NEW WINE INTO OLD BOTTLES: THE FEASIBILITY OF GREENHOUSE GAS REGULATION UNDER THE CLEAN AIR ACT

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On November 29, 2006, *Massachusetts v. EPA* was argued before the United States Supreme Court.[1] Much has already been written,[2] and undoubtedly much more remains to be written, on the central legal issues of the case: the petitioners' standing, the authority of the Environmental Protection Agency (EPA) under the Clean Air Act (CAA or "the Act") to regulate carbon dioxide (CO_2) and—assuming EPA has such authority—whether EPA lawfully declined to regulate motor vehicle CO_2 emissions under title II of the CAA.[3]

This essay addresses a different set of issues: If the Court were to decide that EPA was authorized or required to regulate CO_2 under the CAA, could EPA construct a domestic program to regulate CO_2 emissions and other greenhouse gas (GHG) emissions under the statute in its present form and would such a

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[1] Massachusetts v. EPA, 415 F.3d 50 (D.C. Cir. 2005), *cert. granted*, 126 S. Ct. 2960 (2006).

[2] *See, e.g.*, Arnold W. Reitze, Jr., *Global Warming*, 31 ENVTL. L. REP. 10,253 (2001); Henry W. McGee, Jr., *Litigating Global Warming: Substantive Law in Search of a Forum*, 16 FORDHAM ENVTL. L. REV. 371 (2005); Recent Case, *Administrative Law—Powers of Agencies—D.C. Circuit Shields Environmental Protection Agency From Making Controversial Determination of Climate Endangerment*, 119 HARV. L. REV. 2620 (2006); Doug Obey & Dawn Reeves, *High Court Suit Helps Advocates of CO_2 Rules Despite Uncertain Result*, CLEAN AIR REP., July 13, 2006.

[3] *See* Petition for Writ of Certiorari, Massachusetts v. EPA, 126 S. Ct. 2960 (2006) (No. 05-1120); Brief for the Federal Respondent in Opposition, Massachusetts v. EPA, 126 S. Ct. 2960 (No. 05-1120).

program be a comprehensive and cost-effective means of controlling such emissions?

This essay concludes that were the Court to hold EPA had authority to regulate CO_2 emissions under existing law, the CAA could be effective to regulate CO_2 emissions from large sources, such as electric generators, and to set CO_2 emissions standards for new motor vehicles. However, because of gaps in the potential coverage of CO_2 (and other GHG) emissions, impediments to the establishment of a national cap-and-trade system, and limitations on the control of motor vehicle emissions, a regulatory program under the CAA would be significantly less effective and more costly than a program specifically designed to control GHG emissions.

I. DOMESTIC GHG EMISSIONS: WHAT TO CONTROL AND HOW?

Analysis of the CAA's effectiveness as an instrument to regulate domestic GHG emissions begins with a brief review of the U.S. GHG emissions profile and of the range of options to control those emissions.

A. *Emissions Profile*

In recent years, the U.S. has accounted for approximately 23% of world-wide anthropogenic CO_2 emissions.[4] In the United States, CO_2 accounts for about 84% of overall domestic GHG emissions, mostly from combustion of fossil fuels.[5] Methane, nitrous oxide, and synthetic gases (hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) account for the remainder.[6]

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[4] This estimate is based on data for U.S. emissions provided in ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, EMISSIONS OF GREENHOUSE GASES IN THE UNITED STATES 2005, at x (2006), *available at* http://www.eia.doe.gov/oiaf/1605/ggrpt/pdf/057305.pdf [hereinafter GREENHOUSE GASES IN THE U.S.], and data for worldwide emissions provided in ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, INTERNATIONAL ENERGY OUTLOOK 2006, at 73 tbl.12 (2006), *available at* http://www.eia.doe.gov/oiaf/ieo/pdf/0484(2006).pdf.

[5] GREENHOUSE GASES IN THE U.S., *supra* note 4, at x. There are also natural, non-anthropogenic sources of CO_2 emissions, but generally they do not result in a net increase of carbon in the biosphere. The planet's natural CO_2 uptake system tends to capture such CO_2; fossil fuel combustion, however, adds more CO_2 to the atmosphere than the biosphere can absorb. *Id.* at 5.

[6] *Id.* at x. The heat storage effects of one ton of emissions of each gas are different because each GHG has its own atmospheric lifespan and heat trapping

Looking more closely at CO_2, in 2004 39% of U.S. CO_2 emissions were from electric power generation, largely (82%) from coal-fired power plants.[7] Another 32% was attributable to the transportation sector.[8] The largest contribution to transportation emissions was light-duty motor vehicles (about 60%), followed by heavy trucks, locomotives and certain maritime uses (about 22% combined), and aviation (about 12%).[9] Other significant contributors generally include industrial establishments and residential and commercial emitters.[10] Large stationary sources such as power plants and industrial facilities account for approximately half of all U.S. CO_2 emissions;[11] the balance is emitted by smaller stationary sources and by mobile sources.

B. *Control Options*

The basic options for controlling domestic GHG emissions can be found in academic studies and current legislative proposals.[12] One approach would use conventional command-and-control regulation. A second, more widely advocated set of options would use market-based regulatory mechanisms, such as cap-and-trade programs[13] or GHG taxes.[14] A third set of options

properties. For purposes of determining total emissions, each gas is measured in terms of its relative CO_2 equivalence. *Id.* at xi.

[7] *See* ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, ANNUAL ENERGY REVIEW 2005, at 343 tbl.12.3 (2006), *available at* http://www.eia.doe.gov/aer/pdf/aer.pdf [hereinafter ANNUAL ENERGY REVIEW 2005].

