Climate Change, the Clean Air Act, and Industrial Pollution

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This article, prepared for UCLA Law's spring 2011 symposium entitled "Perspectives on Climate Change, Pollution, and the Clean Air Act," begins by addressing an interesting but narrow question: what are the co-pollutant implications of applying the Clean Air Act (CAA) to stationary source greenhouse gas (GHG) emissions? That inquiry has led inexorably to deeper issues, including the appropriate role of co-pollutant consequences in developing climate policies, the co-pollutant benefits and drawbacks of traditional versus market-based regulation, and, more specifically, the value of using the CAA to reduce GHG emissions.

The CAA's GHG provisions for industrial sources are controversial. Environmental Protection Agency (EPA) Administrator Lisa Jackson, environmental organizations, and industry would prefer new climate legislation to implementing the CAA.[1] Fur-

1. *See* Daniel Stone, *Regulate, Baby, Regulate*, NEWSWEEK, Apr. 2, 2010, at 44 (noting EPA Administrator Lisa Jackson's belief that new legislation tailored to GHGs would be more effective than regulating GHGs under the CAA); Jonas Monast et al., Avoiding the Glorious Mess: A Sensible Approach to Climate Change and the Clean Air Act 1, 7 (Nicholas Inst. for Envtl. Policy Solutions, Working Paper, 2010), *available at* http://nicholasinstitute.duke.edu/climate/policydesign/avoiding-the-glorious-mess. Industry representatives have been highly critical of EPA efforts to apply the CAA to stationary sources. Scott H. Segal, *New Source Performance Standards for Global Greenhouse Gas Emissions from the Power and Refining Sectors: Wrong Mechanism at the Wrong Time*, 41 ENVTL. L. REP. NEWS & ANALYSIS 10,312 (2011).

ther, numerous congressional bills and appropriations riders have sought—persistently but unsuccessfully—to strip EPA of its authority to regulate GHGs under the CAA.[2] An analysis of the CAA's co-pollutant implications can help inform the larger debate about the CAA as a climate policy tool.

Given the strong correlation between GHGs and traditional pollutants, there is little question that regulating GHGs from stationary sources will have important co-pollutant consequences. Fossil fuel combustion to produce energy contributed eighty-seven percent of GHG emissions in the United States in 2009,[3] and stationary sources contributed over half of those emissions.[4] Climate policies addressing stationary sources will therefore significantly impact fossil fuel combustion. In most instances, as GHG emissions decrease, associated co-pollutants, like sulfur dioxide, nitrogen oxides, particulates, and other hazardous components, are also likely to decrease.[5] Given the persistence of

2. *See* James Bradbury, *Bills That Would Limit the U.S. EPA's Clean Air Act Authorities*, WORLD RES. INST. (Apr. 19, 2011), *available at* http://www.wri.org/stories/2011/04/bills-would-limit-us-epas-clean-air-act-authorities (describing legislation to limit EPA authority under the CAA); Jean Chemnick, *Appropriations: EPA Rider More Sophisticated This Time Around – Enviros*, E&E NEWS PM (July 11, 2011), http://www.eenews.net/eenewspm/2011/07/11/archive/4?terms=Jean+chemnick+rider (last visited Feb. 10, 2012) (describing most recent appropriations rider to prevent EPA from regulating stationary source GHG emissions under the CAA); Teresa B. Clemmer, *Staving off the Climate Crisis: The Sectoral Approach Under the Clean Air Act*, 40 ENVTL. L. 1125, 1138 (2010).

3. ENVTL. PROT. AGENCY, EPA 430-R-11-005, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2009, at ES-11 (2011), *available at* http://www.epa.gov/climatechange/emissions/downloads11/US-GHG-Inventory-2011-Complete_Report.pdf. In 2009, carbon dioxide accounted for eighty-three percent of U.S. GHG emissions (taking into account the relative global warming potential of differing greenhouse gases). *Id.* at ES-6. Other GHGs include methane, nitrous oxide, ozone, and numerous forms of halogenated substances. *Id.* at ES-2.

4. *See* Clemmer, *supra* note 2, at 1138. The electric power sector generates thirty-three percent of U.S. GHG emissions, largely from coal and natural gas fired power plants. ENVTL. PROT. AGENCY, *supra* note 3, at ES-15, 2-19. Industry generates twenty percent of U.S. GHG emissions, through both on-site fuel combustion and GHG-generating industrial processes. *Id.* at ES-15, 2-21. Transportation accounts for another twenty-seven percent of U.S. GHG emissions. *Id.* at ES-15.

5. Stationary sources are a substantial source of "criteria" pollutants—the nation's most ubiquitous pollutants. They contribute over half of the emissions of particulates (both fine and coarse), ammonia (which contributes to particulate formation), sulfur dioxide, volatile organic compounds (which contribute to ozone formation), and lead. ENVTL. PROT. AGENCY, EPA-454/R-09-002, OUR NATION'S AIR—STATUS AND TRENDS THROUGH 2008, at 6 (2010), *available at* http://epa.gov/airtrends/2010 [hereinafter OUR NATION'S AIR]. Over forty percent of nitrogen oxides (which also contribute to ozone) are emitted from stationary sources. *Id.*

ongoing air pollution and its pervasive public health and environmental consequences, this "co-pollutant benefit" is significant.

Yet, for the most part, co-pollutant benefits have played little role in climate policy debates. A recent study on the role of co-pollutant benefits in climate policy analyses observed that decision-makers "do not usually consider the full range of effects of actions to address climate change."[6] The omission of more thorough discussions of climate policy benefits, including the reduction of traditional air pollution, "diminishes the role of benefits" in policy selection.[7] The study concludes that "[a]s a result, well-established [air quality] benefits are not a central part of the climate policy discourse."[8]

Part I of this article begins by exploring the threshold issue of why co-pollutant consequences should be an important parameter for evaluating and designing climate policies. It articulates the value of comprehensive analyses in general, and then explores the environmental, administrative, and technical advantages of taking a multi-pollutant approach to regulation. Part I also considers the economic and political implications of integrating co-pollutant concerns. The part ends by exploring how co-pollutant concerns might impact climate policy design.

Part II reviews the CAA's stationary source provisions and how EPA is applying them to GHGs. It provides an overview of the GHG and co-pollutant reduction potential offered by the CAA's traditional regulatory approach.

The debate about the CAA's application to GHGs does not occur in a vacuum. Much of the controversy relates to a deeper issue: the value of the CAA's direct regulatory approach in comparison with a market-based approach like cap-and-trade. Part III explores how accounting for co-pollutant impacts could influence that debate. Assuming that EPA implements the CAA's stationary source provisions through direct regulation instead of market mechanisms,[9] Part III compares the co-pollutant strengths and weaknesses of these two approaches.

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6. G.F. Nemet et al., *Implications of Incorporating Air-Quality Co-benefits into Climate Change Policymaking*, IOP SCI., Jan. 22, 2010, at 1, *available at* http://iopscience.iop.org/1748-9326/5/1/014007/fulltext/.

7. *Id.*

8. *Id.*; *see also id.* at 2 ("Even though the AQ [air quality] co-benefits of climate change actions are well established, policy analyses typically do *not* account for them.").

9. As noted below, it is possible that, rather than simply adopting direct facility controls, EPA will develop a market-based program or allow states to implement

Part IV turns back to EPA's implementation of the CAA, focusing on existing source standards. Applying the CAA to GHGs will give the agency an unprecedented role in controlling existing stationary source emissions, a role that will have important implications for both GHGs and co-pollutants. Due to quirks in the CAA, section 111(d) gives EPA a stronger role in controlling existing sources' GHG emissions than it has in controlling their traditional pollutants. CAA regulation of GHGs will therefore reach some existing sources that have thus far escaped direct federal control requirements. In addition, the CAA language for existing sources potentially offers EPA flexibility to promote significant changes in the power sector, the largest single source of GHG emissions. If those changes were to reduce reliance on coal-fired power and encourage natural gas, renewable energy, and efficiency, they would have substantial co-pollutant benefits.

Although new climate legislation would accomplish these beneficial results more directly, new federal initiatives appear unlikely in the near term. In the meantime, the CAA can provide GHG and co-pollutant benefits. The scale of those benefits will depend upon how aggressively EPA interprets the CAA. If interpreted modestly, without requiring transformative changes, it will provide only a start, and will not offer a sufficient solution to the profound challenges posed by continued reliance on fossil fuels. If the EPA imposes more transformative requirements that further the transition away from fossil fuels and, most particularly, away from coal-fired power, then the CAA could provide more substantial GHG and co-pollutant benefits.

I. THE ROLE OF CO-POLLUTANT CONSIDERATIONS IN CLIMATE POLICY

Climate policies to avert the risk of catastrophic climate change will require substantial changes to existing energy and industrial infrastructure and will have far-reaching impacts on the environment and the economy. Despite the significant societal implications of these policies, the political discourse has been limited. Rather than considering the multiple implications of alternative climate policies, the primary non-climate factor policy-

EPA's standards through market-based programs. *See infra* note 148 and accompanying text.

makers have addressed is short-term "cost minimization."[10] Policymakers have paid little attention to the relative co-pollutant benefits of alternative climate policies and the role of those benefits in choosing among policy options.[11] Focusing primarily on industrial compliance costs, without considering co-pollutant or other co-benefits, could significantly undervalue the benefits of alternative policies.[12]

Integrating co-pollutant considerations into climate policy analysis and policy development has been controversial, with some scholars arguing that co-pollutant concerns should not inform climate policy.[13] This part argues that such integration would improve policy outcomes. It begins by articulating an overarching justification for and explanation of a comprehensive approach. It then addresses in detail how considering co-pollutants would improve climate policy outcomes, and discusses some of the criticisms against incorporating co-pollutant analysis. Finally, it articulates the ways in which integrating co-pollutant concerns could affect the practical design of climate policies.

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10. *See* Nemet et al., *supra* note 6, at 1. In addition to cost minimization, some attention has focused on the potential economic benefits of transitioning to a green economy. *See* Alice Kaswan, *Greening the Grid and Climate Justice*, 39 ENVTL. L. 1143, 1152–54 (2009). California has articulated both the economic and co-pollutant benefits of its climate program. *See* CAL. AIR RES. BOARD, CALIFORNIA'S CLIMATE PLAN, 1–2 (2010), *available at* http://www.arb.ca.gov/cc/cleanenergy/clean_fs2.pdf (describing climate law and its benefits).

11. *See* Nemet et al., *supra* note 6, at 1–2.

12. *See, e.g.*, Dallas Burtraw et al., *Ancillary Benefits of Reduced Air Pollution in the US from Moderate Greenhouse Gas Mitigation Policies in the Electricity Sector*, 45 J. ENVTL. ECON. & MGMT. 650, 651–52 (2003), *available at* http://www.sciencedirect.com/science/article/pii/S0069602000220 (observing that ancillary benefits are an important factor in choosing the best climate policy). For example, if policymakers debating the CAA had focused only on the considerable costs of compliance, estimated at around $65 billion per year through 2020, they would have missed the countervailing benefits, estimated at $2 trillion per year. ENVTL. PROT. AGENCY, THE BENEFITS AND COSTS OF THE CLEAN AIR ACT FROM 1990 TO 2020: SUMMARY REPORT 2 (2011) [hereinafter THE BENEFITS AND COSTS OF THE CLEAN AIR ACT].

13. *See* Todd Schatzki & Robert N. Stavins, *Addressing Environmental Justice Concerns in the Design of California's Climate Policy* (2009), *available at* http://www.analysisgroup.com/PublishSearch.aspx?Keyword=environment+and+natural+resources (arguing that climate policies should focus solely on GHG reductions and that co-pollutant controls should be addressed separately); *cf.* Ann E. Carlson, *Designing Effective Climate Policy: Cap-and-Trade and Complementary Policies* (Sept. 1, 2011) (on file with author) (arguing that considering co-pollutant and other extraneous matters could negatively impact the effectiveness of a GHG cap-and-trade program).

A. *The Value of a Comprehensive Approach*

Before evaluating the specific benefits of considering co-pollutants in climate policy design, this article addresses a broader theoretical question: in developing climate policies, should decision-makers consider only GHGs, or take a more comprehensive approach that considers co-pollutants, compliance costs, energy independence, and all of the many economic, environmental, political, and social implications of potential climate policies? A comprehensive approach could be useful in multiple contexts: (1) deciding whether to adopt climate policies; (2) determining how stringent climate policies should be; and (3) evaluating the strengths and weaknesses of alternative climate policies (like direct regulation, cap-and-trade, carbon taxes, energy subsidies, and the like).

A comprehensive approach is appropriate because environmental policies do not operate in a vacuum; they have major social welfare effects. They are designed to control industries, businesses, and individuals and, as such, inevitably have a wide array of economic and environmental impacts that extend beyond the immediate environmental problem that prompted the policy. In many instances, determining the "best" policy solution requires not only an assessment of the policy's relative ability to solve the discrete problem at issue, but of the policy's overall impact as well.[14]

Progressive economists have articulated an efficiency rationale for this approach. As Professor James Boyce has explained, the "efficiency objective implies that policy should seek to maximize net social benefits from reducing greenhouse gas emissions. These benefits include co-pollutant reductions."[15] Focusing solely on cost minimization—the costs of alternative control strate-

14. *See* Kaswan, *supra* note 10. *See also* Michelle L. Bell, *Ancillary Human Health Benefits of Improved Air Quality Resulting from Climate Change Mitigation*, 7 ENVTL. HEALTH art. no. 41, 2 (2008) (stating that "[w]ell-informed public health and environmental strategies require full consideration of consequences, including co-benefits and potential ancillary harms"). As the National Research Council observed, it is important to be aware of the "social costs of electricity generation," not just the private costs, because that information "could . . . be used to inform choices among fuel types when expanding or replacing generation capacity." NAT'L RESEARCH COUNCIL, HIDDEN COSTS OF ENERGY: UNPRICED CONSEQUENCES OF ENERGY PRODUCTION AND USE 5, 67 (2010).

15. *See* Memorandum from James K. Boyce to Econ. & Allocation Advisory Comm. Members 2 (Dec. 30, 2009), *available at* http://www.climatechange.ca.gov/eaac/documents/member_materials/Boyce_memo_on_investment_indisadvantaged_communities-revised-30_Dec_2009.pdf.

gies—would fail to achieve an efficient policy, because it would fail to realize potential economic benefits.[16]

Nor is the idea of a comprehensive approach novel and untested. Congress and regulatory agencies frequently engage in such analysis, formally and informally, to determine whether and how to regulate. For example, Congress has sought comprehensive information on the CAA to better understand its "economic, health, and environmental effects."[17] More broadly, Congress has long required federal agencies to engage in comprehensive reviews of their actions. Under the National Environmental Policy Act, federal agencies must assess the environmental impacts of major federal actions, and, for rules imposing high compliance costs, agencies must also complete "regulatory impact assessments" that analyze the overarching costs and benefits of proposed regulatory actions. However contested the role of such analyses may be in determining substantive policy choices, Congress has recognized that decision-making is better informed by considering multiple factors than by one-dimensional analyses.

Assuming the value of a comprehensive approach, questions remain. How should such analysis proceed? How determinative a role should ancillary considerations play in climate policy decisions? These questions defy easy answers.

In suggesting the value of a comprehensive approach, I am not proposing a specific test or methodology for Congress or administrative agencies to follow. My intent in this article is to provide a broader conceptual defense for a wide-ranging political discourse about climate policies.

More particularly, I am not suggesting reliance on traditional cost-benefit analysis (CBA). CBA is a policy tool that serves a useful analytical function, but it cannot substitute for the value judgments that climate policy design ultimately requires. CBA attempts to quantify and then assess the relative costs and benefits

16. Professor Boyce notes that failing to consider co-pollutant reduction co-benefits "would be tantamount to leaving health-care dollars lying on the ground." *Id.*

17. The Benefits and Costs of the Clean Air Act, *supra* note 12, at 5, 6. The study broke new ground in considering not only the environmental benefits of improved air quality and the economic costs of compliance, but also the *economic* benefits of improved air quality. The study noted that:

> [I]n reality, effective air pollution control programs do not simply impose costs on the economy. They also improve air quality, which in turn affects the health and productivity of workers, reduces household medical expenditures for air pollution-related health problems, and protects the quality of the environment on which economic activity and growth depend.

Id. at 24.

of regulatory strategies. In some cases, it can help policymakers recognize trade-offs, and it has occasionally increased public recognition of the tangible benefits of environmental regulation.[18]

There are perils, however, to unduly relying on CBA. Such analysis misleadingly implies a final and objective determination about policy trade-offs,[19] when in fact the determination is based upon numerous controversial and non-objective assumptions. The lack of transparency about underlying assumptions means that undue reliance on CBA obscures, rather than aids, open discussion about critical value choices. Although CBA has occasionally highlighted the benefits of environmental policies, it is often impossible to truly quantify benefits.[20] Consequently, CBA often

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18. *See, e.g.*, Matthew D. Adler & Erik A. Posner, *Rethinking Cost-Benefit Analysis*, 109 YALE L. J. 165, 172–74 (1999) (describing case studies in which EPA's assessment of benefits justified regulatory actions); *see also* Nicholas Z. Muller, Robert Mendelsohn, & William Nordhaus, *Environmental Accounting for Pollution in the United States Economy*, 101 AMER. ECON. REV. 1649 (2011) (quantifying the damages caused by air pollution and comparing them to the value added by the polluting sectors); *see also* THE BENEFITS AND COSTS OF THE CLEAN AIR ACT, *supra* note 12 (quantifying the economic benefits of averting pollution); *see also* NAT'L RESEARCH COUNCIL, *supra* note 14 (quantifying the harms caused by energy production).

19. As Professor Doug Kysar notes, cost-benefit analysis aspires to "comprehensive rationality"—to provide a "precise, exhaustive, and objective analysis of government efforts to achieve identified goals[.]" Douglas A. Kysar, *Climate Change, Cultural Transformation, and Comprehensive Rationality*, 31 B.C. ENVTL. AFF. L. REV. 555, 557 n.8 (2004).

20. For example, cost-benefit analyses attempt to assign dollar values to ultimately unquantifiable considerations, like the value of human life, the value of endangered species, or the value of a scenic view. *See* FRANK ACKERMAN & LISA HEINZERLING, PRICELESS: ON KNOWING THE PRICE OF EVERYTHING AND THE VALUE OF NOTHING (2004). The assigned dollar value is often based upon studies revealing individuals' willingness-to-pay for the benefit in question. Such studies are fraught with difficulty, dependent as they are on inequalities in wealth, inequalities in power, and in the artificialness of the inquiry. *See, e.g.*, Kysar, *supra* note 19, at 571–78. They also take an individual's existing willingness-to-pay as a given, without contemplating the possibility that public deliberation about the policies in question could result in the transformation of values and preferences. *Id.* at 585–89. Even if certain considerations are capable of quantification at some point in time, like infrastructure damage from rising sea levels, current efforts to anticipate such values are fraught with unresolvable uncertainties. *See id.* at 563–64.

Analysts resolve that uncertainty either by making controversial and contestable assumptions, see *id.* at 567–70, or, alternatively, by simply leaving the uncertain considerations out of the cost-benefit calculus. *See* THE BENEFITS AND COSTS OF THE CLEAN AIR ACT, *supra* note 12, at 3. In EPA's assessment of the costs and benefits of the CAA, the agency noted that it could not quantify numerous pollution impacts, and therefore could not quantify the benefits of reducing those impacts. *Id.* at 3. Their study therefore underestimated the benefits associated with the CAA. *See also* NAT'L RESEARCH COUNCIL, *supra*, note 14, at 5 (observing that many adverse impacts from energy production cannot be quantified, including impacts on ecosystem services, on non-grain agriculture, and of hazardous air pollutants). Cost-benefit fails to give sufficient weight to environmental benefits, skewing the comparison between costs and benefits that the analysis is designed to achieve. Ultimately, wise policymaking requires a more open-ended substantive discussion about the costs and benefits—quantifiable and unquantifiable, certain and uncertain—of alternative policies than quantitative CBA provides.

As a corollary, the comprehensive approach I suggest will not lead to a single discoverable and objective optimal policy. In light of inevitable scientific uncertainty, policy assessments are likely to be highly contested, and a policymaker's view of the "best" environmental policy will depend upon his or her interpretation of contested facts.[21] Even if the data were uncontested, judgment calls and value choices are inevitable, particularly where they appear to present tradeoffs between environmental and economic goals. The purpose of comprehensive analysis is to bring the issues to the table for political resolution, not to identify objectively correct results.

Assuming a comprehensive approach, the next issue is what role ancillary considerations should play. First, it is important to recognize that some relevant factors, like environmental protection and cost, will conflict. (Part I.C, below, addresses the particular trade-offs that could arise in considering co-pollutants.) The possibility of conflict does not delegitimize the approach. Indeed, superior policy outcomes can be achieved by addressing, rather than avoiding, such conflicts.

A second key issue is the relative weight that ancillary factors, whether co-pollutant impacts, cost, or other parameters, should play in the political debate about climate policies. GHG reduction must remain a primary concern or a comprehensive approach could undermine the achievement of environmental objectives. More generally, the appropriate role for ancillary considerations could vary depending upon the circumstances. A wide-ranging comprehensive approach could be appropriate at some decision-making stages, like the legislative process. But once key decisions have been made, policymakers could determine that the law's goals could be more effectively achieved by a

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analyses also typically discount future benefits, an inherently value-laden enterprise that fails to adequately protect future generations. *See* Kysar, *supra* note 19, at 578–85.

