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U.C. Berkeley School of Law
Student Center, Ste. 3
Berkeley, California 94720-7200
btlj@law.berkeley.edu
http://www.btlj.org

SEEING THE FORESTS AND THE TREES: TECHNOLOGICAL AND REGULATORY IMPEDIMENTS FOR GLOBAL CARBON MONITORING

Molly K. Macauley[†] *& Nathan Richardson*[††]

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I. INTRODUCTION

Forests play a major role in Earth's carbon cycle and have the potential to play an equally significant role in any national or global policy to reduce net carbon emissions and the risks of climate change. The chief vehicle advanced for incorporating forests into carbon mitigation policy is the use of international carbon offsets, by which reductions in net carbon emissions in relatively low-cost regions can be used in lieu of similar reductions in higher

† Senior Fellow and Vice President for Research, Resources for the Future, Washington, D.C.

†† Resident Scholar, Resources for the Future, Washington, D.C.

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cost regions. The costs to the U.S. economy of reducing greenhouse gas ("GHG") emissions would be reduced by half or, in some scenarios, by more than half by managing forests to exploit their natural storage of carbon.[1]

Although international forest carbon offsets could be financially beneficial, two problems continue to limit their use. The first is a lack of data. Perhaps surprisingly in an age when detailed neighborhood maps are available at a touch on smartphones, there is no map with much detail about the world's forests. Accurate measures of extant forest acreage and the capacity to monitor changes in acreage are necessary for carbon markets, just as countable units are required for market exchange of any commodity.

The second problem is legal. It appears likely that the U.S. Environmental Protection Agency's ("EPA") tools under the existing Clean Air Act ("CAA")[2] will be the primary means of limiting carbon emissions from most sectors of the economy in the near future. Under the CAA, the EPA has proposed and finalized rules for reporting GHG emissions and announced steps to regulate emissions from mobile sources (cars and trucks) and new or modified stationary sources (power plants and industrial facilities). The agency is next expected to regulate existing stationary sources (like fossil-fuel power plants and petroleum refineries). Such measures could achieve meaningful reductions in U.S. carbon emissions.[3] Unfortunately, the CAA, as it stands, is likely incompatible with the use of international offsets.[4]

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1. U.S. ENERGY INFO. ADMIN. (EIA), SR/OIAF/2009-05, ENERGY MARKETS AND ECONOMIC IMPACTS OF H.R. 2454, THE AMERICAN CLEAN ENERGY AND SECURITY ACT OF 2009, at xiv (2009), *available at* http://www.eia.doe.gov/oiaf/servicerpt/hr2454/pdf/sroiaf(2009)05.pdf; Cong. Budget Office (CBO), *The Use of Offsets To Reduce Greenhouse Gas Emissions* 7 (Aug. 3, 2009), http://www.cbo.gov/ftpdocs/104xx/doc10497/08-03-Offsets.pdf; U.S. Envtl. Prot. Agency (EPA), Appendix to EPA Analysis of the American Clean Energy and Security Act of 2009 H.R. 2454 in the 111th Congress 64–65 (June 23, 2009), *available at* http://www.epa.gov/climatechange/economics/pdfs/HR2454_Analysis_Appendix.pdf.

2. Clean Air Act, ch. 360, 69 Stat. 322 (1955) (codified as amended at 42 U.S.C. §§ 7401–7671q (2006)).

3. *See* Nathan Richardson et al., *Greenhouse Gas Regulation Under the Clean Air Act: Structure, Effects, and Implications of a Knowable Pathway*, 41 ENVTL. L. REP. 10098, 10099–115 (2011) (stating that the EPA can achieve emissions reductions via performance standards, and detailing specifics for the coal energy sector); *see also* Dallas Burtraw et al., *Greenhouse Gas Regulation Under the Clean Air Act: A Guide for Economists*, 5 REV. ENVTL. ECON. & POL'Y 293, 299–301 (2011), *available at* http://reep.oxfordjournals.org/content/5/2/293.full.pdf (summarizing evidence for emissions reductions available via EPA regulation from various sectors, and suggesting that a 10% overall reduction in US emissions is plausible).

4. *See generally* Nathan Richardson, *Playing Without Aces: Offsets and the Limits of Flexibility Under Clean Air Act Climate Policy* (Resources for the Future, Discussion Paper No. 11-49, 2011), *available at* http://www.rff.org/RFF/Documents/RFF-DP-11-49.pdf; *see also* Nathan

Superficially, this incompatibility appears to reduce the role that forests can play in U.S. climate policy. As a result, the United States is poised to undertake an unnecessarily expensive approach to GHG management, one that overlooks a relatively low-cost means of sequestering carbon.

Part II of this Article describes the science of forests in the global carbon cycle and the economic benefits of sequestration in offsetting greenhouse gas emissions. Part III describes the problem of forest measurement and the technical means necessary for physical inventory of forests. Part IV discusses forest carbon offsets under the CAA. Part V deals with implications for innovation and international diplomacy with respect to forest carbon offsets and suggests areas for future research.

II. THE SCIENCE AND ECONOMICS OF FOREST CARBON SEQUESTRATION

The global carbon cycle is made up of atmospheric, oceanic, and terrestrial processes that circulate and filter carbon, methane, fluorinated gases, and other natural and anthropogenic emissions.[5] Forests are a quantitatively significant link in two of these processes. Forests store carbon by taking in carbon dioxide from the atmosphere during respiration; trees draw the carbon atoms into the plant cell and release oxygen back into the atmosphere.[6] By contrast, when forests are removed (for purposes of agricultural production, development, or other uses) or damaged (by wildfire, pests, drought, or other occurrences), carbon is released (though some portion remains stored in lumber, furniture, and other timber products). Trees are particularly efficient at storing, or sequestering, carbon. Estimates of carbon emissions from forest removal range from seven percent to thirty percent of all GHG emissions.[7] Because changes in forests have the potential to significantly impact those emissions, maintaining intact forests and adding

Richardson, *International Greenhouse Gas Offsets Under the Clean Air Act*, 40 ENVTL. L. REP. 10887 (2010).

5. *See generally* SUSAN SOLOMON ET AL., CONTRIBUTION OF WORKING GROUP I TO THE 4TH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (2007).

6. *See id.* at 1–40.

