkets/cap-trade/docs/arbasics.pdf (2003).

22 *See* EPA, Cap and Trade: Acid Rain Program Results, http://www.epa.gov/airmarkets/cap-trade/docs/ctresults.pdf (2003). Although SO_2 emissions have been reduced by over seven million tons from their 1980 levels, total emissions remain slightly above the cap established by the EPA. *Id.* at 1.

23 This problem is exemplified by the fact that the allowance system established by the Clean Air Act acid rain program was cited in overturning the Clean Air Interstate Rule's attempt to reduce emissions of acid rain precursors to address this continuing problem. *See* N.C. v. EPA, 531 F.3d 896, 902-03 (D.C. Cir. 2008), *modified on reh'g*, 550 F.3d 1176 (D.C. Cir. Dec. 23, 2008).

24 *See* Martin Shapiro, *APA: Past, Present, Future*, 72 Va. L. Rev. 447, 449-50 (1986).

by climate change.[25] In the ANPR, the EPA has outlined an effective vision of how numerous GHG emissions reductions can be achieved using the Clean Air Act;[26] however, the agency's analysis fails to address the critical issues of how the broad range of state and regional programs already in existence can be incorporated, broadened and rationalized into a federal system, or the role of climate planning as a means of achieving this coordination. As discussed in detail below, like many other statutes seeking to address complex problems,[27] the Clean Air Act

25 The authors of this article, as well as others, have previously argued that the Clean Air Act includes tools that can readily be adapted to address climate change effectively and incorporate state programs. *See* Robert B. McKinstry, Jr., John C. Dernbach & Thomas D. Peterson, *Federal Climate Change Legislation as if the States Matter*, 22 NAT. RESOURCES & ENV'T. 3 (2008) [hereinafter McKinstry, Jr. et al., *Federal Climate Change Legislation*]; Peterson et al., *Developing a Comprehensive Approach*, *supra* note 19; Holly Doremus & W. Michael Hanemann, *Of Babies and Bathwater: Why the Clean Air Act's Cooperative Federalism Framework is Useful for Addressing Global Warming,* 50 ARIZ. L. REV. 799 (2008); Robert B. McKinstry, Jr. & Thomas D. Peterson, *The Implications of the New "Old" Federalism in Climate-Change Legislation: How to Function in a Global Marketplace When States Take the Lead*, 20 PAC. MCGEORGE GLOBAL BUS. & DEV. L.J. 61 (2007) [hereinafter McKinstry, Jr. et al., *The Implications of the New "Old" Federalism*].

26 ANPR, *supra* note 4, at 44354.

27 For example, virtually all states employ comprehensive planning as a means to address the complex problems presented by land use regulation. *See* Robert B. McKinstry, Jr., James McElfish, Michael Jacobson & Coreen Ripp*, Opportunities for Regulation of Land Use and Development as a Legal Tool to Protect Biodiversity*, *in* BIODIVERSITY CONSERVATION HANDBOOK 257, 266-67 (Robert B. McKinstry, Jr., Coreen Ripp & Emily Lisy eds., 2006); Linda Breggin & Susan George, *Planning for Biodiversity: Sources of Authority in State Land Use Laws*, 22 VA. ENVTL. L.J. 81, 105-07 (2003). Virtually every federal environmental statute, particularly those addressing land use or complex processes, also require planning. *See, e.g.*, National Forest Management Act, 16 U.S.C. § 1604 (2006) (land and resource management plans); Federal Land Policy and Management Act, 43 U.S.C. § 1712 (2006) (land use plans); Endangered Species Act, 16 U.S.C. § 1533(f) (2006) (endangered species recovery plans); Coastal Zone Management Act, 16 U.S.C. § 1455b (2006) (calling for state management plans/programs for protection of coastal waters); Marine Mammal Protection Act, 16 U.S.C. § 1383b(b) (2006) (calling for conservation plans for depleted species); Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. § 9605 (2006) (providing for the development of a National Contingency Plan to manage remediation of hazardous sites); Resource Conservation and Recovery Act, 42 U.S.C. §§ 6941-6949a (2006) (calling for state solid waste management plans for non-hazardous wastes); Clean Water Act, 33 U.S.C. § 1252 (2006) (comprehensive programs for water pollution control); Clean Water Act, 33 U.S.C. § 1281 (requiring waste treatment management plans as prerequisite to grants); Clean Water Act, 33 U.S.C. § 1288 (area-wide waste treatment plan); Clean Water Act, 33 U.S.C. § 1289 (basin

contains a planning mechanism that could be used to achieve incorporation. Planning mechanisms are necessary to coordinate a wide variety of biological, economic, and social concerns and multiple legal tools. The planning process enables the policy maker to take a big picture view by identifying goals, constraints, and conflicts, and by creating a structure that selects means that will take account of these considerations.[28] Section 110 of the Clean Air Act[29] calls for the development of State Implementation Plans (SIPs) to achieve and maintain national ambient air quality standards (NAAQS). Although the SIP mechanism for other "criteria pollutants" has previously been used in a formulaic manner, it can be readily adapted to incorporate existing progressive state and regional climate plans and programs, if modified to give all states specific numeric GHG emissions reduction targets to be met through their SIPs. Sections 108, 109 and 110 of the Clean Air Act provide the EPA with broad authority to create a cap-and-trade program and other regulatory and management programs that rely first on the states to create a mix of state management, financing, and regulatory programs most appropriate for each state's economy, climate, resources, and legal structure.[30] Use of the SIP or a similar type of model to provide for state level planning will be critical for the success of a comprehensive and cost effective GHG emissions reduction program.

In its comments on the EPA staff draft of ANPR, the Department of Transportation refers to this general language in the Clean Air Act as a "fossil."[31] However, like the fossils of Burgess Shale described by Stephen Jay Gould,[32] the language of sections 108 to 110 remains sufficiently general, unlike the more specific

planning); Clean Water Act, 33 U.S.C. § 1313 (2006) (requiring a continuing planning process for water quality); Clean Air Act, 42 U.S.C. § 7410 (2006).

28 *See* Robert B. McKinstry, Jr., James McElfish & Michael Jacobson, *Coordination and Planning Tools That Can Be Applied to Biodiversity Conservation*, *in* BIODIVERSITY CONSERVATION HANDBOOK 203, 266-67, 203-05 (Robert B. McKinstry, Jr., Coreen Ripp & Emily Lisy eds., 2006).

29 Clean Air Act § 110, 42 U.S.C. § 7410 (2006).

30 Clean Air Act §§ 108-110 (granting the EPA regulatory power to set NAAQS and ozone emission standards as foundations of cap-and-trade programs).

31 ANPR, *supra* note 4, at 44362.

32 GOULD, *supra* note 1, at 47.

provisions of later amendments, such that it can be readily adapted to address new challenges, such as those presented by climate change, while still engaging the range of governmental entities and utilizing the range of tools necessary for this task.

II. Overview of State and Regional Climate Actions and a Structure to Incorporate Those Actions into a National Program Under the Clean Air Act.

States are currently on the forefront of climate change efforts in the United States. These efforts are growing in size and number and are even becoming international in scope. Thirty-three states have already developed or are developing comprehensive climate change mitigation plans or programs to achieve GHG emissions reductions consistent with those required to stabilize the climate.[33] These plans have generally been developed through bottom-up stakeholder and technical-work-group-driven processes, and call for the implementation of a portfolio of policy actions reaching across the entire economy, with initiatives in: energy supply; transportation and land use; residential, commercial and industrial facilities; agriculture, forestry and waste; and cross-cutting issues such as reporting and registries.[34] Each portfolio of actions uses a combination of appropriate instruments that most economically enables emissions reductions through means such as codes and standards, funding incentives, cap-and-trade programs, negotiated agreements, and reporting and disclosure.[35] Because these state planning processes have relied upon the development of best available state or local data and stakeholder input on policy selection and design, they have identified cost-effective policies to reduce GHG emissions. If applied nationally, these policies could allow the United States to reduce emissions to 10% below 1990 levels by the year 2020, at a net annual economic *savings* of $20.8 billion in 2012, $85 billion in 2020, and $535.5 billion

33 *See* Ctr. for Climate Strategies, http://www.climatestrategies.us/ (last visited Feb. 10, 2009).

34 *See* Ctr. for Climate Strategies, Climate Policy Solutions that Work, http://www.climatestrategies.us/ (follow "Policies that Work" hyperlink) (last visited Feb. 10, 2009).

35 *See* Ctr. for Climate Strategies, Climate Policy Integration, http://www.climatestrategies.us/ (follow "Policies that Work" hyperlink) (last visited Feb. 10, 2009).

cumulatively for 2009-2020.[36] The experience of states has shown that the lowest cost and highest value-added approach to the attainment of the GHG emissions reduction targets and timetables needed to stabilize the climate is achieved by a comprehensive policy that involves all economic sectors, all levels of government and a combination of policy instruments.[37]

The states have also created three regional cap-and-trade initiatives that can serve as the foundation for a national cap-and-trade program: the Regional Greenhouse Gas Initiative (RGGI),[38] the Western Governors Climate Initiative (WCI),[39] and the Midwestern Governor's Association Greenhouse Gas Reduction Accord (MGA).[40] Thirty-nine states, six Mexican states and all twelve Canadian provinces have created The Climate Registry (TCR), an emissions registry establishing uniform standards for reporting and verification of emissions and emissions reductions.[41]

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36 *See* CTR. FOR CLIMATE STRATEGIES, POL'Y & PROGRAM OPPORTUNITIES, *supra* note 15, at 3, and discussion *infra* Part V.

37 CTR. FOR CLIMATE STRATEGIES, POL'Y & PROGRAM OPPORTUNITIES, *supra* note 15, at 3.

38 Regional Greenhouse Gas Initiative, http://www.rggi.org (last visited Feb. 10, 2009).

39 Western Climate Initiative, http://www.westernclimateinitiative.org (last visited Feb. 10, 2009).

40 Midwest Governors Ass'n, Midwestern Energy Security & Climate Stewardship Summit: Greenhouse Gas Accord (2007), *available at* http://www.midwestmgovernors.org/Publications/Greenhouse%20gas%20accord_Layout%201.pdf.

41 The Climate Registry, http://www.theclimateregistry.org/ (last visited Feb. 10, 2009). The initial compliance period for the RGGI program, covering New York, New Jersey, Connecticut, Massachusetts, Rhode Island, Maine, New Hampshire, Vermont, Delaware and Maryland began on January 1, 2009 and the first two quarterly auctions of allowances took place on September 25, 2008 and December 17, 2008. *See* Regional Greenhouse Gas Initiative, *supra* note 38 (follow "CO_2 Auctions" hyperlink; then follow "Auction Results" hyperlink) (last visited Feb. 10, 2009). In addition, in January 2009, the ten RGGI states and Pennsylvania announced their intent to develop a regional law carbon fuel standard to reduce GHG emissions from the transportation sector. *See* Nathanael Greene, *11 States Move to Develop a Low-Carbon Fuel Standard*, THE HUFFINGTON POST, Jan. 9, 2009, http://www.huffingtonpost.com/nathanael-greene/11-states-move-to-develop_b_156725.html. The seven western states (Arizona, California, Montana, New Mexico, Oregon, Utah, and Washington) and four Canadian provinces (British Columbia, Manitoba, Ontario, and Quebec) participating in WCI have developed Design Recommendations for the WCI Regional Cap-and-Trade Program. WESTERN CLIMATE INITIATIVE, DESIGN RECOMMENDATIONS FOR THE WCI REGIONAL CAP-AND-TRADE PROGRAM (2008), *available at* http://www.westclimateinitiative.org/ewebeditpro/items/O104F19865.PDF. The governors of six Midwestern states (Minnesota, Michigan,

Although some have argued that it would be preferable to displace state efforts with a single federal program,[42] there are at least five reasons for designing a federal GHG emissions reduction program that incorporates these state and regional programs rather than displaces them. First, it is critical that federal efforts not interfere with state and regional progress, either by slowing implementation of existing programs or by depriving the states of the revenues critical for program success. Because GHGs have extremely long residence times in the atmosphere, achieving the international goal of preventing dangerous anthropogenic interference with the climate system[43] becomes increasingly difficult as actions to reduce emissions are delayed. Second, a federal program must be designed to engage state and local governments fully as partners in the national effort, because some reductions will necessarily be implemented through policy actions over which state and local governments have primary or sole jurisdiction. Areas such as land use regulation; building codes; transportation infrastructure and management; utility regulation; and the regulation of agriculture, forestry, and non-hazardous waste handling and reduction are all traditionally within state or local authority.[44] Major GHG emissions reductions from these sectors will be necessary to stabilize GHG concentrations in the

Wisconsin, Kansas, Iowa and Illinois) and the premier of Manitoba participating in MGA are working on the development of mutual goals and the design of a third regional cap-and-trade system that may be incorporated into one of the existing regional programs. *See* Midwest Governors Association, *supra* note 40, at 4.

42 *See, e.g.*, INTERNATIONAL EMISSIONS TRADING ASS'N, MAKING THE CASE FOR A FEDERAL GREENHOUSE GAS OFFSETS PROGRAM, http://www.ieta.orgieta/www/pages/getfile.php?docID=2968 (last visited Mar. 26, 2009) (181 corporate member association arguing that a federal program would benefit the United States in global markets); BUS. COUNCIL FOR SUSTAINABLE ENERGY, RECOMMENDATIONS FOR A FEDERAL GREENHOUSE GAS OFFSET PROGRAM (2007), http://www.climatetrust.org/pdfs/PR/BCSE_Offset_Principles.pdf (providing recommendations for mandatory compliance with federal offset program); *see also* Consolidated Appropriations Act, Pub. L. No. 110-161 (2007) (requiring the EPA to publish draft rule mandating disclosure of GHGs by states).

43 UNFCCC, *supra* note 6, at art. 2.

44 *See, e.g.*, Forest Service Fire & Aviation Management, Links to State Forestry Pages, http://www.fs.fed.us/fire/partners/fepp/sf_links.html (last visited Feb. 15, 2009); U.S. Department of Energy, State Policy, http://apps1eere.energy.gov/states/state_policy.cfm (last visited Mar. 26, 2009); USDA, State Departments of Public Health and Agriculture, http://www.fsis.usda.gov/fsis_recalls/state_departments_of_public_health/ (last visited Mar. 26, 2009) (illustrating the ambit of authority of state and local governments in these areas).

atmosphere at a level that will prevent dangerous anthropogenic interference with the climate system. By contrast, even the elimination of *all* emissions from sources traditionally regulated pursuant to section 111 of the Clean Air Act[45] will not achieve the necessary reductions. Third, sector-based policies and measures reduce the cost of cap-and-trade programs by removing market barriers to market based systems and using non-price mechanisms that can be less expensive than price mechanisms in key areas.[46] Fourth, state involvement and planning will also be required to identify the most cost-effective, comprehensive mix of GHG reduction measures for all sectors and levels of government, as indicated by the experience of the states described below. Fifth, and finally, the use of a variety of sector based policies and measures chosen with state input allows consideration of co-benefits in ways that uniform federal programs or price-based systems may exclude. This includes co-benefits such as energy security and independence, human health protection, reduction of sprawl and open space conservation, and economic development.

Nevertheless, federal action is required to provide federal floors, to mandate participation by all states, to address markets that cross state borders, and to provide coordination among states. The statutory framework created by the Clean Air Act provides both the authority and the flexibility to incorporate and support state actions in an integrated federal framework for GHG emissions reduction, and involves the type of state level planning that would tailor an approach appropriate for each state's legal and political structure, its climate, and its resources. The Clean Air Act contains a mix of federal floors and requirements for those states that have failed to do the job, but leaves a significant role for states choosing to act in areas beyond federal authority and

45 This section refers to limiting emissions of "stationary sources," which include "any building, structure, facility or installation which emits or may emit any air pollutant." Clean Air Act § 111(a)(3), 42 U.S.C. § 7411(a)(3) (2006).

46 They do so by removing market barriers (such as split incentives) and by providing non-price instruments for actions that do not fully respond to price mechanisms. By reducing emissions in critical economic sectors, these approaches also reduce demand for emissions allowances. A sector-based approach can also ensure that all sectors are fully engaged in attainment of economy-wide goals so that no single sector is disproportionately burdened, particularly where cap-and-trade programs may not cover all sectors.

seeking to initiate new actions.[47] In *Massachusetts v. EPA*, the Supreme Court held that GHGs are pollutants that can be regulated under the Clean Air Act.[48] The Clean Air Act provides federal floors in the form of national technology-based standards,[49] and NAAQS.[50] Of particular importance is the fact that the statute mandates a significant role for state-level planning by requiring states to develop SIPs providing "for implementation, maintenance, and enforcement" of the NAAQS, but maintains federal primacy by providing for EPA supervision and approval of these SIPs.[51]

States are given a wide leeway in determining what types of measures are best suited for achieving and maintaining the NAAQS.[52] SIPs may incorporate both traditional regulatory mechanisms and market-based mechanisms, such as cap-and-trade programs of the sort already being developed or a GHG tax.[53] The SIP mechanism described in the statute (as opposed to that applied in the past for other pollutants) can be adapted to allow the federal government: to incorporate existing state climate planning and implementation measures, including cap-and-trade; to motivate state action in areas where Congress has not currently authorized the Administration to act; and to continue to motivate new state climate action.[54]

Addressing the global issue of climate change and the unique attributes of GHGs will require that state *climate* implementation

47 *See generally* Clean Air Act § 110 (mandating state implementation plans, but leaving specifics of methodology and procedures to the states themselves).

48 Mass. v. EPA, 549 U.S. 497, 529 (2007).

49 *See generally* Clean Air Act §§ 111, 202, 213, 231 (laying out technology standards for the likes of stationary sources, motor vehicle and aircraft engine emissions).

50 *See id.* § 109(a)(1)(A).

51 *Id.* § 110(a)(1).

52 *Id.* § 110 (mandating state implementation plans while leaving the specifics of methodology and procedures to the states themselves).

53 *See id.* § 110(a)(2)(A).

54 *Id.* This is particularly important for the implementation of sector-based measures that remove barriers to actions that may not fully be addressed at the federal level. For instance, many barriers to energy efficiency and conservation are found in state codes and standards that discourage or even prohibit efficient technologies and practices (such as outmoded building and development codes or utility rate structures) that must be modified at the local and state level.

plans (SCIPs) and federal oversight of those plans be quite different from SIPs addressing traditional priority pollutants and federal oversight of those SIPs as described in current EPA regulations.[55] SIPs for priority pollutants regulated under the Clean Air Act have, in the past, focused on *local* concentrations of pollutants that disperse rapidly.[56] Given the lengthy residence times of GHGs in the atmosphere, in order to maintain atmospheric levels of GHGs below dangerous levels, the United States will be required to significantly reduce emissions long before GHG concentrations reach the point of dangerous interference with the climate system.[57] As described further below, SCIPs, like the state climate plans already developed, will need to focus on achieving decreasing levels of overall emissions rather than on irrelevant local concentrations and local modeling (as under the current SIP regime).[58] The statutory language allows the planning mechanism established under section 110 of the Clean Air Act[59] to be used to assign each state declining emissions allowances that could be achieved through its SCIP.[60]

A somewhat different approach to regulation than has been used for other priority pollutants under the Clean Air Act is justified because GHGs are different from traditional priority

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55 *See generally* Clean Air Act § 107, 42 U.S.C. § 7407 (2006) (illustrating current regulations' limitation to each state's geographic area).