21. *See* The Benefits and Costs of the Clean Air Act, *supra* note 12, at 26–27 (noting uncertainties in calculating environmental policies' costs and benefits); Nat'l Research Council, *supra* note 14, at 5 (noting uncertainties in calculating environmental policies' costs and benefits).

more limited focus.[22] Identifying the precise parameters for the role of ancillary considerations is beyond the scope of this article.

The role of ancillary considerations could, however, be more contestable in one policy-making context: setting environmental goals. If a comprehensive approach to climate goals were taken, the public might mistakenly assume that the long-term climate objectives reflect the reductions necessary to achieve long-term climate stabilization, and not realize that they have been influenced by cost or other considerations.[23] And certain goals, like planetary survival, are not amenable to compromise. Considering ancillary factors like compliance costs or co-pollutant benefits in the development of long-term environmental goals could undermine the clarity and integrity of climate objectives. If policymakers do take a comprehensive approach to goal-setting that incorporates ancillary implications, they should do so explicitly to avoid public confusion.

Critics of a comprehensive approach might argue that integrating co-pollutant and other social welfare considerations into pol-

22. For example, the best policy to protect endangered species could require privileging species and precluding economic and other considerations, given the likelihood that development pressures would lead decision-makers making case-by-case determinations to underestimate the cumulative importance of preserving biodiversity. Thus, the Endangered Species Act pointedly prevents agencies from considering economic impacts in listing species and determining violations. 16 U.S.C. § 1533(b) (2006) (requiring that listing determinations be made "solely on the basis of the best scientific and commercial data available"); Tenn. Valley Auth. v. Hill, 437 U.S. 153 (1978) (stating that the Endangered Species Act creates absolute protections for endangered species that do not allow the courts to take the costs of compliance into consideration).

23. This is a matter of current controversy. Policymakers debate whether climate reduction goals should focus solely on the reductions needed to stabilize the environment, or also reflect the costs and feasibility of control. David M. Driesen, *Capping Carbon*, 40 ENVTL. L. 1, 20–23 (2010).

Most environmental statutes establish long-term objectives based solely on environmental factors. For example, the CAA requires that National Ambient Air Quality Standards (NAAQS) for ubiquitous pollutants be set at the level necessary to protect public health, without considering costs of compliance. Clean Air Act § 109(b)(1), 42 U.S.C. § 7409(b)(1) (2006). Costs of compliance are considered in the development of strategies for meeting the NAAQS, *see, e.g.*, § 111(a)(1), 42 U.S.C. § 7411(a)(1) (new source performance standards), but the NAAQS themselves send a clear signal about public health objectives. *See* Whitman v. Am. Trucking Ass'ns, 531 U.S. 457, 486 (2001) (stating that, although costs may be considered in standards for achieving the NAAQS, the NAAQS themselves must be solely health-based). This approach has its critics; some contend that the costs and benefits of achieving the goals should be incorporated into the NAAQS-setting process. *See* James E. Krier, *The Irrational National Air Quality Standards: Macro- and Micro-Mistakes*, 22 UCLA L. REV. 323, 326 (1974) (arguing that NAAQS should consider not only public health, but differential costs of control).

icy-making could create paralyzing complexity. Confronting complexity is important, however, because that complexity mirrors the messy reality of environmental policies and their impacts. Effective climate policies *will* impact co-pollutants, the economy, current jobs in the fossil fuel industry, future jobs in energy efficiency or clean tech, short- and long-term energy supply, energy costs, the distribution of wealth, and many other important parameters. While it might appear simpler to focus only on GHG reductions and on minimizing compliance costs, that narrow focus could create unintended side effects due to the failure to recognize potential adverse impacts, like the adverse impacts of certain energy sources on pollution or water use.[24] A narrow focus could also miss significant opportunities, like improved air quality or new job opportunities, which could influence assessments of the appropriate policy.[25] Ultimately, climate policy will be more effective if it springs from a broader vision of future energy and industrial policy that integrates related environmental and socioeconomic considerations.

B. *The Benefits of Integrating Co-pollutant Considerations into Climate Policy*

Assuming that multiple considerations should guide the choice among climate policies, this part addresses the value of considering co-pollutants in developing climate policies. The part first addresses the environmental benefits to be gained from incorporating co-pollutant concerns. Second, it addresses the administrative and technical benefits of adopting a multi-pollutant approach that incorporates co-pollutant considerations into the development of GHG controls.

1. The Environmental Benefits of Integrating Co-pollutant Considerations

The environmental benefits of addressing co-pollutants in climate policies are a function of the severity of the co-pollutant problem, whether climate policies could provide co-pollutant benefits, and the extent to which climate policies could offer a

24. *See generally* Kaswan, *supra* note 10, at 1150–51, 1155–56 (describing how a comprehensive approach helps avoid the potential adverse environmental and economic effects of climate policies).

25. *See generally id.* at 1148–50, 1152–53 (describing how a comprehensive approach could maximize the potential environmental and economic benefits of climate policies).

worthwhile contribution to co-pollutant reduction initiatives in light of existing co-pollutant controls. Although this article cannot fully resolve these difficult empirical questions, it frames the relevant issues for ongoing policy debates.

a. Existing Air Pollution

Notwithstanding the CAA's role in substantially reducing air pollution, poor air quality remains a serious problem with serious impacts on health and the environment. Fossil fuel emissions from stationary sources include sulfur and nitrogen oxides, volatile organic compounds, particulates, mercury, and other hazardous pollutants.[26] Ozone pollution, partly caused by nitrogen oxide emissions from power plants,[27] causes respiratory problems, including asthma.[28] Sulfur emissions, primarily from coal-fired power plants, contribute to the formation of particulates that increase mortality[29] and, along with nitrogen oxides, contribute to the formation of acid rain, which damages lake and forest ecosystems.[30] Particulate pollution has heart and lung impacts and contributes to premature mortality. Power plants also emit half of the nation's mercury emissions,[31] which are deposited in water bodies and enter the food chain, creating neurological risks.[32] Pollution has economic as well as health impacts.

26. *See* ENVTL. PROT. AGENCY, THE BENEFITS AND COSTS OF THE CLEAN AIR ACT: 1990 TO 2020, at 2-2 tbl. 2-1 (2010), *available at* http://www.epa.gov/oar/sect812/feb11/fullreport.pdf, (indicating that power plants and other stationary sources are substantial sources of nitrogen oxide and sulfur dioxide); NAT'L RESEARCH COUNCIL, *supra* note 14, at 99 (describing heavy metal emissions from coal-fired power plants, including mercury); OUR NATION'S AIR, *supra* note 5, at 6 fig. 2.

27. Mack McGuffey & Gary R. Sheehan, Jr., *Taking Care of CAIR*, NAT. RES. & ENV'T, Summer 2005, at 67 (explaining an EPA program to reduce emissions of ozone precursors from power plants to mitigate eastern ozone levels). Nitrogen oxides and volatile organic compounds are the primary "ozone precursors" that combine to create hazardous ground-level ozone. *See* THE BENEFITS AND COSTS OF THE CLEAN AIR ACT, *supra* note 12, at 10.

28. *See* OUR NATION'S AIR, *supra* note 5, at 4.

29. *See* THE BENEFITS AND COSTS OF THE CLEAN AIR ACT, *supra* note 12, at 4, 10.

30. *See* OUR NATION'S AIR, *supra* note 5, at 3.

31. *See* ENVTL. PROT. AGENCY, FACT SHEET: MERCURY AND AIR TOXICS STANDARDS FOR POWER PLANTS 2 (2011), *available at* http://www.epa.gov/mats/pdfs/20111221MATSsummaryfs.pdf. *See also* ENVTL. LAW INST., CLEANER POWER: THE BENEFITS AND COSTS OF MOVING FROM COAL GENERATION TO MODERN POWER TECHNOLOGIES 2 (2001), *available at* http://www.elistore.org/Data/products/d10-12.pdf (indicating that coal-fired power plants contribute one-third of the nation's mercury emissions).

32. NAT'L RESEARCH COUNCIL, *supra* note 14, at 101.

Society as a whole must absorb medical costs, lost work and school days, and decreased worker productivity.[33]

Reducing air pollution would create measurable society-wide benefits. A recent study of the anticipated benefits of the 1990 Clean Air Act Amendments (CAAA) found that, by 2020, the CAAA could generate almost $2 trillion in annual benefits.[34] Reducing particulates and ozone pollution would prevent hundreds of thousands of premature deaths, heart attacks, and emergency room visits, as well as millions of restricted activity and lost school days.[35] Improving air quality would also lead to economic welfare benefits, including improved worker productivity, reduced medical expenditures, and improved ecological services.[36]

b. *Do Climate Policies Reduce Co-pollutants?*

Co-pollutant reductions are relevant to the development of climate policies only if GHG and co-pollutant reductions are correlated. Policy analysts have found such correlation, and have concluded that climate policies that reduce GHG emissions could generate substantial co-pollutant reduction benefits. A 2010 study on the implications of including air quality benefits in climate policy analyses concluded, based on a survey of thirty-seven peer-reviewed domestic and international analyses, that it is now "clear that the magnitude of [air quality] co-benefits of climate

33. *Cf.* THE BENEFITS AND COSTS OF THE CLEAN AIR ACT, *supra* note 12, at 24 (observing that controlling air pollution and reducing pollution-related health impacts create economic benefits like increased worker productivity and reduced medical expenditures).

34. *Id.*, at 2. The study noted that the benefits result from "significant reductions in air pollution-related premature death and illness, improved economic welfare of Americans, and better environmental conditions." *Id.* The benefits calculation likely undercounts the benefits because many pollutant reduction benefits could not be quantified. *Id.* at 16–17 (noting that the economic benefits from reducing toxics, increasing visibility, reducing impacts on agriculture, timber, and fishing could not be adequately quantified and are therefore not reflected in the quantified benefits). The calculation of benefits is itself a reflection of values, and was based upon studies that indicated what people would be willing to pay to avoid health and mortality risks. *Id.* at 22. *See also* NAT'L RESEARCH COUNCIL, *supra* note 14, at 21 (noting that estimated damages from energy combustion are likely underestimated due to the inability to quantify many types of air pollution damages).

35. THE BENEFITS AND COSTS OF THE CLEAN AIR ACT, *supra* note 12, at 14 Exhibit 8 (listing the health improvements the CAA Amendments are expected to deliver by 2020).

36. *Id.* at 24. Of these economic benefits, only worker productivity improvements and health care savings were capable of being quantified and included in the analysis. *Id.* at 28.

change mitigation are non-trivial."[37] A 2008 review of the air quality benefits of climate policies similarly concluded that, despite the studies' varying methods, "results consistently indicate significant ancillary health benefits from GHG policies."[38]

GHG reduction policies tend to reduce co-pollutants because they replace fossil fuel combustion—which combines high GHG and high co-pollutant emissions—with greater energy efficiency and less-polluting energy sources.[39] In particular, because coal combustion has high GHG and co-pollutant emissions, climate policies that reduce reliance on coal are likely to generate correspondingly significant reductions in co-pollutants.[40] (A more specific assessment of how the CAA's regulatory programs could reduce GHG emissions and provide associated co-pollutant benefits is provided in Part II.)

c. *How Significant are Climate Policies' Co-pollutant Benefits in Light of Existing and Emerging Direct Co-pollutant Controls?*

Some might acknowledge the continued air quality challenge and the connection between GHGs and co-pollutants, but question whether it is necessary for climate policies to consider co-

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37. Nemet et al., *supra* note 6, at 2. *See also* Britt Groosman et al., *The Ancillary Benefits from Climate Policy in the United States* 23 (Middlebury Coll., Dept. of Econ. Working Paper No. 0920, 2009), *available at* http://sandcat.middlebury.edu/econ/repec/mdl/ancoec/0920.pdf (analyzing the co-pollutant reduction consequences of federal climate legislation proposed in 2008). One economist has concluded that the co-pollutant benefits of reducing GHGs exceed recently-calculated climate benefits. *See* Nicholas Z. Muller, *Optimal Climate Policy with Air Pollution Co-Benefits* 16 (Jan. 2011) (unpublished manuscript), *available at* https://seguecommunity.middlebury.edu/view/html/site/nmuller/node/4861421. *See also* Burtraw et al., *supra* note 12, at 670 (finding that a moderate carbon tax on the electricity sector would generate significant co-pollutant benefits above and beyond reductions occurring under existing air pollution control programs).

38. Bell, *supra* note 14, at 3.

39. *See e.g.*, DIANE BAILEY, KIM KNOWLTON, & MIRIAM ROTKIN-ELLMAN, BOOSTING THE BENEFITS: IMPROVING AIR QUALITY AND HEALTH BY REDUCING GLOBAL WARMING POLLUTION IN CALIFORNIA 6 (2008), *available at* http://www.nrdc.org/globalwarming/boosting/contents.asp; David M. Driesen, *Sustainable Development and Air Quality: The Need to Replace Basic Technologies with Cleaner Alternatives*, 18 WIDENER L.J. 883, 890–91 (2009); Kaswan, *supra* note 10, at 1148; Groosman et al., *supra* note 37. In the development of its comprehensive climate plan, California identified concrete co-pollutant reduction benefits from the state's strategy for achieving the state's goal of reducing GHG emissions to 1990 levels by 2020. *See* CAL. AIR RES. BD., CLIMATE CHANGE SCOPING PLAN APPENDICES app. H at H-32–36 (2008), *available at* http://www.arb.ca.gov/cc/scopingplan/document/appendices_volume2.pdf.

40. *See* Groosman et al., *supra* note 37.

pollutant reductions in light of on-going regulation of those co-pollutants. In other words, to what extent can considering co-pollutants in climate policies offer a useful supplement to existing co-pollutant regulation?[41]

Implementation of the CAA to date has not been sufficient to achieve public health standards for air quality. Many of the nation's most populated areas continue to experience non-attainment of national ambient air quality standards (NAAQS).[42] Established for the most ubiquitous pollutants, NAAQS reflect the ambient pollutant concentrations necessary to protect public health and the environment.[43] Despite significant improvement since the CAA was enacted in 1970, in 2008, 127 million people lived in areas that failed to attain the NAAQS.[44] While stationary sources are not the only sources of air pollution, they contribute significantly to poor air quality.[45] The pattern of pollution also has distributional implications: low-income and communities of color are more likely to live in areas that do not meet the NAAQS.[46]

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41. Dallas Burtraw suggests that only those co-pollutant benefits that would not otherwise occur under existing pollution regulation "count" for purposes of assessing a climate policy's co-pollutant benefits. Burtraw et al., *supra* note 12, at 653–56. He argues that many of the existing studies of climate policies' co-pollutant benefits have inflated co-pollutant benefits because many of the reductions would have occurred under direct pollution regulations, irrespective of the climate controls. *Id.* at 655. As discussed further below, I argue that climate policies could complement and reinforce air quality control measures, even if there is some overlap in the reductions they achieve. *See infra.*

42. *See* Our Nation's Air, *supra* note 5, at 10–11.

43. *See* Richard E. Ayres & Jessica L. Olso, *Setting National Ambient Air Quality Standards, in* The Clean Air Act Handbook, 13 (Julie R. Domike & Alec C. Zacaroli, eds., 3d ed. 2011). EPA has established NAAQS for six common air pollutants: sulfur dioxide, particulate matter, nitrogen oxide, carbon monoxide, ozone, and lead. 40 C.F.R. § 50 (2012).

44. *See* Our Nation's Air, *supra* note 5, at 1.

45. *See supra* note 5 (describing stationary sources' substantial criteria pollutant emissions). Reducing stationary source GHG emissions is likely to reduce co-pollutants, but it is important to note that such controls will not be sufficient to eliminate pollution given the substantial role of mobile and other sources to on-going pollution. *See* Our Nation's Air, *supra* note 5, at 6.

46. *See* J. Andrew Hoerner & Nia Robinson, A Climate of Change: African Americans, Global Warming, and a Just Climate Policy for the U.S. 2, 12 (2008), *available at* http://www.greendmv.org/reports/climateofchange.pdf; *see also* Michael Ash et al., Justice in the Air: Tracking Toxic Pollution from America's Industries and Companies to our States, Cities, and Neighborhoods (2009), *available at* http://www.peri.umass.edu/fileadmin/pdf/dpe/ctip/justice_in_the_air.pdf (discussing racially disproportionate exposure); James P. Lester et al., Environmental Injustice in the United States; Myths and Realities (2001).

While measures to date have not fully achieved air quality goals, EPA has recently initiated additional programs that could substantially improve air quality. To address persistent interstate ozone and particulate pollution, EPA promulgated a new Cross-State Air Pollution Rule (CSAPR) that will ultimately reduce emissions in twenty-seven eastern, southeastern, and midwestern states.[47] EPA predicts that the CSAPR will help many states attain federal air quality standards.[48] EPA also promulgated new rules to control mercury and other toxics from coal- and oil-fired power plants.[49] EPA issued (but, at the time of this writing, is reconsidering) controversial standards for air toxics from industrial boilers.[50] In addition, EPA proposed water and coal-ash pollution control measures for coal-fired power plants.[51] These measures, in combination with existing and proposed air pollution regulations, could prompt older polluting facilities to shut down, significantly reducing air pollution.[52]

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47. The Cross-State Air Pollution rule, finalized July 6, 2011, replaced a similar program, the Clean Air Interstate Rule, which had been invalidated by the courts. *See* ENVTL. PROT. AGENCY, FACT SHEET: THE CROSS-STATE AIR POLLUTION RULE: REDUCING THE INTERSTATE TRANSPORT OF FINE PARTICULATE MATTER AND OZONE (2011), *available at* http://www.epa.g ov/airtransport/pdfs/CSAPRFact-sheet.pdf. The final rule is Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals. 76 Fed. Reg. 48,208 (Aug. 8, 2011) (to be codified at 40 C.F.R. pt. 51, 52, 72, 78, 97) [hereinafter Cross-State Air Pollution Rule].

48. Cross-State Air Pollution Rule, *supra* note 47, at 48,210.

49. EPA's new rule to reduce mercury and other air toxics from coal- and oil-fired power plants was signed on December 16, 2011. *See* ENVTL. PROT. AGENCY, FACT SHEET: MERCURY AND AIR TOXICS STANDARDS FOR POWER PLANTS (2011), *available at* http://www.epa.gov/mats/pdfs/20111221MATS summaryfs.pdf. The final rule is National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial- Institutional, and Small Industrial- Commercial-Institutional Steam Generating Units. 77 Fed. Reg. 9,304 (Feb. 16, 2012) (to be codified at 40 C.F.R. pt. 60, 63).

50. The agency is reconsidering its initial air toxics regulations for boilers and now does not expect to issue revised regulations until April 2012. Press Release, Envtl. Prot. Agency, EPA Announces Timeline for Reconsideration of Air Toxics Standards for Boilers and Certain Incinerators .(June 24, 2011) *available at* http://yosemite.epa.gov/opa/admpress.nsf/1e5ab1124055f3b28525781f0042ed40/5530a05d25ddd683852578b900533312.

51. *See* Cross-State Air Pollution Rule, *supra* note 47, at 48,216 (describing recent proposals to regulate cooling water intakes under the Clean Water Act and coal ash under the Resource Conservation and Recovery Act).

52. *See* CREDIT SUISSE, GROWTH FROM SUBTRACTION: IMPACT OF EPA RULES ON POWER MARKETS 60 (Sept. 23, 2010), *available at* http://op.bna.com/env.nsf/id/jstn-8actja/$File/suisse.pdf (estimating that approximately 60 gigawatts out of 340 gigawatts of coal-fired power could shut down in the face of forthcoming environmental measures); Andrew Childers, *Analysis Says EPA Emissions Rules Could*

While these initiatives could yield tangible progress, they are unlikely to resolve all of the nation's pollution problems. The National Research Council anticipates that, by 2030, new clean air initiatives under the CAA will significantly reduce, but not eliminate, damage caused by co-pollutant emissions.[53] The Acid Rain Program has dramatically reduced emissions, but acidification continues.[54] Moreover, while the CSAPR is significant, industry has challenged the rule and the D.C. Circuit has stayed its implementation, creating legal uncertainty about the control of stationary source emissions throughout the east.[55] Furthermore, while the CSAPR is anticipated to help many states achieve the current ozone standard, scientists have concluded that the current ozone standard is insufficient to protect human health.[56] If the CSAPR is designed to meet an outdated standard, then it is unclear whether it would achieve the reductions that are really necessary to protect public health. Even assuming the D.C. Circuit upholds CSAPR, and that it substantially improves East Coast ozone pol-

Shutter Coal-Fired Power Plants, 41 ENV'T REP. (BNA) 2352 (Oct. 22, 2010) (reporting on Credit Suisse analysis); Jessica Coomes, *FERC Says 81 Gigawatts of Capacity Could Retire Because of EPA Rules*, 42 ENV'T REP. (BNA) 1752 (Aug. 5, 2011) (reporting on Federal Energy Regulatory Commission letter predicting that EPA rules could lead to shut-downs of 81 gigawatts of coal-fired power).