[8] *See id*.

[9] *See id*. The sector estimates in the text are based on the share of emissions associated with various fuel types.

[10] *See id.* at xxi figs.7, 8 & 9 (showing significant use of fossil fuel energy in each sector).

[11] *See id.* at 343 tbl.12.3; *see also* CTR. FOR CLEAN AIR POLICY, U.S. CARBON EMISSIONS TRADING: SOME OPTIONS THAT INCLUDE UPSTREAM SOURCES 2 (1998).

[12] *See generally* Robert R. Nordhaus & Kyle W. Danish, *Assessing the Options for Designing a Mandatory U.S. Greenhouse Gas Reduction Program*, 32 B.C. ENVTL. AFF. L. REV. 97 (2005) (discussing control options).

[13] *See, e.g.*, Climate Stewardship Act of 2003, S. 139, 108th Cong. §§ 311–372 (2003); SEN. PETE V. DOMENICI & SEN. JEFF BINGAMAN, S. COMM. ON ENERGY AND NATURAL RES., DESIGN ELEMENTS OF A MANDATORY MARKET-BASED GREENHOUSE GAS REGULATORY SYSTEM (2006), http://energy.senate.gov/public/_files/ClimateChangeWhitePaper.doc; Nordhaus & Danish, *supra* note 12, at 120–45.

[14] *See* DUKE ENERGY, SUBMISSION OF DUKE ENERGY CORPORATION TO THE FEDERAL TAX REFORM ADVISORY PANEL (2005), http://comments.taxreformpanel.gov/_files/ProposalforTaxReformDuke050429.doc;

would combine product efficiency standards with cap-and-trade programs. These three principal options can be summarized as follows:

Command-and-Control Regulation: Conventional environmental regulation, such as that contemplated by the CAA as originally enacted, imposes emission limitations in terms of emissions per period of time (e.g., tons per year) or per unit of input or output (e.g., pounds per million British thermal units). Because these emissions limits are source specific and do not contemplate emissions trading, it is difficult for individual companies or the economy as a whole to pursue least-cost abatement strategies under which emissions are reduced at sources with the lowest control costs.

Market-based Regulation: Market-based regulation can attain aggregate emission reductions equivalent to those produced by a command-and-control regime, while at the same time giving companies the flexibility to follow least-cost abatement strategies. As Professor Robert Stavins has observed, market-based instruments induce firms to choose control levels, for each source, at which their marginal abatement costs are the same, thus minimizing overall pollution abatement costs.[15] He explains:

> Because the costs of controlling pollution vary greatly among and within firms, any given aggregate pollution control level can be met at minimum aggregate control cost only if pollution sources control at the same *marginal cost*, as opposed to the same *emission level*. Indeed, depending on the age and location of emission sources and available technologies, the cost of controlling a unit of a given pollutant may vary by a factor of one hundred or more among sources.[16]

There are two widely recognized forms of market based regulation:

Cap-and-trade: A cap-and-trade program, similar in many respects to the acid rain program under title IV of the CAA,[17] sets an aggregate limit or "cap" on emissions, and then allocates or auctions a fixed number of tradable allowances equal to allowable

Nordhaus & Danish, *supra* note 12, at 146–48.

[15] Robert N. Stavins, *Policy Instruments for Climate Change: How Can National Governments Address a Global Problem?*, 1997 U. CHI. LEGAL F. 293, 297–98.

[16] *Id.* at 298 n.14.

[17] Clean Air Act §§ 401–416, 42 U.S.C. §§ 7651–7651o (2000).

emissions in a particular compliance period. In the case of a "downstream" cap-and-trade program, each emitter is required to surrender allowances equal to its emissions.[18] Firms with low abatement costs can "over-control" and sell their surplus allowances; firms with high abatement costs can purchase these extra allowances rather than control emissions. By contrast, an "upstream" cap-and-trade program requires fuel producers, refiners or transporters to surrender allowances equal to the carbon content of the fuel they distribute in commerce each year. The cost of the surrendered allowances will be reflected in prices paid by or to customers or suppliers of the entities that surrender the allowances, thus incentivizing the production and use of lower carbon fuels.[19] A cap-and-trade program can either be economy-wide or limited to particular sectors. A cap-and-trade program has the advantages of establishing a maximum level of emissions for the economy, or the sectors to which it applies, and, according to economic theory, it will minimize the cost of attaining the required emission reductions.[20]

GHG tax: A GHG tax—like a cap-and-trade program—is market-based, and permits least-cost abatement strategies. It works by imposing a tax on GHG emissions or on the carbon content of fuel (in terms of dollars per ton of CO_2 equivalent).[21] In response, firms will control emissions up to the point at which it becomes cheaper simply to pay the tax; where that point is will depend on their particular control costs. Unlike a cap-and-trade program, a GHG tax does not offer certainty as to the total level of reductions because regulators can only estimate how firms will respond to a particular level of taxation. On the other hand, a GHG tax does provide greater certainty as to the level of abatement costs.[22]

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[18] *See* CONG. BUDGET OFFICE, AN EVALUATION OF CAP-AND-TRADE PROGRAMS FOR REDUCING U.S. CARBON EMISSIONS 20 (2001), *available at* http://www.cbo.gov/ftpdocs/28xx/doc2876/Cap&Trade.pdf [hereinafter CBO EVALUATION].

[19] *See id*. at 17. Such a program could also apply to non-CO_2 GHGs distributed in commerce or emitted as process emissions.

[20] *See* Stavins, *supra* note 15, at 297.

[21] *See id*. at 303.