56 *See, e.g.*, Montana State Implementation Plans, *available at* http://deq.mt.gov/AirQuality/Planning/SIPs.asp (last visited Mar. 26, 2009) (illustrating localized focus of SIPs).

57 I.e., in order to achieve the goal established by the UNFCCC, *supra* note 6, at art. 2. The Fourth IPCC Report indicates that in order to limit temperature increases to 2º C, total GHG atmospheric levels must be restricted to a range of 445 to 490 ppmv CO_2e (carbon dioxide equivalents – the common measure of all GHGs), as compared to 2005 levels of 375 ppmv CO_2e. To maintain GHGs at this level will require that world net emissions be reduced by between 50 and 80% from 2000 levels by the year 2050. *See* 4TH IPCC SUMMARY FOR POL'YMAKERS, *supra* note 7, at 20; Hansen et al., *supra* note 7, at 226. Because the United States emits almost 15% of the world's GHGs with only 4.5% of the world's population, significantly greater reductions will be required in the United States. *See supra* note 8.

58 *See infra* text accompanying notes 67-77.

59 *See generally* Clean Air Act § 110 (mandating the creation of SIPs).

60 *See* McKinstry, Jr. et al., *Federal Climate Change Legislation*, *supra* note 25, at 7; Peterson et al., *Developing a Comprehensive Approach*, *supra* note 19, at 231; McKinstry, Jr. & Peterson, *The Implications of the New "Old" Federalism*, *supra* note 25, at 89; *see also* Doremus & Hanemann, *supra* note 25, at 820.

pollutants in a number of ways. GHGs mix rapidly throughout the atmosphere and persist in the atmosphere for a century or longer in most cases.[61] They are emitted throughout the world, with nearly fifteen percent of world emissions coming from sources within the United States.[62] Changes in emissions levels will not produce short-term impacts because there are significant lag times while the climate system equilibrates.[63] It is the average long term concentration in the atmosphere and not short term or local levels that affect global temperature.[64] Accordingly, stabilization of GHG emissions levels in the atmosphere will require significant emissions reductions long before ambient levels approach the point at which "dangerous anthropogenic interference with the climate system" will occur.[65]

A good plan will first establish goals. In so doing, policy makers can proceed to identify the most efficient means of achieving those goals and the trade-offs which might prove necessary. Under the Clean Air Act, the goal for an air quality standard is expressed as a NAAQS, with a secondary standard established to protect welfare and a primary standard established to protect health.[66] While SIPs for other criteria pollutants have focused on controlling local, ground-level concentrations, the characteristics of GHGs require the achievement of emissions reductions necessary for the United States to meet its "common but differentiated responsibilit[y]" under the UNFCCC,[67] and to maintain levels of GHGs at a concentration low enough to prevent "dangerous anthropogenic interference" with the climate system.[68] The mix of regulatory options should therefore focus on achieving

61 *See* ANPR, *supra* note 4, at 44400.

62 *See id.* at 44402.

63 *See id.* at 44401.

64 *Id.*

65 UNFCCC, *supra* note 6, at art.2. These characteristics of GHGs are discussed by the EPA in ANPR, *supra* note 4, at 44400-01.

66 *See* Clean Air Act § 109(b)(1), (2), 42 U.S.C. § 7409(b)(1), (2) (2008).

67 "The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof." UNFCCC, *supra* note 6, at art. 3, § 1.

68 *Id.* at art. 2.

phased emissions reductions consistent with long-term emissions reduction goals. Most scientists are of the opinion that to prevent significant adverse impacts on welfare, carbon dioxide levels need to be held at or below approximately 450 ppmv.[69] A secondary NAAQS could be established at this level, triggering the need to reduce emissions in order to maintain GHG levels below the standard.[70] Indeed, based on the understanding that worldwide emissions will need to be reduced to stabilize GHG levels, many states have already established interim and longer-term goals for reduction of GHG emissions.[71] Although these goals vary, many include provisions for returning to ten percent below 1990 GHG emissions levels by year 2020, and reducing emissions to eighty percent below 1990 levels by 2050.[72]

An effective federal program will require a mix of measures to

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69 The Fourth IPCC Report indicates that in order to limit temperature increases to 2ºC, upon which the 450 ppmv is based, total GHG atmospheric levels must be restricted to a range of 445 to 490 ppmv CO_2e (carbon dioxide equivalents – the common measure of all GHGs), as compared to 2005 levels of 375 ppmv CO_2e. *See* 4[TH] IPCC Summary for Pol'ymakers, *supra* note 7, at 20. The European Union has also sought to aim for a 2º C limit, although others have suggested that even this amount may be problematic. Hansen et al., *supra* note 7, at 217.

70 As discussed further below, EPA should establish a secondary, welfare-based NAAQS equal to the level required to stabilize GHGs at the level required by the UNFCCC. *See infra* text accompanying notes 148-166. Although climate change can affect health, most of the health effects are secondary impacts of welfare effects (e.g. deaths from increased storminess, disease vectors moving north) rather than the types of direct impacts (lung diseases) associated with pollutants for which a primary standard has been established in the past. While there may be increased heat-related deaths, there will be decreased cold-related deaths, so that setting a health-based standard on that basis would be problematic. As a practical matter, because it appears that the NAAQS would be set at a level above current ambient levels and emissions reductions will be required as a part of a maintenance plan, it may not make a great deal of difference whether or not the EPA adopts a primary standard.

71 *See* Kristina Haddad, Climate Policy Program of the New America Foundation, U.S. States With Greenhouse Gas Emissions Targets (2007), *available at* http://www.newamerica.net/files/States%20with%20GHG%20Reduction%20Targets%208-18-08.pdf; *see also* New America Foundation, Climate Policy Program: Climate Action Plans, http://www.newamerica.net/programs/climate/building_blocks/action_plans (last visited Feb. 7, 2009) (providing access to all existing State climate action plans or their equivalents).

72 *See* PEW Ctr. on Global Climate Change, A Look at Emissions Targets, www.pewclimate.org/what_s_being_done/targets (last visited Feb. 9, 2009). This is consistent with the findings of the 4[TH] IPCC Summary for Pol'ymakers, *supra* note 7, at 20.

achieve these goals and federal floors to assure that all states and all sectors participate. This mix should include categorical emissions standards under sections 111, 202, 213, and 231 of the Clean Air Act[73] for new and modified sources of GHG emissions, and state climate plans that would select a portfolio of actions appropriate for each state. The EPA could utilize the GHG inventories and forecasts that thirty-one states have already developed under their climate planning efforts[74] in order to determine the state by state emissions reduction goals necessary to achieve the national emissions reduction goals. The EPA can then require that each state develop a climate plan to meet its particular goal and promulgate a federal plan where a state fails to do so.

Much of the discussion about federal legislation has focused on the use of cap-and-trade and other market-based programs. Those tools should and will, in most cases, be a part of the mix of measures used to achieve the states' required emissions reduction, but should be only a part. As discussed in greater detail below, economic modeling has shown that many GHG emissions reduction measures have a negative net cost per ton of emissions reduced, suggesting that there may be significant market imperfections or barriers that require a variety of measures rather than reliance on market mechanisms alone.[75]

73 Clean Air Act §§ 111, 202, 213, 231, 42 U.S.C. §§ 7411, 7521, 7547, 7571 (2006).

74 *See, e.g.*, TOM PETERSON, CTR. FOR CLIMATE STRATEGIES, REVISED DRAFT NORTH CAROLINA GREENHOUSE GAS INVENTORY AND REFERENCE CASE PROJECTIONS 1990-2020 (2006), http://www.ncclimatechange.us/ewebeditpro/items/O120F8235.pdf; STEPHEN ROE ET AL., CTR. FOR CLIMATE STRATEGIES, ALASKA GREENHOUSE GAS INVENTORY AND REFERENCE CASE PROJECTIONS 1990-2020 (2007), http://www.dec.state.ak.us/air/doc/AK-GHG-EI-2007.pdf; RANDY STRAIT ET AL., CTR. FOR CLIMATE STRATEGIES, COLORADO GREENHOUSE GAS INVENTORY AND REFERENCE CASE PROJECTIONS 1990-2020 (2007), http://www.cdphe.state.co.us/ap/down/GHGEIJan07.pdf (illustrating the climate planning efforts of various states that might be used by the EPA).

75 All too often, the proponents of market-based approaches will establish a false dichotomy between what they characterize as "command and control" approaches and market-based approaches and suggest replacing "command and control" wholesale with cap-and-trade. In fact, both traditional and market-based approaches rely heavily on market incentives; likewise, any market-based system must necessarily rely heavily on a number of command and control mechanisms. A mix of approaches for different sectors and even different activities within a sector will produce the most workable and cost-effective policy tool. *See, e.g.*, David M. Driesen, *Trading and Its Limits*, 14 PENN. ST. ENVTL. L. REV. 169, 172 (2006) (discussing important limitations on when trading

Nevertheless, these market mechanisms have important advantages that implicate the need for their continued incorporation into whatever plan is devised. Cap-and-trade and other market-based programs may be made a part of an SIP under the express authority of section 110(a)(2)(A) of the Clean Air Act.[76] Because there are clear advantages in having sufficient consistency to establish a national trading regime in GHG emissions reduction credits, the EPA could facilitate such a regime by promulgating regulations setting forth minimum performance criteria for a cap-and-trade system that could be approved by the EPA as a part of an SCIP.[77] These criteria could also set forth the

should and should not be used as a policy tool); David M. Driesen, *Is Emissions Trading an Economic Incentive Program?: Replacing the Command and Control/Economic Incentive Dichotomy*, 55 WASH. & LEE L. REV. 289, 343 (1998) (emphasizing how government decision making must be combined with more free market economic incentives); Robert B. McKinstry, Jr., *Putting the Market to Work for Conservation: The Evolving Use of Market-Based Mechanisms to Achieve Environmental Improvement In and Across Multiple Media*, 14 PENN. ST. ENVTL. L. REV. 151, 158-60 (2006) (discussing limitations on use of trading mechanisms).

76 Clean Air Act § 110(a)(2)(A).

77 *Id.* Although the Court of Appeals for the District of Columbia invalidated a federally created cap-and-trade system for other pollutants established by the Clean Air Interstate Rule (CAIR) in N.C. v. EPA, 531 F.3d 896 (D.C. Cir. 2008), the concerns here are distinguishable because of the differences between GHGs and the pollutants at issue in N.C. v. EPA. There, the court focused in particular on two issues that are not present for GHGs, and that decision is therefore distinguishable and inapplicable here.

First, the court focused on the fact that, with a cap-and-trade program, there could be no assurances that emissions from individual sources in one state would not cause violations of ground level NAAQS or interfere with maintenance of NAAQS in another and therefore would not satisfy the statutory criteria. *See id.* at 918. As noted, local ground level concentrations of GHGs are largely irrelevant to the atmospheric standard. The harm to public welfare does not arise from local, temporary exceedences but from GHGs exceeding the NAAQS throughout the atmosphere after mixing. These differences would support the establishment of a national maintenance plan based on emissions loadings and the establishment of a cap-and-trade program as a mechanism to maintain levels below the NAAQS.

Second, the court focused on the fact that the reductions in sulfur dioxide emissions would have the effect of taking away emissions rights created by the acid rain cap-and-trade system. *See id.* at 917. Since there is no statutory program creating emissions rights, the decision is also distinguishable. Moreover, the court of appeals later modified its decision invalidating and vacating the CAIR so as to allow for it to stand while the EPA reconsidered the Rule on remand. *See* N.C. v. EPA, No. 05-1244, *on petition for reh'g*, 550 F.3d 1176 (D.C. Cir. Dec. 23, 2008). The CAIR was not vacated, but the court did not reverse any of its findings on the flaws of the CAIR. This decision is curious, in that the flaws most applicable to GHGs went to the question of the mechanisms that the EPA might employ if it becomes necessary to impose a federal implementation plan (FIP).

In developing a cap-and-trade program, it is important to maintain flexibility so that existing practices can be retained and incorporated into a federal program and so states can select the most cost-effective mix of market and non-market mechanisms in light of each state's legal structure. To facilitate this goal, the performance criteria could allow automatic approval of existing programs, including the WCI and RGGI regional cap-and-trade programs, and could allow the states flexibility to decide which elements of their GHG emissions reduction programs should be satisfied by a cap-and-trade program. Because no SIP could be approved unless the entire mix of measures achieved the necessary reductions,[78] states could allow different sectors to utilize cap-and-trade and generate different offsets as credits. Once a state system was approved, the credits could be traded across state lines as long as they were created in accordance with permitted volume and standards established in the originating state, and used as permitted in the state where they are retired.

This flexibility would likely produce a more cost-effective and politically acceptable GHG emission reduction program than would a one-size-fits-all program, since differences in state legal systems and areas where emissions reductions can be achieved often will require different mixes of cap-and-trade and other measures.[79] This type of approach has worked to create an

very authority to impose a cap-and-trade program. Although the modification includes very little in the way of reasoning, it can be read to say that cap-and-trade may be required to address criteria pollutants, but the EPA must still assure that there are no ground level violations of the NAAQS. In other words, cap-and-trade can be imposed to solve part of the problem, but no source can contribute to violations of the NAAQS or non-attainment in another state. This would support use of a cap-and-trade to address GHGs under the current structure of the Clean Air Act, since ground level issues should not arise. More importantly, this decision lends further support to the notion that cap-and-trade should be part of a portfolio of measures rather than a "magic bullet."

[78] *See* Clean Air Act § 110(a) (mandating creation of SIPs sufficient to meet minimum federal requirements and reductions as demanded by the NAAQS).

[79] *See, e.g.*, FRANZ LITZ & KATHRYN ZYLA, WORLD RESOURCES INSTITUTE, FEDERALISM IN THE GREENHOUSE: DEFINING A ROLE FOR STATES IN A FEDERAL CAP-AND-TRADE PROGRAM 7 (2008), *available at* http://pdf.wri.org/federalism_in_the_greenhouse.pdf (recommending a hybrid approach between federal and state efforts); *see also* Doremus & Hanemann, *supra* note 25, at 821.

international trading program within the European Union[80] and could work equally well in the United States.

Relying on state plans to identify the mix of measures appropriate for each state, as proposed here within a federal framework and in concert with uniform federal approaches for some programs, will promote the most economically efficient approach to achieving the GHG emissions reductions necessary to stabilize atmospheric GHG levels. Each state has important differences in climate, resources, transportation, legal structures for local governments, finance, and utility regulation.[81] Because of these differences, individualized consideration of the mix of GHG emissions reduction measures, strategies, and market and non-market approaches and the appropriate mix of federal, state, and local responsibilities will produce a more cost-effective response than a federal one-size-fits-all approach. We have developed cost-effectiveness curves for the individualized climate plans that have been developed by twenty states and scaled those experiences up to the national level to demonstrate the reductions that could be achieved if similar plans were implemented in all fifty states.[82] This scale-up shows that state climate plans can achieve reductions of emissions to ten percent below 1990 levels by 2020 at a net economy-wide annual cost *savings* of $85.065 billion for 2020 and net cumulative savings of $535.5 billion for the period 2009 to 2020 on a present value basis.[83]

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80 The European Union's Emissions Trading Scheme assigns reduction targets to each European nation and allows each nation to develop its own emissions reduction plan that includes trading elements, but allows EU wide trading of the credits created for trading in each nation. *See generally* Council Directive 2003/87/EC, 2003 O.J. (L 275) 32-46 (describing greenhouse emission allowances within the European Community); Council Directive 2004/101/EC, 2004 O.J. (L 338) 18-23 (establishing a scheme for emissions in compliance with the Kyoto Protocol); Commission Regulation 2216/2004, 2004 O.J. (L 386) 1-155 (setting up standardized and secured system of emission registries); Commission Regulation 994/2008, 2008 O.J. (L 271) 1-50 (elaborating on system of registries), *available at* http://ec.europa.eu/environment/climat/emission/implementation_en.htm. This system has created a vigorous trading regime with an active futures market on the European climate exchange. *See* European Climate Exchange, http://www.europeanclimate exchange.com/default_flash.asp (last visited Jan. 4, 2009).

81 *See supra* note 44.

82 For the states and sources of data used here, see *supra* note 14 and accompanying text.

83 *See* The Ctr. for Climate Strategies, Climate Change Policy as Economic

This analysis also suggests that these emissions reductions and net cost savings cannot be achieved without a state-by-state planning mechanism and a range of sector based policies and measures that use both price and non-price policy instruments. They certainly cannot be achieved through the simple categorical emissions control standards under section 111 and the various mobile source authorities of the Clean Air Act.[84] Many of the most cost-effective emissions reductions fall within areas that cannot be consistently covered by categorical standards, such as land use, residential and commercial building codes, zoning, resource conservation, and changes in agriculture and forestry practices.[85] Even where regulatory authority exists, such as over fossil fuel-fired electric generating units, cost-effective reductions will require actions to reduce demand for electricity, an area not regulated under the applicable section of the Clean Air Act, section 111.[86] Categorical standards have historically focused on programs that capture or otherwise reduce emissions from a particular technology.[87] For carbon dioxide, this would mean technologies for carbon dioxide capture and sequestration (CCS), which have not yet been shown to be commercially feasible or cost effective at a full plant or market level.[88] There are, however, many cost- effective reductions in the electricity generation sector

STIMULUS: EVIDENCE AND OPPORTUNITIES FROM THE STATES 4 (Nov. 2008), *available at* www.climatestrategies.us/ewebeditpro/items/O25F20494.pdf; *see also* CTR. FOR CLIMATE STRATEGIES, POL'Y & PROGRAM OPPORTUNITIES, *supra* note 15, at 3 (showing significant opportunities for economic stimulus from climate change programs).

84 Categorical emissions standards are numeric maximum emissions limitations established for specific constituents emitted for particular sources, such as light vehicles, trucks, various types of off-road vehicles, and various specific industrial sources and pieces of equipment. *See* Clean Air Act §§ 111, 202, 213, 231t, 42 U.S.C. §§ 7411, 7521, 7547, 7571 (2006). For example, the categorical standards for various stationary sources for other pollutants are set forth in 40 C.F.R. pt. 60 (2008) and the categorical standards for other pollutants for on-road vehicle engines are set forth in 40 C.F.R. pt. 86 (2008).