53. The National Research Council considered the damage caused by emissions of sulfur dioxide, nitrogen oxides, particulates (fine and coarse), ammonia (which contributes to particulate formation), volatile organic compounds (which contributes to ozone formation) in six categories, including "health, visibility, crop yields, timber yields, building materials, and recreation." NAT'L RESEARCH COUNCIL, *supra* note 14, at 68. The Council concluded that regulatory efforts are likely to reduce the mean damages for coal-fired power plants from their current 3.2 cents per kWh to 1.7 cents per KwH. *Id.* at 6–7. That level is still high, as revealed by comparing coal-fired power plant emissions with natural gas power plants, which had mean damages of 0.16 cents per kWh in 2005 and are expected to reduce emissions to 0.11 cents per kWh by 2030. *Id.* at 8.

54. NAT'L SCI. AND TECH. COUNCIL, NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM REPORT TO CONGRESS: AN INTEGRATED ASSESSMENT 3 (2005), *available at* http://www.esrl.noaa.gov/csd/aqrs/reports/napapreport05.pdf.

55. *See* Jessica Coomes, *Appeals Court Blocks EPA Cross-State Rule; Predecessor Program Remain in Place*, 43 ENV'T. REP. (BNA) 3 (Jan. 6, 2012). The CSAPR's predecessor program, the Clean Air Interstate Rule, remains in place during the stay, but that program will not provide a long-term alternative because it has already been invalidated by the courts. *Id.*

56. *See* Andrew Childers, *EPA Proposes Tougher Ozone Standard, Setting of Separate Secondary Standard*, 41 ENV'T REP. (BNA) 61 (Jan. 8 2010).

lution,[57] it will not address western pollution, like California's persistent and intractable ozone pollution.[58]

More broadly, even though existing co-pollutant programs and forthcoming initiatives are likely to result in significant air quality improvements, the question is not only whether climate policies offer an independent co-pollutant benefit, but whether they complement or reinforce air quality initiatives. To some extent, GHG and co-pollutant initiatives could complement one another. For example, facilities addressing co-pollutants are likely to focus on end-of-the-pipe pollution controls, like scrubbers, while GHG measures are more likely to involve enhanced energy efficiency[59] that complements the co-pollutant reductions achieved by existing initiatives. Moreover, EPA's significant new pollution initiatives primarily address the power sector,[60] not other sources of industrial pollution. GHG controls in other industries could provide additional co-pollutant benefits. To the extent there is some overlap in operation, like standards that encourage the use of natural gas rather than coal, GHG requirements could reinforce other co-pollutant initiatives, adding to the incentives already created by co-pollutant regulation.

2. The Administrative and Technical Benefits of Taking a Multi-pollutant Approach

The foregoing part suggests the importance of incorporating co-pollutant considerations into climate policy decisionmaking in order to maximize environmental benefits and improve overall welfare. This part, in contrast, addresses, as a practical matter, the administrative and technical efficiencies that flow from coordinating GHG and co-pollutant control strategies.

The same combustion processes generate GHG and co-pollutant emissions. Policies designed to address one pollutant inevita-

57. EPA projects that the rule will enable virtually all of the covered states to meet the NAAQS for ozone and particulates. Cross-State Air Pollution Rule, *supra* note 47, at 48,210.

58. *See* OUR NATION'S AIR, *supra* note 5, at 16 (observing that California has the nation's highest ozone concentrations).

59. *See infra* note 108 and accompanying text (noting that GHG controls are likely to focus on enhancing energy efficiency).

60. Although the Cross-State Air Pollution Rule is not explicitly limited to the power sector, EPA's initial strategy is to establish federal implementation plans controlling the power sector. Cross-State Air Pollution Rule, *supra* note 47, at 48,210. The states could choose to meet their state emission budgets in alternative ways in the future, but the current approach demonstrates the significance of the power sector in achieving that rule's goals.

bly have implications for others. In many instances, there is a positive correlation between GHG and co-pollutant emissions, so measures designed to reduce one will reduce the other. For example, a GHG policy that encouraged fuel-switching from coal to natural gas would have substantial implications for associated co-pollutants given the lower co-pollutant emissions from natural gas plants.[61] Similarly, energy efficiency improvements, by reducing combustion, are likely to reduce co-pollutants.[62]

In certain instances, however, GHG regulation could increase co-pollutants. For example, certain mechanisms to increase the efficiency of natural gas plants could increase co-pollutant levels.[63] More dramatically, carbon capture and storage, in which carbon is isolated from the emissions stream and shipped to a storage location, is highly energy-intensive. The additional energy generation could significantly increase co-pollutants.[64] Conversely, certain measures to control co-pollutants require additional energy and, as a consequence, increase GHG emissions.[65]

The agencies responsible for developing GHG and co-pollutant controls would benefit from policymaking approaches that allowed for explicit attention to regulations' multi-pollutant impacts. Positive synergies could be exploited, and trade-offs could be rationally assessed and debated. Although the traditional approach to air pollution control has focused on addressing one pollutant at a time,[66] federal and state agencies are increasingly pursuing multi-pollutant control strategies to provide an integrated approach to industrial emissions.[67] In a 2004 assessment of

61. *See infra* note 117 and accompanying text (describing environmental implications of switching from coal to natural gas).

62. *See infra* note 110 and accompanying text (describing general relationship between combustion and co-pollutant pollution).

63. *See infra* note 179 and accompanying text.

64. *See infra* notes 126–27 and accompanying text.

65. ENVTL. PROT. AGENCY, THE MULTI-POLLUTANT REPORT: TECHNICAL CONCEPTS AND EXAMPLES 1–6 (2008) [hereinafter THE MULTI-POLLUTANT REPORT].

66. *See id.* at I-1 (describing how the CAA pushes the agency to take a single-pollutant approach).

67. *See* Sam Napolitano et al., *A Multi-Pollutant Strategy*, PUBLIC UTILITIES FORTNIGHTLY 34, 37 (Jan. 2009). In the mid-1990s, EPA and numerous stakeholders recognized that the CAA would require controls on multiple pollutants from the same facilities, and sought to develop a more streamlined, multi-pollutant approach through the Clean Air Power Initiative. *Id.* at 35. Meanwhile, Congress considered numerous bills in the 2000s that would have provided explicit legislative authorization for new, multi-pollutant reduction targets. *Id.* at 36–38. After initial regulatory efforts encountered legal obstacles, EPA's most recent multi-pollutant initiative for

the nation's air quality management program, the National Academy of Sciences found that:

> Standard setting, planning and control strategies for criteria pollutants and hazardous air pollutants have largely focused on single pollutants instead of potentially more protective and more cost-effective multipollutant strategies. Integrated assessments that consider multiple pollutants (ozone, particulate matter, and hazardous air pollutants) and multiple effects (health, ecosystem, visibility, and global climate change) in a single approach are needed.[68]

This report prompted EPA "to transition toward a comprehensive, multi-pollutant treatment of our nation's air quality problems."[69]

Although EPA's multi-pollutant efforts have historically focused on traditional pollutants,[70] the agency has recently expressed its intent to coordinate its GHG regulatory initiatives with traditional pollutant controls. In developing GHG standards for the power sector, EPA stated that it:

> is coordinating this action on GHGs with a number of other required regulatory actions for traditional pollutants. . . . Together, EGUs [electrical generating units] will be able to develop strategies to reduce all pollutants in a more efficient and cost-effective way than addressing these pollutants separately.[71]

Similarly, in explaining its plans to develop GHG regulations for oil refineries, the agency has stated its intent to establish:

> a comprehensive approach of simultaneously addressing different types of air pollution (GHG, toxics and "criteria" pollutants) from different points at the refinery at the same time and in accord with EPA's Clean Air Act obligations to control emissions from this sector.[72]

Some states are also incorporating multi-pollutant approaches. The San Francisco Bay Area Air Quality Management District's

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traditional pollutants is the Cross-State Pollution Rule. *See* Cross-State Air Pollution Rule, *supra* note 47. Most of these multi-pollutant initiatives have been conceptualized as cap-and-trade programs, but that structure is not an inherent feature of a multi-pollutant approach. *See* Napolitano, *supra*, at 39, 40.

68. NAT'L RESEARCH COUNCIL, AIR QUALITY MANAGEMENT IN THE UNITED STATES 12 (2004).

69. THE MULTI-POLLUTANT REPORT, *supra* note 65, at I-1.

70. *See* Napolitano, *supra* note 67, at 35.

71. ENVTL. PROT. AGENCY, FACT SHEET: SETTLEMENT AGREEMENTS TO ADDRESS GREENHOUSE GAS EMISSIONS FROM ELECTRIC GENERATING UNITS AND POWER PLANTS (2010), *available at* http://www.epa.gov/airquality/pdfs/settlement factsheet.pdf.

72. *Id.*

recent clean air plan, completed to meet state air planning requirements, takes a multi-pollutant approach by incorporating both traditional and GHG emissions. The plan states that the "Air District believes that an integrated and comprehensive approach to planning is critical to respond to air quality and climate protection challenges in the years ahead."[73]

Regulated entities could also benefit from a multi-pollutant approach. Single-pollutant approaches risk piecemeal and potentially conflicting requirements. The recent spate of EPA rulemakings on a variety of pollutants prompted industry calls for a more consolidated analysis of their implications.[74] Although motivated by concerns over the cumulative financial impact of multiple regulations, their calls nonetheless reveal that regulated entities, struggling to make long-term choices about which facilities to operate with what technologies, would benefit from regulatory approaches that consolidate and clarify relevant requirements.

C. *Addressing the Potential Economic and Political Implications of Incorporating Co-pollutant Considerations*

Integrating co-pollutant considerations into climate policy is likely to raise a couple of key concerns. One is the risk that achieving co-pollutant objectives could conflict with another important climate policy parameter: reducing compliance costs. Maximizing co-pollutant benefits could conceivably increase short-term compliance costs. For example, direct regulation might provide greater co-pollutant reduction benefits than a market-based approach, but increase the costs of achieving a given level of GHG reduction. Industry could fear the impact of increased costs on profitability and competitiveness. Environmentalists could fear that policymakers will respond to higher costs

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73. BAY AREA AIR QUALITY MGMT. DIST., BAY AREA 2010 CLEAN AIR PLAN, ES-1–2 (2010). The plan states that:

> The major purpose for developing a multi-pollutant plan is to achieve the greatest possible public health benefit by reducing emissions, ambient concentrations, and public exposure across the four categories of air pollutants [including ozone precursors, particulates, air toxics, and GHGs] addressed in the 2010 CAP. In developing the CAP control strategy, the Air District has attempted to maximize co-benefits, while at the same time minimizing any potential trade-offs among pollutants.

Id. at ES-2.

74. *See* Jessica Coomes & Bebe Raupe, *EPA Asked to Consider Cumulative Effect Air Rules Will Have on Utilities, Economy*, 42 ENV'T REP. (BNA) 1862 (Aug. 19, 2011).

by setting less stringent climate goals.[75] As stated above, however, little is to be gained by avoiding conflict, and recognizing the positive and negative tradeoffs generated by alternative climate policies is an important component of the deliberative process. I do not attempt to resolve the potential conflict; my argument is simply that it is one worth facing.

Moreover, to the extent that economic costs are considered in the climate policy debate, compliance costs are not the only relevant economic parameter. Controlling co-pollutants and lessening the public health consequences of pollution provide important economic benefits. In some instances, co-benefits have played an important role in determining the appropriate policy. For example, in EPA's recently finalized power plant toxics rule, largely designed to control mercury pollution, the lion's share of the rule's quantified benefits stem from the control of a co-pollutant (particulate matter) rather than from the targeted toxic pollutants.[76] (That does not mean that the reductions in the targeted pollutants were not valuable; the agency simply had more quantifiable data about particulate reduction benefits than it had about mercury reduction benefits.[77]) Thus, the co-benefits of regulatory policies can have a significant impact on their overall economic implications, factors that are worth weighing in assessing alternative policies.

A second potential concern about integrating co-pollutant considerations into climate policy debates is the risk of increasing the already-considerable political challenge of developing climate policies. Certain industries have strongly resisted climate

75. *Cf.* Schatzki & Stavins, *supra* note 13, at 1 (noting that climate policies, like cap-and-trade, that minimize compliance costs could lead to more stringent GHG emission targets).

76. National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel – Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units, 77 Fed. Reg. 9304, 9305 (Feb. 16, 2012) (to be codified at 40 C.F.R. pt. 60, 63). Using a three percent discount rate, the agency projected benefits ranging from $37 to $90 billion dollars per year. The particulate benefits constituted $36 to $89 billion of those benefits, while the quantifiable mercury benefits were a small fraction of that. *Id.* at 9306 tbl. 2.

77. 77 Fed. Reg. at 9306 tbl. 2 (indicating that non-monetized benefits included "[o]ther neurological effects of Hg [mercury] exposure," "[o]ther health effects of Hg exposure," "ecosystem effects," and "[h]ealth risks from commercial and non-freshwater fish consumption").

regulation,[78] and factoring co-pollutant controls into the development of climate policies could create another flash point for controversy.

The risk of industry backlash is an important consideration, but is not unqualified. Although industry might react more sharply against climate policies that integrate co-pollutant considerations, the public could respond more favorably to such integration. Recent surveys suggest that the public is more concerned about co-pollutants than GHGs. Climate policies that offer co-pollutant benefits could receive more political support than those that focus solely on GHG reductions.[79]

More broadly, the politics of carbon could be aided by a broader vision of the transition to a more sustainable future. A sustainable future is unlikely to be attainable without substantial changes in existing energy infrastructure. Building the political will to implement those changes, often in the face of vested interests, will require the development of a longer-term vision that addresses not only GHG emission reductions, but the ancillary environmental and economic implications of a transformative shift away from carbon. The public is more likely to accept that transition if it has the opportunity to address the tradeoffs the transition involves and perceives the full range of associated benefits.

D. *How Co-pollutant Implications Could Influence Climate Policies*

Assuming that climate policies' co-pollutant implications are relevant, the next question is how those implications could influence climate policy design. On a meta-scale, and to the extent that co-pollutant benefits are integrated into the goal-setting process, they could provide an overarching justification for setting more stringent GHG reduction targets and timelines.[80] Co-pollu-

78. *See* Lynn Garner, *Oil, Gas Industry Steps Up Lobbying Effort in Final Weeks before November Elections*, 41 ENV'T. REP. (BNA) 2085 (Sept. 17, 2010).

79. *See* Lesley Kaufman, *Environmentalists Get Down to Earth*, N.Y. TIMES, Dec. 18, 2011, at SR6. When California's climate law was threatened with repeal through a voter referendum, those seeking to preserve the law focused extensively on its economic and co-pollutant co-benefits, rather than its GHG benefits. *See* Ann Notthoff, Editorial, *Viewpoints: In Defeat of Prop 23, We All Came Together*, SACRAMENTO BEE, Nov. 14, 2010, at 5E (opposing Proposition 23). *See generally* Kaswan, *supra* note 10, at 1158–59 (describing political benefits of a comprehensive approach that addresses climate policies' co-pollutant implications).

80. *See* Muller, *supra* note 37, at 17; Nemet,et al., *supra* note 6, at 4. That conclusion holds if one takes a comprehensive approach to determining the appropriate

tant considerations are relevant not just to questions of stringency, but also to policy choices. Even if alternative climate policies could achieve the same GHG results, they could have differing co-pollutant outcomes.

Considering GHGs alone, the source and location of the reductions are largely irrelevant: a ton of GHGs reduced (or sequestered) anywhere from any source will have the same impact on the global climate.[81] In contrast, as described below, the co-pollutant benefits of GHG reductions are likely to vary depending on the type of source and its location. If co-pollutant reductions are considered, they could influence the desirability of alternative climate policy design features.

The type of regulated source affects co-pollutant benefits because sources have differing GHG to co-pollutant ratios or, in other words, they have differing "co-pollutant intensities."[82] For example, on average, coal-fired power plants have a high rate of co-pollutant emissions per unit of GHG emissions, so reductions in GHGs from most coal-fired power sources could result in correspondingly large decreases in associated co-pollutants.[83] Even among coal-fired power plants, there are significant differences in co-pollutant damages depending on the type of coal used, the plants' age, and the extent and type of the facilities' pollution control technologies.[84]

level of reductions that incorporates ancillary costs and benefits, like co-pollutant benefits. On the other hand, if GHG reduction goals were based solely on climate stabilization objectives, then co-pollutant considerations would not be a relevant consideration. *See supra* note 23 (discussing the issues raised by taking a comprehensive approach to setting environmental goals).

81. *See* A. Denny Ellerman, Paul L. Joskow & David Harrison, Jr., Emissions Trading in the U.S.: Experience, Lessons, and Considerations for Greenhouse Gases 40–41 (2003). Local GHG concentrations might not be entirely irrelevant. There is some evidence that higher local carbon dioxide concentrations could create "mini" greenhouses that concentrate heat locally, increasing local temperatures and, in some cases, causing associated impacts from higher temperatures and exacerbated pollution. Mark Z. Jacobson, *Enhancement of Local Air Pollution by Urban CO_2 Domes*, 44 Envtl. Sci. & Tech. 2497 (2010).

82. Boyce, *supra* note 15, at 3.

83. *See* Muller, *supra* note 37, at 16 (calculating that coal-fired power generates $75.59 of co-pollutant damage per ton of carbon dioxide equivalent, oil-fired power plants generates $38.98 co-pollutant damages per ton of carbon dioxide equivalent, and that natural gas generates much smaller co-pollutant damages per ton of carbon). *See also* Boyce, *supra* note 15, at 4–6. (describing intersectoral variations in co-pollutant intensity). Professor Boyce notes that "[t]he ratio of co-pollutant emissions to carbon-dioxide emissions varies depending on the fuel source (higher for coal, lower for natural gas, in-between for oil) and on pollution control technologies." *Id.* at 4.

84. Nat'l Research Council, *supra* note 14, at 6.

Similarly, choices among renewable energy technologies will impact net co-pollutant levels. For example, using biomass to generate electricity (either in pure biopower facilities or by co-firing biomass with coal or natural gas) would reduce air pollutant emissions relative to coal-fired power.[85] It would, however, result in greater co-pollutant emissions than renewable energy alternatives like wind or solar power.

The extent of co-pollutant benefits depends not only on the net reductions different types of sources could provide, but also on where the reductions occur. For co-pollutants, unlike GHGs, location matters. Population exposure is a key factor in determining co-pollutant damages and the potential benefits gained from co-pollutant reductions.[86] For example, considering absolute emissions and exposure, the coal-fired plants causing the greatest co-pollutant damages "are concentrated to the east of the Mississippi, along the Ohio River Valley, in the Middle Atlantic and the South."[87] Co-pollutant damages from coal-fired power are much lower in the western states.[88] In general, due to higher population levels and greater concentrations of pollution sources, urban areas are likely to experience greater pollution damages than rural areas.[89] Reducing GHGs and associated co-pollutants in

85. *See* R.L. BAIN ET AL., BIOPOWER TECHNICAL ASSESSMENT: STATE OF THE INDUSTRY AND TECHNOLOGY 6-1 to 6-7 (2003), *available at* http://www.fs.fed.us/ccrc/topics/urban-forests/docs/Biopower_Assessment.pdf. Biomass facilities generate particulate matter, carbon monoxide, volatile organic compounds, and nitrogen oxides. *Id.* at 6-1. The extent of these pollutants depends upon the type of biomass fuel burned, the type of combustion technology, and the presence and nature of air pollution controls. *Id.*

86. As Professor Boyce states, "Damages per unit of co-pollutant emissions vary depending, among other things, on stack heights, population densities, and total exposure[.]" Boyce, *supra* note 15, at 4. Interestingly, the extent of the damage is not necessarily correlated with the size of the facility or its proximity to population centers. Larger facilities, and those located in populated areas, appear to have been more likely to have adopted pollution controls that reduce co-pollutant emissions and associated damages relative to smaller facilities and those in less populated areas. *See* Muller, *supra* note 37, at 17–18.

87. NAT'L RESEARCH COUNCIL, *supra* note 14, at 88. The variations in damages from pollution from coal-fired power tends to be largely a function of very dramatic differences in plants' pollution emissions per kWh, rather than differences in the size of the populations impacted by those emissions. *See id.* at 91.

88. *Id.* at 91.

89. It should be noted that the more pervasive pollution in urban areas is not solely caused by stationary sources; it results from the combined effect of stationary source and mobile source pollution. *See id.* at 55, 69 (explaining that stationary sources in urban areas are more likely to have been required to install pollution controls than those in less populated areas).

the regions with the greatest co-pollutant impacts would increase relative co-pollutant benefits.[90]

Certain renewable or energy efficiency alternatives could also impact the distribution of co-pollutants. For example, if biopower were to become an alternative to traditional fossil fuels, high shipping costs could lead to the development of biopower plants that are smaller and more broadly distributed than the existing fleet of large, centrally-located fossil-fuel power plants.[91] As a result, even if reliance on biopower reduced net co-pollutant emissions relative to coal-fired power, the wider distribution of biopower plants could more broadly distribute associated emissions. Similarly, combined heat and power (CHP) systems, in which power is generated at industrial sites themselves, have the potential to reduce overall GHG and co-pollutant emissions. But, to the extent that CHP systems replace centralized power generation at power plants with decentralized power generation at industrial sites, they could distribute harmful emissions more broadly.[92] Thus, both biopower and CHP could reduce overall

90. *See* Burtraw et al., *supra* note 12, at 671 (suggesting, but reserving for further research, the proposition that "[r]egional differences in ancillary benefits, stemming from geography, meteorology and population density, may suggest that an efficient carbon tax should vary by region of the country"). The general observation that location matters for co-pollutant benefits does not mean that developing a policy for directly incorporating relative co-pollutant benefits into climate policy will be easy or risk-free. One analyst has concluded that including co-pollutant variations could decrease overall social welfare if GHG emissions caps are set too high. Muller, *supra* note 37, at 2–3.