[22] Firms are better able to calculate the costs of a GHG tax because it imposes a fixed cost for each unit of CO_2 emissions, unit of carbon content of fuel, or unit of GHG content of other products rather than the variable market-based cost of the tradable allowances.

Hybrid Programs: A hybrid program could combine a large-source cap-and-trade program (for electric generators and industrial facilities) with product efficiency standards for automobiles, consumer products, and certain equipment used in commercial and industrial establishments.[23] Product efficiency standards are performance standards that set minimum energy efficiency levels or maximum emissions per unit of output (e.g., pounds of CO_2 per mile). For example, a hybrid program could combine a cap-and-trade program for electric generators (modeled on the acid rain program) with more stringent average fuel economy standards under the corporate average fuel economy (CAFE) program[24] and energy efficiency standards under the Energy Policy and Conservation Act (EPCA).[25]

In a previous article,[26] Kyle Danish and I evaluated a number of these options in terms of environmental effectiveness, cost-effectiveness, administrative feasibility, distributional equity, and political acceptability. The analysis focused on programs that would be specifically designed to regulate GHGs and did not address using the CAA for that purpose. It concluded that an economy-wide "upstream" cap-and-trade approach presented the best option for low-cost reductions in GHGs if it could gain sufficient support to be enacted, but that a hybrid alternative might ultimately be chosen because it could build upon existing sector-based approaches, such as the acid rain program for electricity generators, appliance efficiency standards, and motor vehicle fuel economy standards. The analysis also found that an economy-wide "downstream" cap-and-trade program would be infeasible to administer because of the large number of sources to be regulated (several hundred million); that a stand-alone, large-source downstream cap-and-trade program would be feasible to administer but incomplete in coverage (only about 50% of CO_2 emissions would be covered); and that a GHG tax that was not part

[23] *See* Nordhaus & Danish, *supra* note 12, at 149–51; *see also* TIM HARGRAVE, CTR. FOR CLEAN AIR POLICY, AN UPSTREAM/DOWNSTREAM HYBRID APPROACH TO GREENHOUSE GAS EMISSIONS TRADING 5–13 (2000), *available at* http://www.ccap.org/pdf/Hybrid1.PDF (discussing hybrids that distribute the burden between emitters and fuel suppliers).

[24] 49 U.S.C. §§ 32,901–32,919 (2000).

[25] 42 U.S.C. § 6295 (2005) (authorizing the Secretary of Energy to prescribe energy efficiency standards for appliances and other consumer products).

[26] *See generally* Nordhaus & Danish, *supra* note 12.

of a larger tax reform initiative would be unviable politically.[27] While this analysis assumed that Congress would create a new program through legislation, a similar analysis can be applied to GHG regulation under existing CAA authorities.

II. REGULATORY TOOLS UNDER THE CLEAN AIR ACT

If the Court in *Massachusetts v. EPA* reaches the question of EPA's authority to regulate CO_2 emissions under the CAA and determines that EPA has such authority, at least three regulatory instruments would appear to be available for that purpose under the CAA: (1) regulation of CO_2 as a "criteria pollutant," (2) regulation of CO_2 through New Source Performance Standards under section 111 of the CAA and under section 111(d)'s parallel provisions for existing sources, and (3) regulation of CO_2 emissions from mobile sources under title II of the Act (at issue in *Massachusetts v. EPA*). The extent to which these provisions could be used, individually or in combination, to control CO_2 emissions and emissions of non-CO_2 GHGs is discussed below.

A. *Regulation of CO_2 as a Criteria Pollutant*

EPA's most comprehensive authority for controlling air pollution emissions under the CAA is its regulation of "criteria pollutants" under title I of the Act.[28] Under that regime, EPA issues criteria for pollutants emitted by numerous and diverse sources, spelling out the pollutant's effects on public health and welfare (thus, the term "criteria pollutants").[29] For each criteria pollutant, EPA sets a national ambient air quality standard (NAAQS) that is implemented on a state-by-state basis.[30] These

[27] *See id.* at 159–63; CBO EVALUATION, *supra* note 18, at 21.

[28] Authorities under the CAA are vested by statute in the Administrator of the EPA, but for convenience of reference the Administrator is referred to in this article as "EPA."

[29] Section 108 of the CAA directs the EPA to publish a list of air pollutants, emissions of which from numerous or diverse mobile or stationary sources will, in the EPA's judgment, cause or contribute to air pollution that may reasonably be anticipated to endanger public health or welfare. It directs the EPA to issue air quality criteria for these pollutants that reflect current scientific knowledge indicating the kind and extent of all identifiable effects of the pollutant on public health and welfare. Clean Air Act §108, 42 U.S.C. § 7408 (2000).

[30] 42 U.S.C. §§ 7409–7410. Under section 109(b), EPA establishes two types of ambient air quality standards; primary standards designed to protect public health and secondary standards to protect public welfare. *Id.* § 7409(b).

standards specify the maximum permissible level of an air pollutant in the ambient air, usually in parts per million measured daily, monthly or annually. Based on the criteria, they are set at a level that is requisite to protect public health and public welfare, allowing an adequate margin of safety.[31]

Once a NAAQS is set, each state is required by section 110 of the CAA to adopt and submit to EPA a plan for implementing, maintaining, and enforcing the standard within the state (state implementation plan or SIP).[32] The SIP must meet numerous statutory requirements for controlling emissions of the criteria pollutant (or its precursors)[33] from sources within the state, as well as monitoring, enforcement, and related requirements.[34]

If an area within a state fails to meet a NAAQS, then it is to be designated as a "non-attainment area."[35] The state is then required by part D of title I of the CAA to impose emission limitations and other measures respecting existing and new sources that will bring the area into attainment with the standard within the timeframes specified in the Act,[36] including emission control and offset requirements for new and modified sources of the pollutant.[37] "Attainment areas" (areas of the state that are in compliance with a particular NAAQS) are required by part C of title I to adopt emission limitations and other measures (principally applicable to new and modified stationary sources) to prevent significant deterioration of air quality (PSD measures).[38]

In setting these standards, EPA may not consider cost of compliance; however, state agencies may consider cost when designing their implementation plans. *See* Whitman v. Am. Trucking Ass'n, 531 U.S. 457, 467–71 (2001) (citing Union Elec. Co. v. EPA, 427 U.S. 246, 257, 266 (1976)).