7. R.A. Houghton & S.J. Goetz, *New Satellites Help Quantify Carbon Sources and Sinks*, 89 EOS TRANS. 417 (2008); *see also* G.R. van der Werf et al., Commentary, *CO_2 Emissions from Forest Loss*, 2 NATURE GEOSCIENCE 737 (2009), *available at* http://www.biology.duke.edu/jackson/ng09.pdf (stating that carbon emissions from deforestation and forest degradation account for about 20% of global anthropogenic CO_2 emissions).

to forest stocks through reforestation and afforestation confers a benefit in the form of carbon sequestration.[8]

The U.S. Energy Information Administration ("EIA") has estimated the cost to the U.S. economy of managing greenhouse gases through actions such as reducing power plant and vehicle emissions, changing forest management, and other steps. The estimates are presented in various economic terms, including in absolute dollar amounts and as a percentage of the nation's gross domestic product ("GDP"). The annual value of forest carbon offsets in reducing expenditures that would otherwise need to be made (say, instead of reducing power plant emissions) could reach $60 billion annually by 2030.[9] Without the use of forest offsets, U.S. emissions reductions will have to largely come from the domestic electricity and transportation sectors. Expressed another way, in terms of the value of the reduction in U.S. GDP, failing to make use of forest offsets would increase the loss in GDP from 0.2 percent to 0.3 percent over the period from 2012 to 2030.[10]

One of the biggest hurdles to using forest carbon offsets—and reaping their financial benefits—is that they may be difficult to measure accurately. The EIA emphasizes that its estimates are based on the assumption that physical forest carbon sequestration capacity can be accurately measured over time and around the world. The agency further emphasizes, and other experts agree, that this assumption may be too strong, underscoring concerns about whether adequate measurement and monitoring is in fact attainable.[11]

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8. Other concurrent benefits of forests include their role in watershed protection and habitat and biodiversity conservation. Note that these attributes are not necessarily correlated with forest carbon storage; in other words, carbon rich forests are not necessarily species rich. *See* Erin Myers Madeira & Juha Siikamäki, *Progress and Challenges for Forests in Climate Policy—Seeing REDD*, *in* CLIPORE, ANNUAL REPORT 2009, at 17 (2010), *available at* http://www.clipore.se/download/18.2a759bb41277b00e3c380001166/Annual+Report+2009-6.pdf.

9. EIA, *supra* note 1, at xi (multiplying domestic and international offset quantities by estimated domestic and international offset prices for 2030).

10. The costs reported here are discounted because they accrue over time. *See* EIA, *supra* note 1, at xiv, 40.

11. EPA, *supra* note 1, at 53; ROSS W. GORTE & JONATHAN L. RAMSEUR, CONG. RESEARCH SERV., RL34560, FOREST CARBON MARKETS: POTENTIAL AND DRAWBACKS 15–18 (2010), *available at* http://www.cnie.org/NLE/CRSreports/10Jun/RL34560.pdf; PERVAZE A. SHEIKH & ROSS W. GORTE, CONG. RESEARCH SERV., R40990, INTERNATIONAL FORESTRY ISSUES IN CLIMATE CHANGE BILLS: COMPARISON OF PROVISIONS OF S. 1733 AND H.R. 2454, at 13 (2009), *available at* http://www.nationalaglawcenter.org/assets/crs/R40990.pdf; CBO, *supra* note 1, at 4–6. The U.S. Governmental Accountability Office has also written about this problem. *See* U.S. GOV'T ACCOUNTABILITY OFFICE (GAO), GAO-08-1048, CARBON OFFSETS: THE U.S. VOLUNTARY MARKET IS GROWING BUT QUALITY

At present, no global measurements of forests meet the desired accuracy; in fact, current measures fall so far short that few meet existing federal guidelines for voluntary carbon management (undertaken by industries wishing to reduce their carbon footprint) or voluntary carbon exchanges (the precursors to actual carbon markets).[12] The U.S. Government Accountability Office notes that "ensuring the credibility of carbon offsets poses challenges because of the inherent uncertainty in measuring emissions reductions or sequestration relative to a projected business-as-usual scenario."[13] Legislation passed by the U.S. House of Representatives (H.R. 2454) and proposed in the U.S. Senate (S. 1733) limited the total number of offset credits and discounted the purchase of international offsets by requiring companies to buy 1.25 international offsets for one domestic offset credit. As further evidence of the concern about capacity to measure and track offsets, both the House and Senate provisions established an Offset Integrity Advisory Board.[14] As described in the Senate provisions, the Board would establish "methodologies to address the issues of additionality, activity baselines, quantification methods, leakage, uncertainty, permanence, and environmental integrity."[15]

Several measurement issues are of particular concern: the requirement for better baseline estimates and the need to monitor changes in the baseline over time. Both measures help scientists ascertain whether, in fact, atmospheric concentrations of GHGs appear to be stabilizing. Both measures would also be required to satisfy regulators and other parties using forests to offset greenhouse gas emissions from other sources. The two concerns with respect to these measurements are known as leakage and permanence, and both problems could prevent a forest carbon market from functioning effectively to offset GHG emissions. Leakage refers to reduced deforestation in one area that drives deforestation to another area. Forecasts of how much forested area worldwide may be protected for sequestration—which are needed to ascertain if enough carbon sequestration is taking place—may be incorrect if it is assumed that no leakage occurs. Murray et al.

ASSURANCE POSES CHALLENGES FOR MARKET PARTICIPANTS 7–9 (2008), *available at* http://www.gao.gov/new.items/d081048.pdf.

12. *See* MOLLY MACAULEY ET AL., RESOURCES FOR THE FUTURE, FOREST MEASUREMENT AND MONITORING: TECHNICAL CAPACITY AND 'HOW GOOD IS GOOD ENOUGH?' 17–20 (2009), *available at* http://www.rff.org/rff/documents/rff-rpt-technical%20capacity_macauley%20et%20al.pdf (discussing the lack of capacity to meet existing guidelines and the standards set by voluntary markets).

13. GAO, *supra* note 11, at 37.

14. H.R. 2454, 111th Cong. § 731 (2009); S. 1733, 111th Cong. § 731 (2009).

15. S. 1733, § 731.

estimate the potential for leakage at ten to ninety percent in the United States.[16] Without adequate monitoring of forests in all countries throughout the world, leakage could undermine efforts to stabilize GHG emissions.[17]

Additionally, changes in forests from logging, conversion to agriculture, or disturbances such as wildfires and drought affect the long-term physical capacity of forests to store carbon. Monitoring these changes is another component of forest carbon sequestration as an element of greenhouse gas management. Some forest carbon management proposals assume that forests would be rented to account for the possibility of their impermanence.[18] In short, measuring forest sequestration is hard—with leakage and sequestration making it even harder.