91. Kelsi Bracmort, Cong. Research Serv., R41440, Biomass Feedstocks for Biopower: Background and Selected Issues 1–2 (2010), *available at* http://www.fas.org/sgp/crs/misc/R41440.pdf. Advances in biofuel processing could, however, increase the ease of shipping and reduce the incentives to build small and dispersed biopower facilities.

92. *See generally* Int'l Energy Admin., Combined Heat and Power: Evaluating the Benefits of Greater Global Investment 4 (2008), *available at* http://www.iea.org/papers/2008/chp_report.pdf. In a combined heat and power (CHP) system, facilities generate power and then use the waste heat from the power generation process for industrial processes or heating. *See* Pew Center on Global Climate Change, Co-Generation/Combined Heat and Power 1–2 (2011), *available at* http://www.pewclimate.org/technology/factsheet/CogenerationCHP. CHP offers two potential efficiencies: by using waste heat, it reduces the demand for energy for heating, and by distributing electricity generation to the point of use, it reduces the power leakage that occurs during transmission. *See id.* at 2. The distributional consequences of adopting CHP depend upon whether the facilities in question already generate power. *Id.* at 3. If so, CHP measures designed only to capture and use waste heat from existing power generation would not result in any adverse distributional consequences. *Id.* at 2. But if a facility's CHP measures include both developing an on-site power source and utilizing its waste heat, then the CHP project could increase localized emissions by adding a new power facility.

emissions of GHGs and co-pollutants, yet subject more people to those emissions. These consequences are not necessarily adverse; distributing emissions more broadly could decrease currently harmful concentrations in certain areas. Nevertheless, these co-pollutant consequences could influence climate policy design.

Finally, although mechanisms for reducing GHG emissions will usually decrease co-pollutant emissions, certain technologies could increase co-pollutants. For example, if natural gas facilities reduce carbon emissions by increasing combustion temperatures, they could increase nitrogen oxide emissions.[93] Incorporating co-pollutant concerns could, therefore, impact the appropriate level of GHG reduction to be achieved at specific types of facilities.

In sum, climate policies would benefit from comprehensive analyses that assess a wide range of implications, including co-pollutant impacts. Considering co-pollutants could enhance overall environmental benefits and facilitate the administrative and technical coordination of pollution control requirements on sources. Although integrating co-pollutant objectives could potentially increase reduction costs, it could also increase the overall economic benefits of regulation. From a political perspective, considering co-pollutants presents a two-edged sword: although co-pollutant considerations might generate greater industry resistance, they might simultaneously generate greater public support. Ultimately, addressing climate change requires a broad vision that integrates GHG, co-pollutant, economic, and the myriad other considerations relevant to transforming our energy infrastructure.

II.
REGULATION OF STATIONARY SOURCES UNDER THE CAA

Assuming that climate policies' co-pollutant implications are worth considering, what does the CAA's approach to GHGs mean for co-pollutants? This part outlines EPA's GHG initiatives and the GHG reductions they could achieve. Unless stated otherwise, the estimated GHG reductions provide a rough proxy for associated co-pollutant reductions, particularly to the extent that

93. *See* Stephen P. Holland, *Spillovers from Climate Policy* 3 (June 2010) (Nat'l Bureau of Econ. Research, Working Paper No. 16158, July 2010), *available at* http://www.nber.org/papers/w16158.pdf.

EPA regulations reduce combustion through energy efficiency requirements.[94]

In *Massachusetts v. EPA*, the Supreme Court made clear that, because GHGs are "air pollutants," EPA has the authority to regulate them under the CAA.[95] In compliance with the Court's ruling, EPA ultimately took the next step toward regulating GHGs: it issued an "endangerment finding" concluding that GHGs endanger public health and welfare.[96] EPA has issued automobile emission standards,[97] and is in the process of developing requirements for stationary pollution sources under the Prevention of Significant Deterioration[98] and New Source Performance Standard programs.

A. *The Prevention of Significant Deterioration Program*

EPA began applying the Prevention of Significant Deterioration (PSD) program to stationary sources in January 2011. At present, EPA is applying the program only to large GHG emissions sources, like power plants and major industries.[99] Under

94. ENVTL. PROT. AGENCY, EPA-547/B-11-001, PSD AND TITLE V PERMITTING GUIDANCE FOR GREEN HOUSE GASES, 29, 41 (2011), *available at* http://www.epa.gov/nsr/ghgdocs/ghgpermittingguidance.pdf [hereinafter BACT GUIDANCE].

95. Massachusetts v. Envtl. Prot. Agency, 549 U.S. 497, 528–29 (2007).

96. Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66,496 (Dec. 15, 2009) (to be codified at 40 C.F.R. pt. 1).

97. Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, 75 Fed. Reg. 25,324 (May 7, 2010) (to be codified at 40 C.F.R. pt. 85-86, 600).

98. Once a pollutant is "subject to regulation" under any section of the CAA, the PSD program applies to stationary sources that emit that pollutant. *See* Reconsideration of Interpretation of Regulations that Determine Pollutants Covered by Clean Air Act Permitting Programs, 75 Fed. Reg. 17,004, 17,006, (Apr. 2, 2010) (to be codified at 40 C.F.R. pt. 50, 51, 70, 71). When EPA's mobile source standards for GHGs took effect in January 2011, GHGs were "subject to regulation," and the PSD program then applied to stationary sources of GHGs. 75 Fed. Reg. at 17,019.

99. Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule, 75 Fed. Reg. 31,514 (June 3, 2010) (to be codified at 40 C.F.R. pt. 51–52, 70–71) [hereinafter Tailoring Rule]. The CAA subjects facilities to PSD permitting requirements if they will emit more than 100 or 250 tons per year of the regulated pollutant (with the applicable threshold varying by industry). Clean Air Act § 169, 42 U.S.C. § 7479 (2006). Existing facilities are subject to PSD permitting requirements if they make modifications that increase emissions above regulatory thresholds. 40 C.F.R. § 52.21(a)(2)(ii) (2011). Since many sources emit high volumes of GHGs, the statutory and regulatory thresholds would require more than 80,000 PSD permitting actions per year, many of which would involve small sources, like restaurants or other small commercial businesses. Tailoring Rule, *supra*, at 31,554. Due to the administrative complexity of applying the CAA to so many new and small

the PSD program, new and modified stationary sources must install the Best Available Control Technology (BACT) for controlling GHG emissions.[100] State agencies determine what constitutes BACT on a case-by-case basis in state permitting proceedings.[101] EPA has provided state agencies with general gui-

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sources, EPA decided to first apply the CAA only to the largest sources, requiring approximately 1,600 permitting actions per year and encompassing approximately sixty-seven percent of the nation's stationary source emissions. *See* ENVTL. PROT. AGENCY, PSD PERMITTING BURDEN REDUCTIONS (2010), *available at* http://www.epa.gov/NSR/documents/20100413piecharts.pdf.

The PSD requirements for new "anyway" facilities—facilities with GHG emissions over 75,000 tons per year in CO_2 equivalent that were already required to obtain permits for non-GHG emissions—went into effect on January 1, 2011. *See* BACT GUIDANCE, *supra* note 94, at 12. PSD requirements for modified "anyway" facilities are triggered by GHG emissions increases over 75,000 tons per year in CO_2 equivalent. *Id.* at 13. PSD permitting requirements for new facilities subject to the PSD program due solely to GHG emissions exceeding 100,000 tons per year in CO_2 equivalent (and with mass-based emissions above the 100/250 tons per year threshold) went into effect on July 1, 2011. *See id.* at 12. PSD requirements for modified facilities based solely on their GHG emissions would be required for those facilities that generally emit at least 100,000 tons per year of CO_2 equivalent and that then propose to increase GHG emissions by more than 75,000 tons per year in CO_2 equivalent, or by facilities whose increase in CO_2 equivalent emissions alone exceeds 100,000 tons per year in CO_2 equivalent. *See id.* at 14. EPA anticipates that the GHG requirements will lead to approximately 900 new PSD permitting actions per year. ENVTL. PROT. AGENCY, FINAL RULE: PREVENTION OF SIGNIFICANT DETERIORATION AND TITLE V GREENHOUSE GAS TAILORING RULE: FACT SHEET 2 (2010), *available at* http://www.epa.gov/NSR/documents/20100413fs.pdf.

In February 2012, EPA proposed maintaining the existing permitting thresholds and not extending them to smaller sources. ENVTL. PROT. AGENCY, FACT SHEET: PROPOSED RULE: PREVENTION OF SIGNIFICANT DETIORATION AND TITLE V GREENHOUSE GAS TAILORING RULE STEP 3, *available at* http://www.epa.gov/nsr/ghgdocs/Step3FactSheet.pdf. EPA had already indicated, in the original Tailoring Rule, that it will not consider regulating sources smaller than 50,000 TPY until after 2016. *See* Tailoring Rule, *supra* at 31,516.

Given the CAA's explicit 100 and 250 TPY thresholds, the Tailoring Rule is legally vulnerable and it has been challenged by numerous industry groups. Andrew Childers, *States and Industry Groups Say Clean Air Act Violated by Greenhouse Gas Tailoring* Rule, 42 ENV'T REP. (BNA) 1385 (June 24, 2011). The key question will be whether EPA has the administrative discretion to delay or avoid imposing permit requirements on sources that fall within the statutory thresholds.

100. Clean Air Act § 169(3), 42 U.S.C. § 7479(3). The statute defines BACT as "an emissions limitation . . . based on the maximum degree of reduction . . . which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such facility." *Id.*

101. *See* BACT GUIDANCE, *supra* note 94, at 17. Almost all states have incorporated GHG analysis into their PSD permitting programs, while EPA has assumed that responsibility in Texas in light of the state's refusal to apply the program to GHGs. *See* Kate Galbraith, *EPA Issues First Texas Greenhouse Gas Permit*, THE TEXAS TRIBUNE (Nov. 10, 2011), *available at* www.texastribune.org/texas-energy/energy/epa-issues-first-texas-greenhouse-gas-permit/.

dance on how to determine BACT for GHG emissions in its PSD and Title V Permitting Guidance for Greenhouse Gases (BACT Guidance).[102] The BACT Guidance does not specify particular control technologies; instead, it describes the process states should use for determining BACT.

The BACT Guidance makes clear that the process for determining BACT for GHGs does not differ from the process for other pollutants. EPA recommends that states follow the same "top-down" BACT methodology, in which the permitting agency identifies available control technologies, eliminates those that are not feasible for the facility, and then ranks the remaining control technologies based on their effectiveness at reducing the pollutant of concern.[103] Next, the permitting agency evaluates the "energy, environmental, and economic impacts" of the top-ranked option to determine its suitability.[104] The capacity to consider ancillary environmental impacts provides an important mechanism for integrating co-pollutant considerations, as discussed further below.[105] In the final step of the process, the permitting authority considers the relative merits of the ranked options to determine the best approach.[106]

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102. BACT GUIDANCE, *supra* note 94, at 17–18.

103. *See id.* at 18. The top-down methodology is recommended, not required. States can use other mechanisms for determining BACT so long as they meet the statutory requirements. *Id.* at 19.

104. *Id.* at 18.

105. *See* discussion *infra* Part III.B.

106. Rather than directly requiring the facility to apply the selected technology, however, the permitting authority generally establishes an emissions limitation that reflects the reductions that could be achieved by applying the BACT technology. BACT GUIDANCE, *supra* note 94, at 18. So, for example, if the permitting authority identifies energy efficiency measures that would reduce emissions, it could articulate an overall GHG emissions performance standard for the emissions unit that reflects the adoption of those measures, without directly requiring that specific measures be taken. Although facilities are likely to use the technology upon which the standard was based, the discretion to adopt an alternative approach that meets the performance standard gives facilities the incentive to adopt more cost-effective mechanisms for meeting the requirements. *Id.* at 21. Note that, rather than focusing on the operation of discrete efficiency measures singly, EPA recommends that permitting authorities consider an output-based BACT emissions limit that could reflect a variety of measures taken throughout the facility. *Id.* at 45–46.

If establishing an emissions-rate performance standard would not be effective due to difficulties in measuring emissions or other obstacles, then the permitting agency could instead directly require emission reduction measures in the permit, rather than setting a rate-based emissions limitation. *Id.* at 22. Under EPA regulations, permitting agencies can "establish design, equipment, work practices or operational standards to satisfy the BACT requirement." *Id.* at 17 (citing 40 C.F.R. 51.166(b)(12), 52.21(b)(12)), 46 (suggesting that permits could include "conditions requiring the

Although BACT is set on a case-by-case basis, a preliminary sense of the potential for reductions in various sectors can be gleaned from the BACT Guidance and other sources. Given the absence of currently feasible pollution control technologies for reducing GHG emissions,[107] EPA anticipates that most GHG reductions will be achieved by increasing industries' and power plants' energy efficiency.[108] In general, measures that reduce energy use will reduce combustion and result in co-pollutant improvements.[109]

Coal-fired power is of particular significance given its high carbon and co-pollutant intensity and its central role in U.S. power production. In 2007, coal-fired power plants generated forty-nine percent of U.S. power and contributed eighty-two percent of the power sector's GHG emissions.[110] Coal-fired power plant boiler designs vary in their efficiency, and plants could be required to install more efficient boiler types or make other modifications, achieving GHG reductions of approximately ten to twenty-five percent.[111] Moreover, EPA suggests that integrated gasification

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use of a work practice . . . focused on energy efficiency" where it is impracticable to measure emissions and apply an output-based standard).

107. *See* BACT GUIDANCE, *supra* note 94, at 29. One post-combustion option, carbon capture and storage, is not currently considered feasible, and is discussed *infra*, notes 123–126 and accompanying text.

108. *See* BACT GUIDANCE, *supra* note 94, at 21, 45. For new facilities, the permitting agency has the discretion to consider practices throughout the entire facility, and is not limited to individual emissions units. *Id.* at 23. For existing sources that have triggered PSD due to a modification, the BACT requirement applies only to the emissions unit that has increased its emissions. *Id.*

109. *Id.* at 29, 41 (observing that energy efficiency measures to reduce GHGs are likely to reduce co-pollutants).

110. NATL. ENERGY TECHNOLOGY LABORATORY, REDUCING CO2 EMISSIONS BY IMPROVING THE EFFICIENCY OF THE EXISTING COAL-FIRED POWER PLANT FLEET 1 (2008), *available at* http://www.netl.doe.gov/energy-analyses/pubs/CFPP%20Efficiency-FINAL.pdf. EPA has evaluated options for the coal-fired sector in a white paper on available and emerging GHG control technologies. ENVTL. PROT. AGENCY, AVAILABLE AND EMERGING TECHNOLOGIES FOR REDUCING GREENHOUSE GAS EMISSIONS FROM COAL-FIRED ELECTRIC GENERATING UNITS (2010), *available at* http://www.epa.gov/nsr.ghgdocs/electricgeneration.pdf [hereinafter TECHNOLOGIES FOR COAL-FIRED EGUs].

111. For example, boiler designs that use subcritical steam pressure, such as pulverized coal or circulating fluidized bed boilers, are less energy efficient than boilers using supercritical steam pressures. *See* BACT GUIDANCE, *supra* note 94, at 29. EPA reportedly estimates that new supercritical coal-fired power plants could achieve emissions reductions of ten to fifteen percent, and ultra-supercritical plants could achieve reductions of twenty to twenty-five percent. *See* Franz T. Litz & Nicholas M. Bianco, *What to Expect from EPA: Regulation of Greenhouse Gas Emissions Under the Clean Air Act*, 40 ENVTL. L. REP. 10480, 10482 tbl. II (2010), *available at* http://elr.radcampaign.com/sites/default/files/articles/40.10480.pdf.

combined cycle (IGCC) technology could be considered BACT if it is more efficient,[112] but is ambiguous about whether the BACT standard would actually require IGCC.[113]

A critical question for coal-fired power plants is whether they could be required to switch from coal to natural gas.[114] Although lifecycle emissions are a contested subject, natural gas power plants are less carbon-intensive than coal-fired power plants.[115] Fuel-switching would have substantial implications for co-pollutant emissions because natural gas power plants not only generate less carbon, they also have substantially lower co-pollutant emissions.[116] EPA states that requiring a coal-fired plant to switch to natural gas could be considered fundamentally redefining the source, and the permitting agency therefore would not be required to consider such fuel-switching among its BACT options.[117] The agency makes clear, however, that state permitting agencies retain the discretion to consider options that fundamentally redefine the source, including fuel switching, if they so choose.[118] The states' willingness to require fuel-switching from coal to natural gas will strongly affect the BACT standard's potential to influence GHG and co-pollutant emissions. In the first year of implementation, permitting authorities have generally

112. BACT GUIDANCE, *supra* note 94, at 30.

113. The agency notes that if "such a control strategy would disrupt the applicant's basic or fundamental business purpose" then that option would be considered "redefining the source" and would not have to be considered as BACT. *Id.* The agency does not provide any guidance on how to determine whether a technology like IGCC impermissibly redefines the source.

114. It is worth noting that, in 2011, Canada promulgated rules requiring new coal-fired power plants to reduce emissions to the levels achieved by natural gas plants, effectively precluding the development of coal unless technologies like carbon, capture, and storage (CCS) allow the facilities to reduce emissions enough to match natural gas plant emissions. *See* Christa Marshall, *Canada Moves to Phase Out Coal*, CLIMATE WIRE (Aug. 22, 2011), http://www.eenews.net/climatewire/2011/08/22/archive/8?terms=Marshall+Canada+Coal.

115. *See* DEUTSCHE BANK GROUP, COMPARING LIFE CYCLE GREENHOUSE GAS EMISSIONS FROM NATURAL GAS AND COAL (Aug. 25, 2011), *available at* http://www.worldwatch.org/system/files/pdf/Natural_Gas_LCA_Update_082511.pdf. Lifecycle emissions include emissions from the extraction and transmission process. *Id.* The carbon intensity of natural gas extraction is currently in dispute. *See* Alan Kovski, *Cornell Team Defends Analysis Portraying Shale Gas as Worse for Climate than Coal*, 43 ENV'T REP. (BNA) 138 (Jan. 20, 2012).

116. *See* NAT'L RESEARCH COUNCIL, *supra* note 14, at 7–8 (observing that the mean co-pollutant damages caused by coal-fired power plants are 3.2 cents per kWh, while mean damages from natural-gas power plants are 0.16 cents per kWh).

117. BACT GUIDANCE, *supra* note 94, at 27.

118. *See id.* at 27–28.

imposed energy efficiency requirements rather than fuel-switching.[119]

Another option for reducing coal plant GHG emissions is to co-fire coal with biomass.[120] Some types of plants can accommodate approximately ten percent biomass, although the feasibility of using biomass depends upon the availability of local biomass resources.[121] Co-firing with biomass reduces GHG emissions and decreases (but does not eliminate) overall co-pollutants.[122]

The only discrete mechanism for controlling carbon, rather than minimizing its generation, is carbon capture and storage (CCS), which captures carbon dioxide from the emissions stream, compresses it, transports it, and buries or otherwise sequesters the carbon. In its BACT Guidance, EPA has indicated that CCS is an option that permitting authorities should consider when initially cataloguing available control technologies.[123] EPA has indicated, however, that CCS will not be feasible or cost-effective in most cases.[124]

If CCS becomes commercially viable, however, its adverse co-pollutant consequences will present significant policy issues. Although CCS reduces carbon, the energy-intensive process currently has a fifty to eighty percent "energy penalty": coal-fired power plants require fifty to eighty percent more energy to pro-

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119. *See* Andrew Childers, *Industries, Regulators Report Few Problems with Greenhouse Gas Permitting Program*, 42 ENV'T. REP. (BNA) 2790 (Dec. 9, 2011) (describing seventeen permits finalized between January and November 2011). Given the relatively few number of permits, it is premature to assess how stringently states will apply the BACT standard.

120. *See* Nathan Richardson et al., *The Return of an Old and Battle-Tested Friend, The Clean Air Act*, 176 RES. 25, 27 (2010), *available at* http://www.rff.org/RFF/Documents/RFF-Resources-176_CleanAirAct.pdf.

121. *See* DALLAS BURTRAW ET AL., GREENHOUSE GAS REGULATION UNDER THE CLEAN AIR ACT: A GUIDE FOR ECONOMISTS 13–14 (2011), *available at* http://www.rff.org/RFF/Documents/RFF-DP-11-08.pdf. The GHG implications of using biomass are complex and contested, and are beyond the scope of this Essay. *See* Gabriel Nelson, *EPA Grants Biomass a Final Reprieve from CO_2 Rules*, N.Y. TIMES, July 5, 2011, http://www.nytimes.com/gwire/2011/07/05/05greenwire-epa-grants-biomass-a-final-reprieve-from-co2-r-18885.html (stating that EPA will not apply permitting requirements to GHGs from biomass due to uncertainty about calculating the lifecycle GHG implications of biomass combustion).

122. *See* BAIN, *supra* note 85, at 6-1.

123. BACT GUIDANCE, *supra* note 94, at 32–33.

124. CCS is unlikely to be considered feasible due to the nature of the emissions stream or the logistical hurdles associated with developing a secure off-site storage location. *Id.* at 36. In addition, even if CCS is deemed "feasible" in principle, it is likely to be eliminated from consideration at a later point in the analysis, when its relatively high cost is taken into account. *Id.* at 42. In certain instances, however, like industrial re-use of carbon dioxide, the costs might not be prohibitive. *Id.* at 43.

vide CCS.[125] Generating that energy could generate additional co-pollutants. In addition, the chemicals used in the CCS process could increase co-pollutants.[126] It is unclear how those co-pollutant consequences would factor into the BACT process.