[31] "Welfare," as the petitioners in *Massachusetts v. EPA* point out, includes effects on climate. Brief of Petitioners at 2, Massachusetts v. EPA, 126 S. Ct. 2960 (2006) (No. 05-1120) (citing 42 U.S.C. § 7602(h) (2000)).

[32] 42 U.S.C. § 7410.

[33] *Id.* Certain criteria pollutants, like ozone, are formed from chemical reactions of precursor pollutants emitted by mobile or stationary sources. In these cases, SIPs also control emissions of the precursors. *Id.* § 7602(g) (defining "air pollutant" to include precursors).

[34] If a state fails to submit a SIP that meets section 110's requirements, EPA is directed to promulgate a federal implementation plan (FIP) that will be sufficient to bring the state into compliance. *Id.* § 7410(c)(1).

[35] *Id.* § 7407(d).

[36] *Id.* §§ 7501–7509. Nonattainment areas are expected to meet primary NAAQS within five years. *Id.* § 7502(a)(2).

[37] *Id.* § 7503.

[38] *Id.* §§ 7470–7492.

Were EPA to attempt to regulate CO_2 as a criteria pollutant, it would face what would appear to be substantial legal and practical obstacles. The first issue EPA would have to deal with is the legal standard under section 109. EPA would have to determine what CO_2 concentration level is "requisite to protect public health and welfare" allowing an adequate margin of safety. Are current CO_2 levels already too high? Or can we safely let CO_2 levels rise to two or three times pre-industrial levels?[39] Need we take any action at all at this time?

The second issue arises out of the distinctive nature of CO_2 as compared to conventional pollutants. CO_2 is uniformly distributed in the atmosphere. It has a long (50 to 200 year) residence time in the atmosphere. As noted above, only about 23% of global CO_2 emissions are from sources in the U.S.[40] Criteria pollutant regulation, as it was originally conceived in 1970, was designed to deal with localized concentrations of pollutants with short-residence times in the atmosphere. In the late 1970s and again in 1990, when it became apparent that interstate transport of ozone and SO_2 could not be adequately dealt with under the existing CAA title I framework, Congress amended the Act to require upwind states to control emissions transported to non-attainment areas in downwind states and to establish the separate acid rain control program under title IV of the Act.[41] However, transport of criteria pollutants from outside of the U.S. is dealt with, if at all, only through international negotiation and through a generalized reciprocity provision in section 115(c) of the CAA.[42]

It is difficult to see how the SIP mechanism could be used to control global CO_2 concentrations. It appears to be fundamentally ill-suited to the task. Over three-fourths of global CO_2 emissions

[39] Pre-industrial CO_2 concentrations are thought to have been approximately 275 parts per million (ppm). Levels in 2001 were about 380 ppm. Scientists have analyzed (but have reached no consensus on) the impacts of concentrations at twice pre-industrial levels (550 ppm) as well as higher and lower levels. Scott Barrett, *The Problem of Averting Global Catastrophe*, 6 CHI. J. INT'L L. 527, 544–45 (2006) (citing WORKING GROUP I, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, SUMMARY FOR POLICYMAKERS (2001), *available at* http://www.ipcc.ch/pub/spm22-01.pdf).

[40] *See supra* text accompanying note 4.

[41] *See* Clean Air Act Amendments of 1977, Pub. L. No. 95-95, 91 Stat. 685 (1977) (codified as amended at 42 U.S.C. §§ 7410(a)(2)(D), 7426 (2000)); Clean Air Act Amendments of 1990, Pub. L. No. 101-549, 104 Stat. 2399 (codified as amended at 42 U.S.C. §§ 7401-7671q (2000)).

[42] 42 U.S.C. § 7415(c).

come from outside the United States. The U.S. cannot unilaterally set CO_2 concentration levels for the rest of the world. The Kyoto Protocol caps most other industrialized countries' GHG emissions, but does not set concentration limits. Thus, it is unclear how a state could ever make the required showing that its plan provides for the "implementation, maintenance, and enforcement" of the CO_2 standard in the state, as required by section 111(a)(1) of the CAA or that the plan is adequate "to attain or maintain" the CO_2 standard, as provided in section 110(k)(5).[43]

The distinctive nature of GHGs also reinforces the challenge of determining what concentration level to set. As one commentator observed:

> If EPA adopted a criteria pollutant approach to control CO_2, it would have to set atmospheric numerical values that were either above or below present [concentration levels]. If CO_2 NAAQS values were below present CO_2 atmospheric concentration, the entire country would have a non-attainment status with no realistic expectation that any measure taken as part of a SIP would lead to attainment of the standard.[44]

Specifically, because over 75% of global CO_2 emissions are beyond the control of U.S. regulators and because of the long residence time of CO_2 in the atmosphere, it is unlikely that reductions under SIPs would be sufficient to reduce CO_2 concentrations below current levels.[45] But, on the other hand:

> If a NAAQS value above the present CO_2, atmospheric concentration was selected, the entire nation would be in attainment. . . . Compliance with the prevention of significant deterioration (PSD) program would be the major applicable requirement.[46]

The strictures of the PSD program (which relate principally to controls on new and modified major U.S. stationary sources)

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[43] EPA would face the same difficulties as the states if it attempted to prescribe a FIP under section 110(c) of the CAA.

