

ARTICLE

DESIGNING EFFECTIVE CLIMATE POLICY: CAP-AND-TRADE AND COMPLEMENTARY POLICIES

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In this article, I analyze a difficult and surprisingly under-examined issue about how to reduce greenhouse gas emissions most effectively at the lowest cost. If policy-makers commit to using cap-and-trade as a central regulatory mechanism—the dominant policy choice to date—to what extent should they also adopt regulatory programs that contain more traditional direct regulation? Cap-and-trade is by definition designed to harness market forces to allow polluters to make choices about whether and how they will reduce their own emissions or trade for a right to emit more while another polluter cuts emissions more dramatically. Complementary policies, by contrast, designate in advance how greenhouse gases (“GHGs”) must be reduced and the sources from which these reductions must come. While complementary policies can effectively reduce emissions, they also constrain the market options available under cap-and-trade by limiting the choices emitters have about how to reduce their emissions. That constraint can lead to higher compliance costs. Though policymakers may enact complementary policies for reasons other than greenhouse gas emissions reduction, if the goal is solely to reduce greenhouse gases most cost-effectively, cap-and-trade alone is a better choice in a well-functioning market. However, if systematic market failures prevent emitters subject to a cap-and-trade system from choosing the lowest cost compliance options, then, from a climate policy perspective, complementary policies to correct the market failure make sense. Energy efficiency measures are one example of a complementary policy that corrects such a market failure. If no market failure exists, policymakers should recognize the trade-off inherent in limiting the market mechanisms cap-and-trade is designed to promote and evaluate whether ancillary benefits justify the reduction in market flexibility and the potentially higher costs.

I. INTRODUCTION

Cap-and-trade programs to reduce greenhouse gas emissions are burgeoning around the world. The longest running program is the European Union’s Emissions Trading System (“ETS”), which became operational in 2005.¹ The Regional Greenhouse Gas Initiative (“RGGI”)—adopted by a number of northeastern states to limit carbon dioxide emissions from electric utilities—began in 2009.² California has adopted rules to put into place an

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¹ For background, see *Emissions Trading System (EU ETS)*, EUROPEAN COMMISSION, http://ec.europa.eu/clima/policies/ets/index_en.htm (last updated Nov. 15, 2010).

² *Fact Sheet: The Regional Greenhouse Gas Initiative (RGGI)*, REG’L GREENHOUSE GAS INITIATIVE, http://www.rggi.org/docs/RGGL_Fact_Sheet.pdf (last visited Mar. 15, 2012). For

economy-wide cap-and-trade system that will begin auctioning permits in late 2012.³ Quebec and British Columbia have announced that they will join California in the Western Climate Initiative, which will work to harmonize the cap-and-trade programs of its members.⁴ Australia just enacted a carbon tax, which will convert to a cap-and-trade program in 2015.⁵ Even China is getting in on the act, working with the European Union to establish a cap-and-trade program in eight cities around the country.⁶ Although federal action remains stalled, all of the major congressional bills for the past several years have included as their centerpiece a cap-and-trade scheme.⁷ If Congress shifts course over the next several years and adopts climate change policy, cap-and-trade will likely remain at its centerpiece given its policy dominance globally.⁸

background on the Regional Greenhouse Gas Initiative, see REG'L GREENHOUSE GAS INITIATIVE, <http://www.rggi.org/home> (last visited Mar. 15, 2012) [hereinafter REGIONAL GREENHOUSE GAS INITIATIVE WEBSITE].

³ For a detailed description of California's program, see *AB 32 Scoping Plan*, CAL. AIR RES. BD., <http://arb.ca.gov/cc/scopingplan/scopingplan.htm> (last updated Aug. 30, 2011).

⁴ *Western Climate Initiative Jurisdictions Establish Non-Profit Corporation to Support Greenhouse Gas Emissions Trading Programs*, W. CLIMATE INITIATIVE (Nov. 10, 2011), <http://www.westernclimateinitiative.org/news-and-updates/137-western-climate-initiative-jurisdictions-establish-non-profit-corporation-to-support-greenhouse-gas-emissions-trading-programs>.

⁵ See *Flexible-Price Phase—Fiscal Implications*, AUSTRAL. GOV'T, <http://www.cleanenergyfuture.gov.au/flexible-price-phase-%e2%80%94fiscal-implications> (last visited Mar. 16, 2012).

⁶ Kim Chipman & Matthew Carr, *China's Cap and Trade to Come Within Five Years, Professor Stern Predicts*, BLOOMBERG NEWS (Dec. 6, 2010), <http://www.bloomberg.com/news/2010-12-06/china-s-cap-and-trade-to-come-within-five-years-professor-stern-predicts.html>.