BACT requirements also apply to large sources outside the power sector. EPA has estimated that emissions from new refineries could be reduced by twenty percent or more.[127] According to some estimates, GHG emissions from new cement plants could be reduced by forty percent.[128] Nitrous oxides, which are 310 times more potent GHGs than carbon, could be reduced by up to ninety percent and, in the process, also reduce emissions of nitrogen oxides, a significant co-pollutant.[129] More generally, GHG emissions from new industrial boilers could be reduced by ten to thirty percent.[130]

B. *Section 111 Standards*

In addition to the PSD Program, section 111 of the CAA requires EPA to develop New Source Performance Standards (NSPSs) for GHGs from new and modified sources, as well as performance standards for existing stationary sources.[131] For new and modified sources, EPA must designate industrial categories that emit significant quantities of air pollution and then establish NSPSs for each category.[132] Unlike the BACT standards, which are determined on a case-by-case basis by state agencies, EPA

125. Kurt Zenz House et al., *The Energy Penalty of Post-Combustion CO_2 Capture and Storage and its Implications for Retrofitting the US Installed Base*, 2 ENERGY & ENVTL. SCI. 193, 203 (2009).

126. *See* Joris Koorneef et al., *Carbon Dioxide Capture and Air Quality, in* CHEMISTRY, EMISSION CONTROL, RADIOACTIVE POLLUTION, AND INDOOR AIR QUALITY 17, 39 (Nicoloas Mazzeo, ed., 2011).

127. *See* Litz & Bianco, *supra* note 111, 10482 (2010) (citing EPA figures).

128. *See* Clemmer, *supra* note 2, at 1154 (citing EPA cement plant NSPS rulemaking for conventional pollutants that discussed a potential NSPS for Portland cement plants). Estimates of potential reductions for new sources have stemmed from research associated with developing a federal NSPS in the relevant categories. *Id.* Since federal NSPSs set a federal minimum, BACT can be expected to be at least as stringent as NSPSs. *Id.* at 1147.

129. *See id.* at 1155. EPA has declined to set a NSPS for nitrous oxide for nitric acid plants. *Id.* EPA has requested input on measures to control nitrous oxides, but is currently viewing GHG control as a co-benefit of controlling nitrogen oxide, a criteria pollutant, rather than developing a direct GHG standard. Andrew Childers, *EPA Proposal for Nitric Acid Plants Limits Nitrogen Oxides but Not Nitrous Oxide*, 42 ENV'T REP. (BNA) 2291 (Oct. 14, 2011).

130. Litz & Bianco, *supra* note 111, at 10482.

131. Clean Air Act § 111(f), 42 U.S.C. § 7411(f) (2006).

132. § 111(b)(1)(A), 42 U.S.C. § 7411(b)(1)(A).

must develop a uniform national standard for each industrial category—a standard that serves as the minimum baseline for subsequent case-by-case BACT determinations.[133] The NSPSs are to reflect the best demonstrated technology (BDT) for reducing emissions within each category.[134] Like the BACT standard, EPA is required to consider a range of factors in developing its NSPS, including "non-air quality health and environmental impact and energy requirements."[135]

Some commentators have suggested that a NSPS need not take the traditional form of an emissions-rate standard based upon available technologies; the agency could instead adopt a cap-and-trade program as the "best" system of emission reduction.[136] Given constraints in the statutory language, such an approach is unlikely to be adopted for new and modified sources.[137] It is, however, considered a more plausible option for existing sources, as discussed below.[138]

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133. BACT GUIDANCE, *supra* note 94, at 20–21, 25; § 169(3), 42 U.S.C. § 7479(3). The NSPS process differs from the BACT process in several other ways. The applicability thresholds for NSPSs are more complex than for the PSD program. Instead of the set statutory thresholds under the PSD program, EPA has discretion to determine the appropriate NSPS applicability levels for each industrial category based upon its type and size. § 111(b)(2), 42 U.S.C. § 7411(b)(2). Given EPA's greater discretion in the NSPS program, it did not need to develop a Tailoring Rule to adjust the NSPS process. The timing of the two programs also differs. Unlike BACT, which already applies to large new and modified facilities, the NSPSs will not take effect until specific standards are finalized. *See* § 111(b)(1)(B), 42 U.S.C. § 7411(b)(1)(B); *see also* § 169(3), 42 U.S.C. § 7479(3). Moreover, to date EPA is developing NSPSs for only two industries, while the PSD program applies to all facilities emitting regulated pollutants. § 169(1), 42 U.S.C. § 7479(1).

134. § 111(a)(1), 42 U.S.C. § 7411(a)(1) (defining a "standard of performance" as a "standard for emissions of air pollutants which reflects the degree of emission limitation achievable through the application of the best system of emission reduction which . . . the Administrator determines has been adequately demonstrated"). As with the BACT standard, EPA will generally specify the required emissions rate based upon what the agency believes achievable with current technology; the agency does not mandate the use of that particular technology. § 111(b)(5), 42 U.S.C. § 7411(b)(5). If the development of a performance standard is not feasible because the pollutant in question cannot be captured or adequately measured, then EPA can establish a "design, equipment, work practice, or operational standard." § 111(h), 42 U.S.C. § 7411(h).

135. § 111(a), 42 U.S.C. § 7411(a).

136. *See, e.g.*, BURTRAW ET AL., *supra* note 121, at 20; Monast et al., *supra* note 1, at 1.

137. *See, e.g.*, Timothy J. Mullins & M. Rhead Enion, *(If) Things Fall Apart: Searching for Optimal Regulatory Solutions to Combating Climate Change Under Title I of the Existing CAA if Congressional Action Fails*, 40 ENVTL. L. REP. 10864, 10882–83 (2010) (expressing doubts about the legal viability of developing a federal cap-and-trade program to implement a NSPS for new sources).

138. *See infra* note 147 and accompanying text.

At present, EPA has committed to developing NSPSs for GHGs from two important industries: power plants and refineries.[139] As of this writing, the power plant rule is delayed, but imminent, and the refinery rules appear to be in limbo.[140] It is unclear when or if EPA will develop additional standards for other industrial categories.[141] The potential BACT controls for new coal-fired power plants, refineries, cement plants, nitric acid facilities, and industrial boilers, discussed above, suggest the scale of the reductions that NSPSs could achieve.[142] New and modified facilities could be expected to install energy efficient boilers and operate efficiently.[143] For proposed coal-fired power plants, there is at least a possibility that the agency could define the relevant industry category as "power plants" and then determine that the best system of emission reduction requires the use of natural gas rather than coal.[144]

Importantly, whenever the CAA requires a NSPS for a category of new sources, it also requires performance standards for GHGs from existing facilities in the same source category. Section 111(d) states that, for pollutants like GHGs that do not have a NAAQS and are not classified as a hazardous air pollutant, EPA must also develop technology-based emission guidelines for existing sources.[145] The states are then required to develop implementation plans for imposing the federal emission guidelines on existing sources.[146]

The form of the existing source standard is subject to intense debate. Although a cap-and-trade program for new sources is un-

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139. EPA agreed to establish these NSPSs in a December 2010 settlement agreement. *See* Settlement Agreement (Dec. 21, 2010), *available at* http://www.epa.gov/airquality/ghgsettlement.html (under "Fossil-Fuel Fired Power Plants, click on "Settlement Agreement"). The Settlement Agreement resulted from litigation filed by states and environmental groups. *Id.*

140. *See* Tiffany Stecker, *Delay of Refinery GHG Rules is Disappointing, But Not Surprising*, CLIMATE WIRE (Nov. 22, 2011), http://www.eenews.net/climatewire/2011/11/22/archive/6?terms=NSPS+greenhouse+gases.

141. EPA has stated that it will consider a NSPS for the cement industry, but has yet to take regulatory action. *See* Andrew Childers, *Lawsuits Target Greenhouse Gas Limits, Pollution Controls in EPA Rules for Kilns*, 42 ENV'T REP. (BNA) 1103 (May 20, 2011).

142. *See supra* notes 110–30 and accompanying text.

143. *See* TECHNOLOGIES FOR COAL-FIRED EGUS, *supra* note 110, at 25–34; Clemmer, *supra* note 2, at 1149.

144. *See* Jean Chemnick, *Questions Abound as Release of Proposed GHG Rule Nears*, E&E DAILY (Jan. 30, 2012), http://rlch.org/news/questions-abound-epa-release-proposed-ghg-rule-nears.

145. 40 C.F.R. § 60.22(a) (2006).

146. Clean Air Act § 111(d)(1), 42 U.S.C. § 7411(d)(1) (2006).

likely, scholars have argued that the CAA language defining performance standards for existing sources is more flexible than the language defining new source standards. It requires EPA to base the standard on the "best system of emission reduction," rather than on the best technology, and so arguably gives EPA the latitude to consider a cap-and-trade program or other reduction mechanisms. Scholars argue that the "best system" could consist of a direct federal cap-and-trade program for existing sources, or could instead contain a federal standard but then allow states to demonstrate that their state or regional cap-and-trade programs are equivalent to the federal standard.[147] These flexible approaches could have far-reaching implications for both GHG and co-pollutant reductions and are discussed further below in Part IV.B.

Assuming that EPA establishes a traditional performance standard for existing sources in each industrial category, it would likely base that standard on efficiency improvements. In the coal-fired power context, which contributes thirty-three percent of U.S. GHG emissions,[148] such improvements could include installing more efficient boilers and operational adjustments.[149] EPA has estimated that a NSPS for existing coal-fired power plants could reduce emissions by around five percent,[150] while others have predicted decreases in the five to ten percent range.[151] Co-firing coal with biomass could provide another few percentage points in emissions reductions.[152] It is possible, but unlikely, that

147. M. Rhead Enion, *Using Section 111 of the Clean Air Act for Cap-and-Trade of Greenhouse Gas Emissions: Obstacles and Solutions*, 30 UCLA J. ENVTL. L. & POL'Y 1 (2012); Franz T. Litz et al., *What's Ahead for Power Plants and Industry? Using the Clean Air Act to Reduce Greenhouse Gas Emissions, Building on Existing Regional Programs* (World Res. Inst., Working Paper, Feb. 2011), *available at* http://pdf.wri.org/working_papers/whats_ahead_for_power_plants_and_industry.pdf; Mullins & Enion, *supra* note 137, at 10878–84 (2010); *see also* Gregory E. Wannier et al., *Prevailing Academic View on Compliance Flexibility Under Section 111 of the Clean Air Act* (Inst. for Policy Integrity, Working Paper No. RFF DP 11-29, 2011), *available at* http://www.rff.org/rff/documents/RFF-DP-11-29.pdf.

148. *See* BURTRAW ET AL., *supra* note 121, at 10.

149. EPA has evaluated options for coal-fired power in a white paper on available and emerging GHG control technologies. *See* TECHNOLOGIES FOR COAL-FIRED EGUS, *supra* note 110, at 25–29 (2010).

150. *See* Litz et al., *supra* note 147, at 11 (describing EPA's estimate in its 2008 Advanced Notice of Proposed Rulemaking for Greenhouse Gases).

151. Richardson et al., *supra* note 120, at 25, 28.

152. *See* BURTRAW ET AL., *supra* note 121, at 13–14 (stating that two to five percent reductions in GHG emissions could be achieved if coal were co-fired with biomass).

existing coal-fired power plants would be required to switch to natural gas.[153]

For petroleum refineries, which contribute just over seven percent of U.S. emissions,[154] EPA has identified numerous operational and technological mechanisms for reducing emissions at the wide range of discrete emissions sources potentially present at a refinery.[155] Energy efficiency initiatives could decrease electricity consumption at refineries by four to seventeen percent,[156] and EPA has predicted that a performance standard for existing refineries could reduce GHG emissions by ten to twenty percent.[157]

If, and when, EPA moves forward on standards for additional industries, more reductions from existing sources are possible.[158] Cement plants alone generate two percent of U.S. carbon dioxide emissions and five percent of U.S. industrial emissions.[159] EPA has estimated that available controls could reduce emissions

153. *See id.* at 6 (stating that, because the standard is usually developed "for a specific technology and fuel, it may be difficult to expand the regulatory scope to encourage fuel switching").

154. *See* Clemmer, *supra* note 2, at 1150.

155. ENVTL. PROT. AGENCY, AVAILABLE AND EMERGING TECHNOLOGIES FOR REDUCING GREENHOUSE GAS EMISSIONS FROM THE PETROLEUM REFINING INDUSTRY 11-16 tbl. 1 (2010), *available at* http://www.epa.gov/nsr/ghgdocs/refineries.pdf. *See also* ERNST WORRELL & CHRISTINA GALITSKY, ERNEST ORLANDO LAWRENCE BERKELEY NAT'L LAB., ENERGY EFFICIENCY IMPROVEMENT AND COST SAVING OPPORTUNITIES FOR PETROLEUM REFINERIES (2005), *available at* http://www.energystar.gov/ia/business/industry/ES_Petroleum_Energy_Guide.pdf.

156. ENVTL. PROT. AGENCY, AVAILABLE AND EMERGING TECHNOLOGIES FOR REDUCING GREENHOUSE GAS EMISSIONS FROM THE PETROLEUM REFINING INDUSTRY 11 tbl. 1 (2010), *available at* http://www.epa.gov/nsr/ghgdocs/refineries.pdf.

157. *See* Litz & Bianco, *supra* note 111, at 10482 (citing EPA figures). In another report, Litz and Bianco's calculations use a different baseline for determining emission reductions and predict that EPA GHG regulations will have a much smaller impact on existing refinery emissions, ranging from one to ten percent, depending upon how aggressive EPA's requirements are. NICHOLAS M. BIANCO & FRANZ T. LITZ, WORLD RES. INST., REDUCING GREENHOUSE GAS EMISSIONS IN THE UNITED STATES USING EXISTING FEDERAL AUTHORITIES AND STATE ACTION 15 (2010).

158. EPA stated in an earlier cement plant rulemaking that it intended to develop a cement industry NSPS. *See* Clemmer, *supra* note 2, at 1154. To date, however, EPA has not initiated such a rulemaking, prompting an environmental lawsuit. Jessica Coomes, *EPA Should Set Greenhouse Gas Standards for Cement Kilns, Groups Tell Appeals Court*, 42 ENV'T REP. (BNA) 2293 (Oct. 14, 2011). As of this writing, EPA has not initiated any other NSPSs.

159. ERNST WORRELL & CHRISTINA GALITSKY, ERNEST ORLANDO LAWRENCE BERKELEY NAT'L LAB., ENERGY EFFICIENCY IMPROVEMENT AND COST SAVINGS OPPORTUNITIES FOR CEMENT MAKING 8 (2008), *available at* http://www.energystar.gov/ia/business/industry/LBNL-54036.pdf.
Approximately half of the emissions stem from energy use and half from the calcination process. *See id.*

from existing cement plants by one to ten percent.[160] One estimate predicts that nitrous oxide emissions from nitric acid plants could be reduced by ninety percent, with associated reductions in nitrogen oxides, an ozone precursor.[161] Greater energy efficiency could contribute to respectable reductions in the petrochemical industry,[162] which accounts for twenty-eight percent of the energy used in the manufacturing sector. EPA's Energy Star program has sponsored numerous studies of energy efficiency mechanisms in the industrial sector. In addition to the industries discussed above, the agency has assessed energy efficiency mechanisms for the following industries: brewing, corn refining, food processing, glass, metal casting, motor vehicle manufacturing, pharmaceutical manufacturing, pulp and paper production, steel and iron production, and textiles.[163] In general, EPA predicts that performance standards for industrial boilers could reduce GHG emissions by one to ten percent.[164] The World Resources

160. *See* Litz & Bianco, *supra* note 111, at 10482 tbl. II. Emissions reductions could result from both efficiency measures and fuel switching. If cement plants switch from coal to natural gas, co-pollutant emissions could be reduced. *See* WORRELL & GALITSKY, *supra* note 159, at 8. However, cement plants are increasingly burning waste, including tires and other liquid and solid wastes. *Id.* The co-pollutant implications of burning waste are likely to be complex. Using waste for fuel could reduce life cycle GHG emissions but could result in adverse co-pollutant consequences.

161. *See* Clemmer, *supra* note 2, at 1155.

162. *See* MAARTEN NEELIS ET AL., ERNEST ORLANDO LAWRENCE BERKELEY NAT'L LAB., ENERGY EFFICIENCY IMPROVEMENT AND COST SAVING OPPORTUNITIES FOR THE PETROCHEMICAL INDUSTRY (2008), *available at* http://www.energystar.gov/ia/business/industry/Petrochemicals.pdf. For specific examples, see *id.* at 43 (discussing five percent energy savings potential from instituting process control systems); *id.* at 50 tbl. 7.1 (listing boiler controls that could provide energy savings ranging from one to twenty-six percent); *id.* at 55 tbl. 7.2 (listing improvements to steam distribution systems that could provide energy savings ranging from three to eighty-three percent); *id.* at 57 (noting that improvements to furnaces and process heaters could lead to typical energy savings of ten percent); *id.* at 70 (observing the potential for twenty percent energy savings from improvements to pumps, which use sixteen percent of the chemical industry's electricity); *id.* at 77 (observing the potential for 5.9 percent energy savings from improved fans, which use eight percent of the chemical industry's electricity); *id.* at 79 (observing the potential for eighteen percent energy savings from improvements to compressed air systems, which comprise eighteen percent of the chemical industry's electricity use).

163. *See* Envtl. Prot. Agency and U.S. Dep't of Energy, *Industrial Energy Management Information Center*, ENERGY STAR, http://www.energystar.gov/index.cfm?c=industry.bus_industry_info_center#petroleum (last visited Feb. 22, 2011).

164. *See* Litz & Bianco, *supra* note 111, at 10482 tbl. II.

Institute estimates that energy efficiency measures in the manufacturing sector could achieve forty percent energy savings.[165]

Predicting the cumulative extent of the GHG reductions that could be achieved by controls on existing sources through traditional technology-based performance standards is a highly uncertain endeavor because EPA has, at the time of this writing, yet to propose control strategies, and state implementation programs have not yet been developed. It is also difficult to compare various estimates, given the differing baselines, industries, and assumptions used in different studies. For example, based on her assessment of existing studies, Professor Clemmer has estimated that the CAA's controls could reduce stationary source GHG emissions from existing sources by twenty-eight percent,[166] with corresponding reductions in co-pollutants. Less optimistically, another report suggests that, for several significant sectors that have been studied, existing energy efficiency technologies would "yield emission reductions up to 10 percent" below 2005 levels.[167]

Assuming a traditional application of the CAA to GHGs, the law's effectiveness at significantly reducing GHGs (and associated co-pollutant emissions) will depend upon how aggressively EPA and the states interpret the statute. A key factor for both GHG and co-pollutant emission reductions will be the extent to which EPA and the states limit new and existing coal-fired emissions. The BACT Guidance refrains from actively endorsing coal-limiting permitting requirements, although it gives states discretion to do so. EPA is rumored to be creating NSPSs that require emissions equivalent to natural gas plants, but, as of this writing, that rule has yet to be proposed. Moreover, at present, the agency has delayed performance standards for existing power plants and has stalled work on NSPSs for refineries and other industrial sources. The CAA thus has more potential to reduce

165. World Res. Inst., WRI Fact Sheet: EPA, Clean Air Act, and U.S. Manufacturing 1 (2010).

166. Clemmer, *supra* note 2, at 1156. Professor Clemmer's calculations include imposing controls on concentrated animal feeding operations, landfills, and coal mines, sources that go beyond the more commonly considered stationary source smokestacks. *Id.*

167. *See* Burtraw et al., *supra* note 121, at 7–8. The ten percent figure primarily reflects efficiency improvements, without fuel switching (except to include biomass co-firing in coal-fired power plants). The report's authors acknowledge that greater reductions would be achieved if more aggressive measures were required. *Id.* at 8.

GHGs, and associated co-pollutants, than is currently being exercised.

III.
The Co-pollutant Implications of Regulatory versus Market Strategies

GHG regulation under the CAA raises a larger question about regulatory policy: whatever the strengths and weaknesses of EPA's actual implementation of the CAA, how does the CAA's direct regulatory approach compare with the most commonly proposed regulatory alternative, a market-based cap-and-trade program?[168] Industry and environmentalists alike have suggested that market-based mechanisms, like cap-and-trade, would be more efficient and effective at reducing GHGs than the CAA's "command-and-control" approach.[169] As explored in this part, it is possible that EPA will incorporate market mechanisms into its implementation of at least some of the CAA's stationary source provisions, eliminating this criticism.[170] But assuming EPA takes a more traditional regulatory approach, the question remains: how do market and traditional approaches compare in terms of their capacity to offer co-pollutant benefits?

This is not to say that relative co-pollutant benefits should determine the choice among alternative climate policies; they are only one variable among many. This article, however, focuses only on that variable, and does not attempt to evaluate the overall merits of direct versus market-based regulation. That inquiry would include an analysis of numerous relevant parameters, including, for example, each mechanism's relative capacity to

168. The prospect of a comprehensive federal cap-and-trade alternative to the CAA appears unlikely at present. *See* Clemmer, *supra* note 2, at 1136–37. However, the debate about the relative merits of market mechanisms versus the Clean Air Act's regulatory approach remains salient to long-term policy developments.