[44] ARNOLD REITZE, AIR POLLUTION CONTROL LAW: COMPLIANCE AND ENFORCEMENT 417 (2001).

[45] For pollutants with a short residence time in the atmosphere, emissions reductions can result in a prompt and relatively linear reduction in concentrations. Not so with CO_2 and other GHGs, most of which have hundred-year or longer residence times. A CO_2 emissions reduction would not result in a proportionate reduction in CO_2 concentrations, and in many cases would not be sufficient even to stabilize CO_2 concentration levels.

[46] REITZE, *supra* note 44, at 417.

would not be sufficient in the long run to ensure global concentrations of CO_2 remain at or below the concentration level specified by the standard. Absent an enforceable and sufficiently stringent international control regime, at some point in the future the ambient air quality standard for CO_2 is likely to be exceeded, and all states would be pushed into non-attainment status, but too late to deal effectively with the CO_2 already emitted into the atmosphere. Because of the long residence time of CO_2 in the atmosphere and the magnitude of emissions outside the U.S., reducing emissions from U.S. sources after the standard is exceeded will have only a small near-term effect on CO_2 concentrations.[47]

In sum, criteria pollutant regulation under the CAA is incapable of controlling global CO_2 concentrations and does not provide a workable framework on which to erect a domestic climate policy. That, however, is not the end of the argument. As we discuss below, other provisions of the Act provide instruments—albeit imperfect—to control the major share of U.S. GHG emissions.

B. *Regulation of New and Existing Stationary Sources Under Section 111*

Section 111 of the CAA supplements EPA's regulation of criteria pollutants, described above, with authority to prescribe performance standards for stationary sources. That section directs the EPA to designate categories of stationary sources that cause or contribute significantly to air pollution that may reasonably be anticipated to endanger public health or welfare. It then directs the EPA to prescribe standards of performance for new and modified sources within each category.[48] These "new source performance standards" must reflect the degree of emission reduction achievable under the best adequately-demonstrated emission reduction system, "taking into account the cost of achieving such reduction" among other factors.[49] In addition, under section 111(d), EPA has authority to require states to submit plans (similar

[47] Much the same point was made in a Memorandum from Robert E. Fabricant, EPA Gen. Counsel, to Marianne L. Horinko, Acting EPA Adm'r 7–8 (Aug. 28, 2003), *available at* http://www.epa.gov/airlinks/co2petitiongcmemo8-28.pdf.

[48] Clean Air Act § 111(b), 42 U.S.C. § 7411(b) (2000).

[49] *Id.* § 7411(a)(1).

to SIPs under section 110) to control emissions of non-criteria pollutants (pollutants not subject to ambient air quality standards) from existing stationary sources.[50] Performance standards under section 111 are typically expressed in terms of emissions per unit of input or output (e.g., pounds per mmBtu) rather than emissions per period of time (e.g., tons per year).

Were CO_2 to be regulated under the CAA, section 111 would appear to provide an adequate basis for traditional command-and-control regulation of new large stationary sources of CO_2 and (assuming EPA did not attempt to designate CO_2 as a criteria pollutant) also of existing sources. Section 111 also makes specific provisions for considering costs of compliance, so EPA could use some form of cost-benefit analysis in setting levels of emissions reductions.

But, while EPA would have authority to impose source-by-source emissions standards under section 111, it is less clear whether EPA can use section 111 to establish a national cap-and-trade program that captures the efficiency benefits of market-based regulation. EPA's difficulties with the 2005 Clean Air Mercury Rule (CAMR)[51] illustrate some of the challenges of using section 111 authority to establish a national cap-and-trade program. Under that rule, which applies to coal-fired electric generators, EPA allocates to each state a mercury emissions budget (in tons per year) applicable both to new and existing sources. Each state is required to submit an implementation plan that would reduce emissions to the level specified in its budget. EPA established a model cap-and-trade program that states could elect to participate in. If a state opts into this program, its new sources would be required not only to meet the performance standards specified in the rule, but also to acquire allowances sufficient to cover their mercury emissions.[52]

A key question under section 111 is whether EPA can use a cap-and-trade system rather than source-by-source controls. EPA's authority to use that section to control mercury emissions is

[50] *Id.* § 7411(d). A further limitation in § 7411(d) excludes regulating certain hazardous pollutants under that section.

[51] Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units, 70 Fed. Reg. 28,606 (May 18, 2005) (codified in scattered sections of 40 C.F.R. pts. 60, 72, 75 (2006)) (commonly referred to as the Clean Air Mercury Rule).