III. THE TECHNOLOGY OF MEASURING AND MONITORING FORESTS

This Part briefly describes why improving the technology for measuring forests requires the deployment of new technology. Although necessary, institutional and financial constraints limit deployment of new technology. These limits have also led to inaccuracies in the forest measurement data that are now available.

Forest measurement requires a number of steps. The procedure is allometric, and is based on forested land area, the growing volume (height) of the trees, and their biomass, which is determined largely by the tree species and overall tree health. High quality data on these variables have been available only in a small number of places that predominantly fall into two categories: forests that are managed for commercial timber; or small areas where field work has taken place, usually for research on the use of forests for fuelwood, watershed management, or poverty alleviation in developing countries.[19] The only worldwide inventory of forests consists of voluntary,

16. *See* Brian C. Murray et al., *Estimating Leakage from Forest Carbon Sequestration Programs*, 80 LAND ECON. 109, 109 (2004).

17. *See id.*

18. *See* Man-Keun Kim et al., *Permanence Discounting for Land-Based Carbon Sequestration*, 64 ECOLOGICAL ECON. 763 (2008).

19. *See, e.g.*, Sandra Brown & Barbara Braatz, *Methods for Estimating CO_2 Emissions from Deforestation and Forest Degradation*, *in* GOFC-GOLD, SOURCEBOOK: A SOURCEBOOK OF METHODS AND PROCEDURES FOR MONITORING AND REPORTING ANTHROPOGENIC GREENHOUSE GAS EMISSIONS AND REMOVALS CAUSED BY DEFORESTATION, GAINS AND LOSSES OF CARBON STOCKS IN FORESTS REMAINING FORESTS, AND FORESTATION, ch. 2.4, at 2-72 (Report No. COP16 ver. 1, 2010), *available at* http://www.gofc-gold.uni-jena.de/redd/sourcebook/Sourcebook_Version_Nov_2010_cop16-1.pdf [hereinafter GOFC SOURCEBOOK]

self-reported data sent roughly every five years by countries to the United Nations Food and Agricultural Organization ("FAO") for the FAO's Forest Resource Assessment. Inventory practices for the FAO reports vary widely among countries. Many countries differ in their definitions of "forested land." Some extrapolate forested acreage from a sample of field measures and others use state-of-the-art instruments on airplanes to map the height of trees and forested acreage, thus obtaining high quality measures of carbon sequestration. Developing countries, including many that are thought to be rich in forest carbon, often lack measurement capacity altogether. Some countries with large acreages of boreal forests, such as Canada and Russia, use altogether different measurement techniques for estimating forested lands than many other countries, making comparisons even more difficult.[20] The FAO itself acknowledges these problems,[21] which result in wide discrepancies in reported measures compared with actual field data.[22]

Improving forest measurement on a global scale is technically feasible. Specialized remote sensing instruments carried on aircraft or satellites could provide highly accurate, well-calibrated, and spatially consistent measures.[23] At present, aircraft instruments are deployed in only a few places and would require massive deployment for global coverage. Furthermore, the unique vantage point of space satellites, coupled with the fact that they generally cover the same location on the Earth's surface every few days, makes them an especially good choice to meet the requirement of such coverage. Satellites can readily collect measurements globally over time; the repeated coverage of the same location every few days would allow for monitoring of forests, including monitoring of leakage, permanence, and degradation. When

(discussing measurements taken to understand the supply of fuelwood provided by a forest in a developing country).

20. MACAULEY ET AL., supra note 12, at 8.

21. *See* EMILY MATTHEWS & ALAN GRAINGER, UNITED NATIONS FOOD & AGRIC. ORG. (FAO), EVALUATION OF FAO'S GLOBAL FOREST RESOURCES ASSESSMENT FROM THE USER PERSPECTIVE (2002), *available at* http://www.fao.org/docrep/005/y4001e/Y4001E07.htm.

22. *See, e.g.*, Lloyd C. Irland, *Assessing Sustainability for Global Forests: A Proposed Pathway To Fill Critical Data Gaps*, 129 EUR. J. FOREST RES. 777 (2009); *see also* Paul Waggoner, *Forest Inventories: Discrepancies and Uncertainties* (Resources for the Future, Discussion Paper No. 09-29, 2009), http://www.rff.org/documents/RFF-DP-09-29.pdf.

23. *See* MATTHEW FAGAN & RUTH DEFRIES, RESOURCES FOR THE FUTURE, MEASUREMENT AND MONITORING OF THE WORLD'S FORESTS: A REVIEW AND SUMMARY OF TECHNICAL CAPABILITY, 2009–2015 (2009), *available at* http://www.rff.org/rff/documents/rff-rpt-measurement%20and%20monitoring.pdf; GOFC SOURCEBOOK, *supra* note 19; Molly Macauley & Roger Sedjo, *Forests in Climate Policy: Technical, Institutional and Economic Issues in Measurement and Monitoring*, 16 MITIGATION & ADAPTATION STRATEGIES FOR GLOBAL CHANGE 499 (2011).

collected routinely over many years, these data provide a time series to inform baselines and track changes of forests.

Several impediments prevent deployment of aircraft and satellite technologies despite their technical feasibility. First, in the absence of a market for carbon, there is no mechanism to privately finance aircraft or satellite data collection. Without a climate policy that allows inclusion of forest offsets, there is no incentive for public or private financing. Second, although some space satellite systems, deployed mostly by national space agencies, serve to measure air and water quality, land use, urbanization, and other terrestrial processes, none are optimized to measure forested acreage, tree height, or other parameters from which to estimate carbon sequestration. Third, few countries consider forest inventories to be high priority activities, and national space agencies pursue goals other than forest resource management or climate policy. Some countries with sophisticated satellite and other inventory methods use these data on behalf of timber industries and are unlikely to make these data public. For instance, the legislation that authorized the establishment of the National Aeronautics and Space Administration does not include language about natural resources (although it does include language about the "expansion of human knowledge of phenomena in the atmosphere and space").[24] The international organization to which many countries belong for purposes of organizing coordination among Earth-observing satellites, the Group on Earth Observations, has recognized the need to give priority to forest measures and collaborate to overcome the problem that these measures presently receive little priority.[25]

Forest management jurisdiction is another complication. Forests within a country are nationally sovereign resources but their carbon sequestration capacity is a global public good. Nations may undersupply information to global authorities about the extent and health of forests because forest resources, much like deposits of oil, copper, and other resources, are seen as nationally sovereign resources. A nation may fear that sharing data about the quantity, quality, and geographic extent of these resources may reveal information that is commercially important or information that reveals how

24. National Aeronautics and Space Act of 1958, Pub. L. No. 85-568, § 102(c)(1), 72 Stat. 426, 427 (codified at 42 U.S.C. § 2451(c)(1) (1958)), *repealed by* Pub. L. No. 111-314, § 6, 124 Stat. 3328, 3444 (2010).