85 This is largely due to the fact that these areas are mostly regulated by individual states and are thus correspondingly disparate. *See supra* note 44.

86 Clean Air Act § 111.

87 *See id.* § 108(b)(1) (requiring the Administrator to issue information regarding emission reduction technologies).

88 Elizabeth C. Brodeen, *Sequestration, Science and the Law: An Analysis of the Sequestration Component of the California and Northeastern States' Plans to Curb Global Warming*, 37 ENVTL. L. 1217, 1223-24 (2007).

that will arise from either a shift to different low or zero carbon electric generation sources or to energy efficiency and conservation measures in homes, businesses, and industry. These measures cannot be required of electricity generating sources under section 111 of the Clean Air Act[89] and control over many of them fall within spheres of regulation traditionally occupied exclusively by state and local governments, such as building codes.[90]

Many of the most cost-effective GHG emission reductions cannot be achieved through the cap-and-trade mechanism without state planning to facilitate cost reductions or the operation of such a market mechanism.[91] The CCS scale-up results show that there are many measures whose implementation will result in a significant net cost *savings* per ton of GHG emissions reduced (i.e., they appear as net negative costs).[92] The fact that these measures are not being implemented today suggests that there are market imperfections or barriers that are not solely related to emissions price incentives, indicating that it may be more effective to implement non-market-based (or non-price) strategies. Barriers include state utility regulations that prevent electricity users from bearing many costs of pollution and therefore eliminating

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89 Clean Air Act § 111. Some emissions reductions might be achieved by imposing requirements for conservation and energy efficiency on buildings under the New Source Review provisions of the Clean Air Act when emissions of GHGs from building sources such as fossil fuel-fired HVAC units trigger best available control technology requirements. *See id.* § 165(a)(4) (Prevention of Significant Deterioration program requiring best available technology for new or modified major emitting sources). *See also* ANPR, *supra* note 4, at 44354 (summarizing the potential ramifications of EPA regulation of greenhouse gases in response to *Massachusetts v. EPA*); ANPR, *supra* note 4, at 44497-44510 (discussing the potential effects on the preconstruction permitting process if the EPA were to regulate greenhouse gases). However, even if New Source Review requirements could be used to require some energy efficiency measures, this mechanism would still not reach homes and many commercial sources and could result in increased demand for electricity due to switching from fossil fuel-fired HVAC sources to electric sources.

90 John C. Dernbach, *Overcoming the Behavioral Impetus for Greater U.S. Energy Consumption*, 20 PAC. MCGEORGE GLOBAL BUS. & DEV. L. J. 15, 22-24 (2007).

91 Adam Rose, Dan Wei, Jeff Wennberg, & Thomas Peterson, *Climate Change Policy Formation in Minnesota: The Case for a Regional Approach*, in THE ECONOMICS OF CLIMATE CHANGE POLICY (Adam Rose, ed.) (forthcoming 2009); Doremus & Hanemann, *supra* note 25, at 811-16, 826-30.

92 Rose et al., *supra* note 91 (manuscript at 14-15, on file with authors).

incentives for energy savings created by cost savings; the inability of homeowners or mortgage markets to assess cost-effectiveness of energy saving measures in home-buying decisions; a common dichotomy between the owners and investors of energy saving measures and those who actually incur the operating costs or realize the cost savings; the lack of mechanisms to aggregate capital and direct it to many small cost-effective projects, such as home energy efficiency and conservation measures; and, generally, the lack of incentives to attain unpriced co-benefits such as human health, environmental protection, or equitable distribution. State climate plans have identified a number of approaches that states can use to remove barriers or imperfections as well as non-market mechanisms to overcome them. The SCIP approach suggested here will allow each state to adopt the mix of measures that will be most cost-effective and legally effective in light of that state's unique characteristics.[93] This careful consideration of the appropriate mix of measures can only be achieved through an individualized state-by-state planning process involving stakeholders familiar with the individual state's legal, economic and natural environments.

III. Goal Setting Through Listing Air Quality Criteria and NAAQS for GHGs.

The nature of GHGs makes long-term planning and goal setting crucial. Since GHGs have a long residence time, their impacts are delayed. They are generated by infrastructure that has a long lifetime and requires long lead times for financing and construction.[94] For these reasons, planning and implementation of control measures must begin many decades before significant problems manifest themselves, and must continue over many years as well. Moreover, given the fact that there is still scientific uncertainty regarding the sensitivity of the climate system to various levels of GHGs,[95] there must be sufficient flexibility built into the system to allow goals to be adjusted as new scientific evidence becomes available.[96] However, there must be sufficient

93 *See infra* text accompanying notes 148-200.

94 INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: SYNTHESIS REPORT 36-41, 56-61 (2008) [hereinafter 4TH IPCC REPORT].

95 *See* Hansen et al., *supra* note 7, at 227-28.

96 *Id.*

certainty regarding demand for low carbon fuels and electricity to provide confidence regarding returns to capital markets.

The Clean Air Act provides the flexibility to adapt to the problem of limiting GHG emissions; it allows the type of long-term adaptive management necessary to meet the challenge and calls for planning with a significant state role. It establishes long-term goals in the form of NAAQS[97] and calls for each state to develop a plan to achieve or to maintain those standards and to integrate federal minimum standards, using the mix of measures most appropriate for the state.[98] Although state planning has in the past focused on modeling to maintain local concentrations, the legislative structure is sufficiently flexible to allow the EPA to establish state by state emissions goals and to adjust those goals based on new scientific evidence and the experience of the states. Moreover, as evidenced by the Supreme Court's mandate in *Massachusetts v. EPA*,[99] the Clean Air Act includes sufficient specificity to allow judicial intervention when either the Administration or the states fail to meet their responsibilities. The first step, however, is the establishment of a health or welfare based goal.

A. Listing GHGs as Priority Pollutants and Developing Air Quality Criteria Under Section 108 of the Clean Air Act and National Ambient Air Quality Standards Under Section 109.

Under the current law, NAAQS should be established for GHGs. Those NAAQS can serve as the goal guiding both EPA rulemaking and state climate plans. Specifically, given the state of the science as described by the EPA in the ANPR,[100] by leading scientists in the IPCC,[101] and in numerous surveys by National Research Council panels of the National Academy of Sciences,[102]

97 Clean Air Act § 109, 42 U.S.C. § 7409 (2006).

98 Clean Air Act § 110.

99 Mass. v. EPA, 549 U.S. 497 (2007).

100 ANPR, *supra* note 4, at 44367.

101 *See generally* 4TH IPCC SUMMARY FOR POL'YMAKERS, *supra* note 7.

102 *See, e.g.*, COMM. ON SURFACE TEMPERATURE RECONSTRUCTIONS FOR THE LAST 2,000 YEARS, NAT'L RESEARCH COUNCIL, SURFACE TEMPERATURE RECONSTRUCTIONS FOR THE LAST 2,000 YEARS (2006); COMM. ON ABRUPT CLIMATE CHANGE, NAT'L RESEARCH COUNCIL, ABRUPT CLIMATE CHANGE: INEVITABLE SURPRISES (2002); COMM.

the EPA is now legally required to list GHGs as priority pollutants and develop air quality criteria under section 108 of the Clean Air Act.[103] That listing will trigger the requirement for the EPA to establish NAAQS under section 109,[104] and to require the submission of SIPs under section 110.[105] Under section 108(a) of the Clean Air Act,[106] the EPA has a mandatory duty to list each air pollutant (A) whose "emissions . . . cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare; (B) the presence of which in the ambient air results from numerous or diverse mobile or stationary sources; and (C) for which air quality criteria had not been issued before December 31, 1970."[107] It appears that the applicable standards for listing pertain to GHGs.

First, the endangerment standard is satisfied based on EPA's own findings to date. In remanding the question whether GHG emissions "cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare"[108] in *Massachusetts v. EPA*, the Supreme Court narrowly

ON THE SCIENCE OF CLIMATE CHANGE, NAT'L RESEARCH COUNCIL, CLIMATE CHANGE SCIENCE: AN ANALYSIS OF SOME KEY QUESTIONS (2001).

103 Clean Air Act § 108.

104 *Id.* § 109.

105 *Id.* § 110.

106 *Id*. § 108(a).

107 *Id. See also* NRDC v. Train, 545 F.2d 320 (2d Cir. 1976) (requiring the EPA to list lead under section 108 of the Clean Air Act and to establish NAAQS for lead). *NRDC v. Train* held that the additional language in section 108—"but for which he plans to issue air quality criteria under this section"—does not change the mandatory nature of the duty to list. NRDC, 545 F.2d at 325. In the ANPR, the EPA raised the possibility that the decision in *Chevron v. Natural Resources Defense Council*, 467 U.S. 837 (1984), may change that conclusion. ANPR, *supra* note 4, at 44477 n. 229. However, there is nothing in *Chevron*'s holding regarding the deference owed agency determinations in the area of the agency's expertise that would appear to overturn the simple issue of *statutory* interpretation resolved in *NRDC v. Train.* In *NRDC v. Train*, the court specifically rejected the argument that the phrase "but for which he plans to issue air quality criteria under this section" made the decision to list lead one within the discretion of the Administrator. NRDC, 545 F.2d at 325. Moreover, Congress modified the Clean Air Act in the 1977 Amendments specifically to endorse the scientific basis underlying the listing of lead. *See* H.R. REP. NO. 95-294, at 11 (1977), *as reprinted in* 1977 U.S.C.C.A.N. 1077, 1088. Far from modifying the statute to provide the EPA with greater discretion *not* to act, Congress specifically directed that the EPA act to address risks before something bad actually happens. *Id.*

108 Clean Air Act § 202(a)(1).

circumscribed the EPA's discretion, holding:

> Under the clear terms of the Clean Air Act, EPA can avoid taking further action only if it determines that greenhouse gases do not contribute to climate change or if it provides some reasonable explanation as to why it cannot or will not exercise its discretion to determine whether they do. *Ibid*. To the extent that this constrains agency discretion to pursue other priorities of the Administrator or the President, this is the congressional design.[109]

The state of the science outlined by the staff in the ANPR[110] and the EPA's findings made in denying California's request for a waiver from preemption of its GHG automobile emissions standards under section 209(b) of the Clean Air Act[111] enumerated many risks from rising levels of GHGs that endanger welfare.[112] These include sea level rise from thermal expansion and melting of continental glaciers, increased drought stress, decreased storage of water in snow pack, disruption of winter sports, increased storminess, exacerbation of ozone pollution, disruption of existing ecosystems and ecosystem services, and migration of pests and tropical diseases northward.[113] These findings indicate a reasonable likelihood that without reductions in GHG emissions, there is a risk that welfare will be impaired to the point of meeting the statutory threshold for endangerment.[114]

It also appears that the other two criteria for listing are present.

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109 Mass. v. EPA, 549 U.S. 497, 533 (2007).

110 ANPR, *supra* note 4, at 44423-37.

111 Clean Air Act § 209(b).

112 California State Motor Vehicle Pollution Control Standards, 73 Fed. Reg. 12156, 12165-68 (EPA May 27, 2008). On January 26, 2009, President Obama reversed the denial and directed EPA to grant the waiver. Memorandum from President Barack Obama to the Administrator of the EPA (Jan. 26, 2009), *available at* http://www.whitehouse.gov/the_press_office/California_Request_for_Waiver_Under_the_Clean_Air_Act.

113 California State Motor Vehicle Pollution Control Standards, 73 Fed. Reg. at 12163-68. These findings are consistent with the scientific facts described by leading scientists of the world in the Fourth Report of the Intergovernmental Panel on Climate Change. *See* 4TH IPCC Report, *supra* note 94, at 30-33.

114 Under the Clean Air Act, the Administrator of the EPA is required to issue NAAQS for any air pollutant "which may reasonably be anticipated to endanger public health or welfare." Clean Air Act § 108(a)(1)(A).

The EPA's findings in the ANPR establish that "the presence of . . . [GHGs] in the ambient air results from numerous or diverse mobile or stationary sources."[115] The EPA found that GHGs are emitted from millions of sources throughout the nation and across all sectors of the economy, including all of the mobile sources that burn fossil fuel; home and commercial heating and cooking with oil, natural gas, and coal; fossil-fuel-fired energy generation; agricultural, forestry, and waste operations; land use changes; industrial processes such as cement and ammonia manufacturing; and industrial energy generation units.[116] Finally, there is no question that the EPA has not yet issued air quality criteria for GHGs.[117] Thus, all three criteria for listing under section 108[118] are satisfied and it appears that the EPA has a non-discretionary duty to list GHGs.

There is a question as to what pollutant or pollutants should be listed.[119] There are multiple GHGs with different radiative forcing potential:[120] carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6).[121] Should these be listed collectively or individually, and, if collectively, how should they be treated?

It would appear to make the most sense for the EPA to list all GHGs collectively as a single pollutant under the Clean Air Act to adjust the weighting given to each individual pollutant to reflect its radiative forcing potential in terms of carbon dioxide equivalents (CO_2e). This is the standard procedure that has been adopted internationally under the UNFCCC and in the state and regional programs that have regulated GHGs to date.[122] The Climate

115 Clean Air Act § 108(a)(1)(B).

116 ANPR, *supra* note 4, at 44401-03, 44429-37, 44453-54, 44462, 44468.

117 *Id.* at 44354.

118 *See* Clean Air Act § 108.

119 ANPR, *supra* note 4, at 44400-05.

120 I.e., global warming potential.

121 4TH IPCC REPORT, *supra* note 94, at 36-37.

122 *See* Conference of the Parties to the UNFCCC, Geneva, Switz., July 8-19, 1996, *Methodological Issues Related to the Kyoto Protocol* ¶ 3, *available at* http://unfccc.int/resource/docs/cop3 /07a01.pdf#page=31; *see*, *e.g.*, MINNESOTA CLIMATE CHANGE ADVISORY GROUP, FINAL REPORT 2-1 (2008), *available at* http://www.mnclimatechange.us/ewebeditpro/items/O3F16693.pdf; NORTH CAROLINA CLIMATE ACTION PLAN ADVISORY GROUP, RECOMMENDED MITIGATION OPTIONS FOR CONTROLLING GREENHOUSE GAS EMISSIONS 2-1 (2008), *available at*

Registry's General Reporting Protocol, to which thirty-nine states in the United States, all twelve Canadian provinces, and six Mexican states have subscribed, requires reporting of all six major GHGs, adjusted to CO_2e.[123] This approach is analogous to the approach that the EPA took in listing ozone as a pollutant under the Clean Air Act and then only regulating the wide variety of pollutants that cause ozone, various photochemical oxidants and nitrogen oxides.[124]

There seems to be no good reason for departing from this approach. Because virtually all of Canada, a majority of the United States, and the six Mexican border states subscribe to this method,[125] it is already in effect in most of North America. Moreover, retaining this practice would better enable the United States programs to be harmonized with existing international programs, including trading programs.

Listing of a pollutant under section 108 of the Clean Air Act[126] creates a mandatory duty to issue "air quality criteria . . . reflect[ing] the latest scientific knowledge"[127] relating to the impacts on health or welfare caused by the pollutant and "information on air pollution control techniques"[128] for the pollutant. These provide the scientific basis for developing NAAQS and provide information that is useful both to states in developing state implementation plans and to the EPA in making decisions regarding technology-based standards and permitting decisions.

Some critics of the Clean Air Act have suggested that the air quality criteria and information requirement will be cause for

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http://www.ncclimatechange.us/ewebeditpro/items/O120F19992.pdf; CALIFORNIA AIR RESOURCES BOARD, CLIMATE CHANGE PROPOSED SCOPING PLAN 11 (2008), *available at* http://www.arb.ca.gov/cc/scopingplan/ document/psp.pdf.

123 THE CLIMATE REGISTRY, GENERAL REPORTING PROTOCOL 12 (May 2008), *available at* http://www.theclimateregistry.org/downloads/GRP.pdf.

124 *See, e.g.*, 40 C.F.R. § 51.100(s) (2008) (defining photochemical oxidants as a broad range of substances); *id.* Pt. 51, App. W, ¶ 5.2.1 (requiring modeling of photochemical oxidants and nitrogen dioxide to determine ozone impacts).

125 The Climate Registry, Board Directors, http://www.theclimateregistry.org/ memberlist.html (last visited Mar. 26, 2009).

126 Clean Air Act § 108, 42 U.S.C. § 7408 (2006).

127 *Id.* §108(a)(2).

128 *Id.* §108(b).

delay and might warrant developing an alternative federal legislative model to speed the response to climate change.[129] However, as suggested by the ANPR, the EPA could readily adopt the conclusions set forth in the Fourth Report of the Intergovernmental Panel on Climate Change[130] as air quality criteria and air pollution control techniques.[131] State planning processes, state legislators, and state and regional rulemaking proceedings have relied on both this report and prior reports to provide both the scientific basis for their planning processes and information on techniques for limiting GHG emissions.[132]

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129 *See* Ronald P. Jackson, Jr., *Extending the Success of the Acid Rain Provisions of the Clean Air Act: An Analysis of the Clear Skies Initiative and Other Proposed Legislative and Regulatory Schemes to Curb Multi-Pollutant Emissions From Fossil Fueled Electric Generating Plants*, 12 U. BALT. J. ENVT'L L. 91, 95-96, 99-103 (2005); Michael Paul Pegman, *The Ramifications of the W.H. Sammis Settlement: Why Jobs are Being Lost, the Air Remains Unclean, and This Landmark Settlement is Making Progress in the Wrong Direction*, 31 WM. & MARY ENVT'L L. & POL'Y REV. 501, 526-27 (2007).

130 4TH IPCC SUMMARY FOR POL'YMAKERS, *supra* note 7. Each report of the IPCC reflects the latest scientific information on the identifiable and predicted impacts of rising levels of GHGs on health and welfare. IPCC Reports are produced and peer reviewed by hundreds of scientists nominated by the nations of the world. The IPCC produces, at regular intervals, "comprehensive Assessment Reports of scientific, technical and socio-economic information relevant for the understanding of human induced climate change, potential impacts of climate change and options for mitigation and adaptation." IPCC, *Reports - Assessment Reports,* http://www.ipcc.ch/ipccreports/index.htm (last visited Feb. 10, 2009). The *4th IPCC Summary for Policy Makers*, *supra* note 7, produced in 2007, contains four volumes, including one synthesis report, one report on the scientific basis for assessing climate change and its anthropogenic causes, one volume addressing impacts, adaptation and vulnerability and one on climate mitigation, which describes air pollution control techniques. The reports contain all of the information required by the Clean Air Act for air quality criteria and air pollution control techniques for GHGs, and are updated at regular intervals. Moreover, the reports have already been subject to public review and comment. Given the quality and relevancy of the information, the participation of the United States and scientists throughout the United States in the preparation and peer review of these reports, and the opportunity for public review and comment, there appears to be no valid reason that EPA could not adopt the *4th IPCC Report* as the initial air quality criteria and information on air pollution control techniques for GHGs. There is also no good reason for supposing that federal legislative action would be better informed or could move more quickly in this regard.

