THE ENFORCEMENT CHALLENGE OF CAP-AND-TRADE REGULATION

BY

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The enforcement of a cap-and-trade program requires that the government know the mass emissions of all capped facilities—the whole quantity of their emissions over a given compliance period. An economy-wide cap-and-trade program addressing greenhouse gas emissions in the United States would bring with it formidable monitoring and enforcement challenges. This Article explains why accurate emissions data is so important to the success of a cap-and-trade program; discusses the methods available to obtain accurate emissions under a self-monitoring and reporting framework; and recommends a cooperative federalism model of enforcement in which significant roles are played by the federal government, state government, citizen groups, and potentially third party verification entities.

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I. INTRODUCTION

Cap-and-trade regulatory programs present a significant enforcement challenge. To administer a cap-and-trade program, a regulatory agency needs a full accounting of the emissions from each regulated facility in the program.[1] Assembling such data is costly and resource intensive. In the Clean Air Act's[2] Title IV Acid Rain Program (Title IV)—the hallmark cap-and-trade program of the United States Environmental Protection Agency (EPA) to control sulfur dioxide (SO2) emissions from power plants—"measuring and monitoring have been the most complex and costly components" of the trading program.[3] The Los Angeles agency that administers the Regional Clean Air Incentives Market (RECLAIM), another longstanding cap-and-trade program, states that "an unanticipated consequence of RECLAIM was the enormous amount of resources it takes to adequately monitor and enforce compliance."[4]

Cap-and-trade regulation remains the likely instrument of choice for a national program in the United States to regulate the greenhouse gas emissions that cause climate change.[5] The cap-and-trade program set forth in the American Clean Energy and Security Act (ACES Act),[6] passed by the

1 Barbara Baird et al., S. Coast Air Quality Mgmt. Dist., *Chapter Three – Legal Issues*, *in* OVER A DOZEN YEARS OF RECLAIM IMPLEMENTATION: KEY LESSONS LEARNED IN CALIFORNIA'S FIRST AIR POLLUTION CAP-AND-TRADE PROGRAM I-3-2 (June 2007), *available at* http://aqmd.gov/reclaim/docs/Policy_Paper_Part1.pdf ("Special enforcement challenges are presented by a cap-and-trade program under which compliance is no longer measured instantaneously by a concentration throughput, or emission limit."); *see also* Reimund Schwarze & Peter Zapfel, *Sulfur Allowance Trading and the Regional Clean Air Incentives Market: A Comparative Design Analysis of Two Major Cap-and-Trade Permit Programs?*, 17 ENVTL. & RES. ECON. 279, 287–89 (2000).

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

3 Joe Kruger & Christian Egenhofer, *Confidence Through Compliance in Emissions Trading Markets*, SUSTAINABLE DEV. L. & POL'Y, Winter 2006, at 2, 9.

4 Baird et al., *supra* note 1, at I-3-6.

5 *See* Stephanie Benkovic & Joseph Kruger, *To Trade or Not to Trade? Criteria for Applying Cap and Trade*, 1 SCI. WORLD 953, 953 (2001), *available at* http://www.epa.gov/airmarket/resource/docs/tradingcriteria.pdf. For a general introduction on how cap-and-trade regulatory programs work see generally OFFICE OF AIR & RADIATION, U.S. ENVTL. PROT. AGENCY, TOOLS OF THE TRADE: A GUIDE TO DESIGNING AND OPERATING A CAP AND TRADE PROGRAM FOR POLLUTION CONTROL (2003), *available at* http://www.epa.gov/airmarket/resource/docs/tools.pdf.

6 H.R. 2454, 111th Cong. (2009).

House of Representatives in June 2009, would have capped about 85% of all greenhouse gas emissions in the United States and applied to about 7500 entities.[7] Although the ACES Act did not become law due to Senate inaction,[8] a similarly comprehensive cap-and-trade system seems likely to be considered again in the future.[9]

This Article draws on the experience of past cap-and-trade programs to describe and analyze the enforcement challenges that will confront a future U.S. cap-and-trade program for greenhouse gases.[10] Part II of the Article describes why accurate emissions data are so critical to the functioning of a cap-and-trade program. Part III discusses how emissions data are obtained. Part IV argues that a comprehensive cap-and-trade program to reduce greenhouse gas emissions should not be enforced by the federal government alone.[11] Rather, a relatively decentralized cooperative federalism approach is called for. Significant roles should also be played by state enforcers, citizen enforcers, and possibly third party verification entities.[12]

II. THE IMPERATIVE OF ACCURATE EMISSIONS DATA

In a cap-and-trade program, accurate emissions data are essential to determining each regulated facility's compliance. Accurate emissions data also support the market value of the program's tradable allowances and create confidence in the program's attainment of its environmental objectives. Yet, at the same time, incentives for facilities to have their emissions undercounted clearly exist, particularly when allowance prices are high.

7 *See* MARK HOLT & GENE WHITNEY, CONG. RESEARCH SERV., R40643, GREENHOUSE GAS LEGISLATION: SUMMARY AND ANALYSIS OF H.R. 2454 AS PASSED BY THE HOUSE OF REPRESENTATIVES 6, 84 (2009), *available at* http://www.nationalaglawcenter.org/assets/crs/R40643-1.pdf.

8 David Robinson, *U.S. Federal Energy and Climate Change Legislation*, 2 CARBON & CLIMATE L. REV. 127, 127–29 (2010).

9 *See id.* at 134.

10 The cap-and-trade program proposed in the ACES Act as well as the existing cap-and-trade programs described in this Article have all primarily regulated emissions "downstream" (i.e., at the level of the individual industrial emitter) rather than "upstream" (i.e., at the level of the fossil fuel producer or importer). *See* Holly Doremus & W. Michael Hanemann, *Of Babies and Bathwater: Why the Clean Air Act's Cooperative Federalism Framework is Useful for Addressing Global Warming*, 50 ARIZ. L. REV. 799, 808–09 (2008). The discussion and analysis in this Article presumes that a future cap-and-trade program for greenhouse gases would be similar.

11 As used in the article, the term "enforcement" refers broadly to all actions taken to ensure that actors subject to the law are in compliance. Governmental enforcement consists mainly of identifying and imposing sanctions for violations. *See generally* DANIEL RIESEL, ENVIRONMENTAL ENFORCEMENT: CIVIL AND CRIMINAL 1-1 to 1-2 (2010).

12 The European literature on cap-and-trade commonly uses the term "verification" to refer to the enforcement of self-monitoring and reporting requirements. *See, e.g.*, Marjan Peeters, *Inspection and Market-Based Regulation Through Emissions Trading: The Striking Reliance on Self-Monitoring, Self-Reporting and Verification*, 2 UTRECHT L. REV. 177, 184 (2006) (discussing role of verification in emissions regulation).

A. The Compliance Equation

A threshold question in determining whether cap-and-trade is a suitable regulatory approach is whether emissions can be monitored accurately.[13] To determine whether a regulated facility has complied, the agency must be able to ascertain that the facility has enough allowances to "cover" its emissions at the end of the compliance period.[14] To do so, it must have an accurate count of the facility's "mass" emissions—the whole quantity of its emissions over the given reporting period.[15]

Existing cap-and-trade programs in the United States, such as Title IV[16] and RECLAIM,[17] have set the date for the compliance decision to be several weeks to several months after the reporting period ends.[18] In this so-called reconciliation period,[19] the facility has time to conduct trading to buy or sell permits as it deems necessary or advantageous. On the compliance date, the facility must surrender the number of permits representing the amount of pollution that it has emitted over the reporting period, or be deemed to be out of compliance.[20]

B. Market and Environmental Integrity

In the absence of accurate monitoring data, the integrity of the allowance market is compromised. If regulated facilities need fewer

13 *See* Benkovic & Kruger, *supra* note 5, at 955.

14 Lesley K. McAllister, *Putting Persuasion Back in the Equation: Compliance in Cap and Trade Programs*, 24 PACE ENVTL. L. REV. 299, 301 (2007); *see* Peeters, *supra* note 12, at 179 ("One core obligation of an emissions trading scheme is that each covered installation needs to surrender an amount of emission rights which is at least equal to the emissions during a certain well-defined period.").

15 OFFICE OF AIR & RADIATION, *supra* note 5, at 3-3 ("Accurate, comprehensive emission data are a cornerstone of a credible and effective cap and trade program."). Ascertaining the number of allowances held requires monitoring and enforcement of the allowance market, a topic that is beyond the scope of this Article. For relevant discussion and analysis, see Matt Bogoshian & Ken Alex, *The Essential Role of State Enforcement in the Brave New World of Greenhouse Gas Emission Limits*, 27 UCLA J. ENVTL. L. & POL'Y 337 (2009).

16 For more description of Title IV, see A. DENNY ELLERMAN ET AL., MARKETS FOR CLEAN AIR: THE U.S. ACID RAIN PROGRAM (2000); Sam Napolitano et al., *The U.S. Acid Rain Program*, ELECTRICITY J., Aug.–Sept. 2007, at 47, and 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).

17 For more description of RECLAIM, see Richard Toshiyuki Drury et al., *Pollution Trading and Environmental Injustice: Los Angeles' Failed Experiment in Air Quality Policy*, 9 DUKE ENVTL. L. & POL'Y F. 231 (1999); James M. Lents, *The RECLAIM Program (Los Angeles' Market-Based Emissions Reduction Program) at Three Years*, *in* EMISSIONS TRADING: ENVIRONMENTAL POLICY'S NEW APPROACH 219 (Richard F. Kosobud et al. eds., 2000); and Lesley K. McAllister, *Beyond Playing "Banker": The Role of the Regulatory Agency in Emissions Trading*, 59 ADMIN. L. REV. 269, 287–313 (2007).

18 *See* Swift, *supra* note 16, at 321 n.47 (ARP); *cf.* McAllister, *supra* note 17, at 299.

19 Swift, *supra* note 16, at 404.

20 Napolitano, *supra* note 16, at 49; *see also* Swift, *supra* note 16, at 321 (stating that owners must have sufficient allowances to "cover all emissions for that year").

allowances to satisfy compliance because their emissions are undercounted, then there will be less demand for allowances in the allowance market, and the value of allowances will be lower.[21] The monitoring data are critical because they determine the number of allowances that a facility has to surrender for compliance, and in turn, the number of allowances that it must buy or that it can sell.[22]

If any portion of a regulated facility's emissions is not included in the mass emissions count that is used to determine compliance, then the emissions reduction incentives created by the program are reduced. Most directly, the emissions reduction incentives for the facility that is able to avoid reporting some of its emissions are reduced; the facility has less incentive to spend money on emissions reductions if it can simply report lower emissions. This is also the case in a traditional environmental regulatory program.[23] Poorly monitored facilities will not be subject to the types of agency actions that would have otherwise given those facilities the incentive to reduce their emissions.

In a cap-and-trade program, however, the ability of one participating facility to cheat affects not just its own incentives but also the incentives of all other facilities in the program.[24] In a traditional environmental regulatory program, a poorly monitored facility's ability to avoid emissions reductions would have no effect on the incentives faced by a well monitored facility in the same traditional environmental regulatory program. In a cap-and-trade program, in contrast, the two become interrelated. The poorly monitored facility that falsely reports overcompliance can sell allowances to the well monitored facility, thereby enabling the well monitored facility to avoid emissions reductions. Because of the trading, weak enforcement for some facilities affects the emissions reduction incentives of all.[25]

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21 Robert Baldwin, *Regulation Lite: The Rise of Emissions Trading*, 2 REG. & GOVERNANCE 193, 201 (2008); Kruger & Egenhofer, *supra* note 3, at 8.

22 EUROPEAN ENV'T AGENCY, APPLICATION OF THE EMISSIONS TRADING DIRECTIVE BY EU MEMBER STATES 39 (2008), *available at* http://www.eea.europa.eu/publications/technical_report_2008_13/at_download/file ("Monitoring and reporting of emissions by operators and independent verification play a fundamental role in the trust placed in any emissions trading scheme. Plant inventory reports and verified emission reports are crucial since they determine the amount of the allowances which have to be surrendered for each year. This establishes whether an operator is able to sell excess allowances or, for compliance reasons, needs to buy missing allowances or acquire equivalent carbon credits.").

23 *See* David M. Driesen, *Is Emissions Trading an Economic Incentive Program?*, 55 WASH. & LEE L. REV. 289, 302 (1998); *see also* Baldwin, *supra* note 21, at 200 ("A familiar criticism of traditional 'command' regulation is that regulated firms are able to exploit the information asymmetry between regulator and regulated.").