25. *See Professor José Achache, Director, Group on Earth Observations*, RESEARCHMEDIALTD (Aug. 27, 2011, 1:50 PM), http://www.research-europe.com/index.php/2011/08/professor-jose-achache-director-group-on-earth-observations/.

poorly the nation is managing its resources, such as data pertaining to forest degradation or illegal logging.

A United Nations resolution allows satellite observations of countries (unlike airborne imaging, which requires overflight permission).[26] Thus, collecting forest measures from space might be a solution if financing were available to pay for the systems. The question then becomes one of securing financing. Policies that value forest carbon explicitly would encourage national decision makers to change their priorities in favor of better information about forests. If national decision makers favored forest carbon, forest carbon would finally attain monetary value, which would in turn provide an incentive to finance improved measurement.

IV. OFFSETS AND POLICY OPTIONS: THE CLEAN AIR ACT

Offset policies beyond voluntary actions are only possible if carbon emissions are controlled in some way in the first place. If there is no reason to reduce carbon emissions, there is correspondingly no reason to look for ways to do so cheaply (such as reducing deforestation) or to finance the necessary technological improvements for adequate measurement and monitoring of forests. The most obvious way to control carbon emissions and create an opportunity for offsetting is to price those emissions. In a cap-and-trade system for example, offsets can be used to generate additional allowances. Moreover, if carbon is taxed, offsets can generate tax credits and revenue to underwrite measurement and monitoring.

But a price on carbon is not necessary for offsets—purely regulatory policies are equally compatible, at least in principle. Regulators could require specific emissions reductions, perhaps via a performance standard, but accept offsets in lieu of the required reductions. Offsets are similarly compatible with various hybrid policies. In short, any policy that controls or limits carbon emissions is, in principle, compatible with offsets and sufficient to generate at least some incentive to use them and to fund the required monitoring technology. The degree to which offsets are appealing, however, depends on their relative cost compared to that of the primary emissions reductions required by the policy.[27] Moreover, compatibility in principle does not necessarily mean compatibility in practice. Political and legal limitations

26. G.A. Res. 41/65, ¶ 2, U.N. Doc. A/RES/41/65 (Dec. 3, 1986).

27. If a policy targets only relatively cheap emissions reductions (low-hanging fruit), forest offsets may not be a very attractive alternative. But if caps or regulatory requirements are stringent, requiring deep and costly emissions cuts, offsets will appear very attractive (and regulators' decisions on whether to include them will have a large effect on the program's overall costs).

may prevent offsets from being included in a given policy or limit their scope.

The EPA has the authority to regulate carbon emissions under the Clean Air Act. In *Massachusetts v. EPA*,[28] the Supreme Court held that GHGs are "air pollutants" under the CAA and directed the EPA to investigate whether regulating them was warranted.[29] The EPA issued an "endangerment finding" in late 2009.[30] In it, the agency stated its view that GHG emissions do endanger public health and welfare—a finding that, under the CAA, both enables and compels actual regulation.[31]

The 2009 endangerment finding set the EPA on a path to widespread regulation of U.S. carbon emissions. But is this pathway compatible with offsets? As discussed above, it is compatible in *principle*, but it may not be legally compatible. The EPA may lack the authority to implement offsets via CAA carbon regulation, particularly for international and forest offsets.[32] In addition, even if the agency has the authority to implement offsets, there are a variety of reasons to be skeptical about whether the agency will actually exercise that authority. Limitations on the EPA's authority under the CAA appear to be a significant barrier—though not all analysts agree.[33] Moreover,

28. 549 U.S. 497 (2007).

29. *Id.* at 528. The EPA had argued that it could not regulate GHGs via the CAA since they were not pollutants of the type Congress intended the agency to regulate with its CAA powers. *Id.* The Court rejected this argument, but in doing so it did not compel the EPA to regulate carbon. *Id.* at 534–35. Rather it removed the EPA's justification for refusing to do so, leaving the agency with no choice other than to investigate whether regulating GHGs was necessary based on the statute's requirements. *Id.* Essentially, the holding required the agency, if it continued to refuse to regulate GHGs, to articulate a *scientific* rather than a purely *policy* reason for doing so.

30. Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act; Final Rule, 74 Fed. Reg. 66,496 (EPA Dec. 15, 2009).

31. *Id.*

32. For a more complete review of the EPA's chosen regulatory pathways, see, e.g., NATHAN RICHARDSON, RESOURCES FOR THE FUTURE, ISSUE BRIEF NO. 11-02, EPA GREENHOUSE GAS PERFORMANCE STANDARDS: WHAT THE SETTLEMENT AGREEMENT MEANS (2011); Burtraw et al., *supra* note 3; Richardson, *supra* note 4.

33. *See* Coal. for Emission Reduction Policy, Memorandum, *Comments of the Coalition for Emission Reduction Policy on EPA's Forthcoming Proposal To Establish New Source Performance Standards for GHG Emissions from Electric Generating Units and Refineries* 6 (Mar. 18, 2011), *available at* http://www.uscerp.org/assets/attachments/CERP%20Mar%2018%202011%20Comments%20on%20NSPS%20Rulemakings.pdf (claiming that offsets are "adequately demonstrated," found in other CAA programs, and therefore are compatible with CAA § 111 regulation); *see also* INIMAI M. CHETTIAR & JASON SCHWARTZ, N.Y. UNIV. SCH. OF LAW, THE ROAD AHEAD: EPA'S OPTIONS AND OBLIGATIONS FOR REGULATING GREENHOUSE GASES 88 (2009), *available at* http://policyintegrity.org/files/publications/TheRoadAhead.pdf (arguing that legislative history suggests Congressional intent to allow EPA to consider third-party emissions reductions under § 111 regulation).

institutional and political preferences within the EPA may be just as significant as agency general counsel's evaluation of the legal arguments.[34]

A. OFFSETS UNDER THE CAA: THE PAST

Offsets are not unknown in CAA regulation, having been formally included since the 1977 amendments to the statute—albeit in limited fashion. But these existing CAA offsets, known as emissions reduction credits ("ERCs"), are inapplicable to carbon regulation and are a poor model for both legal and practical reasons.