169. *See* J.R. DeShazo & Jody Freeman, *Timing and Form of Federal Regulation: The Case of Climate Change*, 155 U. PA. L. REV. 1499, 1540–46 (describing why environmentalists and industry groups are likely to support a cap-and-trade approach to regulating GHG emissions). The U.S. Climate Action Partnership, an organization designed to bring together industry and environmental groups, developed a blueprint for action that advocates a cap-and-trade approach to reduce U.S. GHG emissions. U.S. CLIMATE ACTION PARTNERSHIP, A BLUEPRINT FOR LEGISLATIVE ACTION 6 (2009), *available at* http://www.us-cap.org/pdf/USCAP_Blueprint.pdf. *See also* Craig N. Oren, *Is the Clean Air Act at a Crossroads?*, 40 ENVTL. L. 1231, 1243–44 (2010) (stating that environmentalists generally believe a market-based system would be preferable to the Clean Air Act).

170. *See, e.g.*, Enion, *supra* note 147.

achieve the necessary emissions reductions, costs of compliance, administrative costs, and ease and certainty of monitoring and enforcement.

This part begins by briefly outlining a theoretical cap-and-trade approach, the most common market mechanism.[171] It then compares the implications of direct regulation and cap-and-trade approaches for co-pollutants, considering a variety of relevant features, including the capacity to integrate GHG and co-pollutant considerations, impacts on co-pollutant distribution, impacts on relative stringency, the relative certainty of reductions, the likelihood of in-sector reductions, technology innovation incentives, and participatory benefits.

A. *Cap-and-Trade*

In a cap-and-trade program, the government's first step is to establish an emissions cap.[172] Covered facilities are then allocated, or must purchase, allowances. Facilities that reduce emissions can sell extra allowances (if they received them for free) or purchase fewer allowances (if required to buy them at an allowance auction). Facilities can maintain or increase emissions by buying allowances to cover their additional emissions.[173] In addition, all currently proposed and operating GHG cap-and-trade programs allow facilities to "offset" their emissions by purchasing reduction credits from facilities or sectors not directly con-

171. Carbon taxes are another frequently discussed market-based option, but one that has had less traction in the United States. *See* Reuven Avi-Yonah and David M. Uhlmann, *Combating Global Climate Change: Why a Carbon Tax is a Better Response to Global Warming than Cap-and-Trade*, 28 STANFORD ENVTL. L.J. 3, 7 (2009). Given the greater political feasibility of cap-and-trade over a carbon tax, this part uses a cap-and-trade program as a prototypical market-based mechanism. Most of the issues raised by a comparison between direct regulation and a cap-and-trade program parallel those that would arise in comparing direct regulation with a carbon tax, with the exception of offsets and certainty of reductions.

172. Existing state and regional GHG programs have established a series of caps. The overall long-term reduction goals establish the starting point, and implementing agencies or legislation then set yearly caps that determine annual allowance allocations. *See, e.g.*, Regional Greenhouse Gas Initiative, Memorandum of Understanding at § 2(D) (establishing ten percent reduction goal for 2018 with interim annual reduction targets), *available at* http://www.rggi.org/docs/mou_12_20_05.pdf; CAL. ENVTL PROT. AGENCY, AIR RES. BD., OVERVIEW OF ARB EMISSIONS TRADING PROGRAM 1 (Oct. 2011) (describing annual declines in cap-and-trade program's cap), *available at* http://www.arb.ca.gov/newsrel/2011/cap_trade_overview.pdf.

173. Under a carbon tax, facilities would likewise choose their preferred level of emissions and pay the associated tax. Facilities that chose to reduce emissions would have lower tax payments, while those that chose to maintain or increase emissions would have higher tax payments.

trolled by the cap-and-trade program. The differences between traditional and trading approaches have co-pollutant implications, as elaborated below.

B. *Integrating Co-pollutant and GHG Control Strategies*

A key feature of a cap-and-trade program is that it devolves decision-making authority to private facilities. The government's primary roles are to set the cap and enforce the system. The government does not dictate individual emission reduction decisions; private companies make their own decisions in response to the incentives created by the carbon price. Because the carbon price does not reflect associated co-pollutant benefits, it does not provide a mechanism for integrating GHG and co-pollutant decisionmaking, maximizing co-pollutant benefits, or avoiding co-pollutant harms.[174] In other words, a carbon price will not provide incentives for companies to reduce emissions more or less depending upon associated co-pollutant impacts.

In contrast, in traditional regulatory processes the government sets industry-wide standards or engages in case-by-case permitting, which provides a greater opportunity for integrating co-pollutant concerns into GHG policy than the privatized, autonomous decision-making that characterizes cap-and-trade programs. Both the PSD and NSPS standard-setting programs provide a mechanism for integrating co-pollutant considerations in the GHG standard-setting process. Under BACT, the state permitting agency initially ranks pollution control options by their effectiveness at reducing the pollutant of concern (here, GHGs). At the next stage in the process, however, the state agency evaluates the control options' other energy, environmental, and economic impacts. Similarly, in setting NSPS, EPA considers a range of environmental and economic considerations, not just control of the pollutant in question.

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174. While a pure GHG cap-and-trade program would not integrate co-pollutant controls, such integration is conceivable. GHG allowances could be allocated based, in part, on co-pollutant intensity or harms, with fewer allowances given to facilities with greater co-pollutant intensity or located in more polluted areas. If allowances are auctioned, then allowance prices could reflect co-pollutant as well as GHG considerations. *See generally* Alice Kaswan, *Environmental Justice and Domestic Climate Change Policy*, 38 ENVTL. L. REP. 10,287, 10,305–06 (describing modifications to GHG trading programs that would maximize co-pollutant benefits); Alice Kaswan, *Reconciling Justice and Efficiency: Integrating Environmental Justice into Domestic Cap-and-Trade Programs for Controlling Greenhouse Gases*, *in* DENIS G. ARNOLD, ED., ETHICS AND GLOBAL CLIMATE CHANGE 232, 249–50 (2011) (describing modifications to GHG trading programs that would maximize co-pollutant benefits).

Although not binding, the BACT Guidance provides helpful elaboration on how agencies could consider co-pollutant impacts in debating appropriate GHG control mechanisms. It explains that the permitting agency must assess whether the available GHG control strategies improve or worsen associated co-pollutant impacts,[175] stating that "EPA has recognized that consideration of a wide variety of environmental impacts is appropriate. . . . such as . . . emissions of other pollutants subject to NSR or pollutants not regulated under NSR such as air toxics."[176]

The permitting agency is authorized to accept a less stringent alternative if necessary to avoid an undesirable co-pollutant consequence.[177] For example, GHG controls to reduce GHG emissions from natural gas power plants could increase nitrogen oxide emissions, a consequence that could be considered in determining the appropriate GHG emissions limit.[178] That tradeoff is already being addressed in current permitting discussions.[179] The capacity to address co-pollutant tradeoffs could be even more important if CCS becomes economically viable. As discussed above, CCS imposes a significant energy penalty that could increase overall co-pollutant emissions.[180] The BACT process allows for an explicit consideration of CCS' co-pollutant consequences, and could help policymakers determine whether it

175. BACT GUIDANCE, *supra* note 94, at 40 (observing that this stage of the BACT analysis focuses "on increases in emissions of pollutants other than those the technology was designed to control").

176. *Id.*

177. *Id.* at 41 (observing that a permitting authority might select a less stringent control for the pollutant of concern if the more stringent option could worsen nonattainment for another pollutant); *id.* at 42 (observing that "EPA and other permitting authorities have most often used this analysis to eliminate more stringent control technologies with significant or unusual effects that are unacceptable in favor of less stringent technologies with more acceptable collateral environmental effects"); *id.* (observing that "[w]here GHG control strategies affect emissions of other regulated pollutants, applicants and permitting authorities should consider the potential tradeoffs").

178. Stephen P. Holland, *Spillovers from Climate Policy* 3 (Nat'l Bureau of Econ. Research, Working Paper No.16158, 2010), *available at* http://www.nber.org/papers/w16158 (observing that GHG controls on natural gas-fired power plants could increase nitrogen oxide emissions).

179. *See* Childers, *supra* note 119 (noting that greenhouse gas BACT determinations for natural gas plants have been lessened because increasing efficiency to reduce GHGs can increase nitrogen oxide emissions). The vice president of a regulated entity noted that the "beauty of the top-down BACT process" is its capacity to deal with conflicts between regulated pollutants. *Id.*

180. *See supra* notes 125–6 and accompanying text.

is an appropriate strategy for addressing GHG emissions from coal-fired power.[181]

Conversely, the BACT Guidance makes clear that a permitting agency could adopt a more stringent GHG BACT option, even if it has a relatively high cost, "if the collateral environmental benefits of choosing such a technology outweigh the economic or energy costs of that selection."[182] By allowing EPA to justify a more demanding GHG standard based on substantial co-pollutant benefits, the CAA allows the agency to adjust GHG reduction requirements in relation to co-pollutant intensity.

Under section 111, as in the BACT process, the CAA requires EPA to consider additional environmental and energy considerations.[183] The NSPS and section 111(d) standards could, therefore, also reflect co-pollutant implications. While GHG reductions are the paramount concern, the CAA allows EPA or state permitting authorities to integrate multi-pollutant concerns and take a more comprehensive approach than a market mechanism, which relies upon private decisions based solely on the price of carbon.

While the CAA offers a greater opportunity to integrate co-pollutant considerations than a market-based mechanism, it is important to note that traditional performance standards under the CAA do not take a fully multi-pollutant integrated approach. It is unclear how strong a role co-pollutant intensity would (or should) play in determining the stringency of GHG standards. Moreover, by addressing each industrial category separately, the CAA does not provide a substitute for an overarching energy policy that could explicitly address the complex issues implicated in power sector controls. It does not provide a forum for debating the continued role for coal-fired power (in light of its significant GHG and co-pollutant emissions, as well as its lifecycle

181. It is conceivable that policymakers would choose not to require CCS due to co-pollutant consequences, potentially undermining the ability to achieve GHG reductions from coal-fired power plants. That consequence could, however, trigger other initiatives to lessen GHG emissions, including greater investment in less-polluting coal alternatives. Whatever the consequences, the integration of co-pollutant analysis is a valuable feature of the CAA permitting and standard-setting processes.

182. BACT GUIDANCE, *supra* note 94, at 41; *see also id.* at 44 (noting that a "permitting authority may find that while a control option with high overall energy efficiency has higher economic costs, those costs are outweighed by the overall reduction of emissions of all pollutants that comes from that higher efficiency").

183. Section 111 of the CAA states that the "standard for performance" should be determined by "taking into account . . . nonair quality health and environmental impact and energy requirements[.]" Clean Air Act § 111(a)(1), 42 U.S.C. § 7411(a)(1) (2006).

impacts), the role of biomass as a supplemental or alternative fossil fuel, the role of combined heat and power, or emission reduction policies outside the regulated sectors, like energy efficiency and alternative energy.

In sum, market-based mechanisms encourage facilities to base reduction decisions only on the carbon price, which is unlikely to reflect co-pollutant considerations. In contrast, the CAA provides certain explicit mechanisms for integrating co-pollutant considerations into the development of stationary source performance standards. However, neither approach facilitates a broader assessment of the nation's energy infrastructure and its combined GHG and co-pollutant implications.

C. *Co-pollutant Distribution*

One of the central distinguishing features of a cap-and-trade system is that the cap controls total emissions, but the system does not control the distribution of emissions. Although the distribution of GHG emissions themselves is not a significant concern because GHGs primarily have global, not local, consequences, emissions distribution does affect associated co-pollutant benefits. Co-pollutant reduction benefits are higher if reductions occur in more polluted and populated areas.[184]

Although net emissions would decrease to the cap level under an effective cap-and-trade system,[185] certain facilities could maintain or increase their emissions by purchasing allowances from facilities that reduced emissions below their allowance allo-

184. *See supra* notes 86–90 and accompanying text (discussing relevance of location to co-pollutant benefits).

185. The presence of a cap is intended to ensure that actual emissions are reduced. If the cap is set too high—if it exceeds prior emissions—then actual emissions could increase. *See generally* Lesley K. McAllister, *The Overallocation Problem in Cap-and-Trade: Moving Toward Stringency*, 34 COLUM. J. ENVTL. L. 395 (2009) (discussing the importance of setting sufficiently stringent caps). The risk of emissions increases is not purely speculative: In the European Union's initial GHG trading program, the Emissions Trading System (ETS), and in a southern California trading program for traditional pollutants, known as "RECLAIM," actual emissions likely increased in the programs' initial years. *See id.* at 411–12 (discussing the ETS increases) and 419–21 (discussing the RECLAIM program); LARRY PARKER, CONG. RESEARCH SERV., RL34150, CLIMATE CHANGE: THE EU EMISSIONS TRADING SCHEME (ETS) GETS READY FOR KYOTO 6 (2007) (discussing increased emissions in the ETS). *See also* Alice Kaswan, *Decentralizing Cap-and-Trade? The Question of State Stringency*, 1 SAN DIEGO J. CLIMATE & ENERGY L. 103, 113 (2009) (discussing insufficiently stringent cap-and-trade programs).

cation.[186] A pure cap-and-trade system does not prevent emissions increase or ensure that emissions decrease, or that associated co-pollutant benefits, are occurring in areas where they are most needed.

This is not to say that co-pollutants could increase without constraint. Co-pollutant increases associated with the purchase of GHG allowances would be subject to existing CAA requirements. But the CAA only controls, and does not prevent, co-pollutant increases.[187]

Nor is this to say that co-pollutant increases are an inevitable byproduct of market-based systems. While some trading programs have led to localized increases in pollution,[188] evidence

186. Static or increased emissions could occur if a facility purchased allowances from another facility that had reduced emissions below its allocation, through allowance purchases at an allowance auction, or through an initial allowance allocation if the allocation exceeds actual emissions (which could occur if the cap is insufficiently stringent). *See* Kaswan, *supra* note 174, at 10,298–302.

187. The CAA requires rigorous pollution control requirements (New Source Review) only for significant emissions increases caused by facility modifications. *See* Clean Air Act § 111(a)(4), 42 U.S.C. § 7411(a)(4) (2006) (defining a "modification" subject to new source standards); DAVID WOOLEY & ELIZABETH MORSS, CLEAN AIR ACT HANDBOOK § 4:4 (2011) (providing general description of CAA requirements for modified emissions sources).

Emissions increases that result from higher levels of operation (rather than physical plant changes) do not trigger new pollution controls. *See* 40 C.F.R. § 51.166(b)(2)(iii)(f) (2010) (clarifying, in the context of the PSD program, that increases in hours of operation or production rates, unaccompanied by a physical change in the plant, do not trigger new source requirements, even if they increase emissions).

In addition, emissions increases that fall below the thresholds set by regulations could occur without triggering additional pollution control requirements. *See* WOOLEY & MORSS, *supra*, at § 4:6 (providing table of thresholds for determining "significant increase"). *See generally* Kaswan, *supra* note 174, at 10,299–301 (2008) (discussing these and other risks of co-pollutant emissions increases).

188. Aspects of Los Angeles' emissions reduction trading program reportedly led to certain localized hot spots. In the early years of the program, four marine terminals purchased allowances generated by a car-scrapping program, resulting in concentrated emissions that had formerly been widely distributed. *See* Richard T. Drury et al., *Pollution Trading and Environmental Injustice: Los Angeles' Failed Experiment in Air Quality Policy*, 9 DUKE ENVTL. L. & POL'Y FORUM 231, 251–58 (1999). A relatively early study found that trading increased nitrogen oxide emissions in Wilmington, California, a heavily-polluted community. *See* Kaswan, *supra* note 174, at 10,299 n. 121 (citing 2005 Lejano and Rose study of emissions from the RECLAIM trading program).

In contrast, a recent study concluded that the broader Los Angeles RECLAIM trading program led to reduced emissions in virtually all—but not every—neighborhood. Meredith Fowlie et al., *What Do Emissions Markets Deliver and to Whom? Evidence from Southern California's NOx Trading Program* 32 (Nat'l Bureau of Econ. Research, Working Paper No. 15,082, 2009) (describing widespread reductions); *id.* at 35 (noting that a few areas had slight increases in emissions). From an from the nation's largest cap-and-trade program, the Acid Rain Program, suggests that it did not result in such "hot spots."[189] The factors that influence whether firms increase or decrease emissions are complex, and include the ease and cost of making reductions versus purchasing allowances for particular facilities, the way allowances are distributed, regulatory factors that impact responsiveness to market signals, as well as the program's overall stringency.[190] Whatever the experience in past programs, however, trading programs provide no assurances that emissions will not increase at particular locations.

While increases in co-pollutants are a concern, the larger question is the extent to which alternative climate strategies provide co-pollutant reduction benefits.[191] Because market-based programs could lead to uneven levels of reduction that are not correlated with co-pollutant benefits, they do not provide an effective

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environmental justice perspective, the neighborhoods that did experience slight emissions increases were not disproportionately minority or low-income. *Id.* at 32.

The lack of emissions increases in the RECLAIM program could also be partially attributable to internal trading restrictions within the program, which restrict trades from the region's less polluted area to its more polluted area. *See* Matthew Polesetsky, Commentary, *Will a Market in Air Pollution Clean the Nation's Dirtiest Air? A Study of the South Coast Air Quality Management District's Regional Clean Air Incentives Market*, 22 ECOLOGY L.Q. 359, 392 (1995). In recent years, the federal Acid Rain program has reportedly led to some emissions increases in poorly educated communities. Evan J. Ringquist, *Trading Equity for Efficiency in Environmental Protection? Environmental Justice Effects from the SO_2 Allowance Trading Program* 92 SOC. SCI. Q. 297 (2011). Although the environmental justice movement properly focuses on the complex web of issues that surround concentrations of pollution in poor and of-color communities, that does not mean that hot spots in other communities, like the poorly educated communities noted in the Ringquist study, do not deserve regulatory concern.

189. *See* Jason Corburn, *Emissions Trading and Environmental Justice: Distributive Fairness and the USA's Acid Rain Programme,* 28 ENVTL. CONSERVATION 323 (2001) (observing that the Acid Rain Program did not lead to increased emissions in poor and of-color communities); Byron Swift, *Emissions Trading and Hot Spots: A Review of the Major Programs*, 35 ENV'T REP. (BNA) No. 19, at 16 (May 7, 2004), *available at* www.epa.gov/airmarkets/ resource/docs/hotspots2004.pdf (describing widespread emissions reductions under the Acid Rain Program and the factors that led to it); Ringquist, *supra* note 188, at 297 (finding that, between 1995 and 2009, the Acid Rain Program did not lead to net emissions imports into black or Hispanic neighborhoods).

190. *See* Swift, *supra* note 189, at 7–8, 16 (describing factors influencing facilities' emission reduction decisions under the Acid Rain Program). Swift observed that the higher-emitting facilities reduced emissions more than lower-emitting facilities because of the way allowances were distributed and because larger facilities could obtain greater financial returns on the cost of installing pollution reducing capital equipment. *Id.* at 16. *See also* BURTRAW, *supra* note 121, at 13 (observing regulatory factors that could influence a utility's responsiveness to energy prices).

191. *See* Kaswan, *supra* note 174, at 10,302.

mechanism for controlling co-pollutant reductions.[192] Under the traditional cap-and-trade paradigm, any such benefits are a matter of chance.

In contrast to market-based programs, direct regulation of GHGs would impose control requirements on all or most facilities, rather than allowing facilities to purchase allowances to cover their emissions. That could result in a more consistent and widespread distribution of GHG reductions, and accordingly, of their associated co-pollutants.

It is worth noting that, although the CAA might provide a more predictably widespread distribution of co-pollutant reductions than a cap-and-trade program, its technology-based standards do not optimize the distribution of co-pollutant benefits. While site-specific BACT standards could respond somewhat to local circumstances, the NSPSs, in particular, impose the same requirements on all similar factories; they do not vary in response to local conditions. The CAA therefore does not provide a mechanism for imposing greater GHG reduction requirements in areas with higher co-pollutant levels in order to maximize the value of associated co-pollutant reductions. Further, although the CAA requires reductions at all covered facilities, it does not affect where those facilities will be located, which limits distributional benefits.[193] Thus, while the CAA is likely to distribute co-pollutant reductions more broadly than market-based mechanisms, it does not optimize the co-pollutant benefits associated with GHG reductions.

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192. For example, the RECLAIM trading program in Los Angeles resulted in few emissions increases, but the pattern of emissions reduction was uneven. The greatest reductions occurred in high-income white areas, and the smallest reductions were located in low-income African-American neighborhoods. Fowlie et al., *supra* note 188, at 22. These differences in reductions were similar to differences in emissions reductions in non-attainment areas subject to traditional regulation. *Id.* Nonetheless, pure market-based programs do not provide any mechanism for addressing racial disparities or for otherwise ensuring that reductions occur in the areas where they are most needed, while a regulatory regime could, at least in theory, do so.

A GHG trading program could, conceivably, be designed to maximize distributional benefits. *See* Muller, *supra* note 37; *cf.* Meredith Fowlie & Nicholas Muller, *Designing Markets for Pollution When Damages Vary Across Sources: Evidence from the NOx Budget Program* (Nat'l Bureau of Econ. Research, Working Paper No. 14504, 2010) (suggesting that a trading program for criteria pollutants could maximize social welfare if it accounted for distributional variations in the benefits of pollution reductions). This article focuses on the traditional operation of cap-and-trade, which does not take distributional issues into account.