131 ANPR, *supra* note 4, at 44483.

132 The various state plans and supporting documents can be accessed at The Center for Climate Strategies, http://www.climatestrategies.us/ (last visited Mar. 26, 2009).

B. What Type and Level of NAAQS is Appropriate for GHGs

Section 109(a)(1)(A) of the Clean Air Act[133] requires the EPA to establish, simultaneously with the issuance of air quality criteria and information on air pollution control techniques, "a national primary . . . and a national secondary ambient air quality standard"[134] for the pollutants. Secondary standards must specify the concentration of the pollutant in the ambient atmosphere "requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of such air pollutant in the ambient air."[135] Primary standards must "allow an adequate margin of safety" and be "requisite to protect the public health."[136]

The nature of GHGs and their impacts make a secondary, welfare-based NAAQS more appropriate.[137] Although climate change can affect health, most of those health effects are secondary impacts of welfare effects[138] rather than the types of direct impacts associated with pollutants for which a primary standard has been established in the past.[139] Physiologically, humans, plants and animals can withstand much higher levels of carbon dioxide and GHGs in the atmosphere than the levels that will cause dangerous interference with the climate system.[140]

133 Clean Air Act § 109(a)(1)(A), 42 U.S.C. § 7409(a)(1)(A) (2006).

134 *Id.*

135 *Id.* § 109(b)(2).

136 *Id.* § 109(b)(1).

137 In the case of most other criteria pollutants, the EPA has established a health-based primary standard and, unless there is a clear basis for a different welfare-based standard, has set the secondary standard equal to the primary standard. *Compare* 40 C.F.R. §§ 50.6, 50.7, 50.9 (2008) (identical primary and secondary standards), *with id.* §§ 50.4-50.5 (differing primary and secondary standards for sulfur dioxide). In the case of GHGs, EPA could either adopt a much higher primary standard based on health alone or set the primary standard equal to the secondary standard. *Id.* § 50.2.

138 For example, some of the impacts of climate change on health are increased mortality due to increased storminess or disease vectors moving north into areas that were formerly free of the vector borne disease. 4TH IPCC REPORT, *supra* note 94, at 48.

139 Effects such as lung diseases, cancer, and asthma led to the establishment of health based primary standards. *Clean Air Amendments of 1970: Hearings on H.R. 12934, H.R. 14960, H.R. 15137, and H.R. 15192 Before the Subcomm. on Public Health and Welfare of the H. Comm. on Interstate and Foreign Commerce*, 91st Cong. 6 (1969) (statement of Jesse L. Steinfeld, Acting Surgeon General, Public Health Service).

140 *See generally* Jonathan L. Scott et al., *Occupational Hazards of Carbon Dioxide Exposure*, J. CHEM. HEALTH & SAFETY (2009).

Increased heat can directly cause stress leading to illness or death under some circumstances in certain regions.[141] However, the increased heat will, at other times of the year and in other regions, reduce the disease and death caused by cold.[142] Because both heat and cold can cause stress,[143] there is no reasonable basis for establishing a health-based standard on the basis of temperature alone. Severe adverse impacts on welfare will manifest themselves long before temperatures rise to the point that would support a health-based standard. As long as the EPA sets secondary NAAQS at a level above current ambient levels and requires emissions reductions as a part of a maintenance plan to achieve a secondary standard, it will not make a great deal of difference whether a primary standard is established.[144]

To determine the criteria for setting a welfare-based standard, the EPA should look to the standard established in the UNFCCC.[145] There, the United States agreed to the goal of stabilizing the concentration of GHGs in the ambient atmosphere at a level that would "prevent dangerous anthropogenic interference with the climate system."[146] That standard appears to be the appropriate one for preventing "adverse effects" on public welfare as that term is used in the Clean Air Act.[147]

Although the Clean Air Act defines effects on "welfare" to

141 *See, e.g.*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2001: SYNTHESIS REPORT, SUMMARY FOR POLICYMAKERS 9, *available at* http://www.ipcc.ch/pdf/climate-changes-2001/synthesis-spm/synthesis-spm-en.pdf [hereinafter 3RD IPCC SUMMARY FOR POL'YMAKERS]; Centers for Disease Control and Prevention, Extreme Cold: A Prevention Guide to Promote Your Personal Health and Safety, http://www.bt.cdc.gov/disasters/winter/pdf/cold_guide.pdf (last visited Feb. 10, 2009); Centers for Disease Control and Prevention, Extreme Heat: A Prevention Guide to Promote Your Personal Health and Safety, http://emergency.cdc.gov.disasters/heat/heat_guide.asp (last visited Feb. 10, 2009).

142 3RD IPCC SUMMARY FOR POL'YMAKERS, *supra* note 141, § Q3.17

143 *Id.*

144 Although most scientists and the IPCC suggest a target level of 450 to 550 ppmv CO_2e, James Hansen has suggested that a level of 350 ppmv may be required. Hansen et al., *supra* note 7, at 206. If the target level is set such that the entire nation would be in non-attainment, establishing a primary level would have significant ramifications. In that case, it may be more appropriate to set the primary standard at a higher, truly health-based level.

145 UNFCCC, *supra* note 6.

146 *Id.* at art. 2.

147 Clean Air Act § 108(a)(2)(C), 42 U.S.C. § 7408(a)(2)(C) (2006).

include effects on "climate,"[148] secondary standards must be established at a level that will protect against "adverse effects" on welfare, not "any effect" on welfare.[149] Increased levels of GHGs have both positive and negative effects. Indeed, increased levels of GHGs will have likely offset the cooling impacts of acid aerosols that induced Congress to include references to climate in the definition of impacts on welfare.[150] Because of the mix of beneficial and adverse impacts, the United States and other nations decided in the UNFCCC that the world should seek to stabilize GHG levels at a level that would prevent *dangerous* anthropogenic interference with the climate system.[151] It is reasonable to adhere to the international standard in deciding what level of GHGs in the atmosphere will be deemed to cause "adverse effects"[152] on welfare.

Scientists are still attempting to determine the concentration at which GHG levels must be stabilized to prevent dangerous anthropogenic interference with the climate system, and new information develops daily. Most scientists are of the opinion that, to prevent significant adverse impacts on welfare, carbon dioxide levels need to be held at or below a 450 ppmv.[153] If the EPA decides to hold levels of carbon dioxide to 450 ppmv, this would require that concentrations of total GHGs be held below

148 Clean Air Act § 302(h).

149 This "any effect" standard has been erroneously cited in testimony opposing the establishment of NAAQS. *See Hearing on Massachusetts v. EPA Part II: Implications of the Supreme Court Decision Before the H. Select Comm. On Energy Independence and Global Warming,* 110th Cong. (2008) (statement of David Bookbinder, Chief Climate Counsel, Sierra Club), *available at* http://globalwarming.house.gov/tools/assets/files/0429.pdf.

150 Thomas J. Crowley & William T. Hyde, *Transient Nature of Late Pleistocene Climate Variability,* 456 Nature 226, 228 (2008); James E. Hansen et al., *Climate Forcings in the Industrial Era*, 95 Proc. Nat'l Acad. Sci. U.S.A. 12753, 12757 (1998) ("it was probably the slowdown of fossil fuel growth rates in the last 25 years that allowed greenhouse gas warming to dominate over aerosol cooling"); *see also* H.R. Rep. No. 95-294, at 138 (1977), *as reprinted in* 1977 U.S.C.C.A.N. 1077, 1217.

151 UNFCCC, *supra* note 6, at art. 2.

152 Clean Air Act § 108(2)(C).

153 *See* Hansen et al., *supra* note 7, at 10. While the majority view looks to hold total GHGs near 450 ppmv range, Dr. Hansen has recently suggested that a much lower level of 350 ppmv may be the desirable level for carbon dioxide alone, which would mean that the world is currently in non-attainment. *Id.*

approximately 510 ppmv CO_2e.[154] These concentrations exceed the current level of carbon dioxide and total GHGs in the ambient atmosphere.

Regardless of the level at which the NAAQS should be established, dramatic reductions of emissions will be required over the next century in order to stabilize concentrations at or below the NAAQS. The IPCC has estimated that worldwide emissions will need to be reduced by 50 to 80% by the year 2050 in order to stabilize climate at a level that will limit temperature increases to 2º C.[155] Because the United States has per capita emissions that are roughly three times as great as the worldwide average, the United States will need to reduce its emissions by 83 to 93% if a per capita allocation is ultimately adopted.[156]

IV. In Light of the Unique Nature of Greenhouse Gases, SCIPs Should Focus on Achieving the Emissions Reductions Necessary to Achieve State-by-State GHG Emissions Caps Based on the Fair Share of Emissions Reductions Required to Maintain the NAAQS.

Section 110(a) of the Clean Air Act requires each state to submit a plan that "provides for implementation, maintenance and enforcement" of the NAAQS.[157] Because the NAAQS for GHGs will likely be established at a level that exceeds current atmospheric levels of those substances,[158] the SCIPs will need to focus on achieving the emissions reductions necessary to maintain atmospheric levels below the NAAQS. Regardless of whether current levels of GHGs are higher or lower than the NAAQS, all SCIPs will need to focus on achieving reductions of all GHG emissions, and should have a different focus than SIPs directed to other priority pollutants in the past.

154 4TH IPCC REPORT, *supra* note 94, at 67, tbl.5.1.

155 4TH IPCC SUMMARY FOR POL'YMAKERS, *supra* note 7, at 20, tbl.SPM.6.

156 *See supra* notes 7-8.

157 Clean Air Act § 110(a)(1).

158 ANPR, *supra* note 4, at 44367-68.

A. The Unique Nature of GHGs and Global Contributions Requires an Emissions– Reduction-Based Approach Rather than One Focused on Local Concentrations and Dispersion Modeling.

The unique nature of GHGs and the nature of the threats they pose to welfare warrant a different focus for SCIPs than has been the case for SIPs for previously regulated criteria pollutants. The threats that GHG pollution poses to public welfare and health arise from average global longer-term concentrations of GHGs, rather than local ground-level concentrations or short-term variations in those concentrations.[159] The danger that GHG emissions pose to climate arises from the ability of global average concentrations of GHGs to trap larger amounts of infrared radiation in the *global* atmosphere over a long period of time.[160] Carbon dioxide and other GHGs rapidly mix in the *global* atmosphere over a far shorter period of time than that during which the climate system will equilibrate. Moreover, the precise atmospheric levels of carbon dioxide, the most common GHG, naturally vary between summer and winter months. After GHGs have been emitted into the atmosphere, they persist for long periods of time; thus,they will accumulate and their average atmospheric concentrations will increase.[161] For example, carbon dioxide has an average residence time in the atmosphere of roughly 100 years, with some percentage persisting far longer.[162] Thus, variations in local, ground level concentrations of GHGs are irrelevant to the risks causing a need to list GHGs as a priority pollutant.

Given these characteristics, SCIPs should focus on the long-term reduction of total emissions to effect a long-term stabilization of GHGs in the atmosphere and should not focus on temporary variations of GHGs at the ground level. This will mean that SIPs for GHGs, and the regulatory program generally, should not require dispersion modeling or any determination of local levels of

159 *See* Tamara S. Ledley et al., *Climate Change and Greenhouse Gases*, 80 Eos. Trans. Amer. Geophysical Union 453 (1999), *available at* http://ecosystems.wcp.muohio.edu/studentresearch/climatechange02/kyoto/articles/greenhousegas.pdf.

160 *Id.*

161 *Id.* at 453.

162 *See* Hansen et al., *supra* note 7, at 226.

GHGs at ground level.[163] Likewise, whether or not NAAQS are exceeded locally should not be a concern. Measures to prevent local, short-term exceeding of a GHG NAAQS will do nothing to prevent the harm to welfare (or health) that the NAAQS are intended to address. Only changes in global concentrations of GHGs will cause such an impact. This is a significantly different focus than has been required for the SIPs for other criteria pollutants, where the need to protect health requires modeling to assure that health based standards are not exceeded at ground level wherever people could be exposed to the pollutant.[164]

Accordingly, new regulations tailoring the requirements of the Clean Air Act to these characteristics of the pollutant being regulated will be needed. The regulations should specify that SCIPs focus on achieving long-term reductions in emissions that will put the United States on a path towards achieving its share of reductions necessary to stabilize GHG levels in the atmosphere at or below the NAAQS—they should be maintenance SIPs. Specifically, they should focus upon achieving the required emissions reductions that will likely be required of the United States based on its "common but differentiated responsibilit[y]" under the UNFCCC.[165] This would mean that the mix of regulatory options to be developed by the states in their SCIPs should aim to achieve phased emissions reductions consistent with long-term emissions reduction goals necessary to keep global concentrations of all GHGs at or below the NAAQS.

163 Section 110(a)(2)(K) of the Clean Air Act requires only that plans require "such air quality modeling as the Administrator may prescribe for the purpose of predicting the effect on ambient air quality of any emissions of any air pollutant for which the Administrator has established a national ambient air quality standard." Clean Air Act § 110(a)(2)(K), 42 U.S.C. § 7410(a)(2)(K) (2006). Given the nature of GHG emissions and their impacts, the Administrator could elect to prescribe no modeling for individual state plans and individual sources and prescribe reliance upon modeling done by the IPCC for the purpose of determining overall numeric emissions reductions required.

164 *See* 40 C.F.R. § 51.115 (2008).

165 UNFCCC, *supra* note 6, at art. 3, ¶ 1.

B. The State by State Emissions Reductions Should be Based Upon a "No Regrets" Emission Reduction Goal for the United States Distributed Among the States.

Although the nature of GHGs and the dangers they pose suggest that modeling and short-term ground level concentrations are irrelevant, this does not answer the question of what emissions reductions should be required. Even if the United States eliminated all emissions of GHGs, it would not achieve the reductions necessary to stabilize concentrations below the NAAQS. Thus, a specific emissions reduction goal for the United States must be determined. This plan must include reduction allocation among the states, as well as a timeline for such reductions. This decision can be guided by science, international law and the experience of the states in developing climate action plans.

To determine the national emissions reduction goal, the EPA can look to science and international law. According to the IPCC, world GHG emissions will need to be reduced by 50 to 80% by 2050 to limit temperature increases to 2ºC, and if world emissions are allocated on a per capita basis, the United States would need to reduce emissions by 83 to 96%.[166] The UNFCCC provides that the nations of the world have a "common but differentiated responsibility"[167] to maintain global GHG levels below the level that would cause "dangerous" interference with the climate system – *viz.* the NAAQS.[168] Where pollution originates outside of the United States, the Clean Air Act specifically authorizes the approval of SIPs where the "implementation plan of such State would be adequate to . . . maintain the relevant national ambient air quality standards . . . but for emissions emanating from outside of the United States."[169] Therefore, in order to determine the emissions reduction goal for the United States in light of foreign emissions, the EPA should start with a "no regrets" policy of emissions reductions that will be required of the United States under any future international scenario but in a time frame that

166 *See supra* text accompanying notes 6-7.

167 UNFCCC, *supra* note 6, at art. 3.1.

168 *Id.* at art. 2.

169 Clean Air Act § 179B(a)(2). An implementation plan must also meet the requirements set forth in the Clean Air Act, with the exception of showing attainment or maintenance by the attainment date. *Id.*

would allow the United States to achieve those reductions under the most likely alternative scenario, as discussed further below.

For the purpose of determining the emissions reductions that would be required nationally, the EPA can consider the experience of the states that have adopted a similar approach. These states have adopted the goal of reducing emissions levels by eighty percent from 1990 levels by the year 2050, with consistent intermediate goals for 2020 or 2025.[170] There is general agreement that worldwide emissions of GHGs will need to be reduced by eighty percent from 1990 levels by the year 2100, perhaps even by 2050, in order to stabilize atmospheric levels near a 450 ppmv CO_2e range.[171] Internationally, there has been a dispute as to whether reduction obligations should be based on pro rata reductions (equal percentage reductions for all), reductions necessary to provide for equal per capita reductions, or programs under which developed nations responsible for past buildup of carbon dioxide emissions reduce their emissions *beyond* their per capita share to account for past disparities in emissions. If a per capita allocation is adopted the United States would need to reduce emissions by an additional two-thirds and under the third distribution scenario even further. Achieving the minimum eighty percent pro rata reduction that will be required of the United States by mid-century would put the United States on a path that will allow it to achieve the reductions necessary by the end of the century under the other two allocation scenarios.

While a 2050 goal is useful for identifying the ultimate emissions reduction goal, it is well beyond a useful planning timeline. Initial goals for recent state climate plans have therefore focused on reductions required by 2020 or 2025. States have found that a ten to fifteen year planning horizon will be necessary for implementation, since uncertainties regarding effectiveness of

170 These intermediate goals have generally represented the goals of the various state climate plans, which are summarized in Appendix 1. These goals have varied, in part due to the varying growth rates of the states, but generally at least require reductions of emissions to levels at or ten percent below 1990 or 2000 levels by 2020. *See infra* app. I.

171 *See, e.g.*, Governor of Florida Exec. Order No. 07-127, *available at* http://www.flclimatechange.us/ewebeditpro/items/O12F15074.pdf (setting reduction target of eighty percent by 2100). The IPCC suggests that worldwide emissions will need to be reduced between fifty and eighty percent by 2050 to stabilize emissions. *See supra* note 7 and accompanying text.

selected measures and changes in technologies will require plan revisions and enable more ambitious goals to be achieved cost effectively in later years. While the Clean Air Act generally requires that actions take place within a certain number of years after a trigger rather than a specific year,[172] establishing nationwide emissions reduction goals necessary to stabilize GHG concentrations at or below the NAAQS will require the establishment of firm goals with specific dates.[173]

The EPA could utilize existing state and federal GHG inventories and forecasts to determine actual and state-by-state emissions reductions necessary to achieve the required national emissions reduction goals and develop a strategy under the Clean Air Act to meet the goals by a mix of federal and state efforts. This mix would include categorical federal emissions standards under sections 111, 202, 213, and 231 of the Clean Air Act for new sources,[174] and state climate plans that will select a portfolio of actions appropriate for each state, including sectoral cap-and-trade programs which may be adopted by states under section 110(a)(2)(A) of the Clean Air Act[175] for the sectors that each state determines could most readily take advantage of a cap-and-trade program.