24 *See* Carol M. Rose, *Expanding the Choices for the Global Commons: Comparing Newfangled Tradable Allowance Schemes to Old-Fashioned Common Property Regimes*, 10 DUKE ENVTL. L. & POL'Y F. 45, 60 (1999) ("[M]onitoring is critical to reassure purchasers that they are not paying for rights that others might be taking for free—a scenario that would cause the whole tradable allowance scheme to unravel.").

25 *See* Driesen, *supra* note 23, at 333–34 (explaining that when a poorly monitored polluter reports overcompliance when it has not complied, this not only causes a loss of reductions at the poorly monitored facility, but also at the purchasing facility); David M. Driesen, *Free Lunch*

Accurate monitoring is also critical to whether the program's environmental goal—the overall cap imposed on all the regulated sources—is truly attained.[26] If sources are emitting at levels higher than they report and such violations are not discovered, the reported level of overall emissions for the program will be lower than actual emissions. In cases where reported emissions are close to the cap, actual emissions may be above the cap, and the environmental goal espoused by the program will falsely appear to be met.

Where the banking of allowances is allowed, the negative impact on the environmental integrity of the program will be carried into the future. In a program with allowance banking, allowances issued in one compliance period do not expire at the end of that period. Rather, regulated facilities can hold on to allowances for use or sale in a future compliance period.[27] If emissions are undercounted in a program with banking, allowances that should have been surrendered will be available to legitimize emissions that may exceed the cap in a future compliance period.[28]

C. Incentives for Fraud

While a reliable accounting of all of each source's emissions is critical to success, a cap-and-trade scheme creates a clear incentive for fraud: the price of an allowance is the monetary reward for not reporting the amount of pollution that that allowance represents. So, at the same time that the allowance price creates an incentive to make emissions reductions that would cost less than that price, it also creates an incentive to find a loophole or commit fraud to avoid having to report emissions.[29] As explained by Professor Marjan Peeters in a study about the European Union Emissions Trading Scheme (EU ETS), the European Union's (EU's) innovative cap-and-trade program to reduce greenhouse gas emissions "[b]y introducing a financial incentive for reducing emissions, an incentive for not following the rules is in fact included."[30] In other words, the acclaimed virtue of cap-and-trade—its ability to put a price on pollutant emissions—is also a path to vice.

or Cheap Fix?: The Emissions Trading Idea and the Climate Change Convention, 26 B.C. ENVTL. AFF. L. REV. 1, 65 (1998) (explaining that trading creates an incentive to rely on credits from the least well-monitored sources of emissions because fraudulent credits will prove cheaper than real ones, and applying this insight to international trades). The author thanks Professor David Driesen for personal communication related to this point.

26 Baldwin, *supra* note 21, at 201 ("The rules of trading must be monitored and enforced since non-observance of allowances will undermine the value of trading and negate ceilings on emissions." (citing T.H. TIETENBERG, EMISSIONS TRADING: PRINCIPLES AND PRACTICE 165 (2d ed. 2006)); Benkovic & Kruger, *supra* note 5, at 955 ("This complete and consistent accounting of emissions is essential to ensure that the environmental goal of the program is achieved and that the overall emissions cap is maintained.").

27 Lesley K. McAllister, *The Overallocation Problem in Cap-and-Trade*, 34 COLUM. J. ENVTL. L. 395, 423 (2009).

28 *See id.*

29 Peeters, *supra* note 12, at 179.

30 *Id.*

Moreover, when allowance prices are high, there is a greater incentive for facilities to cheat than when allowance prices are low.[31] The rational polluter bases the decision whether to comply on a comparison of the expected benefits and expected costs of noncompliance.[32] If the benefits of noncompliance exceed the costs, it is not rational to comply. The expected benefit of not complying is a function of the permit price. By not complying (i.e., by underreporting emissions), the polluter saves the money that it would have had to spend on allowances. The expected cost of noncompliance depends in turn on the likelihood that a penalty will be imposed and the severity of that penalty.

Therefore, when allowance prices are higher, the same level of enforcement requires that the probability of a penalty, the price of that penalty, or both, rise in a proportionate way. For the probability of violation detection to rise, the agency must become more vigilant in conducting inspections and other activities to identify violations. Penalty amounts can rise if agencies have the authority to impose higher penalties and choose to do so.

The enforcement regimes of existing cap-and-trade programs have not often been tested under adverse conditions for compliance. Rather, prevailing allowance prices generally have been quite low relative to expectations and predictions made at each program's inception.[33] In 1990 when Title IV was passed into law, predictions of allowance prices ranged from $290 to $410 in 1995 to 1999 (Phase I) and from $580 to $815 in 2000 to 2010 (Phase II).[34] However, allowances have sold at EPA's annual spot auctions for prices below their predicted levels in all years except 2005 and 2006.[35] Reclaim allowance prices have been below predictions to an even greater extent. For example, from 1996 through 1998, "allowances averaged $277 per ton in comparison to a predicted average price of $9151."[36] In the EU ETS, allowance prices essentially fell to zero for the latter part of the program's first multi-year compliance period (Phase 1, from 2005 to 2007) because more allowances were available on the market than were needed to cover emissions.[37]

31 *See, e.g.*, John K. Stranlund et al., *Enforcing Emissions Trading Programs: Theory, Practice, and Performance*, 30 POL'Y STUD. J. 343, 351 ("When permit prices are high, facilities have a greater incentive to be noncompliant, and when they are low, facilities are more likely to be compliant.").

32 *See id.* at 346.

33 *See* McAllister, *supra* note 27, at 414–18.

34 *Id.* at 416–17.

35 *See* U.S. ENVTL. PROT. AGENCY, ALLOWANCE MARKETS ASSESSMENT: A CLOSER LOOK AT THE TWO BIGGEST PRICE CHANGES IN THE FEDERAL SO2 AND NOX ALLOWANCE MARKETS 1 (2009), *available at* http://www.epa.gov/airmarkets/resource/docs/marketassessmnt.pdf; McAllister, *supra* note 27, at 416–17.

36 McAllister, *supra* note 27, at 416 (citing S. COAST AIR QUALITY MGMT. DIV., ANNUAL RECLAIM AUDIT REPORT FOR THE 1995 COMPLIANCE YEAR (1997); S. COAST AIR QUALITY MGMT. DIV., ANNUAL RECLAIM AUDIT REPORT FOR THE 1997 COMPLIANCE YEAR (1999)).

37 McAllister, *supra* note 27, at 408–10.

If a comprehensive cap-and-trade program for greenhouse gases is to be successful in achieving the greenhouse gas reductions, it is likely that allowance prices will have to rise to levels that will be considered expensive.[38] A higher allowance price would create stronger incentives for cheating. In this situation, agency enforcement would have to be more thorough and punitive than it has been in the past.

III. OBTAINING ACCURATE EMISSIONS DATA

Producing accurate data on mass emissions is "[t]he most difficult task of enforcing an emissions trading program."[39] Evidence of this difficulty is found in the great efforts that have been expended to design and maintain the monitoring and reporting systems of existing cap-and-trade programs. In both, Title IV and RECLAIM agencies have had to develop very detailed rules and guidance documents to establish the monitoring and reporting system.[40] Also, both programs have required significant resources to verify reported data.[41] As suggested below, it is likely that even greater efforts would be necessary to supply the data needed to run a comprehensive greenhouse gas cap-and-trade program.

A. Emission Monitoring Methods

Methods for obtaining reliable data characterizing a regulated facility's emissions have evolved in tandem with the regulatory need for this data. Traditional air pollution control programs did not typically require a full accounting of emissions. Compliance determinations tended to rely instead on the installation of prescribed emissions control equipment in combination with periodic emissions testing.[42]

Important advances in the capacity of environmental agencies to produce complete and reliable records of emissions were made with the institution of the existing cap-and-trade programs, particularly Title IV and RECLAIM.[43] These programs have arguably produced the highest quality emissions data in the history of environmental law.[44] Similarly, the EU ETS has led to important developments in emissions monitoring methods for facilities in the EU.[45] Based on the experiences of these programs, there are

38 *Cf.* ALEXANDRE KOSSOY & PHILLIPPE AMBROSI, WORLD BANK, STATE AND TRENDS OF THE CARBON MARKET 2010, at 6 (2010).

39 Stranlund et al., *supra* note 31, at 349.

40 *See id.* at 348–50 (describing the enforcement of Title IV and RECLAIM programs).

41 *See id.* (describing the technology requirements for verifying data).

42 Andrew Jackson Heimert, *Keeping Pigs out of Parlors: Using Nuisance Law to Affect the Location of Pollution*, 27 ENVTL. L. 403, 447 (1997).

43 *See* U.S. ENVTL. PROT. AGENCY, ACID RAIN AND RELATED PROGRAMS: 2006 PROGRESS REPORT 4 (2007) (ARP); McAllister, *supra* note 27, at 406 tbl.2 (RECLAIM).

44 *See, e.g.*, U.S. ENVTL. PROT. AGENCY, *supra* note 43, at 4; Napolitano et al., *supra* note 16, at 52.

45 EUROPEAN ENV'T AGENCY, *supra* note 22, at 49–53.

two basic approaches to gathering mass emissions data: direct measurement and estimation. This section describes both of these approaches and addresses their advantages and disadvantages.

1. Direct Measurement

Direct measurement of mass emissions is possible for some pollutants through the use of Continuous Emissions Monitoring Systems (CEMS). CEMS are "electromechanical instruments that sample, analyze, measure and record" emissions information and are installed in the smoke stack through which emissions pass.[46] Title IV required that the largest emitters of SO2—namely the coal fired power plants—install CEMS.[47] Overall, about one third of the program's regulated units are required to use CEMS, and these units emit close to ninety-nine percent of the SO2 emissions regulated under the program.[48] The other two thirds of emitters consist primarily of gas and oil fired power plants, which collectively emit the remaining one percent of regulated emissions.[49]

For Title IV, SO2 emissions were the key data needed to determine power plants' compliance.[50] However, the program also required that the power plants regulated by the program monitor and report their carbon dioxide (CO2) emissions.[51] Coal fired power plants generally directly measure CO2 emissions using CEMS,[52] while gas and oil fired plants most often measure and report CO2 emissions using estimation methods as described below.[53]

Through Title IV, high quality data thus exists about emissions of the greenhouse gas CO2 from the electricity generation sector. This data would help meet the needs of a future cap-and-trade system to control greenhouse gases. The electricity generation sector is responsible for about forty percent of all CO2 emissions in the United States,[54] and about eighty percent of these CO2 emissions are from coal fired power plant units that already measure their emissions with CEMS.[55] Notably, the Regional Greenhouse Gas

46 Arnold W. Reitze, Jr. & Steven D. Schell, *Self-Monitoring and Self-Reporting of Routine Air Pollution Releases*, 24 COLUM. J. ENVTL. L. 63, 107 (1999).

47 U.S. ENVTL. PROT. AGENCY, *supra* note 43, at 17; Napolitano et al., *supra* note 16, at 53.

48 U.S. ENVTL. PROT. AGENCY, *supra* note 43, at 17 figs.9 & 10; *see also* U.S. ENVTL. PROT. AGENCY, ACID RAIN AND RELATED PROGRAMS: 2007 PROGRESS REPORT 19 figs.11 & 12 (2009).

49 U.S. ENVTL. PROT. AGENCY, *supra* note 43, at 17 figs.9 & 10; *see also* U.S. ENVTL. PROT. AGENCY, *supra* note 48, at 19 figs.11 & 12.

50 CLEAN AIR MKTS. DIV., U.S. ENVTL. PROT. AGENCY, PLAIN ENGLISH GUIDE TO THE PART 75 RULE 4 tbl.1 (2009), *available at* http://www.epa.gov/airmarkt/emissions/docs/plain_english_guide_par75_final_rule.pdf.

51 *Id.*

52 Kruger & Egenhofer, *supra* note 3.

53 *See infra* Part III.A.2.

54 U.S. ENVTL. PROT. AGENCY, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990–2008, at 2-23 (2010), *available at* http://www.epa.gov/climatechange/emissions/downloads10/US-GHG-Inventory-2010_Report.pdf.

55 *See id.* at 2-18 tbl.2-13.