ERCs, as specified in section 173(c) of the CAA, work in the following manner. Under the CAA, restrictions are placed on the construction of new emitting facilities in areas that violate national air quality standards set by the EPA under section 110 of the Act (called "nonattainment areas").[35] In order for a permit to be issued for construction of a new facility in a nonattainment area, the firm seeking the permit must do two things: first, it must install tight emissions controls (lowest achievable emission rate, or "LAER");[36] second, it must offset the residual emissions from the project.[37] This offsetting is achieved via ERCs. Firms that reduce emissions obtain credits, which can be sold to other firms seeking permits for new projects or used by the reducing firm for its own projects. The ERC program is specified in section 173 of the Act itself; it is not based on the EPA's interpretation of general pollution-control powers under the CAA.[38]

The ERC program, although widely used, is narrow in scope. It is only relevant in nonattainment areas. Furthermore, even in nonattainment areas, offsets are not a general emissions-control tool because offsets only become

34. There has been relatively little discussion of offsets under CAA GHG regulation in the literature. Richardson discussed prospects for *international* offsets alone under the CAA and concluded at the time that such offsets probably could not be included in CAA regulation, though the analysis was necessarily somewhat superficial as the EPA had not yet chosen a regulatory pathway for existing stationary sources. *See* Richardson, *supra* note 4. A recent World Resources Institute and Columbia Law School working paper also briefly addressed offsets under the CAA. The paper concluded that "[i]t is unlikely . . . that offsets could be used to meet the minimum reductions required by EPA's guidelines issued under section 111(d)." Franz T. Litz et al., *What's Ahead for Power Plants and Industry? Using the Clean Air Act To Reduce Greenhouse Gas Emissions, Building on Existing Regional Programs* 20 (Columbia Law Sch. Ctr. for Climate Change Law & World Res. Inst., Working Paper, 2011), *available at* http://pdf.wri.org/working_papers/whats_ahead_for_power_plants_and_industry.pdf. This conclusion is based largely on the simple fact that § 111 includes no explicit mention of offsets, though analysis of this issue was not the focus of the working paper.

35. 42 U.S.C. § 7503 (2006).

36. § 7503(a)(2).

37. § 7503(a)(1).

38. § 7503(c).

relevant when preconstruction permits are needed. Even then, the ERC offsets required for the permit must generally be created within the same nonattainment area.[39] Because of these restrictions, ERC offsets are best viewed as a safety valve that prevents strict regulations on nonattainment areas from completely shutting down economic growth, rather than a general tool for reducing compliance costs.

Despite their long history within CAA regulation, ERCs have little relevance for offsets under CAA programs not related to the section 110 air quality standards, such as those for GHGs. Superficially, the existence of ERCs indicates that offsets are not incompatible with the CAA, at least in principle. By including ERCs in the CAA, Congress demonstrated an awareness of the benefits of offsets and similarly demonstrated it could craft language that specifically includes offsets within the EPA's authority. Congress's failure to include offsets elsewhere in the CAA could thus be interpreted to indicate that Congress did not intend to grant such authority anywhere else. This *expressio unius* argument should not be taken too far. The CAA is a flexible statute, with many different programs aimed at different pollutants from different sources.[40] The EPA has a long history of interpreting these programs relatively independently, and an *expressio unius* argument that depends on Congressional consistency throughout the statute is thus relatively weak. It is difficult to argue that the scope of authority delegated to the EPA should be exactly the same for each of the CAA programs, despite their wide variation in aims and structure.

Even if the *expressio unius* argument fails, however, ERCs are not a useful model for GHG offsets under the CAA for two reasons. First, it is unlikely that national air quality standards will be set for GHGs.[41] Second, the limited

39. *See id.* There is one exception to this rule: offsets can come from another nonattainment area if the other nonattainment area has an equal or higher nonattainment classification than the area in which the source is located and emissions from the other area affect compliance in the area where the permit is being sought.

40. For example, CAA § 112 targets hazardous pollutants from a wide range of sources with strict emissions limits; CAA Title II targets mobile sources with fleetwide and fuel standards; and CAA Title IV implements a national cap-and-trade program for sulfur dioxide emissions. *Id.* §§ 7412, 7521–7554, 7651(b). Each uses different tools to address different pollution problems from different classes of sources. *See id.*

41. *See* Robin Bravender, *EPA Chief Signals Opposition to CAA Curbs on GHGs*, GREENWIRE (Dec. 8, 2009), http://eenews.net/Greenwire/2009/12/08/archive/4?terms=naaqs+petition (quoting Administrator Lisa Jackson saying, "I have never believed and this agency has never believed that setting a national ambient air quality standard for greenhouse gases was advisable"). But it is possible that courts might *force* EPA to set a GHG NAAQS. *See, e.g.*, Ctr. for Bio. Diversity & 350.org, *Petition To Establish National Pollution Limits for Greenhouse Gases Pursuant to the Clean Air Act* 15 (Dec. 2, 2009), *available at* http://www.biologicaldiversity.org/programs/climate_law_institute/global_warming_litigation/clean_air

geographic scope of ERCs precludes the use of the best and cheapest class of offsets—those from forests abroad. The EPA will have to look elsewhere to find a legal basis for including offsets in its GHG regulation.

B. OFFSETS UNDER THE CAA: THE FUTURE

If ERCs are not a useful model for carbon offsets under the CAA, are there other avenues available to the EPA? Perhaps, but it appears unlikely. To understand why, it is first necessary to examine the EPA's plans for carbon—and their statutory basis—in more detail.

The CAA grants authority to the EPA under various regulatory programs that apply to different kinds of pollution from different sources, including mobile sources as well as both new and existing stationary sources. As a result, the EPA's regulatory approach to GHGs is fragmented among different programs and proceeds sequentially as agency actions trigger links between them.