[52] *Id.*

currently subject to litigation,[53] and the litigation will likely include a challenge to the use of a cap-and-trade program for controlling mercury emissions.[54] In addition, a number of states have declined to implement the model cap-and-trade program in their state.[55] The outcome of this litigation is uncertain. But even if the basic architecture of CAMR were upheld, including EPA's authority to permit compliance with section 111 standards through an elective cap-and-trade program, such a decision would not provide EPA with the basis to *require* states to participate in a national cap-and-trade program.[56] Other section 111 questions that could be raised in the context of a CO_2 cap-and-trade program include whether EPA would have authority to combine more than one source category in the same program (e.g., electric generators and steel mills) and the extent to which offsets for CO_2 sequestration projects could be allowed.[57]

Another limitation involved in the use of section 111 is its coverage. While there is no explicit lower limit on the size of stationary sources subject to regulation under section 111, practical considerations of administration and enforcement make it an infeasible mechanism for regulating a myriad of small stationary sources. These sources include home furnaces, kitchen stoves, heating systems for offices and apartments, pizza ovens, and literally thousands of other uses of fossil fuels. They account for over a third of stationary source emissions and almost 20% of overall U.S. CO_2 emissions.[58] Prescribing standards for millions of small emitters, and monitoring and enforcing compliance, is not

[53] *See* New Jersey v. U.S. EPA, No. 05-1097 (D.C. Cir. filed Mar. 28, 2005).

[54] *See Tracking: Clean Air*, INSIDE EPA, Jan. 4, 2006. Objections to the use of a cap-and-trade program to control mercury emissions arise out of concerns that such a program is not capable of controlling localized high levels of emissions (hot spots) and that mercury is a hazardous pollutant that should be regulated as such under section 112 of the CAA. Neither is an issue with CO_2.

[55] *See, e.g.*, *EPA Fighting State Adoption of Strict Mercury Control Regulations*, ENVTL. POL'Y ALERT, May 4, 2006.

[56] Since EPA did not attempt to mandate state participation in the CAMR cap-and-trade program, presumably mandatory state participation will not be at issue in the ensuing litigation.

[57] If EPA attempted to fold non-CO_2 GHGs into the program, further questions of authority could be raised.

[58] Transportation (mobile sources) accounts for about 32% of U.S. CO_2 emissions, and large stationary sources (above 10,000 metric tons of CO_2 per year) account for about another 50%. The balance (about 18%) is small stationary sources. *See supra* notes 5–11 and accompanying text.

a feasible undertaking. For that reason, a CO_2 regulatory program under section 111 would likely be limited to the types of large stationary sources whose emissions of conventional pollutants are currently regulated under section 111.

Thus, as an instrument to regulate CO_2 emissions, section 111 has two significant limitations. First, EPA has questionable authority to require states to participate in a national cap-and-trade program for existing sources and the courts may ultimately decide that any cap-and-trade program is impermissible under section 111. Second, EPA cannot practically reach smaller stationary sources, making it difficult to exploit inexpensive emission reduction opportunities in these sectors. CO_2 control under section 111 would in all likelihood focus on electric generators and other large sources.

These aspects of section 111, combined with the limitations on EPA's authority to control mobile sources under title II of the CAA (see Part II.C, below), have important implications for the efficacy of CO_2 regulation under the CAA, and for the cost-effectiveness of CO_2 controls on electric generators. These implications are discussed in Part IV, below.

C. *Mobile Source Regulation Under the CAA*

Mobile source regulation under the CAA—the issue before the Supreme Court in *Massachusetts v. EPA*—proceeds under title II. Section 202(a)(1)—the general standards-setting provision of title II—requires EPA to prescribe standards applicable to emissions of any air pollutant from new motor vehicles which in EPA's judgment cause, or contribute to, air pollution that may reasonably be anticipated to endanger public health or welfare.[59] These standards take effect after such period as EPA determines necessary to permit development and application of the requisite technology, giving appropriate consideration to cost.[60]

If the Supreme Court were to decide that EPA had authority to

[59] Clean Air Act § 202(a)(1), 42 U.S.C. § 7521(a)(1) (2000).

[60] *Id.* § 7521(a)(2). Other provisions of this section set out statutory standards for specific pollutants, and timetables for implementing those standards. *Id.* § 7521(b)–(m). Title II also contains compliance testing and certification provisions, *id.* § 7525, requirements for compliance in actual use, *id.* § 7541, preemption, *id.* § 7543, regulation of fuels, *id.* § 7545, and enforcement provisions, *id.* §§ 7522–7524. Aircraft emissions are regulated under part B of title II.

regulate CO_2 emissions under title II of the CAA and EPA made the requisite "endangerment of public health and welfare" finding required by section 202(a)(1), EPA could impose CO_2 emissions standards for motor vehicles. Section 202(a)(2) gives EPA authority to phase-in the standards as technology develops, and to take into account cost considerations. EPA has exercised authority[61]—so far unchallenged—to prescribe average emissions standards for certain pollutants, thereby permitting manufacturers to average emissions within their new car fleets.[62] Averaging adds an important element of flexibility that lowers compliance costs while ensuring a level of overall performance of the new vehicle fleet.

Two aspects of the regulatory framework under title II of the CAA should be noted. First, title II emissions standards would set only an emissions rate, in terms of grams of CO_2 per mile, for new motor vehicles. They would not cap a vehicle's total emissions as it is operated. The second noteworthy feature arises from the bifurcated nature of regulation under the CAA. It is not apparent how EPA could integrate the motor vehicle CO_2 emissions standards program under title II with a cap-and-trade program under section 111 (even assuming the latter could be established). As discussed in greater detail below, these two features of title II have important economic efficiency implications for the overall GHG control program.

D. *Regulation of Non-CO_2 Greenhouse Gases*

Though *Massachusetts v. EPA* deals only with regulation of CO_2 under the CAA, the Court's decision could have consequences for the regulation of other GHGs. The logic applied to CO_2 in the decision could apply equally to other GHGs. The ability to regulate non-CO_2 GHGs under the CAA is difficult to analyze because of the diversity of processes and sources that

[61] *See* Control of Air Pollution from New Motor Vehicles: Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements, 65 Fed. Reg. 6698 (Feb. 10, 2000) (codified at 40 C.F.R. pts. 80, 85, 86 (2006)).