Initiative (RGGI), which regulates CO2 emissions from power plants in ten Northeastern and mid-Atlantic states,[56] relies heavily on these data to determine compliance.[57]

While the CO2 emissions of power plants in the United States are well measured, many greenhouse gas emissions that are likely to be included in a comprehensive cap-and-trade program are not. The ACES Act's cap-and-trade program would have regulated not just CO2, but also methane, nitrous oxide (NOx), sulfur hexafluoride, hydrofluorocarbons emitted from a chemical manufacturing process, any perfluorocarbon, and nitrogen trifluoride.[58] Also, the ACES Act included a wide variety of emissions sources in addition to the electric utilities regulated by Title IV, including importers of fuel, natural gas distributors, cement and aluminum producers, petroleum refiners, and a variety of stationary sources.[59]

The U.S. National Greenhouse Gas Inventory discusses the uncertainties associated with current estimates of greenhouse gas emissions. It states:

> some of the current estimates, such as those for CO2 emissions from energy-related activities, are considered to have minimal uncertainty associated with them. For some other categories of emissions, however, a lack of data or an incomplete understanding of how emissions are generated increases the uncertainty surrounding the estimates presented.[60]

Indeed, the difficulty of measuring non-CO2 greenhouse gas emissions is one of the reasons why the EU ETS included only CO2 in program implementation through the year 2012.[61]

Direct measurement with CEMS is generally considered a costly manner of obtaining emissions data, particularly in comparison with

56 The 10 RGGI states are Connecticut, Delaware, Maine, Maryland, Massachusetts, New York, New Jersey, New Hampshire, Rhode Island, and Vermont. Reg'l Greenhouse Gas Initiative, State Regulations, http://www.rggi.org/design/regulations (last visited Nov. 21, 2010).

57 *See generally*, REG'L GREENHOUSE GAS INITIATIVE, OVERVIEW OF RGGI CO2 BUDGET TRADING PROGRAM (2007), *available at* http://www.rggi.org/docs/program_summary_10_07.pdf (referring to EPA CO2 data and EPA regulations).

58 *See* H.R. 2454, 111th Cong. § 311 (2009) (proposing new title to Clean Air Act).

59 *See id.* § 312 (proposing new sections to Clean Air Act). The list of sources includes electric utilities including cooperatives and municipalities; producers and importers of fuel, the combustion of which would emit 25,000 tons or more of CO2 equivalent; natural gas distributors supplying 460 million cubic feet of gas to customers that are not covered entities; sources producing 25,000 tons of CO2 equivalent or more of bulk industrial gases; stationary sources producing cement, primary aluminum, or lime; a variety of chemical and petrochemical sources; petroleum refiners; and stationary sources emitting 25,000 or more tons of CO2 equivalent that produce iron and steel, ferroalloys, glass, zinc, or pulp and paper. *Id.*

60 U.S. ENVTL. PROT. AGENCY, *supra* note 54, at 1-15.

61 Peeters, *supra* note 12, at 181–82 ("[M]onitoring difficulties are an important reason why several greenhouse gas pollutants are not yet covered by the EU emissions trading scheme.").

estimation of emission based on fuel use.[62] In addition to the initial installation costs, maintenance and operation costs can be high.[63] Moreover, the accuracy of CEMS relies on a continuous regimen of quality assurance and quality control (QA/QC) testing that implies additional costs.[64] Because of concerns about both the cost and accuracy of CEMS, the CO2 emissions regulated by the EU ETS are generally not measured directly with the use of CEMS,[65] but rather they are estimated in the ways discussed below.[66]

In sum, existing CEMS technologies are best suited to measuring CO2 emissions from very large stationary sources. Many of the emissions that are likely to be covered by a comprehensive greenhouse gas cap-and-trade scheme are not amenable to direct measurement with CEMS. Emissions monitoring would instead depend on estimation techniques described below.

2. Estimation Using Emissions Factors

The use of emissions factors is widespread and growing in United States air pollution law.[67] A relatively quick and inexpensive way to estimate emissions, emissions factors are typically used when direct measurement is "too expensive or time-consuming to be feasible."[68] Between 1996 and 2004, EPA almost doubled the number of air pollution emissions factors it had developed, from 8838 to 17,111.[69] If a comprehensive cap-and-trade program for greenhouse gases is instituted in the United States, it is likely that emissions factors will be used to determine the mass emissions of some of the sources.[70]

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62 Nikolas Bader & Raimund Bleischwitz, *Measuring Urban Greenhouse Gas Emissions: The Challenge of Comparability*, 2 SAPIENS, no. 3, Dec. 2009, at 1, 8, *available at* http://sapiens.revues.org/index854.html?file=1.

63 Reitze & Schell, *supra* note 46, at 108 (noting that CEMS cost $75,000 to $350,000).

64 See *infra* text accompanying notes 112–119 for additional discussion of QA/QC testing.

65 *See* Kruger & Egenhofer, *supra* note 3, at 63 n.36; Joseph Kruger, Wallace E. Oates & William A. Pizer, *Decentralization in the EU Emissions Trading Scheme and Lessons for Global Policy*, 1 REV. ENVTL. ECON. & POL'Y 112, 124 (2007). *But see* EUROPEAN ENV'T AGENCY, *supra* note 22, at 45 (stating that some facilities do use CEMS).

66 *See infra* Part III.A.2.

67 OFFICE OF INSPECTOR GEN., U.S. ENVTL. PROT. AGENCY, EVALUATION REPORT: EPA CAN IMPROVE EMISSIONS FACTORS DEVELOPMENT AND MANAGEMENT 1–2 (2006).

68 *Air Quality Standards, EPA Solicits Comment on Ways to Improve Calculations for Stationary Source Emissions*, 40 Env't Rep. (BNA) 2390, at 2391 (Oct. 16, 2009); *see also* OFFICE OF INSPECTOR GEN., *supra* note 67, at 3 (noting that emissions factors are fast and inexpensive).

69 OFFICE OF INSPECTOR GEN., *supra* note 67, at 9. For more discussion of emissions factors, see generally OFFICE OF AIR QUALITY PLANNING & STANDARDS, U.S. ENVTL. PROT. AGENCY, COMPILATION OF AIR POLLUTANT EMISSIONS FACTORS VOLUME 1: STATIONARY POINT AND AREA SOURCES (AP 42) (5th ed. 1995), *available at* http://www.epa.gov/ttnchie1/ap42/ (under section entitled "Table of Contents, AP 42, Volume I, Fifth Edition," click on "Introduction to AP 42, Volume I, Fifth Edition"). AP 42 is the primary guidance and source of rated emissions factors used by EPA. OFFICE OF INSPECTOR GEN., *supra* note 67, at 3 n.2.

70 *See* Inho Choi, *Global Climate Change and the Use of Economic Approaches*, 45 NAT. RESOURCES J. 865, 933 (2005).

An emissions factor quantifies the amount of emissions produced per unit of an activity that emits pollutant. The general equation for emissions estimates is: "Activity Rate x Emissions Factor = Emissions."[71] The measure of the activity may be expressed in a variety of ways, such as the number of hours a facility operates (i.e., units of time), the amount of fuel combusted, or the output produced by a facility (i.e., units of mass or volume).[72] Emissions factors are expressed as the mass of the pollutant emitted (e.g., tons of NOx) divided by the corresponding unit time, mass, or volume of the activity emitting the pollutant.[73]

Many concerns have been raised about the accuracy of emissions factors as used by EPA.[74] Of the emissions factors developed by EPA, over half are rated by the agency as being of "below average" or "poor" quality.[75] A 2006 report by EPA's Office of Inspector General found that the misuse of emissions factors had resulted in significant uncontrolled emissions and that EPA's management of the emissions factors program needed improvement.[76]

EPA's Title IV, as mentioned above, permitted oil and gas fired power plants to estimate their emissions.[77] EPA's rules, however, set forth a complex methodology that ensures greater accuracy than the use of a general emissions factors.[78] The rules require that each unit using the estimation method to monitor SO2 emissions use a calibrated fuel flow meter to collect continuous data on fuel flow.[79] Each unit must also conduct periodic fuel sampling to determine the fuel's sulfur content.[80] The two are then combined to calculate the SO2 mass emissions rate.[81] In effect, the rules require continuous direct measurement of the activity level as well as sampling that enables the facility to determine a facility-specific emissions factor.

A few hundred units in Title IV classified as "low-mass emitters" are permitted to estimate their emissions based on a more typical general emissions factor approach.[82] They do not continuously monitor either their

71 OFFICE OF INSPECTOR GEN., *supra* note 67, at 3.

72 *See* OFFICE OF AIR QUALITY PLANNING & STANDARDS, *supra* note 69, at 1.

73 *Id.*

74 *See, e.g.*, Drury et al., *supra* note 17, at 259–60.

75 OFFICE OF INSPECTOR GEN., *supra* note 67, at 8.

76 *Id.* at 10, 15.

77 *See* CLEAN AIR MKTS. DIV., *supra* note 50, at 12–13, 43; *see also* John Schakenbach et al., *Fundamentals of Successful Monitoring, Reporting, and Verification Under a Cap-and-Trade Program*, 56 J. AIR & WASTE MGMT. ASS'N 1576, 1576–77 (2006) (discussing alternative monitoring methods involving estimation of emissions).

78 *See generally* CLEAN AIR MKTS. DIV., *supra* note 50, at 28–36 (outlining EPA's methodology for monitoring gas fired and oil fired units); OFFICE OF AIR QUALITY PLANNING & STANDARDS, *supra* note 69, at 3 ("[E]mission factors frequently may not provide adequate estimates of the average emissions for a specific source.").

79 OFFICE OF AIR QUALITY PLANNING & STANDARDS, *supra* note 69, at 11–12, 28–29.

80 *Id.* at 30.

81 *Id.* at 32–34.

82 Interview with EPA Official (Sep. 17, 2009) (stating that only hundreds of units in the program are low-mass emitters). For a definition of low-mass emitters, see CLEAN AIR MKTS. DIV., *supra* note 50, at 43.

emissions or their fuel flow. Fuel flow can be estimated from records of fuel usage, and emissions are estimated by multiplying this activity level by a default emissions factor for the type of fuel used.[83]

The EU ETS has relied almost entirely on the estimation of emissions, with varying levels of sophistication. In 2003, the European Council issued the directive establishing the EU ETS, which obliged the Commission to adopt guidelines for monitoring and reporting of industrial emissions.[84] In 2004, the Commission released its legally binding Monitoring and Reporting Guidelines.[85] The guidelines standardize emissions monitoring and verification procedures across the EU while leaving considerable flexibility to facilities and member states.[86]

The guidelines set forth different tiers of methodologies with different assumed accuracies for calculating a facility's emissions.[87] Facilities are required to choose a methodology in the highest tier, but they may petition to use lower-tiered methods if they show that the more accurate method is not economically or technologically feasible.[88] Each member state has the authority to consider such petitions and grant variances in appropriate situations.[89]

An example assists in understanding how the accuracy of different tiers may vary. As explained by Kruger and Pizer:

> [F]or general combustion activities (for example, burning fuel in an industrial boiler), the highest tier method would require measurement of fuel with methods resulting in a maximum permissible uncertainty of [plus] or [minus] 1% and would require an installation specific emissions factor for the batch of fuel used. The lowest tier method would require measurement of fuel with methods resulting in a maximum permissible uncertainty of [plus] or [minus] 7.5% and would allow the use of standardized, general emissions factors listed in the Appendix of the EU guidance.[90]

The highest tier method is similar to the method generally used by oil and gas fired combustion units in Title IV,[91] and requires facilities to measure

83 *See* CLEAN AIR MKTS. DIV., *supra* note 50, at 43.

84 *See* Council Directive 2003/87, art. 14, 2003 O.J. (L 275) 32, 37 (EC).

85 *See* Commission Decision 2004/156, arts. 1–2, 2004 O.J. (L 59) 1, 1 (EC). The Commission adopted a revised version of these guidelines on July 18, 2007. Commission Decision 2007/589, arts. 2–3, 2007 O.J. (L 229) 1, 3 (EC).

86 Joseph Kruger, *Companies and Regulators in Emissions Trading Programs*, *in* EMISSIONS TRADING 3, 15 (Ralf Antes et al. eds., 2008).

87 Joseph Kruger & William A. Pizer, *The EU Emissions Trading Directive* 18 (Res. for the Future, Discussion Paper 04-24, April 2004), *available at* http://www.rff.org/documents/rff-dp-04-24.pdf.

88 Kruger, Oates & Pizer, *supra* note 65, at 124; Kruger & Egenhofer, *supra* note 3, at 6; Peeters, *supra* note 12, at 185–86.