The EPA could allocate the national emissions caps among the states based on their current emissions, adjusted by population projections. The EPA could also calculate expected emissions reductions from categorical standards which it expects to establish. SIPs could then be required to designate the mix of measures calculated to achieve the additional reductions beyond EPA categorical standards required of each state in order to meet the state's reduction goal. Thirty-one states have already started or successfully completed plans using this methodology, and developed portfolios of proposed measures that can cost effectively reduce emissions to meet goals consistent with the

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172 *See, e.g.*, Clean Air Act § 172 (calling for attainment of primary standards within five years of designation of an area as non-attainment).

173 Requirements in the Clean Air Act for updating SIPs are still appropriate under this formulation, since reassessment will be required as new information becomes available (including information on the efficacy of the selected GHG emissions reduction measures initially selected in a state's SCIP).

174 Clean Air Act §§ 111, 202, 213, 231.

175 *Id.* § 110(a)(2)(A).

minimum eighty percent pro rata reduction required of the United States by mid-century.[176]

C. A Workable Structure for State Climate Implementation Plans Including an Effective Cap-and-Trade Mechanism Can Be Implemented Under Existing Clean Air Act Authority.

Planning represents a tool that can be used to help coordinate the many diverse laws and measures required to achieve the emissions reductions necessary to satisfy the "no-regrets" GHG emissions reductions required of the United States.[177] State plans are particularly appropriate given differences among the states in land use law, transportation law, utility law, municipal law, and finance law, as well as differences in climate and resources. The state implementation planning mechanism can be adapted and used to craft a state-by-state approach that will not only provide a workable program for addressing the problem of climate change, but will produce the most cost effective mix of mechanisms for addressing the issue across all economic sectors.

The current regulations governing the content of SIPS and the procedures for their development are ill suited to the development of plans for GHG emissions reductions as described here.[178] To best realize the advantages, new regulations will be needed for SCIPs. At a minimum, these would need to specify the emissions reductions required for each state and direct that an SCIP designate the mix of measures appropriate for the state that can achieve the emissions reductions necessary to meet the goals by the initial intermediate deadline.[179] The plans could include any mix of measures that EPA and the state determine are appropriate, but the regulations could describe the types of measures to be included. A successful plan would need to include: methods to reduce demand for electricity sufficient to facilitate reduction of emissions reductions in the utility industry; methods to reduce

[176] *See supra* text accompanying note 74.

[177] *See supra* notes 27-28.

[178] 40 C.F.R. pt. 51 (2008). The current regulations focus on modeling, new source review, and designation of implementing regulations and laws. *Id.*

[179] As noted above, this would be established as a 2020 or 2025 emissions reduction goal. *See supra* note 7 and accompanying text.

emissions in areas where categorical federal standards might not apply, such as land use and transportation use, agriculture, forestry and waste, heating and cooling in residential and commercial buildings, and building codes; methods to facilitate implementation of GHG reduction measures such as financing techniques and other incentives; any emissions limitations more stringent than the federal program; methods to implement a cap-and-trade program, including which sectors would be covered for the state, number of allowances that will be provided, and methods of allocating the distribution of emissions allowances; and methods to implement the EPA's categorical standards. These plans should *not* require air quality modeling or any analysis of local air quality impacts (which are irrelevant to GHGs), but would need to examine cost effectiveness and potential emissions reductions from the recommended measures.

The regulations could also specify other procedures and criteria that have made state climate planning processes successful. To make the plans most effective, the SCIP regulations could require that SCIPs be developed with the broad stakeholder input provided in the current state climate planning processes. For example, state climate plans have typically been developed by stakeholders and technical working groups (TWGs), which assess, develop and evaluate GHG reduction measures in the relevant socio-economic sectors: energy supply (ES); transportation and land use (TLU); residential, commercial and industrial facilities and processes (RCI); agriculture, forestry and waste (AFW); and cross-cutting strategies. The state processes have engaged stakeholders from the relevant technical areas and interest groups in a stepwise process for developing and evaluating reduction options. In the twenty state plans used for scale up analysis in this article, 1,200 stakeholders and TWG members were involved in selecting, designing and analyzing roughly 900 specific policy recommendations combined. These intensive technical collaboration processes identify, from a list of over 350 policy options, those most appropriate for the TWG and the state, and make those options priorities for analysis. The priorities are analyzed for GHG reduction potential, cost-effectiveness, co-benefits, feasibility and other criteria, and are either retained or rejected for further analysis. Regulations for SCIPs could direct that state processes consider reductions in all of these areas and include measures to assure that stakeholder input is provided in the formulation and analysis of options. The traditional notice and comment approach to public participation will not generate the quality of information that early engagement in a planning process provides.

The regulations should also provide for a modified two phase plan development and submission process. Because measures for GHG emissions reductions span all areas of the economy, California found that a two phase planning process was useful for the design and implementation of its economy-wide program, developing a conceptual plan followed by specific regulations.[180] Other state planning processes began similarly. An analogous approach would be useful for SCIP development and approval. Under this approach, in the first phase, a state would adopt and submit to EPA for approval a conceptual plan outlining the portfolio of proposed GHG reduction measures, the cumulative emissions reductions that they would achieve, their projected costs (positive or negative), and feasibility. In the second phase, the state would submit the actual implementation mechanisms (laws and regulations, including methods for implementing any cap-and-trade system and allocating emissions allowances). Upon submission of individual implementation measures consistent with the conceptual plan, the measures would become part of the SIP and federally enforceable.[181]

Cap-and-trade and other market-based programs will, in most cases, be a part of the mix of measures that will be selected to achieve a state's required emissions reduction. Cap-and-trade and other market-based programs may be made a part of an SIP under the express authority of section 110(a)(2)(A) of the Clean Air Act. [182] Virtually all of the states that have adopted state climate plans have included cap-and-trade and other market-based mechanisms as part of those plans. Many of the states that have developed climate plans are also participating in regional cap-and-trade programs. EPA can utilize the section 110 planning process and

180 *See* CAL. AIR RESOURCES BOARD, CLIMATE CHANGE PROPOSED SCOPING PLAN 1 (2008), *available at* http://www.arb.ca.gov/cc/scopingplan/document/psp.pdf (adopted pursuant to the California Global Warming Solutions Act of 2006, CAL. HEALTH & SAFETY CODE §§ 38500-38599).

181 *See* Clean Air Act §§ 113, 304.

182 *Id.* § 110(a)(2)(A).

its approval authority to coordinate these market mechanisms into a national cap-and-trade program.

Regulations setting forth minimum performance criteria for a cap-and-trade system that could be approved by the EPA as a part of an SCIP under section 110(a)(2)(A) of the Clean Air Act[183] would also be necessary to assure that state cap-and-trade programs are integrated into a national program. In defining the performance criteria for a federal cap-and-trade program, these regulations should define the type of system that the EPA would impose in a federal implementation plan should it be required to promulgate one, including the method by which the EPA would allocate emissions allowances to sources within the state covered by the FIP cap-and-trade program.

Upon approval of a state's SCIP with a cap-and-trade strategy that will achieve all the required reductions required for the state (through both other measures and the cap-and-trade) or promulgation of a FIP with a cap-and-trade program, the credits that would be created and allocated by the state would become federal credits that could be traded among all states with SCIP-approved cap-and-trade programs. If a state chose to allocate by auction, the credits created could be auctioned in a single federal auction, as is done under the RGGI program and is contemplated for the WCI program. To account for the fact that electricity is traded across state lines, it will be necessary to require that states achieve reductions on the basis of both Type 2 (demand based) and Type 1 (direct) emissions.[184] State plans have developed mechanisms to avoid "leakage," or, in this case, the transfer of emissions to an out-of-state source; requiring reductions on both bases will avoid these problems.

In developing a cap-and-trade program, it is important to maintain flexibility so that existing programs can be retained and incorporated into a federal program and so that states can select the most appropriate mix of market and non-market mechanisms in light of each state's legal structure. The performance criteria could achieve this by allowing automatic approval of existing

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183 *Id.*

184 *See* THE CLIMATE REGISTRY, GENERAL REPORTING PROTOCOL FOR THE VOLUNTARY REPORTING SYSTEM § 5.1 (2008), *available at* http://www.theclimateregistry.org/downloads/GRP.pdf.

programs, including the WCI and RGGI regional cap-and-trade programs.[185] Efficiency could be assured if the program allowed the states flexibility to decide what elements of their GHG emissions reduction programs should be satisfied by a cap-and-trade program. *The EPA would only approve a SCIP if the combination of the cap-and-trade program and other measures specified by the SCIP were calculated to achieve the cumulative reductions required for that state.* However, after the EPA has approved a program defining how credits could be used within the state and how many credits would be generated and allocated by the state, credits could be freely bought and used throughout the national system. This flexibility would likely produce a more cost effective GHG emission reduction program than would a one-size-fits-all program, since differences in state legal systems and differences in where emissions reductions can be achieved often will require different mixes of cap-and-trade and other measures.[186]

This approach, which leaves considerable flexibility to the states, has several advantages over alternative mechanisms discussed in the ANPR. First, it provides a mechanism consistent with the statutory authority provided currently under the Clean Air Act. As noted, section 110 of the Clean Air Act specifically allows SIPs to include market mechanisms, and such mechanisms have successfully been used to address NO_x reductions in the past. Although the United States Court of Appeals for the District of Columbia invalidated a federally created cap-and-trade system for other criteria pollutants established by the CAIR in *North Carolina v. Environmental Protection Agency*,[187] this case is distinguishable because of the context in which the decision arose and the differences between GHGs and the pollutants at issue in *N.C. v. EPA*. The CAIR was adopted to address instances where interstate transport from one state to another interfered with attainment of NAAQS in the second state.[188] The court focused on the fact that with a cap-and-trade program, there can be no assurances that emissions from individual sources in one state

185 Rose et al., *supra* note 91.

186 *See, e.g.*, LITZ & ZYLA, *supra* note 79.

187 N.C. v. EPA, 531 F.3d 896 (D.C. Cir. 2008).

188 *Id.* at 903.

would not cause violations of local, ground-level NAAQS or interfere with maintenance of those local, ground-level concentrations in another state.[189] As noted, local, ground level concentrations of GHGs are irrelevant to the atmospheric standard for GHGs.[190] The harm to public welfare from GHG pollution does not arise from local and temporary exceeding of a GHG concentration, but from GHGs exceeding the NAAQS throughout the atmosphere after long-term mixing.[191] Moreover, because the SCIPs would be designed to reduce emissions to levels required of the United States for maintenance of NAAQS set at a concentration above current atmospheric levels, a cap-and-trade program represents a logical and legal mechanism to maintain overall levels below the NAAQS in the long run. These differences would support the establishment of a national maintenance plan based on emissions loadings, would support the establishment of a cap-and-trade program as a mechanism to maintain levels below the NAAQS, and make the CAIR Decision distinguishable from the case at hand.[192]

Second, establishment of a cap-and-trade program as an SIP element will allow a wider and more effective use of market-based mechanisms than the alternative approach under section 111(d) of the Clean Air Act[193] and would be more consistent with the law. The EPA and some non-governmental organizations have suggested that establishing a cap-and-trade program under section 111(d) would be preferable to utilizing the section 110 mechanism. This approach suffers first from the infirmity that it is inconsistent with the statute. As noted, the EPA is legally required to list GHGs under section 108 of the Clean Air Act and therefore, the EPA cannot proceed under section 111(d).[194] Second, section 111(d) will limit the use of cap-and-trade to stationary sources, which represent only a fraction of the important GHG emissions. Significant emissions of GHGs arise from residential, commercial, and industrial space heating, as well as from mobile sources, the

189 *Id.* at 907.

190 *See supra* text accompanying note 77.

191 *Id.*

192 *Id.*

193 Clean Air Act § 111(d), 42 U.S.C. § 7411(d) (2006).

194 *See supra* notes 107, 118 and accompanying text.

inclusion of which in a cap-and-trade program developed under section 111(d) may be problematic. The WCI has sought to include these sources in phase two of its cap-and-trade program by imposing requirements upstream, at the point of sale of fuel products,[195] but that approach would not be authorized under section 111(d).[196] A section 111(d) approach suffers from the third infirmity in that it could not be supported by the other state planning measures that will make a cap-and-trade approach most effective.

Third, since the RGGI cap-and-trade program is already in place, and the WCI cap-and-trade program has already been designed, with implementation and reporting scheduled to begin in 2011,[197] applying cap-and-trade through the section 110 mechanism will provide fast results.

Fourth, preserving these existing programs will allow states to continue to generate revenues from the auctions of allowances. These revenues are being used to fund other programs that will reduce GHG emissions, assist with adaptation or mitigate adverse impacts of regulation or climate change.

The mechanism suggested here is similar to that which the European Union has adopted in which member nations are assigned emissions reduction caps and the emissions attributable to the sources that each state decides will be covered by cap-and-trade are included in a trading program.[198] The European cap-and-trade program supports a robust emissions trading program on the European Climate exchange,[199] and many of the European nations will achieve their Kyoto Protocol emissions reduction targets under this system.[200] The system suggested here, with EPA oversight and the ability to approve and disapprove state climate

195 WESTERN CLIMATE INITIATIVE, DESIGN RECOMMENDATIONS FOR THE WCI REGIONAL CAP-AND-TRADE PROGRAM 22 (2008), *available at* http://www.westernclimateinitiative.org/ewebeditpro/ items/O104F19865.PDF.

196 Clean Air Act § 111(d).

197 Western Climate Initiative, *supra* note 195, at 43.

198 *See supra* note 80.

199 *See* European Climate Exchange, http://www.europeanclimateexchange.com/ default_flash.asp (last visited Mar. 26, 2009).

200 *See* UNFCCC, National Reports, http://uncfccc.int/national_reports/items/1408. php (last visited Mar. 26, 2009) (collecting the National Reports documenting progress in meeting Kyoto Protocol emissions reduction targets).

plans and impose an FIP, will provide greater coordination than the EU system.

As discussed further in the next section, allowing states to select the range of measures that is most appropriate, including the areas to be addressed by market and non-market mechanisms, will promote economic efficiency by allowing selection of least-cost mechanisms.

With the foregoing structure, the EPA could modify the existing NAAQS and SIP mechanism provided by sections 108 through 110 of the Clean Air Act to make it fully workable for achieving GHG emissions reductions in a flexible and cost effective manner.[201] The effectiveness of the procedures described here has been established through numerous state climate planning processes, and the program is similar to those that have been effective for EU nations.

V. Allowing States to Select the Mix of Measures and Policy Instruments to Achieve Reductions Will Produce the Most Cost-Effective Approach to GHG Emissions Reduction.

Relying on state plans to specify a mix of measures will promote the most economically efficient approach to achieving necessary GHG emissions reductions and can assist in promoting economic recovery and development. Each state has important differences in climate, resources, industry mix, transportation and legal structures for local governments, public finance, and utility regulation. Because of these differences among the states, individualized consideration of the mix of GHG emissions reduction measures, strategies and market and non-market

201 There may be concerns about the speed with which this system could be established. In developing SCIP-specific regulations, the EPA could introduce new measures that would allow it to take full advantage of the expertise that has been developed by the state experience. Many states have used third party organizations such as the Center for Climate Strategies to provide expert facilitation. *See* The Ctr. for Climate Strategies, http://www.climatestrategies.us/ (last visited Mar. 26, 2009). The EPA could certify these organizations and then provide for expedited approval of the phase one conceptual plans, where these organizations certify that the appropriate procedures have been followed, the required analyses have been performed, and the measures designated in the plan will achieve or exceed the reductions required for the state. The EPA could then approve state conceptual plans based on these third party certifications.

approaches appropriate for each state will produce a more cost-effective approach than a federal one-size-fits-all approach.

The benefit of a comprehensive federal system that coordinates and incorporates individual plans is evident from consideration of two studies that we and others have conducted for the Center for Climate Strategies and will present here. First, we have developed cost-effectiveness curves for the individualized climate plans that have been developed by twenty states, and have scaled those experiences up to demonstrate the GHG emissions reduction that could be achieved if this planning process were implemented in all fifty states, including the cost-effectiveness of those reductions. Second, we have analyzed the individual policies developed by states for their potential for economic development and implementation by state, local and federal levels of government. The latter study makes it clear that significant state and local involvement is critical to the success of a cost-effective program for GHG emissions reductions in the United States.

A. *Scale-up of Twenty State Plans and Cost-Effectiveness Analysis.*

Relying on the latest data available from the twenty states that have completed quantified climate plans and associated policy portfolios, we have constructed a model that scales up and projects their combined economic impacts and opportunities to a national level. The preliminary analysis, summarized here and presented in detail in the appendix, suggests that by adopting a portfolio of climate change mitigation policies touching every sector of the economy, the United States can stimulate the economy toward recovery, cut consumption of fossil fuels, and reduce GHG emissions simultaneously. The quantified result is graphically represented by the following "marginal cost curve."[202] This curve suggests that if portfolios of similar policies were developed by all

202 The cost curve has been constructed from a series of line segments joined together. Each line segment that has been plotted refers to a specific recommended policy action (from a state climate plan) defined by two attributes. First, the length of each line segment is determined by the GHG emission reduction potential of the related policy option (the longer the line segment, the greater the emission reduction). Second, the cost curve shows the potential net cost or savings associated with each policy measure. If the policy measure saves money on a net basis, its line segment finds its place below the "0" line. If it costs money or requires investment on a net basis, it finds its place as a line segment above the "0" line.

fifty states with coordination by the federal government, the United States could reduce GHG emissions to 10% below 1990 levels by 2020 at an estimated net economic savings of $20.8 billion in 2012 and $85 billion in 2020, and from 2009 to 2020 cumulative net savings of $535.5 billion, through implementing a climate plan involving all states and economic sectors. These results do not include additional economic benefits associated with avoidance of climate change damages: improvement in health or air quality, land protection, creation of jobs, local community investment, improved energy independence, or other co-benefits.

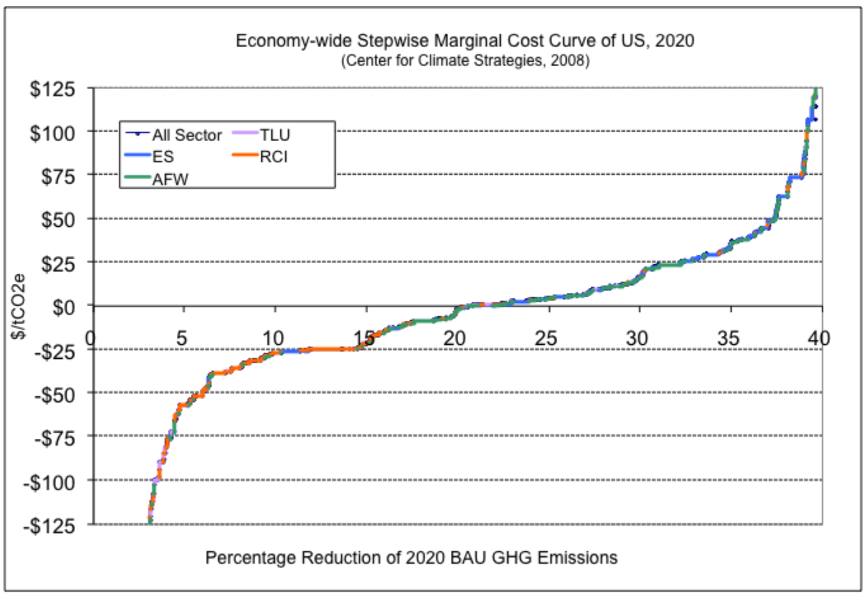


Figure 1. Stepwise Marginal Cost Curves for the U.S., 2020[203]

This portfolio of climate policies[204] selected by each state returns greater savings (area below "0") than it expends in costs (area above "0") and, if fully implemented at an equivalent level in all fifty states, would reduce emissions to 10% below 1990 levels

203 AFW=agriculture, forestry, and waste management; ES=energy supply; RCI= residential, commercial, and industrial; and TLU=transportation and land use.