[62] Averaging of emissions under section 202 of the CAA is similar in concept to fleet-wide fuel economy averaging under the CAFE program. The CAFE program requires each automobile manufacturer or importer to meet average fuel economy standards for the fleet of new vehicles it manufactures or imports in each model year. *See* 49 U.S.C. §§ 32,901–32,919 (2000).

produce these gases.[63] To the extent these emissions come from large identifiable sources, such as methane from coal mines or hydrochlorofluorocarbons (HCFC) from manufacturing operations, it may be feasible to control the emissions under section 111. Other types of emissions—such as HCFCs from home air conditioners or methane from dairy farms—would be more difficult to reach under section 111.

Certain non-CO_2 GHG emissions from motor vehicles probably can be controlled under section 202(a) of the CAA to the extent they can be measured in the test cycle currently used to determine compliance with emissions standards and average fuel economy standards. HCFC emissions from automotive air conditioning systems may pose a more difficult problem, since they are not measured under current EPA test procedures. However, California's mobile source emissions standards program does attempt to reach these emissions and might provide a workable model for testing and compliance.[64]

In brief, the efficacy of controls of non-CO_2 gases under the CAA will depend on which gas is controlled, the type of source, and the nature of the control technology.

III. EFFECTIVENESS OF GHG REGULATION UNDER THE CAA

As discussed in Part II of this paper, section 111 and title II of the CAA could provide technically feasible mechanisms for the regulation of GHG emissions. This part considers how effective such a program would be. To answer this question, we look at three aspects of a potential GHG regulation under the CAA; coverage, structural limitations on mobile source regulation, and ability to implement a cap-and-trade program.[65]

[63] For example, methane emissions come from sources such as coal mining, landfills, and agriculture. Sources of nitrous oxide emissions include energy use, agriculture, waste management, and industrial processes. HCFC emissions are attributed to their use in solvents, domestic and commercial refrigerants, and aerosols, while emissions of perfluorocompounds (PFCs) and sulfur hexafluoride are a byproduct of their use in industrial processes and electrical applications, respectively.

[64] CAL. HEALTH & SAFETY CODE § 43018.5(a) (West 2006).

[65] The analysis in this section assumes that EPA would not attempt to regulate GHGs as criteria pollutants. Were EPA to attempt to do so, many of the same issues could arise.

A. *Coverage*

As discussed above, performance standards under section 111—if they applied to large (above 10,000 tons/year) stationary sources—could control sources that account for about 50% of U.S. CO_2 emissions.[66] Emissions standards for new light duty motor vehicles could reach another 20% of CO_2 emissions, once the existing fleet was replaced by vehicles subject to standards (the average useful life of light duty motor vehicles is about 16 years).[67] If authorities under section 202(a) and 231 were exercised with respect to heavy trucks and aircraft respectively, in theory another 10% of CO_2 emissions could be reached,[68] but it is unclear how effective the exercise of those authorities would be.[69] Section 111 and title II of the CAA are thus capable of regulating in some fashion 70–80% of CO_2 emissions depending on whether or not aircraft and heavy trucks were covered, leaving roughly 20–30% of CO_2 emissions unregulated.

Because CO_2 emissions constitute 84% of U.S. GHG emissions, the CO_2 component of a regulatory program under the CAA could cover roughly 59–67% of GHG emissions. Coverage of some of the non-CO_2 GHGs could add to that coverage, but the extent to which non-CO_2 GHGs could or would be regulated under the CAA is difficult to predict because the diversity of sources and control techniques. In any circumstance, a significant proportion of U.S. GHGs—perhaps more than 40%—would remain outside any form of controls.

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[66] *See supra* note 11 and accompanying text. References to "tons" are in terms of metric tons.

[67] JOHN DECICCO & FREDA FUND, ENVTL. DEFENSE, GLOBAL WARMING ON THE ROAD 8 (2006).

[68] Heavy trucks, locomotives, and vessels account for about 7% of U.S. CO_2 emissions (22% of the transportation sector's 33% of U.S. CO_2 emissions). Heavy trucks produce the lion's share of these emissions—estimated at 6% of U.S. CO_2 emissions. Aircraft account for about 4% of U.S. CO_2 emissions (12% of the transportation sector's 33% of U.S. CO_2 emissions). *See supra* note 9 and accompanying text.

[69] Current EPA rules regulate emissions from new heavy truck *engines* rather than new heavy *trucks*. It is unclear whether this approach would be an effective way of regulating CO_2 emissions because it would not reflect a number of key aspects of performance such as wind resistance, tires, and transmission efficiency. With one exception, for smoke emissions, current aircraft emissions standards apply only to new aircraft engines and in some cases only to newly-certified engines. *See* Control of Air Pollution from Aircraft and Aircraft Engines; Emission Standards and Test Procedures, 70 Fed. Reg. 69,664 (Nov. 17, 2005) (codified at 40 C.F.R. pt. 87 (2006)).

B. *Structural Limitations on Mobile Source Regulation*

While the CAA might reach 70–80% of CO_2 emissions, between a quarter and a third of the CO_2 emissions that the CAA could reach are emissions from motor vehicles that can be regulated only through emissions standards for new vehicles and engines.