89 Kruger, Oates & Pizer, *supra* note 65, at 124.

90 Kruger & Pizer, *supra* note 87, at 18.

91 *Compare id.* (noting the highest tier methodology permits minimal uncertainty in required fuel measurements) *with* CLEAN AIR MKTS. DIV., *supra* note 50, at 8, 9, 18, 28–36 (detailing the continuous monitoring required for fuel measurements at oil fired or gas fired units).

their fuel use in a reliable way and to develop a facility-specific emissions factor.[92] The lowest tier method, in turn, is similar to the method required of low-mass emitters in Title IV.[93] It allows a less reliable measure of fuel use and a general emissions factor.[94]

However, estimation methods have often been used in the EU ETS that do not even meet the minimum standards. In some member states, even the lowest tier of methodologies is not considered to be feasible because of the absence of appropriately accredited laboratories.[95] In 2007, twenty-five out of the twenty-seven member states had at least one facility that used a methodology lower in accuracy than the lowest tier, and fifteen out of twenty-seven member states reported that at least half of their reported emissions were generated using such low accuracy methodologies.[96]

B. Self-Monitoring and Reporting

Because of resource constraints, government agencies rely heavily on self-monitoring and self-reporting of pollutant emissions under many environmental laws. This reliance would continue in a cap-and-trade program for greenhouse gases. Given the need for accurate emissions data in a cap-and-trade program, however, self-monitoring data must be subject to verification. The rulemaking and enforcement processes that have been developed to enable verification of self-monitoring data in other cap-and-trade programs serve as examples of what will be necessary for a greenhouse gas cap-and-trade scheme.

1. Self-Monitoring and Reporting in Environmental Law

Most of the monitoring of pollution discharges in environmental law is self-monitoring. Self-monitoring prevails because of the inability of government agencies with limited resources to directly monitor all relevant facilities frequently enough.[97] Yet, under environmental laws such as the Clean Water Act,[98] the Emergency Planning and Community Right-to-Know Act,[99] and the Clean Air Act, most of the self-monitoring data that is reported

92 Kruger & Pizer, *supra* note 87, at 18.

93 *Compare id.* (noting the lowest tier methodology permits greater uncertainty in measurements than the highest tier methodology allows) *with* CLEAN AIR MKTS. DIV., *supra* note 50, at 43, 46 (indicating that for low-mass emitters, continuous monitoring of certain parameters is not required and generic default emission rates can be used instead of measured values).

94 Kruger & Pizer, *supra* note 87, at 18.

95 EUROPEAN ENV'T AGENCY, *supra* note 22, at 39.

96 *Id.* at 39.

97 *See* Incentives for Self-Policing: Discovery, Disclosure, Correction and Prevention of Violations, 65 Fed. Reg. 19,618, 19,619 (April 11, 2000).

98 Federal Water Pollution Control Act, 33 U.S.C. §§ 1251–1387 (2006).

99 Emergency Planning and Community Right-to-Know Act of 1986, 42 U.S.C. §§ 11001–11050 (2006).

remains unverified by the government.[100] Given the importance of this data to the operation of a cap-and-trade program, it is necessary that cap-and-trade regulatory programs incorporate rigorous verification.

There are many benefits of self-monitoring and reporting requirements. These requirements "shift much of the burden for documenting compliance from the government to the regulated community."[101] Assuming the truthfulness of reported data, the government role can focus on responding to noncompliance events, either with compliance assistance programs or penalties, and governmental resources are conserved. In addition, in comparison to periodic inspections by a governmental agency, self-reporting has the potential to produce a continuous data stream, which gives a much better indication of how emissions vary over time. Self-monitoring pushes facilities towards internalizing compliance assurance—it educates facilities about compliance and the impact of releases on the environment; it makes the facility develop in-house compliance monitoring expertise or relationships with contracted expertise; and it provides them with a more thorough compliance record on which to base production and investment decisions.[102]

The Toxics Release Inventory (TRI) is an example of a self-monitored and reported program that does not include verification. Like a cap-and-trade program, the TRI requires that sources report mass emissions of certain pollutants on an annual basis.[103] Entities file their data with EPA in a standardized format, often electronically, and EPA compiles a publicly accessible online emissions database.[104] Yet, TRI data is not generally verified. Indeed, the statute does not authorize EPA to inspect facilities to verify the accuracy of the reported data.[105] States may do so, and the few states that have inspected facilities to determine compliance with TRI reporting requirements have reported widespread undercompliance.[106] One study suggested that some facilities' estimates of releases may be in error by as much as "a factor of two."[107]

Unfortunately, self-monitoring data is inherently suspect. To produce accurate self-monitoring data, the government must have systems in place to verify the data and sanction noncompliance with the monitoring and

100 *See* Bradley C. Karkkainen, *Information as Environmental Regulation: TRI and Performance Benchmarking, Precursor to a New Paradigm?*, 89 GEO. L.J. 257, 335 n.325 (2000).

101 Marcia E. Mulkey, *Judges and Other Lawmakers: Critical Contributions to Environmental Law Enforcement*, 4 SUSTAINABLE DEV. L. & POL'Y, Spring 2004, at 2, 5.

102 *See* Karkkainen, *supra* note 100, at 295–97 (explaining that self-monitoring places information into the hands of managers and that it can help them improve their environmental performance).

103 *Id.* at 286 n.124.

104 *Id.* at 289.

105 *Id.* at 335 n.325.

106 *See id.*

107 *Id.* at 335–36.

reporting rules.[108] Without verification, self-reporters will become lax, and likely lean towards underreporting if that is in their self-interest.

2. Self-Monitoring and Reporting Rules in Cap-and-Trade: A Reprise of Best Available Technology

In cap-and-trade regulation, a complex set of self-monitoring and reporting rules is necessary for program implementation. Generally applicable rules need to be developed to determine how sources should choose monitoring technologies, ensure that monitoring technologies are maintained, maintain records, and report data to the agency. The form that such rules will likely take is a form that is familiar in environmental law: prescriptive "command and control" regulation.

Title IV provides an example of the type of complicated and detailed rules needed to enable accurate monitoring and reporting. EPA's regulations governing CEMS (part 75)[109] number several hundred pages, and require continuous monitoring and reporting of SO2 as well as CO2, nitrogen oxides, and heat input.[110] Given the complexity of part 75, EPA produces a more readable Plain English Guide to part 75.[111]

A wide variety of QA/QC requirements characterize Title IV self-monitoring system.[112] For example, strict requirements are set forth for testing the accuracy of the CEMS. After installing the CEMS, the facility is required to conduct certification tests and submit a certification application, including the test results.[113] Once certified, the source is required to perform quality assurance (QA) testing on a regular basis using either in-house or contracted expertise.[114] As an incentive for high accuracy readings, the regulations provide for reduced QA testing requirements when favorable test results are achieved.[115]

Title IV facilities have an incentive to keep their certified monitoring equipment online and quality assured: If it is not, the facility is required to use the "missing data provisions" to estimate its emissions.[116] If the number of hours of unavailable reliable data is under a certain threshold, then the emissions that are estimated using the missing data provisions tend to be close to actual values.[117] However, the more time that reliable data is missing, the more the missing data provisions are designed to be

108 *Cf.* Mulkey, *supra* note 101, at 5 (government will need to have a legal framework in place to ensure accurate self-monitoring).

109 40 C.F.R. pt. 75 (2009).

110 Schakenbach et al., *supra* note 77, at 1576.

111 *See generally* CLEAN AIR MKTS. DIV., *supra* note 50.

112 *See* Schakenbach et al., *supra* note 77, at 1579.

113 Reitze & Schell, *supra* note 46, at 118.

114 *See* Schakenbach et al., *supra* note 77, at 1583.

115 *Id.* at 1577.

116 *Id.*; CLEAN AIR MKTS. DIV., *supra* note 50, at 85.

117 CLEAN AIR MKTS. DIV., *supra* note 50, at 87.

environmentally conservative and overestimate actual emissions.[118] The overestimated emissions then become part of the emissions record of the facility, and the facility must surrender enough allowances at the end of the compliance period to cover them.[119]

Techniques for monitoring and reporting emissions, with their various levels of reliability and accuracy, come at differing costs.[120] As discussed in Part III.A, direct measurement tends to be more expensive than estimation. Also, a higher degree of QA/QC costs more than a lesser degree; keeping more complete records costs more; reporting more frequently or in more detail costs more.

Because there are alternatives as to methods and degrees of monitoring and reporting, policy debates turn to the same kinds of cost-effectiveness questions that run throughout environmental policy.[121] In traditional environmental pollution law, the questions were often: What techniques are available to reduce pollution? How well do they work? And how much do they cost?[122] Here the questions are similar: What techniques are available to measure emissions? How well do they work? And how much do they cost?

Environmental law's answer to such questions has generally taken the form of a best available technology (BAT) inquiry. The Clean Air Act requires, for example, that the agency determine and require the installation of "best available control technology" for new or modified stationary sources located in areas of the country that are in attainment of national ambient air quality standards.[123] As directed by the law, the agency considers the effectiveness of the technology in reducing pollution and the costs of requiring the facility to install it.[124]

A BAT inquiry for monitoring technologies would be similar. The agency would survey the various monitoring technologies and reporting options for a given polluter or group of polluters and determine which is best in terms of effectiveness and affordability.[125] In the EU ETS, for example, the monitoring and reporting guidelines require that sources use the monitoring techniques with the highest achievable accuracy unless this is not technically or economically feasible.[126] Member states are responsible

118 *Id.*

119 *Id.* at 4, 87.

120 *See* discussion *supra* Part III.A.1.

121 Kruger & Egenhofer, *supra* note 3, at 8. ("[W]ith progressive implementation [of emissions trading schemes] the spotlight turns to costs, notably how to reduce them.").

122 CRAIG N. JOHNSTON ET AL., LEGAL PROTECTION OF THE ENVIRONMENT 6–7 (2005).

123 42 U.S.C. § 7475(a)(4) (2006).

124 *Id.* § 7479(3).

125 The required monitoring technology could be expressed as a performance standard, just as BAT regulations generally have been. For example, the technology must be capable of monitoring emissions within a certain degree of accuracy. *See* Schakenbach et al., *supra* note 77, at 1582 (stating that an approach that does not dictate the monitoring equipment, but requires a facility to achieve a certain performance standard would generate market competition among equipment vendors).

126 *See* Kruger & Egenhofer, *supra* note 3, at 6; Kruger, Oates & Pizer, *supra* note 65, at 124; Peeters, *supra* note 12, at 185–86.

for issuing a permit to each regulated source that specifies the applicable monitoring and reporting requirements. Sources may petition to use less accurate techniques, and each member state has the authority to grant variances.[127]

Professors Ackerman and Stewart wrote in the 1980s that the use of emissions trading regulation would "immediately eliminate most of the information processing tasks that are presently overwhelming the federal and state bureaucracies" related to making BAT pollution control determinations.[128] They also wrote that polluters would no longer have the incentive to "delay regulatory implementation by using legal proceedings to challenge the economic and engineering bases of BAT regulations and permit conditions."[129] Yet, because of the need for accurate emissions accounting under emissions trading regulation, the government will continue to be in the business of writing prescriptive regulations that may impose high costs—the monitoring, recordkeeping, and reporting regulations.

To the extent that large costs to industry hang in the balance of such decisions, regulations that specify monitoring technologies and how to operate such technologies can be expected to generate legal controversies in the same way that other BAT regulations have.[130] Like BAT pollution control standards, if BAT monitoring standards are uniform across an industry, they may impose very high costs on some facilities.[131] And, to the extent BAT monitoring standards vary, they may impose higher monitoring costs on newer and more profitable facilities because those are the facilities that can best afford them, thus penalizing them to the benefit of older, less profitable facilities.[132]

Completing the analogy to prescriptive regulation, a cap-and-trade program for greenhouse gases will likely require that each regulated facility obtain a permit that specifies its monitoring and reporting obligations. Such permits have been used in all major cap-and-trade programs that have been implemented, including Title IV, RECLAIM, and the EU ETS.[133] Under the

127 Kruger, Oates & Pizer, *supra* note 65, at 124.

128 Bruce A. Ackerman & Richard B. Stewart, *Reforming Environmental Law: The Democratic Case for Market Incentives*, 13 COLUM. J. ENVTL. L. 171, 180 (1988).

129 *Id.* at 182.

130 Peeters, *supra* note 12, at 185–86 (discussing potential issues of legal controversy over monitoring and reporting regulations in the EU). Legal controversies around the monitoring, recordkeeping, and reporting requirements of the Clean Air Act, 42 U.S.C. § 7414 (2006), provide another comparable example. *See, e.g.*, United States v. Hugo Key & Son, Inc., 731 F. Supp. 1135, 1144 (D.R.I. 1989). *See generally* C. Russell H. Shearer, *Costs and Benefits of Audit Disclosure*, 11 NAT. RESOURCES & ENV'T, Summer 1996, at 48, 50 (describing possible criminal liability for a corporation stemming from required environmental audits).

131 Ackerman & Stewart, *supra* note 128, at 173.

132 *Id.* at 173–74.