Although the EPA could, in principle, attempt to include offsets in any of its three GHG regulatory programs, the analysis that follows focuses on the EPA's performance standards for existing stationary sources for two reasons. First, the mobile source and stationary source permitting programs are relatively mature at this point and do not include offsetting. Existing source regulation is the only opportunity to include them without redesigning an existing program. Second, regulation of existing stationary sources is the more natural venue for offsets because it covers the sources of the majority of U.S. emissions and will probably generate the largest compliance costs (and therefore the largest opportunity for offsetting).

The EPA's choice of regulatory program for existing stationary sources appears to be performance standards. Under section 111 of the CAA, the EPA can set performance standards for new sources and, via the states, also set standards for existing sources. Under these programs, the agency identifies the "best system of emission reduction"[42] for categories of sources (such as fossil fuel steam power plants and petroleum refineries). These sources are then required to meet the level of emissions set by the standard,[43]

_act/pdfs/Petition_GHG_pollution_cap_12-2-2009.pdf (containing a petition filed by environmental groups claiming that the EPA is required by the CAA to issue a GHG NAAQS); Nathan Richardson, *Greenhouse Gas Regulation Under the Clean Air Act: Does* Chevron *Set the EPA Free?*, 29 STAN. ENVTL. L.J. 283, 308–15 (2010) (arguing that *Chevron* doctrines are likely insufficient to insulate EPA against the statutory arguments that it is required to issue a GHG NAAQS).

42. 42 U.S.C. § 7411(a)(1).

43. § 7411(e).

though they are not required to use any specific technology to do so.[44] The standards for new sources under section 111(b) are termed new source performance standards ("NSPS") and the standards for existing sources under section 111(d) are termed existing source performance standards ("ESPS"). As a result of a settlement agreement, the EPA has announced plans to issue proposed NSPS and ESPS in two categories by the end of 2011: fossil fuel power plants[45] and refineries.[46]

It appears very likely that emissions trading[47] in some form can be incorporated into the GHG NSPS/ESPS program, as discussed in detail in some of our earlier work.[48] To summarize, it appears possible for the EPA to define emissions trading as part of section 111 "standards of performance," which must be based on the "best system of emission reduction," even though the statute does not explicitly permit doing so.[49]

Prospects for including offsets under section 111 performance standards are not as favorable, however. International offsets in particular appear to be legally problematic. As one of us pointed out in a recent paper, there is no precedent for international offsets under the CAA, and it is difficult to interpret section 111 so as to allow their inclusion in performance standards.[50] Nevertheless, it may not be impossible. If, under section 111 performance standards, the "best system of emission reduction" can be interpreted so as to include emissions trading, it might be possible to

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44. § 7411(b)(5).

45. *See* Settlement Agreement, New York v. EPA (*Boiler GHG*), No. 06-1322 (D.C. Cir. Dec. 21, 2010), *available at* http://www.epa.gov/airquality/pdfs/boilerghgsettlement.pdf. Note the specific source category covered by the settlement is category Da, which includes only fossil fuel powered steam boiler EGUs. Gas-fired turbines and a few other types of fossil power plants are not included in the source category specified in this agreement. *See also* RICHARDSON, *supra* note 32.

46. *See* Settlement Agreement, Am. Petroleum Inst. v. EPA (*Refinery GHG*), No. 08-1277 (D.C. Cir. Dec. 21, 2010), *available at* http://www.epa.gov/airquality/pdfs/refineryghg settlement.pdf.

47. The line between what is considered emissions trading and what is considered use of offsets is not always clear. For purposes of this Article, we consider exchange of emissions credits in some form between different regulated sources to be trading; offsets, in contrast, are the exchange of emissions or carbon credits between a regulated source and an unregulated source, like a forest landowner.

48. *See, e.g.*, Burtraw et al., *supra* note 3, at 297–99; Richardson et al., *supra* note 3, at 10105–06, 10108–11.

49. *See* Richardson et al., *supra* note 3, at 10105–06. The EPA articulated this argument in its 2005 Clean Air Mercury Rule. *See* Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units; Final Rule, 70 Fed. Reg. 28,606, 28,616 (May 18, 2005) (stating that "[i]n the final rule, EPA interprets the term 'standard of performance,' as applied to existing sources, to include a cap-and-trade program").

50. *See* Richardson, *supra* note 4.

interpret section 111 to include offsets as well.[51] But pressing the statutory language to support both trading and offsets is a heavy burden for it to bear. Also, offsets—unlike emissions trading—allow emissions reductions to come from outside the regulated sector. This is in tension with the section 111 sectoral regulatory approach, in which standards are set for EPA-defined "source categories." Although the EPA could in principle draw broad source categories and allow trading or offsetting within them, it could never include international sources, since emissions sources outside the United States are almost certainly outside the reach of section 111.[52] Finally, many offsets, including most types of forest offsets, do not result in emissions reductions, but rather in putative reductions in atmospheric carbon concentrations. Addition or preservation of carbon sinks like forests increases the rate at which carbon is pulled from the atmosphere but does not change the amount of emissions generated from any source, source category, the United States, or human activities in total. In this sense, offsets are not a "system of emission reduction" at all and therefore may be fundamentally incompatible with performance standards as defined in the CAA.

Prospects for purely domestic offset programs are perhaps not as grim as those for international offsets, because not all of the above arguments apply in the domestic context. However, the most fundamental arguments against offsets still apply. In any case, domestic offsets alone would likely have a much smaller impact on the cost of emissions reductions, since the most cost-effective sources of offsets are believed to be in developing countries with large forested areas.[53]

The EPA may also lack the powers and institutional capacity to negotiate, implement, and enforce the agreements necessary to support an international offset regime. This is particularly true if agency resources are threatened by congressional budget-cutting. Moreover, to the extent that bold legal arguments would be necessary to include offsets in CAA regulation, the

51. Or it might not: many types of offsets, most notably forestry offsets, do not reduce GHG emissions, but rather GHG *concentrations*, via sequestration of atmospheric carbon. They therefore are not (arguably) a "system of emissions reduction" at all.

52. While the definition of "stationary source" at 42 U.S.C. § 7411(a)(3) (2006) does not explicitly exclude sources outside the United States (it makes no mention of sources' location), nothing in § 111 appears to counter the presumption against extraterritoriality.

53. *See, e.g.*, ADRIAN DEVENY ET AL., RESOURCES FOR THE FUTURE, FOREST CARBON INDEX: THE GEOGRAPHY OF FORESTS IN CLIMATE SOLUTIONS 40–42 (2009), http://www.forestcarbonindex.org/RFF-Rpt-FCI_small.pdf (measuring likely availability of forest carbon offsets and concluding that 18 of the top 20 sources are developing countries).

agency's troubles in the Court of Appeals for the D.C. Circuit in recent years[54] may temper its enthusiasm for legal risk.