This limitation has two important consequences: first, because of the long useful life of vehicles currently on the road, it will be many years before the motor vehicle fleet will be comprised of vehicles that were subject to standards when new. Second, as noted above, new vehicle emissions standards regulate emissions per mile, but do not constrain vehicle miles traveled (VMT).[70] A vehicle's total emissions are the product of CO_2 emissions per mile multiplied by VMT.[71] A fully effective motor vehicle emissions program would deal with both elements of the equation. The inability to constrain VMT means—as a number of analysts have pointed out in the context of the CAFE program[72]—that the program will be significantly less effective and more costly than either a cap-and-trade program with upstream coverage of transportation fuels or a carbon tax. Moreover, to the extent that CO_2 emissions standards increase efficiency of motor vehicles and lower the cost per mile of driving, these standards—like fuel economy standards—are likely to result in a small but not insubstantial increase in VMT.[73] This "rebound effect" further

[70] By contrast, both a cap-and-trade program and a carbon tax have the effect of reducing VMT by increasing fuel prices and the cost per mile of driving.

[71] Another relevant factor is the renewable fuel content of the motor fuel. A CO_2 emissions standard could give credit for renewable content of motor fuels. Alternatively, policymakers could rely on the renewable fuels standard under title XV of the Energy Policy Act of 2005, which requires minimum levels of renewable fuels, such as ethanol, in gasoline. Energy Policy Act of 2005, Pub. L. No. 109-58, 119 Stat. 594 (2005).

[72] For example, one study compared an economy-wide cap-and-trade program with a large-source cap-and-trade combined with increased average fuel economy standards under CAFE. It found that the latter resulted in costs to the economy (in terms of long-term welfare loss) that were twice as high as the cost associated with an efficient economy-wide cap-and-trade program. A similar result would probably occur if new vehicle emissions standards were substituted for average fuel economy standards. Anne Smith et. al., *Implications of Trading Implementation Design for Equity-Efficiency Trade-offs in Carbon Permit Allocations* 15 tbl.3 (Dec. 2002) (Working Paper, *available at* http://www.feem.it/NR/Feem/resources/conferences/PRE2004-01-03-01.Smith.pdf).

[73] The rebound effect has been estimated to offset the initial fuel reduction

undercuts the effectiveness of new vehicle emissions standards as a CO_2 control tool.

The Energy Information Administration projects that VMT will increase by 57% between 2004 and 2030.[74] Emissions per mile for the entire vehicle fleet have to decrease by 36% during the same period just to stabilize motor vehicle emissions. The combination of the effects of slow penetration into the fleet of new vehicles subject to standards and an unconstrained increase in VMT means that new vehicle emissions standards are an incomplete and—according to some analysts[75]—unnecessarily costly means of controlling motor vehicle emissions.

C. *Impediments to Implementing a National Cap-and-Trade Program*

As noted in the discussion of stationary source regulation under section 111, EPA has asserted authority to allow sources to comply with performance standards under section 111 through a cap-and-trade program in which the states can elect to participate. If EPA prevails on this point in the CAMR litigation and a similar cap-and-trade program were set up for CO_2, the program would apply only to larger stationary sources[76] and only in states that elected to participate. Moreover, as noted in the discussion of title II, it does not appear feasible to integrate mobile source emission controls into the stationary source cap-and-trade program.[77]

The limited scope of a cap-and-trade program under section 111 would thus deny the U.S. a significant part of the efficiency benefits from an economy-wide cap-and-trade system. Low-cost opportunities to control mobile sources, smaller stationary sources or sources in states that opt out would be beyond the reach of participants in the cap-and-trade program. As a result, companies

from tighter CAFE standards by 10–20% or more. *See* David L. Greene et al., *Fuel Economy Rebound Effect for U.S. Household Vehicles*, ENERGY J., July 1999, at 27; *see also* Nordhaus & Danish, *supra* note 12, at 157.

[74] *See* ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, ANNUAL ENERGY OUTLOOK 2006 WITH PROJECTIONS TO 2030, at 145 tbl.A7 (2006), *available at* http://www.eia.doe.gov/oiaf/aeo/pdf/0383(2006).pdf.

[75] *See* Smith et al., s*upra* note 72.

[76] *See* discussion *supra* Part II.C (discussing integration of mobile source standards with stationary source cap-and-trade).

[77] Additional questions can be raised respecting inclusion of multiple source categories in the program, offsets, and inter-pollutant trading. *See* discussion *supra* Part II.B.

would be unable to pursue least-cost abatement strategies that entail reducing emissions from sources not covered by the cap-and-trade program.

Moreover, most of the compliance burden of the GHG control program would be borne by electric generators, large industrial sources of CO_2, and automobile manufacturers. Other sectors of the economy—even if they presented lower cost control opportunities—would largely be beyond the reach of the program.

IV. CONCLUSION

Were the Supreme Court to hold that EPA had authority to regulate CO_2 emissions under the CAA, that statute could be effective to control CO_2 emissions from large sources, such as electric generators, and to set CO_2 emissions standards for new motor vehicles and aircraft. However, the combination of gaps in coverage of CO_2 and other GHG emissions, impediments to establishing a national cap-and-trade system even for covered emissions, and the inability to deal with motor vehicle emissions other than through emissions standards for new vehicles, would render the regulatory program significantly less effective and more costly than an economy-wide cap-and-trade program or a carbon tax.

If the petitioners prevail in *Massachusetts v. EPA*, Congress may be faced with a choice of allowing GHG regulation to proceed under an imperfect Clean Air Act regulatory regime, or enacting a new regulatory regime specifically designed for cost-effective control of GHGs. A program specifically tailored to the regulation of GHGs could cover the full range of GHG emissions, could institute an economy-wide cap-and-trade program. and would not have to be principally reliant on new vehicle standards to control transportation emissions. Such a program could be more environmentally effective and less costly than one that uses existing regulatory tools under the Clean Air Act.