193. In addition, no matter what the program, stationary source controls can only go so far in reducing pollution, given the substantial role of mobile and area sources in causing many regions' persistent pollution. *See supra* note 45.

D. *Impact on Stringency and Associated Co-pollutant Benefits*

One of the most important factors for determining a climate policy's impact on co-pollutants is stringency. Given the strong correlation between GHGs and co-pollutants, the more stringent the GHG policy, the greater the likely reduction in co-pollutants.[194] In theory, both market-based and direct regulation could be stringent or lax; there is nothing inherent in either system that dictates relative stringency.

Certain features of market-based programs create the potential for greater stringency, although that result is not inevitable. One feature is relative cost-effectiveness. The CAA requires EPA to consider the costs of control in setting technology-based standards. If the costs of control are high for a particular industrial category, then the standards are likely to be relatively lenient. Market-based programs are purported to be more cost-effective than traditional regulation because they allow facilities with high emission reduction costs to purchase allowances rather than investing in emissions controls. More of the reductions are therefore accomplished by facilities with lower costs of control, lessening overall compliance costs. A trading program's greater cost-effectiveness could lead to more stringent GHG reduction targets, and associated co-pollutant reductions, than would be achieved under the CAA's regulatory approach.[195]

In the energy sector, where utilities have many options for shifting supply, reducing demand, and otherwise affecting system-wide emissions, the other regulatory feature that could affect stringency is flexibility. If CAA standards are established based on each facility's capacity to reduce emissions (in the case of BACT) or each industrial category's emission reduction potential (in the case of NSPSs), the standards would not reflect the reductions that could occur if EPA considered dramatic shifts in power generation or demand management. The standards would maintain the status quo of energy generation, including extensive reliance on highly polluting coal-fired power plants. If, however,

194. The primary context in which the correlation would not hold would be if CCS became the predominant mechanism for controlling GHGs. In that case, co-pollutants would increase due to CCS' high energy demands. *See supra* notes 125–26 and accompanying text.

195. *See* A. DENNY ELLERMAN ET AL., PEW CENTER ON GLOBAL CLIMATE CHANGE, EMISSIONS TRADING IN THE US: EXPERIENCE, LESSONS, AND CONSIDERATIONS FOR GREENHOUSE GASES v–vi, 29, and 34 (observing that policymakers were willing to set more stringent reduction targets for mobile sources because of the cost savings achieved by trading opportunities).

EPA develops emissions standards for fossil-fuel power plants as a group rather than for each type of fossil-fuel plant, then the standard is likely to reflect the least-polluting form—natural gas plants. In that case, the CAA would achieve a somewhat more stringent result. It remains, however, highly uncertain whether EPA, in its NSPSs, or states, in their BACT determinations, would be willing to essentially force a switch from coal to natural gas.

A market-based approach could, in theory, base emission reduction objectives on a much wider array of options and thus lead to a more stringent goal. If a GHG reduction objective were based upon utilities' shifting power generation to less polluting sources, reducing energy demand, or replacing existing generation with renewable energy, then a much more demanding GHG reduction goal could be set, with significant co-pollutant benefits. These issues are at the forefront of debates about whether the CAA offers enough flexibility to allow EPA to forego traditional technology-based performance standards and reflect such measures in its performance standards for existing sources. Because that debate turns on an interpretation of the CAA's existing source provisions, rather than a debate about the CAA versus a hypothetical cap-and-trade program, a more detailed discussion is deferred to Part IV.B.

Thus, in theory, a market-based approach's cost-effectiveness and flexibility could lead to more stringent reduction goals than are likely under the CAA's technology-based performance standards for existing sources. In practice, however, most cap-and-trade programs developed to date have suffered from insufficient stringency.[196] Market-based systems' greater cost-effectiveness and flexibility do not necessarily translate into greater stringency. Regulatory options should not, therefore, be rejected outright based on the assumption that they will be less stringent than a market-based approach.

E. *Certainty of Reductions*

Overly lax cap-and-trade programs are not just insufficiently rigorous, they create the risk that nothing will happen. If actual

196. Many market-based programs have suffered from insufficiently stringent caps, in which the cap exceeds actual emissions or leads to more modest reductions than could be easily achieved by the facilities in the program. *See* McAllister, *supra* note 185, at 395–440 (discussing oversupply of emissions credits in existing cap-and-trade programs).

emissions are less than the cap, then facilities have little incentive to adopt pollution controls, and little if any change in technological infrastructure will take place.[197] The risk of "slack caps" is not hypothetical; it has characterized several GHG cap-and-trade programs adopted to date.[198] In the European Union's Emissions Trading System for GHGs, the cap exceeded emissions,[199] so emission-reduction measures were not adopted. In the northeastern states' Regional Greenhouse Gas Initiative (RGGI) program the cap currently exceeds emissions,[200] reducing incentives for emission reductions. Whether caps are too lenient due to the political fear of imposing real restrictions,[201] the fear of constraining future growth with a stringent cap,[202] or economic recessions that reduce energy demand,[203] lenient caps fail to reduce emissions and fail to create incentives to adopt technology controls.

Market-based programs could also fail to induce reductions if the relevant industries are unresponsive to market signals. In the power sector, publicly owned utilities, unlike shareholder-owned utilities, are less motivated by profits and may therefore be less

197. The risk of an insufficient cap could be alleviated by a sufficient price floor, which would maintain allowance prices, and their incentives, even if the cap were insufficiently stringent.

198. *See* McAllister, *supra* note 185.

199. *See id.* at 411–12 (describing overallocation in the European Emissions Trading System); PARKER, *supra* note 185 (same).

200. Emissions in the participating northeastern states in 2010 were about 137 million tons, fifty-one tons fewer than the approximately 188-ton RGGI emissions cap. ENV'T NORTHEAST, RGGI EMISSION TRENDS 1 (2011), *available at* http://www.env-ne.org/public/resources/pdf/ENE_RGGI_Emissions_Report_110502_FINAL.pdf; Gerald B. Silverman, *Carbon Dioxide Emissions Rise in RGGI Area, But Total Emissions Remain Well Below Cap*, 42 ENV'T REP. (BNA) 978 (May 6, 2011). The states participating in the program will soon be considering whether to reduce the cap in future years. *See* Gerald B. Silverman, *RGGI States Retiring Unsold Allowances, Signaling Possible Tightening of Carbon Cap*, 43 ENV'T REP. (BNA) 269 (Feb. 3, 2012).

201. *See* McAllister, *supra* note 185, at 414 (noting that some commentators believe that starting programs with weak caps is an appropriate mechanism for gaining political support); *id.* at 422–33 (explaining role of politics in Illinois); *see also id.* at 434 (describing how formulas for allocating allowances are designed to be "'politically salable'").

202. Policymakers set caps to accommodate what turned out to be unrealized growth in California's RECLAIM program, *see id.* at 412–13, 433, and in Europe's ETS. *See* PARKER, *supra* note 185, at 12–13.

203. One of the causes for the RGGI program's inflated cap is the economic recession. *See* ENV'T NORTHEAST, *supra* note 200. Other causes of decreased emissions, including fuel switching from coal to natural gas, *id.*, resulted from low natural gas prices, and could also have been motivated, in part, by the incentives created by RGGI's cap-and-trade program.

responsive to costs. In addition, state utility regulations can reduce utilities' incentives to reduce costs, blunting the emission reduction incentives otherwise created by a market-based program.[204]

Where emissions caps are below actual emissions or relevant industries are not responsive to market signals, traditional regulations could provide a superior mechanism for ensuring that actual emission reductions occur.[205] In Southern California, when slack caps led to very low allowance prices and large power plants failed to install controls, regulators turned to direct regulation, temporarily pulling the facilities from the program and imposing direct technology-based performance standards.[206] While the relative stringency of the CAA's stationary source provisions remains unclear, the CAA at least requires facilities to adopt available emission-reduction measures, instead of relying on market-based incentives that could prove ineffective if the cap is insufficiently stringent or the industries are unresponsive to market signals.[207]

F. *Offsets and In-sector Reductions*

If a cap-and-trade program permits the use of offsets, as have all the GHG cap-and-trade programs currently operating or pro-

204. *See* BURTRAW, *supra* note 121, at 13. Dallas Burtraw has studied differences in utilities' adoption of cost-saving energy efficiency measures to determine how responsive they are to markets. Publicly owned plants, and utilities that can pass costs along to consumers, are less efficient than other plants, a result that may be due to the fact that they are less sensitive to costs (and profits) than independently- or investor-owned utilities. *Id.*

205. *See id.* at 13.

206. Lesley K. McAllister, *Beyond Playing "Banker:" The Role of the Regulatory Agency in Emissions Trading*, 59 ADMIN. L. REV. 269, 290 (2007).

207. The certainty that emissions controls will be adopted is also a function of adequate compliance and enforcement, key issues in both traditional and market-based systems. Market-based systems with sophisticated monitoring requirements, like the Acid Rain Program's controls on larger power plants, have excellent compliance records. *See* Lesley K. McAllister, *Enforcing Cap-and-Trade: A Tale of Two Programs*, 2 SAN DIEGO J. CLIMATE & ENERGY L. 1, 4–8 (2010) (describing how continuous emissions monitoring equipment requirements and automatic verification systems for large facilities in the Acid Rain Program achieved high compliance levels and efficient enforcement). However, outside of the large facilities in the Acid Rain Program, monitoring and verification mechanisms are often less effective, creating both compliance and enforcement challenges in other cap-and-trade programs. *See id.* at 11–12 (describing monitoring challenges in Los Angeles' RECLAIM emissions trading program).

posed,[208] then industrial sources may avoid GHG and associated co-pollutant reductions.[209] For example, under an offset program, a timber company could plant or preserve trees that would sequester carbon. The timber company could then sell credits representing the sequestered carbon to an industrial facility that would use them to offset its carbon emissions. Assuming that the carbon sequestration project had environmental integrity,[210] the GHG emission benefits would be the same. The co-pollutant benefits would differ, however, because allowing facilities to use non-industrial offsets instead of industrial allowances would result in fewer GHG and co-pollutant emission reductions from the controlled industrial sectors. Some offset projects, like promoting alternative energy in developing countries, could have co-pollutant benefits, but those benefits would not occur in the U.S. industrial sectors subject to GHG controls. In a direct regulatory program, by contrast, the regulated facilities would be required to make the required reductions, providing both GHG reductions and associated co-pollutant benefits.

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208. PEW CTR. ON GLOBAL CLIMATE CHANGE, COMPARISON OF DOMESTIC OFFSET PROVISIONS IN CLIMATE AND ENERGY LEGISLATION IN THE 111TH CONGRESS, *available at* http://www.pewclimate.org/federal/analysis/congress/111/comparison-chart-domestic-offset-provisions-energy-and-climate-legisla; Memorandum of Understanding on the Reg'l Greenhouse Gas Initiative 4–6 (Dec. 20, 2005), *available at* http://www.rggi.org/docs/mou_final_12_20_05.pdf (establishing offset program for the northeastern states' GHG cap-and-trade program); CAL. AIR RES. BD., PROPOSED REGULATION TO IMPLEMENT THE CALIFORNIA CAP-AND-TRADE PROGRAM: STAFF REPORT: INITIAL STATEMENT OF REASONS ES-4 to ES-5 (2010), *available at* http://www.arb.ca.gov/regact/2010/capandtrade10/capisor.pdf (describing proposed offset provisions for California's cap-and-trade program).

209. MKT. ADVISORY COMM. TO CAL. AIR RES. BD., RECOMMENDATIONS FOR DESIGNING A GREENHOUSE GAS CAP-AND-TRADE SYSTEM FOR CALIFORNIA 64–65 (2007), *available at* http://www.climatechange.ca.gov/publications/market_advisory_committee/2007-06-29_mac_final_report.pdf (observing concern that "offsets could seriously reduce incentives for emissions reductions in urban areas where pollution levels are relatively high"); PEW CTR. ON GLOBAL CLIMATE CHANGE, GREENHOUSE GAS OFFSETS IN A DOMESTIC CAP-AND-TRADE PROGRAM 3 (2008), *available at* http://www.pewclimate.org/docUploads/Offsets.pdf (observing that "the use of offsets by a firm forgoes any environmental co-benefits, such as reduced sulfur dioxide emissions, that would be associated with making an emissions reduction on site").

210. *See* JONATHAN L. RAMSEUR, CONG. RESEARCH SERV., RL34436, THE ROLE OF OFFSETS IN A GREENHOUSE GAS EMISSIONS CAP-AND-TRADE PROGRAM: POTENTIAL BENEFITS AND CONCERNS 18–22 (2008) (describing concerns about offset programs and provisions necessary to ensure integrity); *see also* PEW CTR. ON GLOBAL CLIMATE CHANGE, *supra* note 209, at 2–4 (same).

G. *Incentives for Technology Transformation*

A key issue for climate policy is its capacity to create incentives to transition away from carbon-intensive fossil fuels. The greater the incentives to transition from coal and other fossil fuels, the greater the associated co-pollutant benefits.

Market-based approaches, like cap-and-trade, are often heralded for creating technology innovation incentives.[211] To the extent that market-based programs set sufficiently stringent caps, then pollution allowances will have value. Companies will have the incentive to switch to less-polluting modes of production (or develop pollution-control technology) to reduce the number of allowances they must purchase and, potentially, to generate allowances they could sell for a profit. For example, a utility confronted with high allowance costs would be more likely to reduce its reliance on carbon-intensive coal-fired power, and have a greater incentive to provide power from natural gas facilities, develop renewable energy, or promote consumer energy efficiency.

However, a cap-and-trade program's innovation incentives depend upon the program's stringency. As discussed above, if the program is not stringent, then facilities can easily purchase cheap allowances. They will have little incentive to develop transformative alternatives, and developers of alternatives will have little incentive to engage in research and development because cheap allowance prices create an uncertain market for new technology.

The CAA's transformative potential will depend upon how aggressively it is implemented. To the extent that EPA develops traditional performance standards based on an assessment of the cost and feasibility of industry-specific measures, and does not require new technologies or fuel sources, the CAA is unlikely to create significant incentives for profound shifts to less carbon-intensive energy sources or processes.[212] For example, if coal-fired power plants were required only to adopt efficiency improvements, not switch to lower-carbon (and co-pollutant) fuels, their emissions would continue to exceed those of natural gas facilities and alternative energy sources, notwithstanding CAA regulation. So long as they meet the regulatory requirements, coal-heavy utilities would have little incentive to shift to other, lower-

211. *See, e.g.*, Bruce A. Ackerman & Richard B. Stewart, *Reforming Environmental Law*, 37 STAN. L. REV. 1333, 1349–50 (1985); Daniel J. Dudek & John Palmisano, *Emissions Trading: Why Is This Thoroughbred Hobbled?*, 13 COLUM. J. ENVTL. L. 217, 234–36 (1988).

212. Oren, *supra* note 169, *at* 1256–57.

carbon, sources of energy. In addition, by requiring only what is feasible now, the standards would provide no incentive for industries to develop controls or alternatives that would lead to greater GHG and co-pollutant reductions.[213]

On the other hand, if EPA interpreted the CAA to give it broader authority to require more profound changes, like fuel-switching from coal to natural gas,[214] much more substantial shifts in technology use and incentives for alternatives would result. The requirements could not only force investments away from the most-polluting technologies but, to the extent they increase the cost of fossil-fuel investments, they could create at least some incentive for investments in alternative energy or energy efficiency.[215] As discussed above, EPA has indicated that states could plausibly require such fuel-switching as BACT, but that such switching is not mandated under the CAA. EPA could conceivably impose such requirements under the NSPS process, but the standard remains to be seen.

It should be noted that some forms of direct regulation could create stronger innovation incentives than the CAA's stationary source provisions. Direct regulation could be highly transformative if it required the achievement of a certain level of reduction, and expected industry to develop the necessary technology to accomplish that goal, whether through the development of new controls or a transition to less polluting energy sources. For example, under a different section of the CAA, Congress required automakers to reduce certain air pollutants by ninety percent, despite the absence of an identified control technology.[216] That approach to regulation has, however, been more the exception than the rule, and is not contemplated by the current CAA's stationary source provisions.

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213. *See id.*

214. *See infra* notes 114–119 and accompanying text (discussing fuel switching as a possible BACT option).

215. At present, however, the relatively cheap price of natural gas will likely drive investments into natural gas rather than alternative energy or efficiency. *See* Tripp Baltz, *Shale Gas Delays Markets for Low Emission, Renewable Technologies, Report Says,* 43 ENV'T REP. (BNA) 198 (Jan. 27, 2012).

216. Clean Air Act § 202(b), 42 U.S.C. § 7521(b) (2006). Recently, California considered but rejected imposing flat GHG reduction requirements on certain industrial sectors. CAL. ENVTL PROT. AGENCY, AIR RES. BD., FINAL SUPPLEMENT TO THE AB 32 SCOPING PLAN FUNCTIONAL EQUIVALENT DOCUMENT 73–74 (Aug. 19, 2011), *available at* http://www.arb.ca.gov/cc/scopingplan/document/final_supplement_to_sp_fed.pdf.

To the extent that EPA takes a traditional regulatory approach in implementing the CAA, the CAA will not adequately induce the kinds of transformative technology that could reduce dependence upon fossil fuels and provide needed GHG and co-pollutant reduction benefits. A sufficiently stringent market-based program would be more likely to generate appropriate innovation incentives.

H. *Participatory Benefits*

While not directly related to co-pollutants, it is worth noting that direct regulation offers distinct participatory advantages. Industry has favored the flexibility and autonomy offered by market-based regulation. The flip side of that autonomy, however, is that facilities do not engage in public permitting proceedings that allow the public to be aware of and weigh in on facility pollution control choices. Traditional regulatory approaches provide a mechanism for neighboring communities to participate in the permitting process and render industry decision-making more transparent and accountable.[217]

I. *Conclusion*

The co-pollutant implications of the CAA's regulatory approach versus a cap-and-trade approach are complex and defy easy generalizations. The CAA offers certain co-pollutant advantages. First, the CAA standard-setting process specifically allows EPA to consider co-pollutants in the development of GHG standards, creating the potential for a more integrated standard-setting process. Second, by imposing reduction requirements on all covered sources, the CAA will ensure that GHG reductions, and associated co-pollutant reductions, are widely distributed. In contrast, the distribution of emissions under a market-based program could be uneven. Third, regulation would ensure that at least some reductions occur: assuming adequate implementation, compliance, and enforcement, the CAA will impose specific requirements and avoid the risk that a lax cap or market failures would fail to generate emission reductions. Fourth, at least as traditionally implemented, the CAA does not allow offsets from unregulated sectors,[218] which avoids the risk in market-based

217. *See* Kaswan, *supra* note 174, at 10,302–03 (2008) (discussing participatory justice implications of trading versus direct regulatory approaches).

218. As discussed below in Part IV.B, it is conceivable that EPA will adopt a cap-and-trade program for implementing at least some aspects of the NSPS require-

programs that many GHG reductions (and their associated co-pollutant reductions) will not be from regulated industrial sources.[219] Fifth, a regulatory approach offers greater opportunities for public participation than private trading. All of these co-pollutant benefits are worth considering in evaluating the CAA.

Market-based approaches could, however, offer their own co-pollutant advantages, most of which hinge on program stringency. If the EPA develops traditional, industry-by-industry stationary source performance standards, it would achieve important, but not dramatic, reductions in GHGs and associated co-pollutants. A market-based program's greater cost-effectiveness and flexibility could, at least in theory, lead to more demanding GHG reduction targets. Moreover, sufficiently stringent market-based programs would create on-going incentives for a wide variety of transformative measures, including fuel-switching, greater reliance on lower-emitting facilities, the development of alternative energy sources, and energy efficiency measures. To the extent a market-based program could trigger fundamental shifts in fossil fuel use, it could provide significant co-pollutant benefits.

This article does not address a third option: combining market and regulatory approaches in order to maximize the benefits of each.[220] Arguably, a regulatory approach could require industries to adopt relatively certain and widespread emission control measures, while a market-based program could create a firm cap and a carbon price that would create appropriate incentives for further reductions and innovation.

Analyzing the implications of climate policies for co-pollutants provides important insights into the debate between traditional and market-based regulatory approaches. In some cases, considering co-pollutants impacts the analysis. For example, the capacity to integrate GHG and co-pollutant standard-setting matters only if considering co-pollutants matters. Similarly, distributional effects and the use of offsets are more significant issues if co-pollutants are taken into account than if GHG reductions alone are considered.

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ments. However, it is likely that states would have to demonstrate that cumulative facility reductions would meet the performance standard, and they would not be allowed to include offsets in that calculation. *See* Litz et al., *supra* note 147, at 19–20.

219. *See supra* notes 208–210 and accompanying text (describing how offsets could reduce the co-pollutant benefits of a trading program).

220. *See* Kaswan, *supra* note 174, at 10,304–05 (discussing the benefits of combining market and regulatory approaches to GHGs).

In other cases, the GHG and co-pollutant benefits and drawbacks track one another. For example, the issues of stringency, certainty, incentives for technology transformation, and participatory impacts are the same for both GHGs and co-pollutants. In these instances, the addition of co-pollutant concerns amplifies, but does not fundamentally change, the comparison between traditional and market-based regulation.