C. THE STATES: OFFSETS' LAST, BEST HOPE?

If the EPA is unable to include offsets in federal-level GHG regulation, might states be able to include offsets instead? Yes, but not without complications. In recent years, states have taken the lead on U.S. climate policy, filling the gap left by federal inaction. A group of Northeastern states under the Regional Greenhouse Gas Initiative ("RGGI") have led the way with an electricity-sector GHG trading program.[55] California is also nearing implementation of its own emissions control program under AB32, which is planned to include an expansive emissions trading system.[56] Though these programs are necessarily smaller in scope than a federal program, they are also likely to be more stringent. State programs are therefore capable of generating small but substantial markets for offsets as well as incentives to assess and monitor offset availability and quality—but only if barriers to inclusion of offsets can be overcome.

Since state legislatures (and, via powers delegated from those legislatures, state environmental regulators) control the design of state-level climate polices, those policies can, in principle, include almost any particular tool. For example, a state could enact a cap-and-trade system (as California and the RGGI have), a renewable portfolio standard (as many states have done), a carbon tax, or other mechanisms, including offsets. Nothing prevents California, for example, from allowing land-use changes of some type in the state to generate offsets for use in the AB32 cap-and-trade program. Assuming that interstate trading programs like the RGGI are generally legal, offsets from any of the participating states could similarly be included. For that matter, a program could include out-of-state offsets even if those states are not part of the program.

But legal problems with offsets may arise in two scenarios: first, international offsets may present constitutional problems that could limit or prevent their adoption; second, the limitations on federal-level offsets

54. *See* North Carolina v. EPA, 531 F.3d 896, 901–29 (D.C. Cir. 2008) (striking down the EPA's Clean Air Interstate Rule); *see also* New Jersey v. EPA, 517 F.3d 574, 583 (D.C. Cir. 2008) (striking down the EPA's Clean Air Mercury Rule, on grounds unrelated to the agency's interpretation of CAA § 111 allowing a trading program).

55. *See Memorandum of Understanding*, REGIONAL GREENHOUSE GAS INITIATIVE (Dec. 20, 2005), *available at* http://rggi.org/docs/mou_final_12_20_05.pdf.

56. *See* CAL. AIR RES. BD., CLIMATE CHANGE SCOPING PLAN (2009), *available at* http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf.

discussed above could cause compatibility issues with state-level programs, perhaps even causing states to forgo them.

1. States and International Offsets

The power of the states to set their own climate policies is, as noted above, limited only by the Constitution. Although international offsets appear to be the source of the lowest-cost emissions reductions, and have the potential to significantly reduce the costs associated with state offset programs, state-level international offsets are legally risky at best. A variety of constitutional objections to state-level international offsets can be raised, but the common thread among the various arguments is that the power to regulate and conduct foreign affairs is traditionally reserved for the federal government. These arguments have been discussed by some scholars, though they have not by any means been resolved. As Douglas Kysar and Bernadette Meyler put it in a 2008 paper:

> [A]nalyses must necessarily depend on assuming debatable positions within notoriously underdetermined areas of constitutional law, including various restrictions on state foreign affairs activities that emanate from the Treaty Clause, the Compact Clause, the Foreign Commerce Clause, and the foreign affairs preemption doctrine. Although unsatisfying, the safest conclusion to draw in this context is that the recent foreign affairs activities of state and local governments exist in a constitutional fog, similar in many respects to the dim doctrinal haze that covers the interbranch distribution of foreign affairs authority at the federal level.[57]

Full analysis of these constitutional issues is beyond the scope of this paper. In any case the implications for state-level international offsets remain ambiguous. These constitutional issues are at least a legal risk the architects of state programs must consider. Analysts studying the issue disagree over how significant that risk is.[58]

Although academic discussions have focused on linkage of state trading programs with parallel foreign programs (such as the EU's Emissions Trading System), the legal issues for state-level offsets are similar. Incorporating international offsets into a domestic trading program requires some form of agreement with the public or private provider of the emissions reduction credits. It also requires ongoing verification, oversight, and enforcement if there is to be any assurance of offset quality. These ongoing

57. *See* Douglas Kysar & Bernadette Meyler, *Symposium: Like a Nation State,* 55 UCLA L. REV. 1621, 1625 (2008).

58. *See id.* at 1624 n.11.

commitments compel the regulating state to enter into an ongoing and likely formalized relationship with a foreign government, raising similar concerns to those relationships created by the agreements necessary to link trading markets. Although it might in principle be possible to conduct some of the necessary negotiation and agreement exclusively with private parties abroad, it seems likely that some form of negotiation with the political powers responsible for enforcement and capable of giving consent to monitoring efforts would be necessary. And even if states maintain relationships purely with foreign private actors, some of the constitutional objections may remain legally significant.

On the other hand, the relevant constitutional doctrines are ambiguous. It is impossible to say that any one of them conclusively or even probably limits the states' ability to include international offsets in its programs.

2. Federal-State Compatibility

Constitutional concerns regarding *domestic* offsets are much less significant, though again the value of purely domestic offsets in both cost and environmental terms is limited. Whether the focus is on domestic offsets or the constitutional issues are simply set aside for the time being, interaction between EPA regulation under the CAA and any state programs may create practical obstacles for state-level offset programs. That is, even if states face no legal restrictions on their ability to incorporate offsets (domestic, international, or both), states could ironically be discouraged from doing so by the presence of the parallel EPA program.

If the EPA cannot include offsets in its federal program, or simply chooses not to, the EPA's program may become partly or wholly incompatible with state programs that do include offsets. If emitters in, say, California, comply with emissions cuts required by the state solely via offset purchases without reductions in emissions from the regulated source category (sector) itself, the emitters would be out of compliance with the federal standard. This is true even if state requirements are stricter than federal requirements in emissions terms. In this scenario, offsets would only be useful for *additional* emissions reductions required by states, increasing the cost of those programs without any emissions benefit.[59] It is possible that the

59. This simple scenario hides much legal complexity. *See* 42 U.S.C. § 7411(d) (2006). ESPS regulation is primarily a state activity; the EPA simply sets initial guidelines and reviews state plans, intervening only if states fail to act. But states do not have complete discretion in writing their § 7411(d) plans. As discussed above, states must set standards of performance within the definition of the CAA, which appears to limit their ability to incorporate offsets. Section 7411(d) does not restrict states' ability to regulate emissions more stringently, but this does not grant states the ability to use tools other than "standards

EPA could take more creative approaches to section 111(d) regulation, such as setting state-level budgets rather than facility-level targets. But it remains unclear whether such approaches would permit any additional flexibility regarding offsets (or trading that includes uncovered sources).