204 An example list of the policy measures for the state of Florida included in the cost curve can be found in the detailed analysis in Appendix I.

by 2020.[205]

A growing body of related economic analysis indicates that these climate policies could have a significant and beneficial effect on job creation and overall economic development.[206] Two important forces are at play. First, actions that reduce energy demand and/or infrastructure expenses save money at a business, household, and consumer level. By freeing up scarce capital for other uses, these actions have an expansionary effect on the economy. In many cases, they also have an economic stimulus effect through investment in labor-intensive installation of new energy efficient equipment, buildings and facilities. Second, actions that shift energy supply away from conventional fossil fuel sources to renewable and alternative sources typically result in proportionately higher use of labor per unit of energy produced. The higher cost of production for some of these options also results in more highly leveraged investments in job creation. This is even more pronounced when new domestic energy supplies replace imported energy.

To examine the potential impact on economic development, our scale-up analysis also analyzed 900 policies from the twenty states and grouped them into eighty bundles of similar policies.[207] This analysis revealed that these policies could be powerful economic drivers while providing significant progress in reducing GHG emissions. Forty-four of the bundles, more than half, could move funding into the economy within a one year period and thus

205 It is worth noting that the assumptions behind the state climate plans are conservative and have been overtaken by recent events. We are in the process of revising this analysis by inserting into the model higher fuel prices more reflective of current market conditions. It is safe to assume that this would increase the savings side of the cost curve, as the value of energy efficiency gains would be even greater than they already are. We are also revising estimates of projected greenhouse gas emissions levels to take the economic slowdown into account. Since emissions will rise at a slower rate, the impact of reductions as a percentage of the total carbon footprint will likely be more significant. In short, we expect the new analysis to point to the potential for even steeper emissions reductions and even greater net economic benefit. In addition, some important emissions reduction actions in state plans do not provide numerical estimates of costs but were expected to provide net savings or low costs. These actions are not included in the current cost curve and would expand its coverage and reduce its overall costs.

206 Many state governments have taken action on climate change as an economic development tool. *See supra* note 14.

207 *See* CTR. FOR CLIMATE STRATEGIES, POL'Y & PROGRAM OPPORTUNITIES, *supra* note 15 *passim*.

could be used for immediate economic stimulus. Sixty-eight of the policy bundles, or roughly eighty-five percent, had high to moderate job creation potential. Ten of these policies had the capability of producing three million tons or more of CO_2e emissions reduction.[208]

B. Economic Development Benefits from State Climate Change Plans–North Carolina and Arizona.

The results of state climate action plans show that economic development benefits can result from specific sector-based policies and measures for these reasons, and others. This is exemplified by detailed analysis of the results of the planning processes in North Carolina and Arizona.

In 2008, the North Carolina Climate Action Plan Advisory Group proposed fifty-six comprehensive climate mitigation action recommendations in all economic sectors, which are estimated to reduce GHG emissions in North Carolina to within 1% of 1990 levels by 2020.[209] An economic analysis of thirty-five quantified recommendations revealed that they will yield a net savings of over $5 billion (net present value over 2007-2020); create more than 15,000 jobs, generate $565 million in employee and proprietor income, and increase $302 million in gross state product by 2020; generate more than $2.2 billion in net additional employee and proprietor income, and more than $1.2 billion (net present value) in net gross state product over the 2007 to 2020 period.[210]

These figures represent net impacts. There are sectors and individual companies that will incur increased costs and decreased jobs. These losses and costs will be more than offset by gains by other companies, individuals, and sectors. The state-by-state planning approach can minimize some of these impacts by selecting the most cost effective measures by sector and can also identify mitigating measures.

208 *Id.*

209 N.C. CLIMATE ACTION PLAN ADVISORY GROUP, RECOMMENDED MITIGATION OPTIONS FOR CONTROLLING GREENHOUSE GAS EMISSIONS (2008), *available at* http://www.ncclimatechange.us/capag.cfm.

210 DAVID PONDER, JEFFERY TILLER & JASON HOYLE, SECONDARY ECONOMIC IMPACT ANALYSIS OF GREENHOUSE GAS MITIGATION OPTIONS FOR NORTH CAROLINA 3-4 (Oct. 2008), *available at* http://www.ncclimatechange.us/ewebeditpro/items/O120F19986.pdf.

These points can be exemplified by consideration of two North Carolina examples: the portfolio of policies selected in that state's planning process for the residential, commercial and industrial (RCI) sector, and one specific option that was recommended by the North Carolina climate action plan.

Table 1 presents summary results for the RCI mitigation options analyzed in the North Carolina climate action plan. By 2020, these options would result in the net creation of more than 9,100 jobs, $364 million in additional employee and proprietor income, and $42 million in net gross state product. Over the study period, 2007–2020, the options would generate $1.9 billion (net present value) in additional employee and proprietor income and $937 million (net present value) in gross state product. The economic impacts associated with these options are driven primarily by energy bill savings resulting from energy efficiency measures.

Table 1: Summary Results for North Carolina Residential, Commercial and Industrial Climate Mitigation Policy Options[211]

Residential, Commercial and Industrial Options	Net Annual Employment (FTE)			Net Income ($2004, million)				Total Value-Added ($2004, million)			
	2010	2015	2020	2010	2015	2020	2007-2020 NPV	2010	2015	2020	2007-2020 NPV
RCI 1, 2 & 11 (Efficiency Funding & Energy Audits)	1,309	3,121	4,575	45	105	160	789	18	(4)	(55)	36
RCI 4&5 (Market Transformation & Appliance Standards)		430	771		15		87		1	(11)	(9)
RCI 6 (Energy Codes)	1,964	2,076	2,163	83	86		623	96	77	57	571
RCI 7 & 3 (High Performance Buildings)	126	1,239	1,372	3	61		388	(5)	46	32	273
RCI 9 (Bulk OPurchasing & Green Power)	105	99	12	4	4	(1)	33	5	3	(5)	
RCI 10 (Solar Water Heating)	13	(4)	218	1	0	13	21	0	1	24	37

211 *Id.* at 22. "Values in parentheses identify loss of jobs, income, or [v]alue [a]dded to the economy. NPV = net present value. FTE=Full Time Equivalent." *Id.*

All RCI Policies	**3,518**	**6,961**	**9,110**	**136**	**271**	**364**	**1,942**	**114**	**125**	**42**	**937**

The results in Table 1 indicate that actions related to energy efficiency and conservation for buildings, facilities, and manufacturing in North Carolina generate net gains in employment, income, and investment. These actions also yield some of the highest GHG reductions in the state plan. This category of actions has a high potential for saving money by saving energy, starting immediately, and for freeing up scarce capital for investment that has an economic stimulus effect. Figure 2 demonstrates this graphically for income effects. All state climate action plans have found that energy efficiency and conservation measures have a high potential for net economic savings and greenhouse gas reduction. Results from North Carolina suggest that they may have broader economic benefits as well.

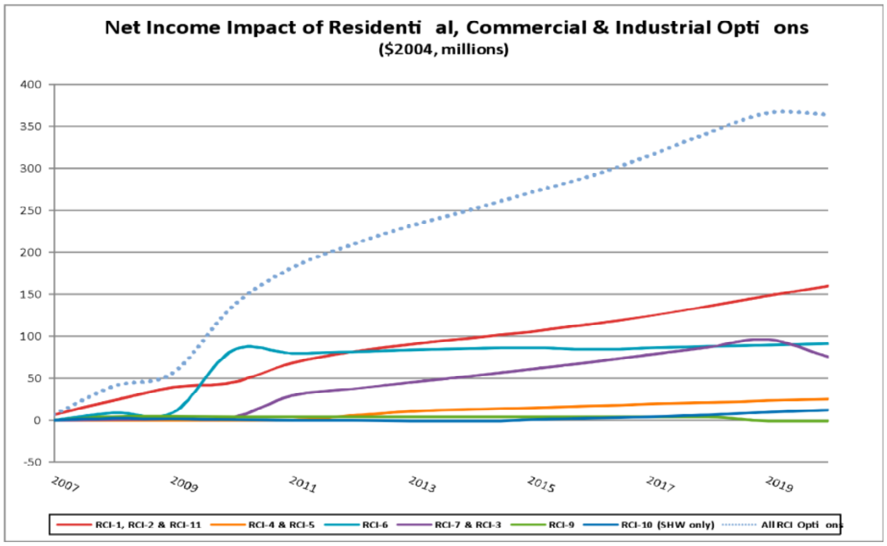


Figure 2. Net Income Gains from North Carolina Residential, Commercial and Industrial Climate Mitigation Policy Options[212]

These points are also evident from consideration of the cellulosic ethanol production subsidy recommended in the North Carolina climate action plan. This recommended policy proposes to displace ten percent of North Carolina's gasoline consumption with starch and cellulosic derived ethanol by 2010, and to increase that percentage to twenty-five percent by 2025. The option assumes a state subsidy to support ethanol producers worth $0.23 per gallon through 2015, at which time the plan assumes that technological advances will make cellulosic ethanol production costs more competitive.[213]

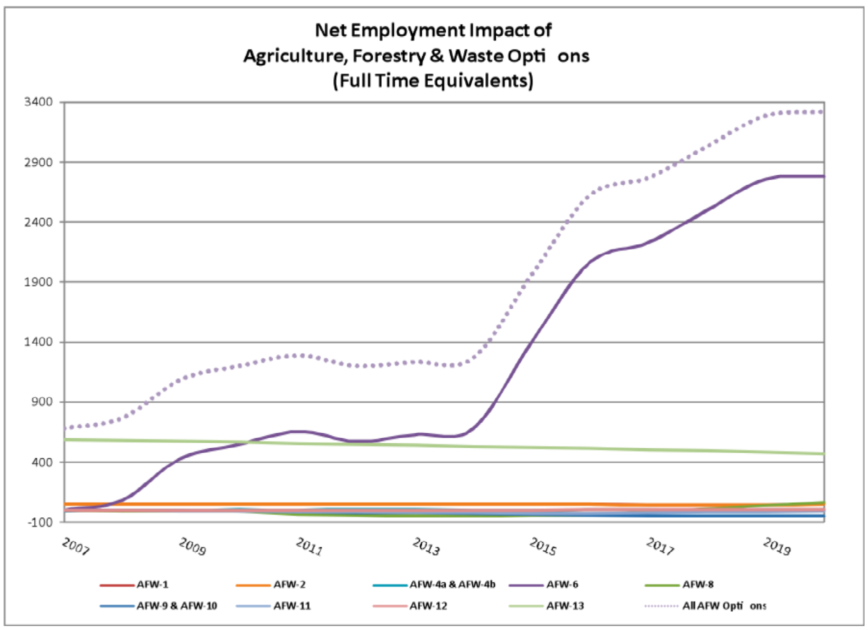
The Agriculture, Forestry and Waste (AFW) technical working group analysis that produced this recommendation quantified the cost of the subsidy, but not the value of the capital investments and operating expenses, including feed stocks, required to meet the production targets. In this study, we have relied on additional

212 *Id.* Numbers refer to specific options in this sector from the North Carolina climate action plan.

213 N.C. CLIMATE ACTION PLAN ADVISORY GROUP, *supra* note 209, at 5-11 to 5-12, 6-11.

investments research and literature to quantify these values. When all these factors are considered, this mitigation option would result in the creation of more than 2,781 jobs, $163 million in additional annual employee and proprietor income, and more than $298 million in annual gross state product by 2020. For the study period 2007-2020, the mitigation option would increase employee and proprietor income by $547 million (NPV) and gross state product by more than $1.2 billion (NPV). Figure 3 below shows the high job creation potential for this climate policy option (the solid purple line) in absolute terms as well as compared to other actions in the agriculture, forestry and waste management sectors.

Figure 3. Net Employment Gains from Actions to Expand In-State Cellulosic Ethanol Supplies in North Carolina[214]



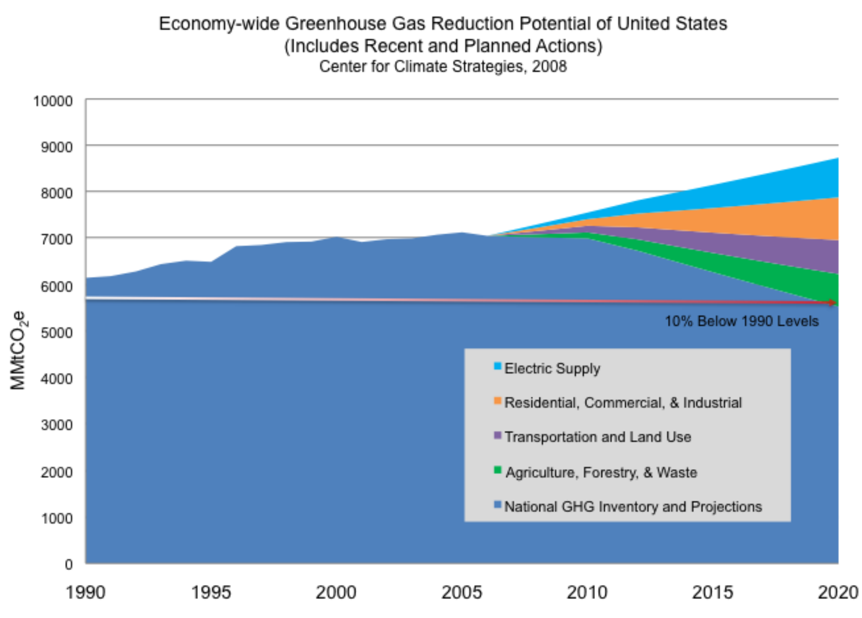
214 AFW=agriculture, forestry and waste management. Numbers refer to specific options in this sector from the North Carolina climate action plan.

Follow-up studies of the recommendations of the Arizona Climate Change Advisory Group estimated a cumulative net increase in employment associated with new clean and renewable energy supply options of 289,000 jobs by 2020. [215] In addition, policies that have the potential to save money by saving energy and infrastructure expenses are likely to have an expansionary effect on the economy by freeing up scarce capital for other uses.

C. Sectoral Contributions to GHG Emissions Reductions.

The scale-up of state data also shows that all contributions from all sectors will be required to achieve cost-effective reductions. One of the strengths of state planning is its ability to achieve reductions in all sectors, while, as discussed below, federal power may be somewhat more limited. The data from the states on a sector-by-sector basis, as shown in Figure 4, provides the estimated scale and trajectory of actions in each sector.

Figure 4. United States GHG Reductions by Sector 2009-2020



[215] Adam Rose & Dan Wei, *Economic Impacts of Climate Policies in Arizona, 2006-2020*, prepared for the Center for Climate Strategies as a supplement to the Arizona Climate Change Advisory Group Report, (Aug. 2006).

$MMtCO_2e$=million metric ton carbon dioxide equivalent

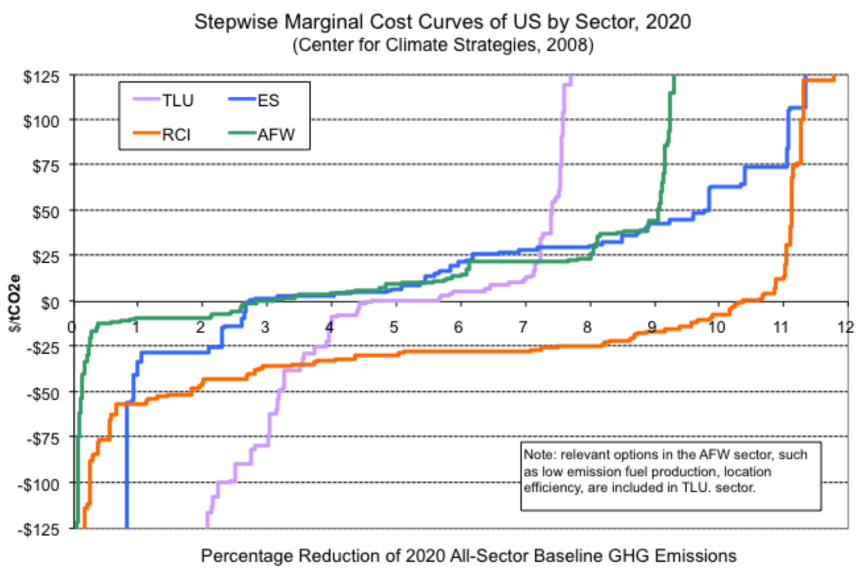
As the "wedge" graph shows, implementation of climate policy options could begin immediately and provide near term economic benefits (jobs, income, investment) as programs expand to full levels in later years. Climate change mitigation options in this analysis are grouped into one of four sector areas:

1. Transportation and Land Use (vehicle efficiency, location efficiency, and lower carbon fuels);
2. *Agriculture, Forestry and Waste* (land conservation, improved management practices, waste reduction and recycling);
3. *Residential, Commercial and Industrial* (energy efficiency and conservation, and industrial process improvements); and
4. *Heat and Power* (clean and renewable energy supplies for electricity and direct fuel use).

This sectoral snapshot shows that emission reduction opportunities are available across all economic sectors, and suggests that a comprehensive approach (i.e., all economic sectors, policy instruments, and levels of government) is critical to achieving full, cost-effective benefits for national goals. The comparison of cost curves across economic sectors and actions within each sector demonstrate that each is unique and must be addressed by appropriate policy instruments. These differences reflect choices made by stakeholders and technical work groups as they developed policy agreements. Through the stepwise process, stakeholders work to identify the most appropriate policy implementation mechanisms that simultaneously reduce emissions, reduce costs, address feasibility issues, and maximize co-benefits. To do this they match the best policy instruments (e.g., codes and standards, funding incentives, market based approaches, negotiated agreements, information and education, reporting and disclosure) with each of the underlying policy actions (e.g., advancing energy efficiency, renewable energy, transportation improvements, resource conservation, etc.) to create optimal policy design.