133 Jill Whynot, *Chapter Two – Key Design Features*, *in* OVER A DOZEN YEARS OF RECLAIM IMPLEMENTATION, *supra* note 1, at I-2-2 (stating that a permit was generated for each facility in RECLAIM); Peeters, *supra* note 12, at 185–86 (noting that monitoring and reporting requirements must be included in EU ETS permits); U.S. Envtl. Prot. Agency, Acid Rain Permitting Fact Sheet, http://www.epa.gov/airmarkt/progsregs/arp/permitting-factsheet.html

ACES Act, the cap-and-trade related legal obligations of each major emitter would have been incorporated into its permit under the Clean Air Act.[134]

3. Enforcement of Self-Monitoring and Reporting Rules

Enforcement of self-monitoring and reporting rules of a cap-and-trade program in many ways resembles other types of environmental enforcement. An important part of the enforcement process has been compliance assistance. In Title IV, EPA devoted extensive resources to answering and documenting questions about monitoring requirements.[135] Meetings with industry were held routinely to "clarify misunderstandings and resolve implementation concerns."[136] The officials credit these meetings with having increased flexibility for industry without compromising environmental goals.[137] EPA has also developed several informal mechanisms for answering monitoring questions, including taking technical questions by phone and email, reviewing petitions for clarification and guidance from sources, and developing a book length monitoring question and answer manual.[138]

Detecting violations of cap-and-trade program rules is likely to require facility inspections just like traditional environmental rules.[139] Under traditional regulation, such inspections often focus on whether the required pollution control equipment is operating adequately.[140] In a cap-and-trade program, the focus is on whether the required emissions monitoring equipment is operating adequately. In either case, the inspection could vary in its thoroughness. In a more thorough inspection, the agency would take samples to generate data about how well the pollution control or monitoring equipment is working or observe the facility staff performing the procedures they use to generate their self-monitoring data.[141] In a less thorough paperwork inspection, the agency

(last visited Nov. 21, 2010); *see* CLEAN AIR MKTS. DIV., *supra* note 50, at 2, 5 (noting that all electric generating units that burn fossil fuel and serve a generator of greater than 25 megawatts are subject to continuous monitoring and reporting requirements).

134 H.R. 2454, 111th Cong. § 337(d)(3) (2009) (proposing amendments to Clean Air Act, 42 U.S.C. § 7604(f) (2006)).

135 *See* Kruger & Egenhofer, *supra* note 3, at 2–4 (describing the process by which company officials can follow up with EPA monitoring specialists assigned to their facility for NOx and SO2 trading schemes); Schakenbach et al., *supra* note 77, at 1580.

136 Schakenbach et al., *supra* note 77, at 1580.

137 *See id.*

138 *Id.*

139 S. Coast Air Quality Mgmt. Dist., *Executive Summary*, *in* OVER A DOZEN YEARS OF RECLAIM IMPLEMENTATION, *supra* note 1, at EX-4 (stating that inspections remained essential); McAllister, *supra* note 14, at 308–09 (noting the importance of inspections in traditional environmental regulation).

140 McAllister, *supra* note 14, at 308–09.

141 *Cf.* Reitze & Schell, *supra* note 46, at 104–05 (noting that the EPA's CAM rule imposes different levels of monitoring and recordkeeping requirements).

would review the records kept by the facility about the operation of the equipment and other facility characteristics.[142]

Notably, Title IV was able to avoid heavy reliance on physical inspections by using sophisticated electronic auditing methods of the electronically reported data from the CEMS. Given the continuous nature of the monitoring, very large volumes of data were generated and required to be reported.[143] Regulated entities reported emissions to EPA each quarter in a standard electronic data reporting format, and entities generally used software developed by EPA to prescreen the data for errors.[144] Once EPA computers received the reports, EPA performed additional electronic auditing to verify data accuracy and then notified the source whether the quarterly data were acceptable.[145] As explained by one commentator, "after more than a decade of implementing the Acid Rain Program, EPA administrators say that their main task consists of two activities: processing huge amounts of information and disseminating huge amounts of information."[146]

When a violation of Title IV's monitoring and reporting rules is detected, the Clean Air Act's penalties may be applied.[147] The statute requires that a "designated representative," generally a facility manager, certify the truth and completeness of all reported data.[148] Civil and criminal penalties can be imposed for false statements and other violations.[149] From 1994 through 2004, EPA assessed nine civil penalties totaling $589,805 for monitoring violations under Title IV.[150] In some cases, facilities failed to install and operate monitors on time.[151] In others, the monitors were installed, but facilities failed to conduct periodic testing or report results.[152]

The other major long standing cap-and-trade program in the United States, California's RECLAIM program, was unable to implement the type of comprehensive electronic auditing used in Title IV. Rather, it employed a more typical enforcement regime reliant on physical inspections and sanctions. In a retrospective analysis of the program, agency officials explain that the diversity of the types of sources included in RECLAIM prevented it from being able to rely on electronic verification.[153] "The lack of uniformity in the data collected prevented the development of an all

142 *Id.* at 123.

143 *Id.* at 116 (stating that 20 units would generate three to four million data values each year).

144 Schakenbach et al., *supra* note 77, at 1578; Kruger & Egenhofer, *supra* note 3, at 4.

145 Kruger & Egenhofer, *supra* note 3, at 4.

146 Blas Pérez Henríquez, *Information Technology: The Unsung Hero of Market-Based Environmental Policies*, RESOURCES, Fall/Winter 2004, at 9, 10.

147 Clean Air Act, 42 U.S.C. § 7651(k) (2006); McAllister, *supra* note 14, at 331 & n.235.

148 Peeters, *supra* note 12, at 180; *see also* Schakenbach et al., *supra* note 77, at 1583 (providing the certification statement language).

149 42 U.S.C. § 7413(a)(3) (2006); Reitze & Schell, *supra* note 46, at 116.

150 McAllister, *supra* note 14, at 322.

151 Interview with EPA Official (Jan. 6, 2006).

152 *Id.*

153 Carol Coy et al., S. Coast Air Quality Mgmt. Dist., *Chapter Two – On-Going Implementation*, *in* OVER A DOZEN YEARS OF RECLAIM IMPLEMENTATION, *supra* note 1, at II-2-2.

encompassing emission calculation tool that can be employed facility to facility."[154] With many different types of sources, many different types of monitoring and reporting equipment and methods have to be used.

Enforcing the self-monitoring and reporting rules of RECLAIM required the use of resource intensive physical compliance audits of each facility after the end of each year. The designers of RECLAIM did not anticipate the need for such audits. Rather, early program documents stated that the District would inspect facilities and audit emissions records throughout the year, with no mention of a post-compliance year audit.[155] In practice, however, the agency found that audits of each facility were necessary to verify compliance.[156] The audits revealed failures in the CEMS, such as computer programming bugs, analyzer failures, and improper daily calibration, as well as problems with the fuel meters and timers used to calculate emissions using emissions factors.[157] The audits also revealed data calculation errors and inaccurate records that presumably could not have been identified without the audits.[158] Each audit was conducted by a team of agency employees, included a thorough review of the facility's records, and required a couple weeks to complete.[159]

RECLAIM, unlike Title IV, also created a large workload for agency prosecutors as the compliance audits revealed many violations. A study of enforcement actions showed that almost 80% of facilities that have participated in RECLAIM have been subject to at least one enforcement action.[160] One third of the facilities have been subject to three or more.[161] Of almost one thousand enforcement actions that were initiated between the beginning of the program in 1994 and 2006, 40% involved late or missing emissions reports; 38% involved excess emissions; 21% alleged that the facility failed to install, maintain, or quality test its emissions monitoring equipment; and 13% alleged inaccuracies in reported emissions data.[162]

The amount collected in penalties for monitoring and reporting violations in RECLAIM has also been several times higher than Title IV. Between 1995 and June 2005 penalties for enforcement actions that included monitoring and reporting violations totaled about $5 million. Approximately $1.5 million in penalties was assessed for monitoring and reporting

154 *Id.*

155 S. COAST AIR QUALITY MGMT. DIST., RECLAIM: VOLUME I: DEVELOPMENT REPORT AND RULES 4-16 (1993).

156 Carol Coy et al., *supra* note 153, at II–2–2.

157 *Id.* at II–2–2 to –3, II–2–10 to –11; *cf.* Drury et al., *supra* note 17, at 259 ("Emission factors are hotly argued among technical specialists from different fields and change as new information becomes available. Emissions factors are poor surrogates for actual measurements.").

158 Carol Coy et al., *supra* note 153, at II–2–2 to –3.

159 Phone Interview with South Coast Air Quality Management District Official (June 29, 2010).

160 Lesley K. McAllister, *Enforcing Cap and Trade: A Tale of Two Programs*, 2 SAN DIEGO J. CLIMATE & ENERGY L. (forthcoming 2010) (manuscript at 13) (on file with author).

161 *Id.*

162 *Id.* at 14–15 (indicating that the stated percentages sum to more than 100% because many enforcement actions alleged more than one type of violation).

violations, and another $3.5 million was assessed for a combination of monitoring and reporting violations and excess emissions violations.[163]

C. The Additional Burdens of Verifying Offsets

The use of "offsets" in cap-and-trade programs is often promoted as a way to reduce the cost of reaching the cap.[164] Offsets, if allowed by a program, can be used by a regulated source in lieu of program allowances to satisfy its compliance options.[165] In other words, at the end of the reporting period, the regulated source would have to show that it has enough allowances and offsets to cover its emissions.

There are two basic ways that offsets could be generated: by reducing emissions or by sequestering emissions.[166] Upon verification of emissions reductions at a source not included in the cap-and-trade program, the source could be awarded an offset credit that could be traded in the market like an allowance. For example, landfills, coal mines, waste water treatment plants, and agricultural operations could earn offset credits by reducing their methane emissions.[167] Small trucking companies not covered by the cap could install idle reduction equipment that reduces their greenhouse gas emissions.[168]

Offsets might also be earned by sources that sequester emissions biologically or geologically. Forestry companies might be able to earn sequestration offsets by cultivating new forests, replanting forests, or limiting deforestation.[169] Companies might also earn sequestration offsets by operating geological sequestration activities through which greenhouse gases are stored in "saline formations, oil wells, or other geologic formations."[170]

Both types of offset generation imply monitoring and verification complexities that go beyond those of a cap-and-trade program that does not allow offsets.[171] Indeed, the reason that certain types of emissions reductions

163 *Id.* at 19.

164 *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 12–13 (2009); Michael W. Wara & David G. Victor, *A Realistic Policy on International Carbon Offsets* (Program on Energy and Sustainable Dev., Stanford University, Working Paper No. 74, 2008).

165 Christopher Carr & Flavia Rosembuj, *Flexible Mechanisms for Climate Change Compliance: Emission Offset Purchases Under the Clean Development Mechanism*, 16 N.Y.U. ENVTL. L.J. 44, 48 (2008).

166 PEW CTR. ON GLOBAL CLIMATE CHANGE, CONGRESSIONAL POLICY BRIEF: GREENHOUSE GAS OFFSETS IN A DOMESTIC CAP-AND-TRADE PROGRAM 4–7 (2008), *available at* http://www.pewclimate.org/docUploads/Offsets.pdf.

167 *Id.* at 5.

168 *Id.*

169 *Id.* at 5–6.

170 *Id.* at 6.

171 Title IV did not allow the use of offsets. *See* U.S. Envtl. Prot. Agency, Acid Rain Program, http://www.epa.gov/airmarkt/progsregs/arp/basic.html (last visited Nov. 21, 2010). Offset provisions in RECLAIM were proposed early in the program but encountered many barriers to

are not included in a program is often precisely because of the difficulties of ascertaining and measuring those reductions.[172] Measuring the emissions of land use activities such as landfills, coal mines, and cattle ranches is for obvious reasons more complicated than measuring the emissions of industrial sources. Similarly, monitoring many small industrial sources is more difficult and costly than monitoring a few large ones. With respect to biological sequestration, it is difficult to quantify the capacity of a forest to sequester CO2.[173] In many sequestration proposals, concerns also abound about the difficulty of monitoring projects to ensure that emissions remain sequestered.[174]

In addition, legislative proposals in the U.S. indicate that it is likely that a greenhouse gas cap-and-trade scheme would allow offsets generated outside the U.S. to be used for compliance. Under the ACES Act, for example, offsets from domestic and international sources were each capped separately at 1 billion metric tons in each year of the program, with provision for the use of even more international offsets if EPA determines that the supply of domestic offsets is insufficient.[175] The task of monitoring and verifying offsets generated outside the United States is even more challenging.[176] Since such offsets become fungible with program allowances, they should be held to the same standards of accurate measurement.

implementation and eventually were only included in a limited way. *See* S. Coast Air Quality Mgmt. Dist., *Recommendations and Conclusions*, *in* OVER A DOZEN YEARS OF RECLAIM IMPLEMENTATION, *supra* note 1, at III-1-2, III-1-7.