This article attempts to clarify the relevant parameters; it does not provide a final answer on the relative desirability of traditional versus market mechanisms, a judgment that depends as much on the particular policies in question as on generalized descriptions. For example, strong regulatory requirements that enhance distributional outcomes would be superior to a weak trading program. Alternatively, a stringent market-based program that induced transformative investments away from fossil fuels could be superior to a weak regulatory program that offered certainty and wide distribution—but little change.

Nor is the choice between traditional and market mechanisms only a function of their co-pollutant implications. This article does not address the many other relevant factors that a comprehensive analysis would include, such as their relative cost-effectiveness, administrative ease, national security implications, short- and long-term job implications, or other considerations that are relevant to the ultimate choice among market-based regulation, traditional regulation, or a combination of the two.

IV.
Performance Standards for Existing Sources: Extending the CAA's Reach

To round out the discussion of how the CAA's regulation of GHGs implicates co-pollutants, this part returns to and addresses another specific feature of EPA's GHG requirements: national performance standards for existing stationary sources—standards that could have significant GHG and associated co-pollutant consequences. Performance standards for existing sources under section 111(d) will create an unprecedented federal role in existing stationary source emissions, and could extend the reach of the CAA to some previously unregulated facilities. In addition, section 111(d) presents challenging interpretive issues with dramatic differences in the program's stringency, impacting both GHG and co-pollutant emissions.

A. *Extending the CAA to Previously Unregulated Facilities*

Historically, there has been less direct federal regulation of existing sources than of new sources. However, given the peculiar status of GHGs under the CAA, EPA is required to set federal guidelines for *existing* as well as new sources, potentially extending the CAA's reach to previously unregulated sources.[221] Such GHG controls could provide the first federally-required controls on some existing facilities, with at least some indirect co-pollutant benefits.

The significance of imposing GHG standards on existing sources depends in part on the extent to which the section 111(d) guidelines will impose limitations on existing facilities that had previously been un- or under-regulated. That question warrants a brief overview of the history of the CAA's treatment of existing sources.

The CAA's carefully wrought framework for criteria pollutants is designed to balance federal and state power.[222] The CAA establishes federal emission control parameters for new and modified sources under the nonattainment, PSD, and NSPS programs, but has historically provided less federal guidance for existing sources. Although the CAA does require existing sources in nonattainment areas to adopt modest emissions controls,[223] the NAAQS provisions do not require states to impose emission limitations on their existing pollution sources in attainment areas.[224] For many years, the states did not impose substantive limits and, as a consequence, the CAA left many existing sources uncontrolled.

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221. Although EPA has developed section 111 standards for a few pollutants from existing sources, the guidelines applied to relatively discrete or small categories of sources. *See* Oren, *supra* note 169, at 1255.

222. While federalism concerns have impacted the regulatory structure for criteria pollutant controls, the regulatory structure for toxic pollutants envisions a stronger federal role. The CAA requires EPA to develop federal performance standards for toxic pollutants from both new and existing sources. *See* WOOLEY & MORSS, *supra* note 187, at § 6:5.

223. Nonattainment areas are regions that fail to meet the NAAQS. Existing sources in nonattainment areas must adopt controls that reflect Reasonably Available Control Technology. Clean Air Act § 172(c)(1), 42 U.S.C. § 7502(c)(1) (2006). States can impose additional restrictions on existing sources as part of their State Implementation plans for achieving NAAQS. § 172(c)(6), § 7502(c)(6).

224. Those existing sources might have to obtain operating permits under Title V, § 502, 42 U.S.C. § 7661, but Title V was designed only to consolidate state, local, or federal requirements and ensure adequate monitoring; it does not impose specific federal emission reduction requirements on sources. *See* WOOLEY & MORSS, *supra* note 188, § 8:1.

In the last twenty years, the CAA's treatment of existing sources has become more complex and somewhat more comprehensive. Since 1995, the federal Acid Rain Program has required many large existing sources to hold allowances for sulfur and nitrogen oxide emissions, and has led to substantial reductions in emissions from existing sources.[225] The NO_x Budget program likewise established a trading program in many eastern states to control interstate ozone emissions.[226] The Clean Air Interstate Rule, recently replaced by the Cross-State Air Pollution Rule, built upon these programs to require reductions in ozone and particulates throughout most of the eastern half of the country.[227]

To date, these programs have nonetheless left many existing facilities uncontrolled. According to a 2010 report by Credit Suisse, thirty percent of coal-fired power plants lack air pollution controls.[228] The lack of controls at some facilities could be attributable, at least in part, to the fact that recent programs have been cap-and-trade programs that, by definition, allow facilities to purchase allowances rather than install pollution controls.[229] In addition, coal-fired power plants have met sulfur dioxide requirements by switching to low-sulfur coal rather than installing controls.[230] Switching to low-sulfur coal reduced sulfur emissions, but did not necessarily reduce other pollutants, like particulates and mercury. On the toxics front, because EPA is only just beginning to regulate toxics from power plants, forty percent of coal-fired power plants lack advanced controls for air toxics.[231]

Even though new EPA pollution initiatives, like the Cross State Air Pollution Rule and recent toxics controls on power plants, could further extend EPA controls over existing

225. *See* Byron Swift, *How Environmental Laws Work: An Analysis of the Utility Sector's Response to Regulation of Nitrogen Oxides and Sulfur Dioxide under the Clean Air Act*, 14 TUL. ENVTL. L.J. 309 (2001).

226. *See* WOOLEY & MORSS, *supra* note 187, at §§ 3.7–3.8.

227. *See* Cross-State Air Pollution Rule, *supra* note 47.

228. CREDIT SUISSE, *supra* note 52, at 20. In fact, as of 2010, thirty-seven percent of coal-fired facilities lacked pollution controls; the thirty percent figure reflects planned upgrades as well as existing controls. *Id.*

229. For example, under the Acid Rain Program, numerous utilities installed pollution controls at just one plant and then used the allowances to cover emissions at their other plants. *See* Swift, *supra* note 225, at 329.

230. *See* Swift, *supra* note 225, at 335–38 (stating that fifty nine percent of the reductions in the first phase of the Acid Rain Program were achieved by switching to low-sulfur coal rather than installing pollution controls).

231. ENVTL. PROT. AGENCY, *supra* note 49, at 3.

sources,[232] the section 111(d) standards are likely to reach some existing sources that would otherwise remain control-free. The Cross-State Air Pollution Rule covers only the eastern half of the nation, and some facilities could use its trading provisions to avoid controls.[233] Many recent EPA initiatives are also concentrated on the power sector,[234] so section 111(d) standards could play an important role in addressing GHG emissions and, indirectly, co-pollutant emissions, for existing stationary sources outside the power sector.

B. *The Nature of Section 111(d) Standards: Modest or Transformative?*

To evaluate the co-pollutant implications of applying section 111(d) to GHGs, it is necessary to explore further the nature of the section 111(d) requirements. As EPA develops NSPSs for pollutants, it must also develop "emission guidelines" for existing sources in the same industrial categories.[235] Like the NSPSs, the guidelines are to reflect the "best system of emission reduction" that "has been adequately demonstrated," taking cost into consideration.[236] EPA has the discretion to develop nuanced guidelines for differing industrial subcategories that reflect facility differences, including control costs, physical limitations, or geographic factors.[237]

As noted above, the federal section 111(d) standards do not apply directly; the states must develop plans for adopting them.[238] According to EPA's implementing regulations, a state's plan must impose requirements at least as stringent as the federal guidelines,[239] unless the state can demonstrate that the guideline would impose unreasonable costs in light of facility characteristics, that it is physically impossible to implement, or the state can

232. *See supra* notes 47–52 and accompanying text.

233. *See* ENVTL. PROT. AGENCY, *supra* note 47 (describing the CSAPR and its state-based trading program).

234. Although the Cross-State Air Pollution Rule is not explicitly limited to the power sector, EPA's initial strategy is to establish federal implementation plans controlling the power sector. Cross-State Air Pollution Rule, *supra* note 48, at 48,210. The states could choose to meet their state emission budgets in alternative ways in the future, but the current approach demonstrates the significance of the power sector in achieving that rule's goals.

235. 40 C.F.R. § 60.22(a) (2011).

236. *Id.* § 60.21(e); *id.* § 60.22(b)(5).

237. *Id.*

238. Clean Air Act § 111(d), 42 U.S.C. § 7411(d) (2006); 40 C.F.R. § 60.23.

239. 40 C.F.R. § 60.24(c).

otherwise show that a less stringent standard is more reasonable.[240] The CAA also allows states to consider "the remaining useful life of the existing source" in developing their compliance plans, a provision that allows a state to impose more lenient standards on sources whose short remaining useful lives would not justify substantial investment.[241]

One critical issue will be the different treatment of new versus existing sources and its impact on the standards' stringency. Although section 111(d) does extend the CAA's reach to existing sources, the standards for existing sources could differ from—and be less stringent than—those for new sources given EPA's flexibility to take numerous costs and limitations into account. Because the states have significant flexibility to impose lesser standards if they can show that they are "more reasonable" or that the facilities have short "remaining useful lives," it is unclear how demanding GHG standards for existing sources will be, and accordingly, how great an impact on associated co-pollutants they will have.

A second set of questions involves the form of the standard and the mechanisms that states could use to meet it. This issue is important not only to basic questions of policy design, but because the range of options for meeting the standard could influence the standard's stringency (and associated co-pollutant impacts). Because the power sector is the most important source of GHGs and also generates significant co-pollutants, the remainder of this part focuses on the form of a performance standard for existing electricity-generating units (EGUs).

As discussed above, performance standards establish specified emission rates for each industrial category, like a certain amount of GHGs per million BTU of heat input for coal-fired boilers.[242] Traditionally, the performance standard is based upon EPA's assessment of each industry's available and affordable control technologies. As noted above, under this approach, the standard for coal-fired EGUs would likely reflect energy efficiency measures and, potentially, co-firing with biomass. (It is possible, but unlikely, that the NSPS for existing coal-fired power plants would be premised upon fuel-switching to natural gas.) Every facility within the designated category would be required to meet the

240. *Id.* § 60.24(f).

241. § 111(d)(1)(B), 42 U.S.C. § 7411(d)(1)(B).

242. *See* Mullins & Enion, *supra* note 137, at 10,883 (describing typical NSPS).

performance standard established for that particular type of source.

Assuming that fuel switching is not required, such traditional technology-based performance standards would lead coal-fired units to continue to emit considerably more GHGs than other types of EGUs. Furthermore, if the existing mix of facilities remained constant, with coal-fired EGUs continuing to contribute fifty percent of electricity generation, then the section 111(d) standards would, overall, generate only a modest reduction in GHGs and associated co-pollutants.[243]

Narrow technology-based performance standards have limited emissions reduction potential because they would not promote changes in the energy sector to reduce reliance on coal-fired power. In addition to fuel-switching at existing coal-fired power plants, less reliance on coal-fired power could be accomplished by retiring coal-fired power plants and by meeting demand through greater reliance on natural gas rather than coal-fired EGUs. Furthermore, developing alternative energy and reducing consumer demand through energy efficiency measures would reduce GHG and co-pollutant emissions from all types of fossil-fuel combustion. Standards based on narrowly drawn industrial categories are unlikely to promote any of these favorable options.

According to a number of scholars, section 111(d) could be interpreted to allow EPA to consider these flexible options in developing the performance standard. Section 111(d)'s reference to the "best system of emissions reduction" does not explicitly refer to the best "technology." That language could, arguably, allow EPA to move beyond traditional, category-specific, technology-based performance standards for existing sources.[244] If section 111(d) could be lawfully interpreted to reflect the full range of possible emission reduction measures in the power sector, it could incorporate the much greater reductions that such measures would achieve.[245] In other words, it could lead to a more

243. *See* BURTRAW ET AL., *supra* note 121, at 10.

244. The relevant statutory language for new sources appears to require facility-specific limits, and so most scholars have focused on more flexible options only for existing, not new, sources. *See supra* note 137–39 (noting that some scholars have focused on trading programs for existing sources due to skepticism about the legal viability of a cap-and-trade program for new sources).

245. Determining the legality of reflecting some or all of these measures in the performance standard is an important and complex question beyond the scope of this article.

stringent performance standard than would be set based on a category-by-category technology-based performance standard.[246]

Assuming that a more flexible section 111(d) performance standard is legal, the next issue is how EPA would structure the standard. EPA would likely need to define the relevant industrial category broadly, including all fossil-fuel generation. It could then determine the emission reduction opportunities throughout the electricity-generating sector—including fuel-switching and increased reliance on less- or no-polluting sources—and set the existing-source standard based on those opportunities.[247]

Conceivably, EPA could develop a federal cap-and-trade program to achieve that performance standard.[248] More likely, EPA could announce a federal performance standard, but allow states to submit compliance plans that satisfy the standard with market-based and other non-traditional approaches.[249] One option would be to allow utilities to average emission rates across their facilities, including both coal-fired and other facilities.[250] That option would create an incentive for utilities to utilize less-polluting sources within their fleet. It would not promote alternative energy or demand reduction, however. While those measures would reduce aggregate emissions, they would not improve the regulated fleet's average emissions rate.

Another option, suggested by numerous scholars, would be to allow states to meet the requirements through state or regional cap-and-trade programs that would accomplish the same or greater reductions as imposing the performance standard.[251]

246. *See* BURTRAW ET AL., *supra* note 121, at 6.

247. To maximize flexibility, EPA could conceivably convert the emissions-rate standard into a mass-based standard. An emissions-rate standard addresses only changes in emissions rates, not reductions in the volume of emissions that could occur through energy efficiency or alternative energy measures. For example, if new solar power reduced the *volume* of GHG emissions by five percent, that would not change the emissions *rate* from existing EGUs, notwithstanding the reduction in actual emissions. Only a mass-based standard could capture the GHG reduction benefits of a shift to alternative energy or reduced consumer demand.

248. *See* Monast et al., *supra* note 1, at 11. At one time, EPA proposed a trading program under section 111(d) for mercury emissions, but that program was struck down on other grounds. New Jersey v. Envtl. Prot. Agency, 517 F.3d 574, 578 (D.C. Cir. 2008).

249. *See generally* Jonas Monast et al., Regulating Greenhouse Gas Emissions from Existing Sources: Section 111(d) and State Equivalency (November 2011), *available at* http://nicholasinstitute.duke.edu/climate/policydesign/regulating-greenhouse-gas-emissions-from-existing-sources.

250. *Id.* at 4–5.

251. Enion, *supra* note 147; Litz et al., *supra* note 147; Mullins & Enion, *supra* note 138, at 10,878–84; Wannier et al., *supra* note 147. Most of the commentary

Market-based programs could achieve reductions in net emissions through all of the mechanisms described above. That option appeals to many states that are already controlling existing power sources through GHG cap-and-trade programs, and could encourage more states to participate in these initiatives.

In addition, some have suggested that energy efficiency initiatives and state renewable portfolio standards, which mandate the development of low or no-emission energy sources, should "count" in demonstrating compliance with section 111(d). Even though these programs do not directly affect facilities' emission rates (and thus appear incompatible with typical performance standards), they do reduce the power sector's overall emissions.[252]

All of these options present complex practical challenges, including how the standard would be formulated and how compliance would be demonstrated. If the section 111(d) standard is an emissions-rate standard, then policymakers will have to determine how state programs that achieve mass-based results (like percentage reductions in overall GHG emissions) would be deemed equivalent to the federal standard.[253] Trading programs that allow emissions banking, offsets, and other flexibility mechanisms also create significant compliance questions.[254] These questions are, however, beyond the scope of this article.

EPA's interpretation of section 111(d) could have significant co-pollutant implications. The critical issue is whether compliance flexibility would lead to a more stringent performance standard that reflects and encourages a shift away from coal-fired power and other fossil fuels. Although compliance flexibility does not offer the distinct co-pollutant advantages associated with direct regulation,[255] a sufficiently robust increase in stringency could nonetheless offer other substantial co-pollutant benefits, largely from reductions in the use of coal-fired power.

considers the viability of a trading program for existing sources due to CAA constraints associated with new sources. *See, e.g.*, Mullins & Enion, *supra* note 137, at 10,882–83) (exploring possible trading program for new sources but expressing doubts).

252. *See* Monast et al., *supra* note 1, at 2–4.

253. *Id.* at 7–10.

254. Litz et al., *supra* note 147, at 19–23.

255. *See supra* Part III.B (describing the CAA's capacity to integrate GHG and co-pollutant considerations in standards); *supra* Part III.C (describing the CAA's distributional advantage); *supra* Part III.E (describing the certainty of reductions direct regulation can offer); *supra* Part III.H (describing regulation's participatory benefits).

It is also conceivable that the performance standard could reflect the best of both worlds. It could have two components: (1) minimum technology-based efficiency requirements on all facilities; and (2) a more stringent performance standard that reflects a wider range of options to reduce energy sector emissions and that could be met through a flexible array of compliance options.[256] The technology-based efficiency requirements would ensure that the nation's existing infrastructure reduces emissions as immediately and cost-effectively as is feasible, and would provide the distributional benefits associated with ensuring that all facilities adopt minimum controls. The more stringent performance standard would encourage the kinds of transformative measures that are necessary to address energy sector emissions.

EPA could also adopt a section 111(d) approach that reflects the worst of both worlds. EPA might establish a traditional technology-based performance standard that reflects only the gains that could be achieved by applying existing technology to existing facilities, but then allow states to submit compliance plans that achieve the technology-based standard through market or other mechanisms. That flexibility would likely reduce the costs of compliance. However, if the flexibility is not translated into a more stringent standard, then that approach would not provide stringency-related co-pollutant benefits, and would also eliminate the co-pollutant benefits that flow from direct regulation (like widespread distribution of controls, relative certainty that facilities will adopt controls, the potential to integrate GHG and co-pollutant considerations in standard-setting, and participatory benefits). Under this approach, compliance flexibility would not translate into greater stringency, and the greater co-pollutant benefits resulting from greater stringency would not compensate for the loss of the benefits of direct regulatory approaches.

Even if the CAA can legally be interpreted to incorporate a wide range of transformative measures into the existing source performance standard, it is important to recognize that that effort is awkward. Under a straightforward application of section 111(d), EPA would simply adopt industry-specific technology-based measures. It would be challenging to create a performance

256. *Cf.* Envtl Def. Fund, *Section 111(d) of the Clean Air Act,* (on file with author) (proposing default 111(d) standard that imposes category-specific onsite efficiency improvements as well as requiring reductions in demand). It should be noted that Environment Defense Fund proposes this approach as a default, and it would then allow states to meet the standard using other compliance mechanisms. *Id.* at 2.

standard that was not based on the adoption of industry-specific technology but that instead contemplates the adoption of a wide range of measures, many of which are unrelated to specific facility emission rates. There is little question that it would be easier to require or incentivize these more transformative measures through new and direct legislation. But because new climate legislation is not forthcoming, it is worth pursuing legally-defensible interpretations of the CAA that could prompt the kinds of transformative measures necessary to prompt significant power sector emission reductions—measures that would reduce both GHGs and co-pollutants.

V. CONCLUSION

Ultimately, addressing climate change will require fundamental transformations in our energy and industrial infrastructure, changes with widespread environmental, economic, political, and social implications. Climate policies premised on a vision that integrates those implications will provide greater environmental, administrative, technical, and economic benefits than a narrow focus on GHG reductions alone. Given the close connection between GHG and co-pollutant emissions, co-pollutant implications are an important factor in assessing alternative GHG policies.

Assuming that co-pollutant considerations are relevant to climate policies, what does that mean for our assessment of the CAA's application to stationary sources? At this stage in EPA's implementation of the requirements, the CAA clearly offers the potential to reduce GHGs and associated co-pollutants, but the extent of the reduction remains highly uncertain.

Co-pollutant considerations are also relevant to our assessment of how the CAA's direct regulatory approach compares with proposed market-based mechanisms. Including co-pollutants in the calculus does make a difference for some parameters. Direct regulation could better integrate multi-pollutant concerns into facility controls, more widely distribute GHG and associated co-pollutant reductions, ensure in-sector reductions by eliminating the possibility of offsets, avoid the risk of insufficient caps and market failures, and provide better participatory opportunities.

However, co-pollutant considerations do not all weigh in favor of direct regulatory approaches. A key issue is relative stringency. If—and it is a big if—market-based programs offer greater stringency than the CAA's technology-based program, then market-based programs could lead to greater reductions in GHG emissions, with corresponding decreases in co-pollutants. If the reductions were substantial relative to what would be achieved under the CAA, then they could conceivably compensate for the loss of some of the co-pollutant reduction benefits that would otherwise have flowed from the CAA's traditional approach.

The devil is in the details. Without program specifics for the CAA or potential market-based alternatives, this article offers the relevant parameters for analysis; it cannot make sweeping generalizations about the co-pollutant benefits of direct versus market regulation.

One significant factor that will determine the CAA's effectiveness at reducing GHGs and associated co-pollutants will be how EPA interprets section 111(d), which gives the agency the power to control emissions from existing sources. If interpreted modestly, the CAA and its regulatory program will not make a significant dent in the nation's GHG or co-pollutant emissions. If interpreted more aggressively, however, the CAA could have a more transformative effect. There is little question that taking an aggressive approach would present difficult legal and administrative questions. New legislation that more directly addresses existing source emissions (whether through direct regulation, market mechanisms, or a combination of the two) would likely be easier to implement.

At present, however, the CAA fills an important void, and its control mechanisms can start the nation down the path of reducing stationary source emissions. The positive impacts on pollution amplify the climate benefits of EPA's CAA initiatives.