Figure 5. Stepwise Marginal Cost Function for U.S. Economic Sectors, 2020

Mapping Implementation Across Jurisdictions and Policy Instruments



D. Analysis of Jurisdictional Responsibility.

State climate action plans have typically found that the mechanisms needed to adopt a full range of policy solutions would be difficult to undertake by a single level of governmental jurisdiction (local, state, federal) alone.[216] For example, energy efficiencies that can be captured through improved building codes may best be determined locally, whereas improved appliance efficiency standards may best be determined at a regional or national level due to market scale issues for manufacturers and wholesalers. The result has been the development of policies that call for integrated state and national solutions. From a technical perspective, in order to attain the lowest cost approach to national emissions reduction goals, a combination of policies and measures at the state and federal levels is likely to be needed.

216 *See* Peterson et al., *Developing a Comprehensive Approach*, *supra* note 19, at 230-31.

To determine whether this perception was correct, our analysis of 900 policies from the twenty states grouped into eighty bundles also examined the level of government having jurisdiction over various climate policies. Our findings suggest that implementing climate policies without significant state and local involvement will preclude the involvement of some sectors critical to success and exclude important tools. The federal government has some role in fifty-two of the policy bundles or 65%, either through funding, implementation, or both. However, the federal government could be said to exercise exclusive jurisdiction in only three of the policy areas, less than 4%. By contrast, state governments have a role in implementing seventy of the bundles (87.5%) and arguably exercise exclusive jurisdiction in eighteen of the policy area bundles, or more than 20%. Local governments, which are creatures of state governments, have a role in twenty-two bundles and arguably exercise exclusive jurisdiction in one.[217]

In other words, a federal climate policy that engages the states and involves them actively in a partnership is not only desirable, but a necessary element of success, both in environmental and economic terms.

E. The Emissions Savings and Cost Savings Achieved Through State Planning Cannot Be Achieved Without State Level Planning.

Most importantly, this analysis shows that these emissions reductions and cost savings likely cannot be achieved without a state-by-state planning mechanism that involves stakeholders from all relevant sectors. First, they certainly cannot be achieved through simple categorical standards under section 111 of the Clean Air Act[218] and the various mobile source authorities. Some of the most cost-effective reductions are found in areas that cannot be federally mandated or even regulated under the Clean Air Act–areas such as land use, building codes, transportation controls, agriculture, and forestry. Second, even where there is regulatory authority, such as over fossil fuel-fired generating units, cost-effective reductions will require actions in areas not regulated that

217 CTR. FOR CLIMATE STRATEGIS, POL'Y & PROGRAM OPPORTUNITIES, *supra* note 15, at 5.

218 Clean Air Act § 111(b), 42 U.S.C. § 7411(b) (2006).

will reduce demand. Add-on carbon capture and storage technology is not yet feasible. Most reductions in the utility sector will need to arise from energy efficiency and conservation measures in homes, businesses, and industry; demand reduction and management; and other measures that can be regulated by states through SIPs but cannot be mandated by the federal government. Other reductions will be achieved through changing the technology of energy reduction to no carbon sources such as nuclear, wind, hydro, solar, geothermal, biomass, and tidal power. This switch will require state action through mechanisms such as utility regulation and renewable portfolio standards. These measures cannot be mandated under section 111.[219]

These reductions also cannot be achieved solely or most cost-effectively through the cap-and-trade or GHG tax mechanism without state planning that will facilitate such a market mechanism.[220] The scale-up results presented above show that there are a significant number of measures that have significant cost savings per ton of GHG emissions reduced.[221] More importantly, the modeling and analysis from state planning processes to date show that many emissions reduction measures that are cost-effective today are not being implemented, such that policies other than (or in addition to) market-based policies are likely required. This is evident from the fact that many measures have significant net negative costs per ton of carbon dioxide reduced. This can be explained by the fact that there are many market barriers and imperfections that require other, targeted measures that can best be identified in a state-specific planning process and have been identified in many state plans to date.[222] These include the following:

Lack of knowledge. For example, many builders will not incorporate energy saving into new construction, even where cost effective, because buyers lack information about the relationship between the additional capital costs, energy savings, and rate of return.[223]

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219 Clean Air Act § 111.

220 Doremus & Hanemann, *supra* note 25, at 811-16, 826-30.

221 *See supra* notes 14-16 and accompanying text.

222 *See* Rose et al., *supra* note 91.

223 William H. Golove & Joseph H. Eto, MARKET BARRIERS TO ENERGY EFFICIENCY: A CRITICAL REAPPRAISAL OF THE RATIONALE FOR PUBLIC POLICIES TO PROMOTE ENERGY

Lack of connection between capital and operating budgets/decisions. There are many systemic problems that separate decisions on capital and operating costs, such that cost effective investments may not be made. For example, net commercial leases may make the owner responsible for capital improvements and the lessee responsible for energy costs.[224] Lenders often do not look at operating costs from energy savings in the determination of how much to lend for a mortgage on a new or existing home.[225] Typically, governments and industry alike will have different parts of the organizational structure making operating and capital decisions.[226]

Legal authorization barriers. Sometimes states lack authorization for mechanisms that can provide the financing for the capital requirements to improve energy efficiency or conservation. For example, local governments may face bond caps that prevent them from raising capital that will have very short payoff periods and require legislation to allow energy increment financing. Only a few states have authorized energy efficiency utilities.[227]

Inability to pass through increased carbon emission costs. Each state has a separate program of utility rate regulation that often can impose limits on utilities' ability to pay costs or to obtain a return on cost-effective energy efficiency and conservation measures.[228] These barriers, addressed by multiple measures in state plans, could not be addressed under the existing federal law and are unlikely to be addressed in any federal climate legislation.

Inability to aggregate capital for many small actions. Many of the most cost-effective measures will need to be implemented by homeowners and small businesses who may not have immediately

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EFFICIENCY 36-44 (1996), *available at* http://eetd.lbl.gov/ea/emp/reports/38059.pdf.

224 *Id.* at 9-10.

225 *Id.* at 10.

226 *See id.* at 30.

227 The first such utility is Efficiency Vermont, established in 2000 pursuant to 30 V.S.A. § 209 (1999). *See also* CVR § 30-000-051 (2009). Delaware has also established a Sustainable Energy Utility (SEU), 29 Del. C. § 8059 (2008).

228 *See* NAT'L ACTION PLAN FOR ENERGY EFFICIENCY, UNDERSTANDING COST-EFFECTIVENESS OF ENERGY EFFICIENCY PROGRAMS: BEST PRACTICES, TECHNICAL METHODS, AND EMERGING ISSUES FOR POLICY-MAKERS 6-1 to 6-10 (2008), *available at* http://www.epa.gov/cleanenergy/documents/cost-effectiveness.pdf.

available capital. Mechanisms such as low and no interest loan funds or energy efficiency utilities can be set up to aggregate capital for many small projects that are unlikely to be implemented without these measures.

Uneven distribution of costs and benefits. In many cases, costs and benefits are not distributed equally, so that the party making the critical decision may face perverse incentives. For example, auto emissions standards produce significant net societal savings but the manufacturers of automobiles have resisted building small or energy saving vehicles because their profit margins are higher on larger vehicles and they face retooling costs.

Lack of a market. Many cost-effective measures are not implemented because there is no market. This is particularly true of land use decisions and transportation decisions, which are dictated by state and local decisions on land use regulation and infrastructure investments.

These barriers present problems not just for federal cap-and-trade but other federal legal tools, particularly in the area of electricity generation. For example, establishing an emissions standard for fossil fuel-fired electric generating units is unlikely to encourage energy efficiency that will reduce demand for fossil fuel-fired generation. Planning is a necessary element if the necessary links and choices are to be made. State-level planning is necessary because many of the links fall within areas traditionally left largely or exclusively to state and local governments.

As is evident from CCS' analysis of state, federal, and local jurisdiction over climate matters, while state planning is a necessary element, it is not solely sufficient to achieve GHG emissions reductions cost-effectively. Federal oversight and coordination establishing floors and coordinating strategies and a federal-state-local partnership are necessary. The SCIP approach suggested here, including giving each state the discretion to determine the scope of the cap-and-trade program, the methods for allocation of emissions allowances and use of revenues, and the mix of other measures, will allow each state to adopt the mix of measures that will be most cost-effective and most legally effective in light of that state's unique characteristics.

This careful consideration of the appropriate mix of measures can best be achieved through an individualized state-by-state planning process for four key reasons:

1. Emissions reductions delivered through non-market sector-based policies and measures at the state and federal level reduce emissions and thereby relieve pressure on a cap-and-trade program (or other market based mechanisms) to deliver economy-wide emissions reductions entirely on its own.
2. Specific policies and measures, properly designed, can reduce barriers to efficient GHG emissions markets by using "non-price" policy instruments where emission prices are not likely to be fully effective at stimulating behavioral response, and by otherwise addressing specific market imperfections and failures (such as split incentives). In so doing, they reduce the cost of national cap-and-trade or GHG tax programs that rely solely or primarily on efficiently priced markets and mechanisms.
3. Sector-based policies and measures developed at the state level also can assure the full level of effort needed to reach economy-wide emissions reduction targets if a federal cap-and-trade or GHG tax program does not fully cover all economic sectors.
4. Sector-based policies and measures developed by states through the climate planning process described above provide a means to achieving co-benefits (e.g. health, energy security) by selecting policies using a broader set of criteria than "cost per ton of GHG emissions reduced."

These issues highlight the importance of constructing a comprehensive policy portfolio that appropriately matches responsibility for policy implementation with the appropriate jurisdiction level and policy instruments – recognizing that overlap is inevitable and integration is important. The requirements for planning to develop an appropriate policy design for GHG emissions in each state with federal oversight and coordination contained in section 110 of the Clean Air Act provide a medium to accomplish this.

VI. Conclusion

Thus, there are important economic and environmental advantages in preserving existing state and regional programs and planning within the structure of the Clean Air Act. Under the structure proposed here, the EPA would need to undertake a number of specific duties that would create a federal construct and federal floors. It would establish technology-based standards for appropriate sectors (automobile, off road vehicles, some stationary sources, best energy management practices for buildings pursuant to new source review requirements). It would also be responsible for establishing new standards for GHG state implementation plans in an SIP call or other implementing regulations. The EPA would determine and assign state-by-state emissions reduction goals, establish the standards for a national cap-and-trade program that states would adopt under section 110(a)(2)(A) of the Clean Air Act,[229] the standards for approving state climate plans, and standards for the contents of an FIP. It would then be responsible for reviewing and approving state plans and developing and imposing an FIP for states that fail to act.

States would be responsible for doing what they do best, developing and implementing the SCIPs. Based on the California experience, it would likely be more effective for states to first develop a conceptual plan very much like those developed to date. After submitting conceptual plans to the EPA, the states could then adopt or propose the specific implementation measures that would become part of the SIP in a second phase. The state plans would (1) select and describe a mix of market and non-market mechanisms appropriate to meet emissions reduction goals (after considering federal reductions) established by the EPA, and (2) where cap-and-trade is selected as one of the measures, determine what sectors would be covered, the point of regulation, and allocation mechanisms. The EPA would not approve an SIP (or a cap-and-trade element) unless the mix of measures selected in the state plan achieved the necessary reductions.

This type of cap-and-trade would work similarly to the successful EU trading program, where the individual nations are given allocations that are met through a mix of market and non-market mechanisms. Upon federal approval of the conceptual SIP

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229 Clean Air Act § 110(a)(2)(A), 42 U.S.C. § 7410(a)(2)(A) (2006).

and the implementing measures, a state's cap-and-trade allocations would become part of the federal system and could be traded nationwide and used in each state according to the use approved in the receiving state's SIP. Reductions outside of the allowance system could not create offsets. If a state fails to submit a suitable SIP, the EPA may designate an FIP, with allowances allocated to emitters covered by the cap-and-trade portion of the FIP.

Given this structure, and based on the states' experience with auctioning allowances, all existing incentives for responsible state action would be retained and there would be incentives beyond those for existing SIPs. A plan developed by state stakeholders will be more likely to gain their acceptance and that of state lawmakers. More importantly, the state will be able to use revenues from allowance auction revenues, while, if the federal government promulgated an FIP under the current Clean Air Act authority (in the absence of new implementing legislation), it would lack authority to auction allowances, which would be awarded to existing covered facilities free of charge, so that the state would receive no revenues. These revenues and other measures can be used to spur new industries with significant economic development potential, as evidenced by the CCS studies. This program would also maintain all existing enforcement mechanisms and incentives under the Clean Air Act, which have achieved significant improvements in air quality for other criteria pollutants.

Thus, there are multiple advantages for preserving state planning and implementation responsibility under this structure. State and local planning will: (1) promote economic efficiency and greater economic development potential; (2) produce greater stakeholder acceptability; (3) be more likely to be effective because it addresses sectors where the federal government cannot or will not regulate and will approach the problem with a scalpel rather than a meat ax; (4) preserve existing progress at state level; and (5) rely on better state specific information and be less likely to be influenced by lobbyists and trade associations that adopt the least common denominator of their constituencies. Most importantly, this structure will work better because, for the reasons described below, the task of reducing GHG reductions cannot be accomplished at the federal level alone.

Appendix I – State GHG Emissions Reduction Goals

State, Province, or Region	1990-2020 GHG Forecast	**State Goals**	**Climate Plan Coverage**
Arizona	144%	• 2000 levels by 2020; 50% below by 2040 • 15% below 2005 levels by 2020 (WCI)	106%
Arkansas	63%	• Recommended: 20% below 2000 levels by 2020, 35% below 2000 levels by 2025, 50% below 2000 levels by 2035	100%
California	40%	• E.O.: 2000 level by 2010; 1990 by 2020; 80% below 1990 by 2050 • AB-32: 1990 levels by 2020 • 15% below 2005 levels by 2020 (WCI)	100%
Colorado	71%	• 20% below 2005 level by 2020; 80% below by 2050	75%
Iowa	43%	Two reduction scenarios below 2005 levels: 1% by 2012, 11% by 2020, and 50% by 2050; and 3% by 2012, 22% by 2020 and 90% by 2050.	TBD
Connecticut	32%	• 1990 level by 2010; 10% below by 2020; 75% below by 2050	100%

Florida	86%	• 2000 level by 2017; 1990 level by 2025; 80% below 1990 by 2050	111% for 2017; 134% for 2025
Kansas	25%	TBD	TBD
Massachusetts	?	• 1990 level by 2010; 10% below by 2020; 75% below by 2050	?
Maine	34%	• 1990 level by 2010; 10% below by 2020; 75% below by 2050	100%
Michigan	26%	Interim Goals - Reduce GHG from 2002 baseline levels by 10-20% by 2015; 25-35% by 2025 Interim Goal - Reduce GHG from 2002 baseline level by 80% by 2050.	TBD

State, Province, or Region	**1990-2020 GHG Forecast**	**State Goals**	**Climate Plan Coverage**
Maryland	42%	• Recommended: 10% below 2006 levels by 2012; 15% below 2006 levels by 2015; 25% (enforceable)-50% (science based) below 2006 levels by 2020; 90% below 2006 levels by 2050.	100%
Minnesota	48%	• Next Generation Energy Act: 15% below 2005 levels by 2015; 30% by 2025; 80% by 2050	101% for 2015; 98% for 2025
Montana	30%	• 1990 level by 2020; 80% below by 2050 (consumption & production)	89%-105%
North Carolina	88%	TBD	TBD
NEG/ECP	?	• 1990 level by 2010; 10% below by 2020; 75% below by 2050	TBD
New Jersey	28%	• E.O. 54: 1990 level by 2020; 80% below 2006 levels by 2050	TBD
New Mexico	65%	• 2000 level by 2012; 10% below by 2020; 75% below by 2050 • 15% below 2005 levels by 2020 (WCI)	133%
New York	24%	• 5% below 1990 by 2010	?
Ontario	?	• 6% below 1990 by 2014	n/a

Oregon	61%	• 10% below 1990 by 2020; 75% below 1990 by 2050 • 15% below 2005 levels by 2020 (WCI)	85%
Puget Sound	37%	• 1990 level by 2010; 10% below by 2020; 75% below by 2100	100%
Rhode Island	35%	• 1990 level by 2010; 10% below by 2020; 75% below by 2050	100%
South Carolina	87%	• 5% below 1990 levels by 2020 (voluntary)	99%
Utah	95%	• 15% below 2005 levels by 2020 (WCI)	TBD
Vermont	26-59%	• 25% below 1990 levels by 2012; 50% below 1990 by 2028; 75% below by 2050	TBD
Washington	40%	• E.O.: 1990 levels by 2020; 25% below 1990 by 2035; 50% below 1990 by 2050 • 15% below 2005 levels by 2020 (WCI)	TBD
WCI	54%	• 15% below 2005 levels by 2020 (AZ, NM, CA, OR, UT, WA, BC, MB)	TBD
British Columbia	69%	• 15% below 2005 levels by 2020 (WCI)	TBD
Manitoba	TBD	• 15% below 2005 levels by 2020 (WCI)	TBD

Appendix II – Development of State and National Marginal Cost Curves for GHG Mitigation

This Appendix provides a detailed explanation of how the marginal cost curves in Figures 1 and 5 were derived. Table 2 below provides the list of policy options that were part of the analysis. Also provided in this Appendix is a summary of key assumptions and uncertainties to permit independent corroboration of the findings.

1. Developing State Marginal Cost (MC) Curves

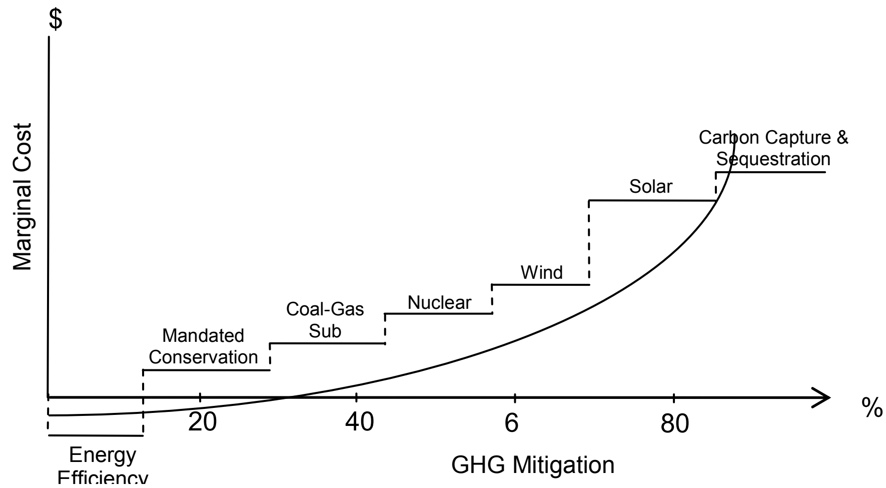
To build a marginal cost curve of climate mitigation actions by state and sector, a number of steps are required. First, the following data are developed and summarized for each of the quantified climate mitigation options in the climate action plans for early and mid-term target years in each of the twenty states for which it is currently available:

The GHG reduction potential of the mitigation option (maximum percentage of total emissions that can be reduced by the option)

The cost (or cost-saving) per ton of GHG that can be reduced (specified in terms of cost-effectiveness)

For each state, the full list of climate mitigation policy actions are then ordered from lowest cost to highest cost. A step function is developed based on the mitigation potential and cost per ton of GHG reduction for each policy option. This marginal cost curve of GHG emissions reductions can be used for direct assessments of cost-effectiveness of individual or cumulative actions, as done in the state climate action plans. A stylized step function characterizing a few major option categories is presented in Apx. I – Figure 1 and a smooth fitted curve to the step function using regression methods is also depicted in the figure. The fitted curve can be used as the marginal cost curve for formally modeling scenarios of state level policy instrument design, including a variety of policies and measures, cap and trade, carbon tax, or some combination.