172 *See, e.g.*, HOUSE COMM. ON ENERGY & COMMERCE, CLIMATE CHANGE LEGISLATION DESIGN WHITE PAPER: SCOPE OF A CAP-AND-TRADE PROGRAM 20 (2007), *available at* http://energycommerce.house.gov/images/stories/Documents/PDF/selected_legislation/White_Paper.100307.pdf (noting that agricultural greenhouse gas emissions are not ideal for cap-and-trade treatment because they "generally do not lend themselves to regulation under a cap-and-trade program" because of the "large number of sources with small individual emissions that would be impractical to measure" and because "accurately determining emissions is also an issue").

173 ROSS W. GORTE & JONATHAN L. RAMSEUR, CONG. RESEARCH SERV., RL34560, FOREST CARBON MARKETS: POTENTIAL AND DRAWBACKS 15–16 (2008), *available at* http://www.nationalaglawcenter.org/assets/crs/RL34560.pdf; *see also* Toni E. Moyes, *Greenhouse Gas Emissions Trading in New Zealand: Trailblazing Comprehensive Cap and Trade*, 35 ECOLOGY L.Q. 911, 960–61 (2008) ("Distrust of [monitoring, reporting, and verification] is one of the reasons why forestry is not included in the EU ETS and that Kyoto credits generated from land use change and forestry cannot currently be imported into the EU ETS.").

174 *See, e.g.*, GORTE & RAMSEUR, *supra* note 173, at 17–18.

175 ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, ENERGY MARKET AND ECONOMIC IMPACTS OF H.R. 2454, THE AMERICAN CLEAN ENERGY AND SECURITY ACT OF 2009, at v (2009).

176 The experience of the Clean Development Mechanism is instructive. *See* Michael Wara, *Measuring the Clean Development Mechanism's Performance and Potential*, 55 UCLA L. REV. 1759, 1762–63 (2008); Wara & Victor, *supra* note 164, at 15–21. On the difficulties of ensuring the reliability of forestry-related offsets, see Michael L. Brown, Note, *Limiting Corrupt Incentives in a Global REDD Regime*, 37 ECOLOGY L. Q. 237, 243–52 (2010).

IV. ENFORCEMENT THROUGH COOPERATIVE FEDERALISM

To ensure the reliability of emissions data, the enforcement of a national greenhouse gas cap-and-trade program should involve significant roles not just for the federal government but also for state governments and citizen groups. A cooperative federalism model is called for, but it must be more robust and better coordinated than the enforcement achieved under other environmental laws. This section recommends roles for the federal environmental agency, state environmental agencies, citizen enforcement agents, and potential third party verification agents.

A. Federal Role

Defined simply, cooperative federalism is a system of shared authority between the federal and state governments.[177] Federal environmental pollution control laws generally put the federal government in the "driver's seat," but also "carve[] out a significant role for the states either in implementing the federal standards or in supplementing federal regulatory initiatives."[178] In the Clean Air Act, for example, Congress gave the federal agency broad authority to identify pollutants and establish regulatory standards for them.[179] States, in turn, were authorized to take the primary role in implementing these standards by writing permits with facility-specific emissions limits and enforcing permit requirements.[180]

Notably, however, Title IV, which was added to the Clean Air Act in 1990,[181] has not been implemented and enforced through cooperative federalism.[182] Rather, the administration of the program, including enforcement, was heavily centralized in EPA. EPA took primary responsibility for writing, implementing, and enforcing monitoring and reporting regulations as well as for assessing each facility's compliance with its annual cap.[183] The state role has been limited to receiving and processing acid rain permit applications and conducting a relatively small number of

177 *See, e.g.*, John P. Dwyer, *The Role of State Law in an Era of Federal Preemption: Lessons from Environmental Regulation*, 60 LAW AND CONTEMP. PROBS. 203, 216 (1997) (discussing how states become "junior partners").

178 Robert L. Glicksman, *From Cooperative to Inoperative Federalism: The Perverse Mutation of Environmental Law and Policy*, 41 WAKE FOREST L. REV. 719, 740 (2006).

179 Clean Air Act, 42 U.S.C. §§ 7408(a)(1), 7409(b) (2006).

180 Robert A. Wyman, Jr. et al., *Meeting Ambient Air Standards: Development of the State Implementation Plans*, *in* THE CLEAN AIR ACT HANDBOOK 41, 41 (Robert J. Martineau, Jr. & David P. Novello eds., 2004) (stating that states are the primary enforcers of most Clean Air Act requirements).

181 Jamie Gibbs Pleune, Article, *Do We CAIR About Cooperative Federalism in the Clean Air Act?*, 2006 UTAH L. REV. 537, 545 (2006).

182 *See, e.g.*, *id.* (explaining that Title IV did not comport with the cooperative federalism approach of the Clean Air Act).

183 *See* Debra Jezouit, *The Acid Rain Program*, *in* THE CLEAN AIR ACT HANDBOOK, *supra* note 180, at 423, 442–43.

physical inspections of acid rain facilities, often at the request of EPA.[184] EPA has handled all other aspects of the enforcement process itself.[185]

In many ways, centralized enforcement seems to have worked well in Title IV. As explained by EPA officials, the centralized administration of EPA has provided several benefits, several of them closely related to monitoring and enforcement:

> (1) all data go through the same quality checking software, both at the source and at the regulatory agency; software updates are easily provided to everyone via downloads from the regulatory agency's web site; (2) all sources in the program are subject to the same regulatory requirements; (3) the sources in the program are covered by the same interpretations of the regulatory requirements and resolution of petitions; (4) the same audit procedures are used on all of the sources in the program; (5) all data are publicly available; and (6) sources within the program are subject to common penalties and enforcement procedures.[186]

However, the apparent success of Title IV does not necessarily portend success in a comprehensive national greenhouse gas cap-and-trade system. Title IV regulated a single air pollutant, SO2, through a cap-and-trade program.[187] The ACES Act would have regulated seven.[188] Title IV regulated a single type of source: power plants.[189] The ACES Act would have regulated not just power plants, but also importers of fuel, natural gas distributors, cement and aluminum producers, petroleum refiners, and a variety of stationary sources.[190] Title IV regulated approximately 1200 facilities under the SO2 cap-and-trade program.[191] The ACES Act would have regulated 7400.[192]

184 U.S. Envtl. Prot. Agency, Acid Rain Permitting Fact Sheet, http://www.epa.gov/airmarkt/progsregs/arp/permitting-factsheet.html (last visited Nov. 21, 2010). An EPA official reports that EPA has no legal leverage to require states to perform physical inspections to verify compliance with monitoring and reporting requirements and that EPA does not have any records of how many are performed. E-mail from anonymous EPA Official, to author (July 6, 2010) (on file with author). The official gave a ballpark estimate that 30 to 50 part 75 compliance audits are conducted each year, with six to eight performed by EPA contractors and the remainder performed by state and local offices and EPA regions. *Id.*

185 Schakenbach et al., *supra* note 77, at 1581 (explaining the benefits of EPA's centralized administration of Title IV).

186 *Id.*

187 *See* Napolitano, *supra* note 16, at 48 (stating that although Title IV regulated both SO2 and NOx, it implemented a cap-and-trade system for SO2 alone).

188 *See* H.R. 2454, 111th Cong. § 312 (2009) (proposing new title to Clean Air Act). The complete list of gases that would be regulated includes fossil fuel-based CO2, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons emitted from a chemical manufacturing process, any perfluorocarbon, and nitrogen trifluoride. *Id.*

189 *See* Clean Air Act, 42 U.S.C. §§ 7651a(17)(A), 7651b(a)(1) (2006) (capping SO2 emissions for "utility units," which "serve[] a generator in any State that produces electricity for sale").

190 H.R. 2454, 111th Cong. §312 (2009) (proposing new title to Clean Air Act). The list of sources includes electric utilities (including cooperatives and municipalities); producers and importers of fuel, the combustion of which would emit 25,000 tons or more of CO2 equivalent; natural gas distributors supplying 460 million cubic feet or more of gas to customers that are not covered entities; sources producing 25,000 tons of CO2 equivalent or

In contrast to Title IV, the EU ETS provides an example of a decentralized approach to cap-and-trade enforcement. Member states are responsible for all aspects of compliance and enforcement, including emissions verification.[193] Recognizing the importance of ensuring that all member states produce accurate emissions data, the European Commission issued binding guidelines on monitoring, reporting, and verification that set the minimum standards to be used throughout the program.[194] Member states write the facility-specific permits that set forth the legal obligations of the facility, including the applicable monitoring and reporting requirements and the facility's obligation to surrender allowances equal to its total emissions each year.[195]

The risk of inconsistent enforcement in the EU ETS remains significant. Industries important to a member state's national economy might successfully exert pressure on their government not to enforce the rules rigorously or to impose harsh sanctions.[196] Also, states inevitably differ in their resources and capacities. Notably, the EU does not have authority to conduct its own compliance inspections.[197] In many ways, the very decentralized approach of the EU ETS was likely a matter of political reality rather than optimal regulatory design.[198]

The ideal enforcement regime for a national greenhouse gas cap-and-trade program in the United States would forge a middle ground between the centralization of Title IV and the decentralization of the EU ETS. It would place the federal government in the driver's seat but preserve an important role for states. As typifies cooperative federalism, the federal agency would write the regulations that set the standards for monitoring and enforcement,

more of bulk industrial gases; stationary sources producing cement, primary aluminum, or lime; a variety of chemical and petrochemical sources; petroleum refiners; and stationary sources emitting 25,000 or more tons of CO2 equivalent that produce iron and steel, ferroalloys, glass, zinc, or pulp and paper. *Id.*

191 Email from Anonymous EPA Official, to author (July 6, 2010) (on file with author).

192 H.R. REP. NO. 111-137, pt. 1, at 360 (2009).

193 Peeters, *supra* note 12, at 186. States may choose to require third party verification and may establish an accreditation system for such verifiers. Commission Decision 2007/589, 2007 O.J. (L 229) 1, 10 (EC). Yet, ultimately, responsibility for the verification of emissions still lies with each member state. *Id.* at 32.

194 In 2003, the European Council issued a directive establishing the EU ETS, which obliged the European Commission to adopt guidelines for monitoring and reporting of industrial emissions. *See* Council Directive 2003/87, art. 14, 2003 O.J. (L 275) 32, 37 (EC). In 2004, the European Commission released its legally-binding monitoring and reporting guidelines. *See* Commission Decision 2004/156, art. 1–2, 2004 O.J. (L 59) 1 (EC). The Commission adopted a revised version of these guidelines on July 18, 2007. *See* Commission Decision 2007/589, art. 2–3, 2007 O.J. (L 229) 1, 3 (EC).

195 Peeters, *supra* note 12, at 186.

196 *Id.* at 183.

197 *See* Kruger & Egenhofer, *supra* note 3, at 6; Peeters, *supra* note 12, at 182 (noting that the European Commission determines whether member states are capable of enforcement and may proceed against the member state if it finds a deficiency).

198 *See* Kruger & Egenhofer, *supra* note 3, at 6 (describing how a decentralized approach is consistent with the makeup of the EU political system).

but states would implement and enforce them. As is common in environmental law, states could opt to impose higher standards to attain more accurate data.[199] This would allow states the ability to improve upon federal standards and otherwise innovate.[200] The federal agency would have authority to oversee state enforcement activities and to conduct independent inspections to enforce the program's requirements directly.

Many of the benefits of centralized cap-and-trade administration could also be gained with careful design of a decentralized program. For example, if EPA were to develop data quality-checking software and reach agreement that all the state agencies would use it, then all data would still go through the same quality-checking software. And if strong communications were established between EPA and state agencies, then regulatory interpretations and enforcement procedures could be relatively harmonized. EPA could also manage a national public database about the program.

In addition to these benefits, the program would have an all-hands-on-board approach rather than suffering from scant enforcement resources. As explained by Professor William Buzbee, "federal law could fail if a lack of monitoring and enforcement destroyed the integrity of the new carbon allowance market. Empowering state and local governments to play their own supplementary roles in enforcing the law could be the equivalent of additional cops on the beat."[201] With states actively involved, irregularities in the reported data could be investigated relatively quickly and easily—potentially as part of the state's enforcement regime for other air pollution problems. Compliance would be likely to increase through a degree of regulatory redundancy that enables "higher rates of monitoring [and] detection of violations."[202]

Importantly, the federal agency would have to exercise its oversight and direct enforcement authority to a greater extent than it does under many other environmental laws in which states play a primary enforcement role. Studies have suggested that the environmental enforcement conducted by

199 John P. Dwyer, *The Practice of Federalism Under the Clean Air Act*, 54 MD. L. REV. 1183, 1196 (1995); *see also* William W. Buzbee, *State Greenhouse Gas Regulation, Federal Climate Change Legislation, and the Preemption Sword*, 1 SAN DIEGO J. CLIMATE & ENERGY L. 23, 35–37 (2009) (explaining that ceiling preemption in federal environmental law is rare).