If states with their own climate programs are unable to use offsets for compliance with section 111(d), these states' program choices will be limited and the likelihood of other states joining existing interstate climate agreements may decrease. States with existing programs will be much less likely to include offsets in their programs since they would only be useful for emissions restrictions beyond federal requirements. The administrative, enforcement, and compliance costs of an offset program might not be justified under these conditions. As a result, the cost of cutting emissions would increase (assuming offsets are the cheapest option available to emitters for meeting state requirements). This has obvious effects on the regulating states, but it also makes other states less likely to join interstate programs. Increasing costs for state programs may be only the first part of a double blow—federal climate regulation could also undermine these programs' political momentum.

V. SUMMARY AND FUTURE STEPS

Even with the physical and economic significance of forest carbon offsets in climate policy, and despite the technological capacity to measure and track forests around the world, federal climate regulation under the CAA appears unlikely to allow inclusion of forest offsets. Although it is not possible to rule out GHG offsets under the CAA on legal grounds, the arguments against legality discussed above make it much less likely that the EPA will take the risk of including them. Although the agency has made some bold interpretive moves in the recent past, most notably in its Clean Air Mercury Rule, courts have not generally been receptive to these ambitious statutory interpretations.[60] The agency may therefore have lost some of its appetite for ambitious interpretation of the CAA, particularly in the context of the EPA's already-controversial GHG regulatory programs.

Ultimately, more research is needed to determine the legality and feasibility of carbon offsets in state and federal climate policy. Some legal issues surrounding the plausibility of *domestic* offsets remain unclear; while the opportunities for cost reduction from these offsets are limited, they are not

of performance." This is in contrast to state plans under the CAA NAAQS program, which does grant such broad flexibility so long as environmental targets are met.

60. *See, e.g.*, cases cited *supra* note 54.

necessarily trivial. And if such offsets can be included in EPA regulation, there would be incentives to invest in technology that might later be expanded internationally. Many aspects of the relationship between EPA/CAA section 111 performance standards and state emissions programs also remain unclear. Although this Article has attempted to explore these issues to some degree, more study is needed. The coming months will likely reveal a great deal about the EPA's intentions and states' preferences with regards to the use of carbon offsets, though the final boundaries of legality may not be known until likely ensuing litigation is resolved.

Moreover, implementing offsets will likely be difficult in light of the probable reductions in EPA funding in the coming years. Offset programs are likely to be administratively complex and labor-intensive for the agency, especially relative to more traditional approaches to performance standards under section 111. Although some of this workload could in principle be shifted to states under section 111(d), much could not—especially insofar as international offsets are concerned. And the budgetary situations in the states are hardly more favorable.

With domestic action at the federal and state levels uncertain, opportunities for exploiting forest carbon sequestration are likely to continue to play a role, albeit a limited one, in the United States' international diplomatic actions. For example, the Fiscal Year 2011 U.S. Budget includes $347 million, to be administered by the U.S. Department of the Treasury and the Agency for International Development, for enhancing forest sequestration management in developing countries.[61] This program will draw on the technical capacity to measure and monitor but will fall far short of realizing the economic benefits of including forest management in domestic climate policy. Meanwhile other nations appear to be moving ahead with forest carbon offsetting as a component of domestic policy. For example, Norway is actively engaged in the mapping, monitoring, and financing of

61. *See* Dep't of State, USAID & Dep't of the Treasury, *FY 2011 Budget for International Climate Change Financing*, *available at* http://www.usclimatenetwork.org/resource-database/resource-database/fy-2011-summary-of-core-climate-assistance-budget (last visited Nov. 5, 2011). This action is a step towards fulfilling U.S. promises made at the 15th Conference of the Parties (CoP) to the United Nations Framework Convention on Climate Change (UNFCCC) in December 2009 in Copenhagen. Robert N. Stavins and Robert C. Stowe assess in detail the Copenhagen meetings and these provisions. *See* Robert N. Stavins & Robert C. Stowe, *What Hath Copenhagen Wrought? A Preliminary Assessment*, ENV'T MAG., May/June 2010, *available at* http://www.environmentmagazine.org/Archives/Back%20Issues/May-June%202010/what-wrath-full.html.

forest carbon storage in developing countries and then counting this effort toward Norway's domestic emissions reduction target.[62]

If the U.S. climate policy pathway leaves offset opportunities unexploited, as legal and institutional barriers indicate it will, at least over the short term incentives to innovate and invest in the technology necessary to support global forest offsets will be substantially blunted. Without this technological investment, *future* offset programs will be more difficult and more costly to implement. Countries that do pursue international offsets as part of their emissions reduction policy will have to bear a much larger share of the technological burden. This will likely reduce the quality of offsets that are available (increasing their cost or reducing their real emissions impact), dissuade countries from including offsets in their policies at all, or both. Assuming land use and offset information would be shared (and there is little reason it would not be), monitoring and verification technology is a public good. Although the lack of U.S. participation does not necessarily doom development of this technology, it is a big blow.

Moreover, the likely failure to include offsets and promote forest monitoring technology is an unnecessary artifact of the particular path the United States has chosen for climate policy. If the United States adopted no emissions reduction policy at all, then of course there would be no incentive for U.S. investment in offset technology. But this would be the least of the environmental problems flowing from the choice to do nothing. In fact, the United States does and will continue to have an emissions reduction policy, even over the short term, driven by the EPA and the states. The difficulty of integrating offsets into this regime is among its largest failures. This limitation of Clean Air Act climate policy will increase costs, decrease achievable emissions benefits, and result in a missed opportunity for technological and environmental investments with large present and future benefits.

62. *See* NORWEGIAN MINISTRY OF THE ENV'T & MINISTRY OF FOREIGN AFFAIRS, THE GOVERNMENT OF NORWAY'S INTERNATIONAL CLIMATE AND FOREST INITIATIVE (2010), *available at* http://www.regjeringen.no/upload/MD/Vedlegg/Klima/klima_skogprosjektet/mai2010.pdf.