Apx. I - Figure 1. Stylized Marginal Cost Curve for GHG Mitigation



Using Florida as an example, Apx. I - Table 1 summarizes 28 climate mitigation options analyzed in a quantitative manner for the state by the Center for Climate Strategies through the technical work group process. Column 3 of the table presents the estimated 2025 annual GHG reduction potential for each option, with reduction potentials translated into percentages of the 2025 BAU emissions level in Column 5. The estimated cost or cost savings per ton of GHG removed by each option in 2025 is presented in Column 4. The options are listed in ascending order in terms of cost, beginning with the cheapest option. Column 6 lists the cumulative GHG reduction potentials of the policy options listed in the table. The last column presents the proportion of GHG mitigation contributed by each option.

Apx. I - Table 1. GHG Mitigation Options for Florida in 2025[230]

Sector	Climate Mitigation Actions	Estimated 2025 Annual GHG Reduction Potential (MMtCO2e)	Estimated Cost or Cost Savings per ton GHG Removed	GHG Reduction Potential as Percentage of 2025 Baseline Emissions	Cumulative GHG Reduction Potential	Weights (add-up to 100)
TLU	Develop and Expand Low-GHG Fuels	12.62	-$142	2.72%	2.72%	5.83
TLU	Low Rolling Resistance Tires and Other Add-On Technologies	1.84	-$90	0.40%	3.12%	0.85
TLU	Improving Transportation System Management (TSM)	6.98	-$80	1.51%	4.63%	3.22
AFW	Improved Commercialization of Biomass-to-Energy Conversion and Bio-Products Technologies—C. Bio-Products Technologies and Use	0.3	-$62	0.06%	4.69%	0.14
ESD	Demand-Side Management (DSM)/Energy Efficiency Programs, Funds, or Goals for Electricity	21.8	-$43	4.71%	9.40%	10.06

[230] AFW=agriculture, forestry and waste management; ESD=energy supply and demand; TLU=transportation and land use. The Florida 2025 projected consumption-based gross GHG emission level is 463.3 million metric tons of carbon dioxide equivalent (MMtCO2e).

ESD	Building Codes for Energy Efficiency (HB 697 and Executive Order 127)	15.4	-$30	3.32%	12.72%	7.11
ESD	Promoting Renewable Electricity through Renewable Portfolio Standard (RPS), incentives and barrier removal (20% by 2020)	34.5	-$29	7.45%	20.17%	15.93
ESD	Energy Efficiency in Existing Residential Buildings	5.4	-$28	1.17%	21.34%	2.49
ESD	Improved Building Codes for Energy Efficiency	4.9	-$27	1.06%	22.39%	2.26
AFW	Improved Commercialization of Biomass-to-Energy Conversion and Bio-Products Technologies—A. Manure Digestion/Other Waste Energy Utilization	0.09	-$17	0.02%	22.41%	0.04
ESD	Power Plant Efficiency Improvements	8.9	-$14	1.92%	24.33%	4.11
AFW	Promotion of Farming Practices That Achieve GHG Benefits—A. Soil Carbon Management	0.9	-$9	0.19%	24.53%	0.42
AFW	In-State Liquid/Gaseous Biofuels Production	8.2	-$8	1.77%	26.30%	3.79
ESD	Landfill Gas-To-Energy (LFGTE)	8.7	$1	1.88%	28.18%	4.02
TLU	Increasing Freight Movement Efficiencies	1.1	$2	0.24%	28.41%	0.51
AFW	Afforestation	3.1	$5	0.67%	29.08%	1.43
ESD	Combined Heat and Power (CHP) Systems	2.2	$5	0.47%	29.56%	1.02

AFW	Reforestation	11.6	$5	2.50%	32.06%	5.35
AFW	Promotion of Advanced Municipal Solid Waste (MSW) Management Technologies (Including Bioreactor Technology)	4.4	$9	0.95%	33.01%	2.03
AFW	B. Urban Forestry	8.7	$10	1.88%	34.89%	4.02
AFW	A.Pine Plantation Management	0.9	$11	0.19%	35.08%	0.42
AFW	B.Non-Federal Public Land Management	0.4	$11	0.09%	35.17%	0.18
AFW	Expanded Use of Agriculture, Forestry, and Waste Management (AFW) Biomass Feedstocks for Electricity, Heat, and Steam Production	40	$21	8.63%	43.80%	18.46
AFW	Forest Retention—Reduced Conversion of Forested to Non-Forested Land Uses	0.6	$26	0.13%	43.93%	0.28
AFW	Promotion of Farming Practices That Achieve GHG Benefits—C. Nutrient Management	0.3	$26	0.06%	44.00%	0.14
ESD	Nuclear Power	7.3	$36	1.58%	45.57%	3.37
AFW	Improved Commercialization of Biomass-to-Energy Conversion and Bio-Products Technologies— B. WWTP Biosolids Energy Production & Other Biomass Conversion Technologies	5	$44	1.08%	46.65%	2.31

AFW	Reduce the Rate of Conversion of Agricultural Land and Open Green Space to Development	0.5	$93	0.11%	46.76%	0.23

Based on the data presented in Apx. I - Table 1, the stepwise marginal cost function for Florida in 2025 is drawn in Apx. I - Figure 2. The horizontal axis represents the percentage of GHG emissions reduction, and the vertical axis represents the marginal cost or savings of mitigation. In the figure, each horizontal segment represents an individual mitigation option. The width of the segment indicates the GHG emission reduction potential of the option in percentage terms. The height of the segment relative to the x-axis shows the average cost (saving) of reducing one ton of GHG with the application of the option.

In this example, the step function is color-coded for three different sectors (ESD: Energy Supply and Demand; TLU: Transportation and Land Use; AFW: Agriculture, Forestry, and Waste Management). The figure indicates that, collectively, the reduction potential of the 28 options from all these sectors can avoid about 47% of 2025 baseline emissions in Florida. The ESD sector has the highest reduction potential. On average, options in the AFW sector have the highest costs per ton, while most options in the TLU and ESD sectors would result in cost savings.

One possible specification of a marginal cost (MC) curve for Florida is the following functional form:

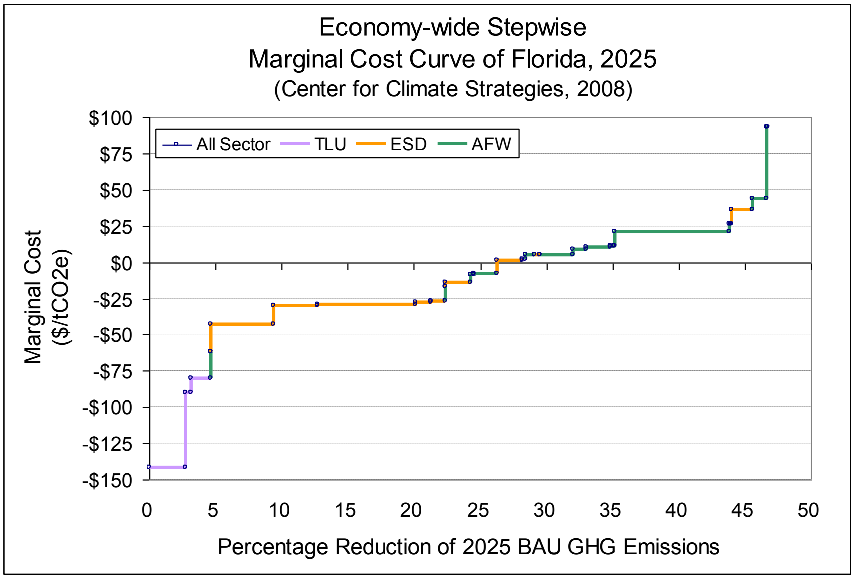
$$MC = a + b \times \ln(1 - R)$$

where, MC is the marginal cost; R is the percentage reduction of GHG emissions; a and b are intercept and slope parameter values, respectively.

This logarithmic functional form is consistent with theoretical expectations and empirical findings on diminishing returns of emission control.[231] As the emission reductions increase along the X-axis, the cost to reduce one additional unit of emission increases at an accelerating rate; in other words, it exhibits diminishing returns.

231 WILLIAM D. NORDHAUS, MANAGING THE GLOBAL COMMONS (MIT Press 1994).

Apx. I-Figure 2. Stepwise Marginal Cost Function for Florida, 2025[232]



When we fit the curve, we weight each policy option based on its GHG mitigation potential. This gives relatively greater influence to those options that have the potential for higher levels of application, and thereby should improve the accuracy of the estimation.

The logarithmic marginal cost curve for Florida (the pink curve) depicted in Apx. I - Figure 3 has the following specification:

$$MC = -78.43 - 195.14 \times \ln(1 - R)$$

The curve has a Y-axis intercept at MC = -$78.43. The curve increases to MC=0 at the emission reduction level of 33%, which indicates that Florida has cost-saving mitigation options (such as energy efficiency) up to that level of the 2025 BAU emissions. The regression analysis that estimates the fitted curve has an R-square of 0.7649, indicating a reasonably good fit.

An alternative specification of the step-function is to use a third-order polynomial functional form. This alternative fitted curve is also depicted in Apx. I - Figure 3 (the green curve). It

[232] AFW=agriculture, forestry and waste management, ESD=energy supply and demand, TLU=transportation and land use.

indicates the usual diminishing returns at the tail end of the mitigation process, but also better captures the influence of the broad range of energy efficiency and other cost saving options.

The third-order polynomial cost curve for Florida has the following specification:

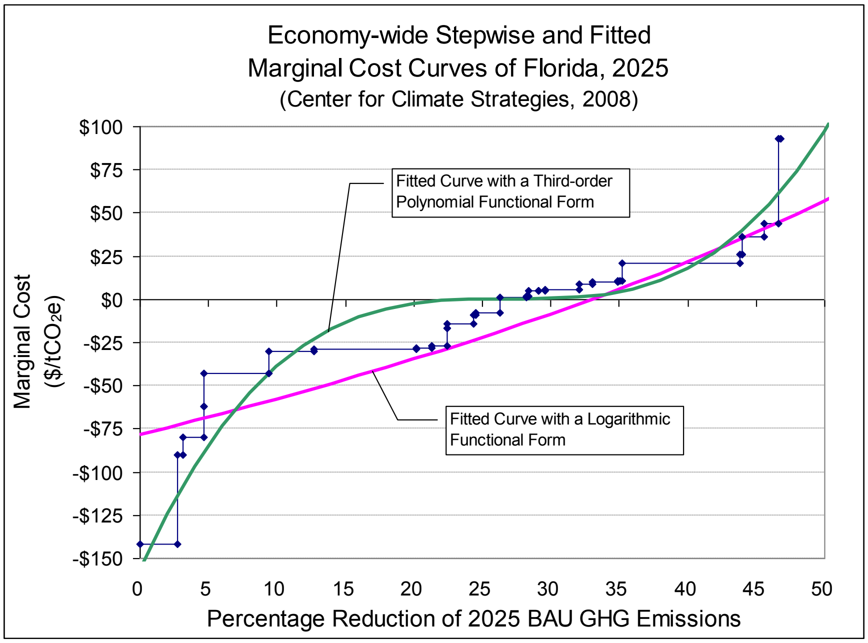
$$MC = 0.00796 \times (R - 27)^3$$

This fitted curve has a Y-axis intercept at MC = -$156.72. The curve increases to MC=0 at the emission reduction level of 27%. The regression analysis that estimates this fitted curve also has a good fit, with an R-square of 0.8639.

Either fitted MC curve then can be used in our non-linear programming model of policy instrument design, which has been applied to the analysis of cap and trade, carbon tax, and/or regulatory (command and control) responses to the Kyoto Protocol, European Union Trading System, Regional Greenhouse Gas Initiative (RGGI), Midwestern Governors Association (MGA) region, Western Climate Initiative (WCI), Pacific Rim states and countries, and Florida's choice of joining RGGI or WCI.[233]

233 *See* Rose et al., *International Equity and Differentiation in Global Warming Policy*, 12 ENVTL. & RESOURCE ECON. 25 (1998); Adam Rose & ZhongXiang Zhang, *Interregional Burden-Sharing of Greenhouse Gas Mitigation in the United States*, 9 MITIGATION & ADAPTATION STRATEGIES FOR GLOBAL CHANGE 477 (2004); MINNESOTA CLIMATE CHANGE ADVISORY GROUP, MINNESOTA CLIMATE CHANGE ADVISORY GROUP FINAL REPORT, A REPORT TO THE MINNESOTA LEGISLATURE, *available at* http://www.mnclimatechange.us/MCCAG.cfm (2008); Adam Rose & Dan Wei, *Greenhouse Gas Emissions Trading Among Pacific Rim Countries: An Analysis of Policies to Bring Developing Countries to the Bargaining Table*, 36 ENERGY POL'Y 1420 (2008); FLORIDA GOVERNOR'S ACTION TEAM ON ENERGY AND CLIMATE CHANGE, FLORIDA'S ENERGY AND CLIMATE CHANGE ACTION PLAN (2008), *available at* http://www.flclimatechange.us./stakeholder.cfm.

Apx. I – Figure 3. Stepwise and Fitted Marginal Cost Curves for Florida, 2025[234]



[234] BAU=business as usual (no new actions to address climate) $/tCO2e= cost per ton carbon dioxide equivalent.

2. Developing National Marginal Cost (MC) Curves

We developed the GHG mitigation marginal cost curve for the United States based on the mitigation and cost data of the twenty states with quantification analysis available. The GHG mitigation (sequestration) options for the twenty states are put together and then classified into the four sectors (ES, RCI, TLU, and AFW). [235]Next, the national MC step function is developed using the same methodology as described in Section 1. Apx. I - Figure 4 shows the stepwise marginal cost curve of the United States for the year 2020. Each horizontal segment in Apx. I - Figure 4 represents an individual policy option from a state. Although many similar policy options (such as Renewable Portfolio Standard and Clean Car Standard) are recommended in more than one state Action Plans, since different states would have different implementation costs associated with these policies, we did not combine the same policy options implemented in different states. The reduction potential of each policy option (as shown along the horizontal axis in Apx. I - Figure 4) is computed with respect to the total emissions of the twenty states in the year 2020. Since the national curve is developed from the data collected from the twenty states, it can be viewed as the weighted average curve of these states.

3. Summary of Key Assumptions:

- The state curves for AZ, CA, CO, CT, IA, MD, ME, MT, NC, NM, NY, RI, SC, UT, and WA are for year 2020. The curves for AR, FL, MI, and MN are for 2025, and the curve for VT is for 2028.
- UT only has data for energy efficiency options in RCI and TLU sectors. Thus, the cost curve for UT is partial.
- The standard year we used for national curves is 2020. The mitigation cost data for options of AR, FL, MI, MN, and VT

235 The mitigation options for Arkansas, Florida, Michigan, and Minnesota are analyzed for Year 2025, and the options for Vermont are for Year 2028. The data for the remaining states is for Year 2020. For the national curves, we used Year 2020 as the standard year. In order to approximate 2020 MC curves for the states that have performed quantification analysis for target years other than 2020, we assumed a 2% technical improvement or innovation rate for these states. Our method is to shift the step function of AR, FL, MI, and MN 2% a year upward from 2025 back to 2020, and shift the step function of VT 2% a year upward from 2028 back to 2020.

are adjusted to year 2020 based on the assumption of 2% annual technical improvement or innovation rate. In other words, we used the same reduction potential numbers for individual options in year 2020 as in year 2025 (2028), and assumed the cost per ton of CO_2e reduction being about $(1+2\%)^n$ (n=5 for AR, FL, MI, and MN, and n=8 for VT) higher in year 2020 than in year 2025 (2028).

- Some policy options are analyzed for different sensitivity cases or the per unit mitigation costs are presented in cost ranges. In such cases, we used average numbers in the cost curve development.
- When we developed the fitted MC curves from the step MC step functions, each policy option is weighted based on its GHG mitigation potential. This gives relatively greater influence to those options that have the potential for higher levels of application and should improve the accuracy of the estimation.
- The marginal cost curves embody direct mitigation costs only and do not include various transactions costs.
- The marginal cost curves do not distinguish between producer vs. consumer allocation of permits.

4. Summary of Key Uncertainties:

- In state Climate Change Action Plans, some policy options are only analyzed in a qualitative way, i.e., no quantified GHG reductions or mitigation costs/cost savings or both have been evaluated. When we develop the state and national cost curves, we only utilized the list of options that have both the reduction and cost data available. Potentially, this would result in an underestimation of the total mitigation potential of all applicable GHG mitigation options.
- National economy-wide and sectoral marginal mitigation cost curves are developed based on the options of the twenty states that have reduction and cost data. This method approximates the national curves as the weighted average of the twenty state curves. We consider these twenty states a good representation of the United States in terms of the proportions of GHG emissions contributed by different sectors and the coverage of

regions.[236] The accuracy of the national curve can be improved as more state data become available.

- For most states, the step function orders individual options (that have quantified cost/savings) from lowest cost to highest, without taking account of overlaps among options. Some states have evaluations of aggregated overlaps at the sectoral level. Only a few states provide overlaps analysis at the option level. We are only able to eliminate the overlaps among options for AR, CA, IA, and MI in the cost curves. Absence of adjustment of overlaps in other states results in an overestimation of their mitigation potential.

236 The proportions of the 2020 projected emissions from the ES, RCI, AFW, and TLU sectors of the 20 states are 34.3%, 24.4%, 8.4%, and 32.9%, respectively. Based on the U.S. 2006 emissions inventory, the corresponding proportions are 38.7%, 25.1%, 9.5%, and 26.8%. Therefore, if we assume the emission proportions are the same in 2020 for the U.S. as in 2006, the 20 states only slightly under-represent the emissions from the energy supply sector, and slightly over-represent the emissions from the transportation and land use sector.