200 There is a large amount of literature on the significance of states as regulatory innovators in environmental law. *See, e.g.*, James P. Lester, *A New Federalism? Environmental Policy in the States*, *in* ENVIRONMENTAL POLICY IN THE 1990S, at 51, 63 (Norman J. Vig & Michael E. Kraft eds., 2d ed. 1994); Kirsten H. Engel, *Harnessing the Benefits of Dynamic Federalism in Environmental Law*, 56 EMORY L.J. 159, 182–83 (2006); David L. Markell, *States as Innovators: It's Time for a New Look to Our "Laboratories of Democracy" in the Effort to Improve Our Approach to Environmental Regulation*, 58 ALB. L. REV. 347, 353–54 (1994).

201 Buzbee, *supra* note 199, at 53.

202 *Id.*; *see also* Robert A. Schapiro, *From Dualism to Polyphony*, *in* PREEMPTION CHOICE: THE THEORY, LAW, AND REALITY OF FEDERALISM'S CORE QUESTION 33, 43–44 (William W. Buzbee ed., 2009) (discussing the benefits of state and federal regulatory overlap).

many states in the past has been weak and inadequate,[203] and EPA has generally been reluctant to use its powers to seek greater quality or consistency among the states.[204] In a national greenhouse gas cap-and-trade program, EPA would need to do so.

B. The Role of States

Given the magnitude of the enforcement task implied by a comprehensive national greenhouse gas cap-and-trade scheme, state agencies should play a much larger role than they did in Title IV.[205] As explained by Professor John Dwyer, "Since the 1970 enactment of the Clean Air Act, legislators and EPA officials have known that the federal government does not have, and probably never will have, the resources to implement federal air pollution policy without considerable state assistance."[206] Strong state involvement has long been considered essential to confronting conventional air pollution, and states will remain essential in confronting global warming pollution.[207]

The diversity of greenhouse gases and facilities included in a cap-and-trade program has a direct impact on the difficulty of verifying self-monitored and reported emissions. A cap-and-trade program that just regulates CO2 emissions from power plants could likely be enforced in a manner very similar to Title IV, with heavy reliance on highly accurate CEMS data and electronic auditing.[208] In contrast, a cap-and-trade program like the one contemplated by the ACES Act will utilize a wider variety of monitoring methods, generating emissions data that is much more variable in data and form. Some facilities would use CEMS to directly measure their emissions while others would estimate their emissions based on fuel use and other factors. Different methods would require different types of QA/QC techniques and different data reporting rules.

The experience of the RECLAIM cap-and-trade program strongly suggests that verifying such data is likely to require extensive agency resources dedicated to field audits of regulated facilities.[209] In RECLAIM, annual compliance audits were deemed essential to program enforcement. As explained by agency officials who administered RECLAIM, "Auditing of various reports and records became equally important as field enforcement.

203 David L. Markell, *The Role of Deterrence-Based Enforcement in a "Reinvented" State/Federal Relationship: The Divide Between Theory and Reality*, 24 HARV. ENVTL. L. REV. 1, 43–61 (2000).

204 Matthew D. Zinn, *Policing Environmental Regulatory Enforcement: Cooperation, Capture, and Citizen Suits*, 21 STAN. ENVTL. L.J. 81, 115–16 (2002) (explaining that EPA has not often used the powers it has to oversee state enforcement); Dwyer, *supra* note 177, at 217 ("EPA has neither the resources nor the political capital to intervene widely or frequently.").

205 Bogoshian & Alex, *supra* note 15, at 340–41.

206 Dwyer, *supra* note 177, at 1216.

207 *Id.* at 1190, 1216–19.

208 The RGGI is an example of such a program. *See supra* text accompanying notes 54–57.

209 *See supra* Part III.B.3.

Auditing each facility could take weeks. Any program based on mass emissions needs to take into account the resource needs for adequate enforcement under this new method of measuring compliance."[210]

For a comprehensive national cap-and-trade program, state resources will need to be relied upon as the front line of enforcement as they have been in other major environmental laws that utilize a cooperative federalism model. States conduct far more inspections and enforcement actions under federal environmental laws than EPA does.[211] They are actively engaged in enforcing a broad range of environmental law requirements at the same facilities that would become part of a national greenhouse gas cap-and-trade scheme.[212]

Moreover, enforcement of the monitoring and reporting regulations of a cap-and-trade scheme would be similar to the enforcement of other pollution standards. The state agencies would write the program permits specifying the applicable monitoring, recordkeeping, and reporting requirements, in accordance with federal regulations. Inspections would verify that the required technologies (here, monitoring technologies) are installed and operational. Inspections would ensure that the appropriate records are being kept and that the emissions data reported to the agency are properly calculated. States would be empowered to enforce the program through inspections and enforcement actions independently of the federal agency. These are the types of "command and control" enforcement tasks that state environmental agencies have been successfully carrying out for many years.[213]

Following the model of State Implementation Plans (SIPs) in the Clean Air Act, states could be required to make a certain showing of capacity in order to be authorized to become the primary enforcer of the national greenhouse gas cap-and-trade system.[214] In Title IV, states have the authority, but not the obligation, to conduct field audits of state facilities regulated by Title IV.[215] In a comprehensive greenhouse gas program, as in RECLAIM, it can be projected that regular audits will be necessary for many or most sources. To be granted primacy in enforcing the program, the state would

210 Baird et al., *supra* note 1, at I-3-6.

211 James Salzman et al., *Regulatory Traffic Jams*, 2 WYO. L. REV. 253, 259 (2002) ("[I]n a good year, EPA will conduct about 22,000 inspections leading to 4000 civil actions; and states . . . will conduct 146,000 inspections and 9000 enforcement actions."); *see also* Markell, *supra* note 203, at 32 (noting that states conduct approximately 90% of inspections and bring 80%–90% of enforcement actions).

212 *See* Markell, *supra* note 203, at 31–32.

213 *Id.* at 110.

214 *See* Dwyer, *supra* note 199, at 1193–94.

215 *See* COMM. ON ENERGY & COMMERCE, CLIMATE CHANGE LEGISLATION DESIGN WHITE PAPER: APPROPRIATE ROLES FOR DIFFERENT LEVELS OF GOVERNMENT 2 (2008). "[ARP field] audits generally consist of preaudit preparation . . . , on-site inspection of the monitoring equipment, records review . . . , QA test observations, and interviews with plant personnel." Schakenbach et al., *supra* note 77, at 1579. ARP regulations require that facilities notify EPA and the state air agency when QA testing is taking place so that the government can send an observer. *Id.* at 1583.

have to show that it has both the necessary electronic and physical verification systems in place.

As with SIPs generally, states would likely be interested in acquiring primacy because it gives them some ability to ensure that their industries' needs are heard and taken into account to the extent possible.[216] As under the Clean Air Act, if EPA determined that a state is not adequately enforcing the program, it could deny or rescind that state's primacy.[217] Also, states could choose not to assume this enforcement role, in which case EPA would have full authority in its jurisdiction.[218]

While the present discussion focuses on the state's enforcement role, states may also play other roles in the implementation of a national greenhouse gas cap-and-trade scheme. Professor Alice Kaswan has argued that states should be able to make a national cap-and-trade program more stringent within their borders by requiring greater emissions reductions and retiring the associated allowances.[219] Kaswan has also argued that states should retain autonomy within a national cap-and-trade system to impose direct regulatory requirements on capped facilities; regulate the use and integrity of offsets; and impose state specific trading rules that maximize the extent to which emissions of other pollutants harmful to human health are achieved in combination with greenhouse gas emissions reductions.[220] An array of benefits may flow from allowing such state autonomy.[221]

C. Citizen Enforcement

A federal law creating a national greenhouse gas cap-and-trade scheme should also enable a strong citizen enforcement role. Citizen enforcement provisions allow a citizen or citizen group to enforce the law independently of the government, essentially stepping into the shoes of the agency enforcement division.[222] Citizen enforcement provisions have become a standard feature in federal environmental law and are widely considered to have enhanced environmental enforcement.[223]

Citizen enforcement could support and supplement federal and state enforcement in a cap-and-trade program in several ways. If a regulated entity

216 *See* Dwyer, *supra* note 199, at 1198.
217 *Id.*; Glicksman, *supra* note 178, at 741.
218 Glicksman, *supra* note 178, at 741.
219 Alice Kaswan, *Decentralizing Cap-and-Trade? The Question of State Stringency*, 1 SAN DIEGO J. CLIMATE & ENERGY L. 103, 124 (2009).
220 Alice Kaswan, *Decentralizing Cap-and-Trade? State Controls Within a Federal Greenhouse Gas Cap-and-Trade Program*, 28 VA. ENVTL. L.J. (forthcoming 2010).
221 *Id.*; Buzbee, *supra* note 199, at 53–54.
222 Zinn, *supra* note 204, at 119.
223 Adam Babich, Comment, *Citizen Suits: The Teeth in Public Participation*, 25 Envtl. L. Rep. (Envtl. Law Inst.) 10141, at 10141 (1995); *see also* Barton H. Thompson, Jr., *The Continuing Innovation of Citizen Enforcement*, 2000 U. ILL. L. REV. 185, 185 ("Perhaps the most pervasive, prominent, and continuing innovation in the modern environmental era has been the involvement of citizens in the enforcement of environmental laws.").

reports a greater number of emissions than can be covered by its allowance holdings, but is not penalized by the government for exceeding its cap, then a suit to enforce the cap could be filed. Citizens could also enforce self-monitoring, recordkeeping, and reporting rules. If citizen groups have sufficient access to reported data, they could review it to look for irregularities, much as EPA does in its electronic monitoring of Title IV data. Citizen groups might also be able to gather outside evidence that proves inaccuracies in the self-monitoring data or other rule violations.

The key to a strong citizen enforcement role is the provision of data and other information that enables citizens to show that a violation has occurred. Title IV was more transparent than many environmental programs, with information available online about annual emissions and allowance trading.[224] However, to fully enable citizen enforcement, even more information would need to be made publically available. For citizens to be able to effectively monitor compliance and detect irregularities in cap-and-trade program data, they should have greater access to the self-monitoring data. Congress should facilitate such public disclosure through appropriate statutory language, as some of self-monitoring data would likely be argued to constitute confidential business information.

The trend toward more restrictive standing doctrine for federal environmental citizen suits may also present a barrier for plaintiffs. In particular, showing a "concrete and particularized injury"[225] may be difficult for the citizen plaintiff who sues to impose civil penalties on a regulated entity that has misrepresented its emissions in a self-monitoring report.[226] Environmental citizen suit plaintiffs have been most successful in showing standing where the environmental damage at issue physically affects the plaintiff.[227] The United States Supreme Court has stated that it will not

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224 *See, e.g.*, Kruger & Egenhofer, *supra* note 3, at 4 ("Transparent regulatory regimes and markets provide the public with timely and accurate information based on [monitoring, reporting, and verification] data as a means to instill trust and confidence in the market with evidence of high compliance.").

225 Massachusetts v. U.S. Envtl. Prot. Agency (*Massachusetts v. EPA*), 549 U.S. 497, 517 (2007).

226 To have standing, a plaintiff must have a "concrete and particularized injury that is either actual or imminent" (injury); the injury must be "fairly traceable to the defendant" (causation); and it must be "likely that a favorable decision will redress that injury" (redressability). *Id.*

227 *Compare* Friends of the Earth v. Laidlaw Envtl. Servs., Inc., 528 U.S. 167, 181–82 (1999) (finding injury-in-fact), *with* Lujan v. Defenders of Wildlife, 504 U.S. 553, 566–67 (1992) (finding no injury-in-fact). A plaintiff might also allege an informational injury, as has occurred in association with citizen enforcement of the TRI reporting requirements. A citizen group that maintains and perhaps publicizes a database with emissions data information in it might prove injury in this way. *See* Deirdre H. Robbins, *Public Interest Environmental Litigation in the United States*, *in* PUBLIC INTEREST PERSPECTIVES IN ENVIRONMENTAL LAW 3, 30 (David Robinson & John Dunkley eds., 1995); Randall S. Abate & Michael J. Myers, *Broadening the Scope of Environmental Standing: Procedural and Informational Injury-in-Fact After* Lujan v. Defenders of Wildlife, 12 UCLA J. ENVTL. L. & POL'Y 345, 374–76 (1994).

"entertain citizen suits to vindicate the public's nonconcrete interest in the proper administration of the laws."[228]

New statutory language could be helpful to citizen plaintiffs in surmounting standing barriers. In *Lujan v. Defenders of Wildlife*,[229] Justice Kennedy stated in concurrence that "Congress has the power to define injuries and articulate chains of causation that will give rise to a case or controversy where none existed before . . . ."[230] Citing this language, the *Massachusetts v. EPA* Court agreed.[231] To enable citizen suits, Congress could insert language that defines the injury to a plaintiff from a facility's failure to accurately report its emissions.

An early version of the ACES Act, referred to as the Waxman-Markey Discussion Draft, included such language.[232] It defined the class of persons entitled to bring suit broadly as "any person who has suffered, or reasonably expects to suffer, a harm attributable, in whole or part, to a violation or failure to act."[233] Further, it defined harm as "any effect of air pollution (including climate change), currently occurring or at risk of occurring, and the incremental exacerbation of any such effect or risk that is associated with a small incremental emission of any air pollutant . . . , whether or not the effect or risk is widely shared."[234] Finally, the discussion draft stated:

> [A]n effect or risk associated with any air pollutant . . . shall be considered attributable to the violation or failure to act concerned if the violation or failure to act slows the pace of implementation of this Act or compliance with this Act or results in any emission of greenhouse gas or other air pollutant at a higher level than would have been emitted in the absence of the violation or failure to act.[235]

By making actionable the risk of a widely shared harm, this language would have eased the way for plaintiffs to show standing. [236]

Critics of citizen suit provisions have suggested that they may reduce the effectiveness of environmental laws by "producing costly and crippling litigation."[237] Critics are often suspicious of the motivations of citizen groups, contending that many citizen suits are "arbitrary and frivolous and serve

228 *Massachusetts v. EPA*, 549 U.S. at 516–17 (quoting Lujan v. Defenders of Wildlife, 504 U.S. 555, 581 (1992) (Kennedy, J., concurring in part and concurring in judgment)).

229 504 U.S. 555 (1992).

230 *Id.* at 580 (Kennedy, J., concurring in part and concurring in judgment).

231 *Massachusetts v. EPA*, 549 U.S. at 516.

232 American Clean Energy and Security Act of 2009, H.R., 111th Cong. § 336 (discussion draft, Mar. 31, 2009, prior to introduction of ACES Act, H.R. 2454, 111th Cong. (2009)).

233 *Id.*

234 *Id.*

235 *Id.*

236 *Cf. Massachusetts v. EPA*, 549 U.S. at 522 (noting that a harm that is widely shared can still be individualized for purposes of standing analysis).

237 *Earthjustice Claims California GHG Plan Illegal; Citizen-Suit Powers Urged*, CARBON CONTROL NEWS, Aug. 13, 2008, http://www.biologicaldiversity.org/news/mediaarchive/EarthJusticeCarbonControl08-14-08.pdf.

mostly to exact attorneys' fees out of companies."[238] And even those that see great value in citizen enforcement recognize that it may also impede desirable cooperative enforcement interactions between the regulators and regulated entities.[239] Yet, in actuality, "principled motivations" have predominated and to the extent there are unwarranted suits, the courts serve as gatekeepers.[240] Many commentators have documented how citizen suits serve as a useful complement and supplement to government enforcement.[241]

One argument against citizen suits is that they interfere in the discretion of the agency to choose to penalize or not to.[242] In several cap-and-trade programs, excess emissions penalties are automatic.[243] So, if they are not imposed and a citizen sues over this, then there should be no concern about a loss of agency discretion. In situations where a citizen suit might instead target violations of self-monitoring and reporting rules that affect the accounting of their emissions, the law has not provided for automatic sanctions that express the intention that all such violation should be penalized. Yet, discovery and penalization of reporting errors is, as described above, essential to maintaining a level playing field for all the regulated entities. In this context, the concerns about interfering with agency discretion are less pronounced in cap-and-trade regulation than in other regulatory programs.

Some commentators might assert that citizen suits are part of an old model of environmental regulation—the litigious, inefficient "command and control" model—and that they are inappropriate in a market based regulatory approach like cap-and-trade.[244] However, in cap-and-trade regulation, reliable enforcement is even more important than it is in direct regulation, and citizen enforcement is just as important or more important than a supplement to government enforcement. While Title IV seems to have been well enforced and there have not been any citizen enforcement suits,[245] there is no guarantee that future cap-and-trade programs will be so.

238 *Id.*

239 *See* Zinn, *supra* note 204, at 84.

240 Marcia Valiante, *"Welcomed Participants" or "Environmental Vigilantes"? The CEPA Environmental Protection Action and the Role of Citizen Suits in Federal Environmental Law*, 25 DALHOUSIE L.J. 81, 101–02 (2002).

241 *See, e.g.*, Mark Seidenfeld & Janna Satz Nugent, *"The Friendship of the People": Citizen Participation in Environmental Enforcement*, 73 GEO. WASH. L. REV. 269, 301–02 (2005); Zinn, *supra* note 204, at 133–34.

242 Zinn, *supra* note 204, at 140.

243 Kruger & Egenhofer, *supra* note 3, at 4, 7 (stating that "excess emissions penalties are nondiscretionary and automatic" in both Title IV and EU ETS).

244 *Cf.* Valiante, *supra* note 240, at 100 (describing how citizen suits could interfere with regulatory approaches crafted to deal with specific compliance issues or ambiguous regulations and result in inconsistent treatment of individual facilities).

245 *Cf.* Kruger & Egenhofer, *supra* note 3, at 5.

D. Third Party Verification

Responding to the need for highly accurate data and the limits on governmental resources, some cap-and-trade programs have required third party verification of self-monitored data. The EU ETS and California's greenhouse gas cap-and-trade programs are examples. Third party verification offers advantages in the quest for accurate data, but it also brings with it the complication of adding a new actor to the enforcement process.

In a cap-and-trade program that requires third party verification, an independent, non-governmental entity is contracted by a facility to verify its emissions data before they are reported.[246] The verifier has the responsibility of ensuring that the facility has monitored and reported emissions in accordance with applicable rules.[247] Third party verification for cap-and-trade systems is in some ways similar to other types of auditing processes, particularly financial auditing, but it is different in that the verifier is generally expected to have a technical background in pollution control.[248]

Like audits conducted by a governmental verifier, audits conducted by a third party would be very likely to increase the accuracy of self-monitored and reported data.[249] Requiring third party verification has the benefit of avoiding the creation of new or expanded bureaucracies to perform the accounting-like work of emissions verification. It is possible that private entities may be more able to develop efficient verification approaches that might develop into trusted industry standards.[250]

The EU ETS relies heavily on third party verification. Under the EU guidelines, member states may require that regulated entities use third party verifiers if they do not have the capacity to verify emissions themselves.[251] Each member state has the authority to set up its own procedures for the accreditation of verifiers.[252] In practice, all but three of the twenty-seven member states have set up rules for accrediting independent verifiers.[253] In twenty member states, the member state subjected at least some of the verified emissions reports to additional checks to monitor the quality of the verification process.[254] In all but seven member states, governmental authorities have the right to adjust the verified emissions reports if they are deemed unsatisfactory.[255]

246 *See* Jennifer Rohleder, *The Role of Third party Verification in Emissions Trading Systems: Developing Best Practices*, SUSTAINABLE DEV. L. & POL'Y, Winter 2006, at 26, 26.

247 Kruger & Egenhofer, *supra* note 3, at 7.

248 *Id.*

249 *See* Rohleder, *supra* note 246, at 26 (noting that emissions data must be subject to verification in order to be trustworthy).

250 *Id.* at 28.

251 Kruger, Oates & Pizer, *supra* note 65, at 124; *see also* Peeters, *supra* note 12, at 187 (discussing requirement for verification and option to use independent verifiers).

252 Kruger, Oates & Pizer, *supra* note 65, at 124 (noting further that there are efforts underway to encourage the harmonization of such accreditation processes).

253 EUROPEAN ENV'T AGENCY, *supra* note 22, at 54.

254 *Id.*

255 *Id.* at 55.

California currently requires third party verification for its Mandatory Greenhouse Gas Reporting program, as would a future California cap-and-trade system for greenhouse gases. While third party verification was optional for emissions reported in 2009, it is required in 2010.[256] Facilities may choose a verification body from a list of verification bodies and verifiers accredited by the California Air Resources Board.[257] The third party verification requirement of the mandatory reporting rule would remain in place after a California cap-and-trade system came into force in 2012.[258]

Significant practical and legal issues may arise in an enforcement system that relies on third party verification. With third party verification, the government must become the verifier of the verifiers. To do this, there may be a need for new legal authorities allowing governmental entities to inspect verifier entities and sanction them if necessary.[259]

At the beginning of a program, concerns are also likely to arise about whether there will be enough verifiers with the necessary level of expertise. To the extent that states set forth and apply strict accreditation requirements, there may be too few.[260] Another issue is how to attain sufficient consistency in the monitoring reports. Inconsistencies may result from differences in the competence and judgment of third party verifiers.[261] They may also result from differences in how third party verifiers interpret their task under applicable regulations and guidance documents.[262]

Third party verification adds an additional actor to the legal compliance process, and this new actor's legal powers and liabilities with respect to the other actors in the compliance process need to be determined. For example, in situations where a verifier fails to perform his duties or is otherwise deemed to be in violation of the rules of the program, the legal status of its client facilities may come into question. Would the verifier or the facility be legally responsible for appropriate penalties? Is the verifier legally required to inform the state of errors or irregularities detected in particular facilities?[263] In what ways are verifiers agents of the state as well as agents of the owners of the facility? Similar questions have been confronted in the area of financial auditing, [264] and they would need to be considered and resolved in this new context as well.

256 CAL. AIR RES. BD., EMISSIONS DATA VERIFICATION FACT SHEET FOR GHG EMISSIONS REPORTERS 1 (2010), *available at* http://www.arb.ca.gov/cc/reporting/ghg-ver/verification.pdf.

257 *Id.*

258 *See* CAL. AIR RES. BD., OVERVIEW, PRELIMINARY DRAFT REGULATION FOR A CALIFORNIA CAP-AND-TRADE PROGRAM 90 (2009), *available at* http://www.arb.ca.gov/cc/capandtrade/meetings/121409/pdr.pdf.

259 *Cf.* Peeters, *supra* note 12, at 189 (indicating the need for EU ETS members to establish systems for sanctioning verifiers).

260 *See* Kruger & Egenhofer, *supra* note 3, at 11 ("Member states are trying to find the right balance between qualification requirements and ensuring the availability of sufficient verifiers.").

261 Kruger, *supra* note 86, at 15–16.

262 *Id.*

263 Peeters, *supra* note 12, at 188.

264 *See, e.g.*, Richard R. Carlson, *Citizen Employees*, 70 LA. L. REV. 237, 302 (2009) (discussing whistleblower protections for employees who report financial fraud).

V. CONCLUSION

The enforcement history of United States pollution law raises many questions about the government's ability to collect reliable emissions data. Government environmental agencies have generally not had sufficient resources to conduct monitoring on a frequent basis, and they came to rely heavily on self-monitoring and reporting of emissions data by pollution sources. While agencies received a lot of data the reporting requirements that were established, agencies rarely verified such data. Absent verification, inaccuracies of all types—whether due to mere sloppiness or conscious misreporting—go undetected and unsanctioned.

In this context, the prospect of a new national cap-and-trade program to control greenhouse gas emissions presents significant enforcement challenges. The monitoring burden of a cap-and-trade scheme is high: To enforce the cap, the government must have an accurate accounting of all greenhouse gases emitted by all facilities regulated by the program. Given constraints on governmental resources, self-monitoring and reporting will inevitably form the basis of the emissions accounting, and these data will require robust verification to prevent intentional and unintentional misreporting that would affect both the program's market integrity and its environmental integrity.

A key design question regards whether program enforcement should be centralized in the federal government or decentralized. Title IV, which in many ways serves as a model for a national greenhouse gas program, took a highly centralized approach to program administration: EPA carried out almost all essential functions, and the states did very little. In many ways, this model worked well for Title IV.

This Article argues, however, that a comprehensive national greenhouse gas cap-and-trade system that regulates several different greenhouse gases and many different industries, should take a more decentralized approach to enforcement. While EPA would still play a critical role in setting the rules for the program and overseeing their enforcement, states would also have major enforcement roles as they have under most other environmental pollution control laws that take a cooperative federalism approach. In addition, citizen enforcement should be enabled through providing ample public access to reported emissions data that would allow citizen groups to also detect violations. Finally, third party verification of emissions data should be considered based on the strong need for accurate data and the chronic enforcement resource limitations that governments experience. While obtaining reliable emissions data may be costly, it will be essential to the program's success.