⁷ In 2010, the U.S. House of Representatives passed H.R. 2454, the American Clean Energy and Security Act of 2009 (also known as the Waxman-Markey Bill), the centerpiece of which was a cap-and-trade scheme. H.R. 2454, 111th Cong. (2009). U.S. Senators Barbara Boxer (D-Cal.) and John Kerry (D-Mass.) also introduced a bill in the 111th Congress to regulate greenhouse gas emissions in large measure through cap and trade. S. 1733, 111th Cong. (2010). Senators Kerry and Joseph Lieberman (I-Conn.) also drafted and circulated legislation that included cap-and-trade as a central component. Press Release, Sen. John Kerry, Kerry, Lieberman: American Power Act Will Secure America's Energy, Climate Future (May 12, 2010), available at <http://kerry.senate.gov/press/release/?id=5e1dc216-ce17-4cc2-92e1-8321efc8240c>. The later versions of the Bill limited the cap-and-trade program to utilities. See Josh Voorhees & Robin Bravender, *Kerry, Lieberman Push Their Own Utility-Only Climate Bill as Reid's Decision Nears*, N.Y. TIMES (July 14, 2010), <http://www.nytimes.com/cwire/2010/07/14/14climatewire-kerry-lieberman-push-their-own-utility-only-69652.html?pagewanted=all>. The Bill has not been formally introduced as of this writing.

⁸ It is also possible, of course, that Congress could choose alternative regulatory means, including a carbon tax, to reduce greenhouse gas emissions. Many economists believe that carbon taxation is the best means to combat climate change and have advocated for a change in policy direction away from cap-and-trade. See, e.g., Oliver Tickell, *Replace Kyoto Protocol with Global Carbon Tax, Says Yale Economist*, THE GUARDIAN (Mar. 12, 2009), <http://www.guardian.co.uk/environment/2009/mar/12/carbon-tax-should-replace-kyoto-protocol>; Oliver Tickell, *Replace Kyoto Protocol with Global Carbon Tax, Says Yale Economist*, (quoting economist William Nordhaus as saying that "[t]axation is a proven instrument"); Joseph Stiglitz, *Carbon Taxing the Rich*, THE GUARDIAN (Dec. 7, 2007), <http://www.guardian.co.uk/comment/isfree/2007/dec/07/carbon taxing the rich>. For an extensive argument that a carbon tax is the most effective tool for reducing greenhouse gas emissions, see SHI-LING HSU, THE CASE FOR A CARBON TAX (2011).

The idea of cap-and-trade is straightforward. A total amount of allowable pollution is set (the cap). Those subject to the cap are allocated allowances (in sum equal to the cap) that allow them to pollute (typically one ton of pollutant per allowance,⁹ with the total number of allocated allowances equal to the cap). Emitters may meet their allocated amount in one of three ways. They may use all of their allowances. They may cut their pollution to levels below the amount they have been allocated and trade/sell the excess allowances to those who need them. Or they may pollute in excess of the amount of allowances allocated and make up the difference by purchasing allowances from those emitters who don't need all of theirs.¹⁰

But cap-and-trade has by no means been the only mechanism proposed to tackle climate change. To the contrary, at the federal, state, and local jurisdictions have proposed and sometimes enacted numerous policies to “complement” cap-and-trade by specifying in advance how to achieve reductions in greenhouse gases. These complementary policies include energy efficiency standards for new and existing buildings,¹¹ renewable portfolio standards to require electric utilities to provide a percentage of their electricity from renewable sources,¹² and performance standards for automobiles,¹³ ap-

⁹ See Robert N. Stavins, *Addressing Climate Change with a Comprehensive US Cap-and-Trade System*, 24 OXFORD REV. OF ECON. POL'Y 298, 299 (2008) (“[B]ecause [firms] have to surrender an allowance for each ton of their emissions they will undertake all emission reductions that are less costly than the market price of an allowance.”).

¹⁰ For further explanation of cap-and-trade, see ROBERT N. STAVINS, BROOKINGS INST., A U.S. CAP-AND-TRADE SYSTEM TO ADDRESS GLOBAL CLIMATE CHANGE 8 (2007).

¹¹ Section 201 of the Waxman-Markey Bill would for the first time adopt a national building code for new residential and commercial buildings. See H.R. 2454, 111th Cong. § 201 (2009). The Boxer-Kerry Bill contains significantly weaker provisions. See Shari Shapiro, *Boxer-Kerry Punts on National Energy Efficiency Building Code*, GREEN BLDG. L. BLOG (Sept. 30, 2009), <http://www.greenbuildinglawblog.com/2009/09/articles/waxmanmarkey-1/boxerkerry-punts-on-national-energy-efficiency-building-code>. At the state level, California has long led the way. The state first enacted energy efficiency standards for both residential and non-residential buildings in the 1970s. See CAL. ENERGY COMM'N, 2008 BUILDING ENERGY: EFFICIENCY STANDARD FOR RESIDENTIAL AND NONRESIDENTIAL BUILDINGS (2008). California passed legislation in 2009 to require its Energy Commission to establish building standards for existing residential and nonresidential buildings. See Assemb. B. 758, 2009–2010 Legis. Sess. (Cal. 2009), available at http://info.sen.ca.gov/pub/09-10/bill/asm/ab_0751-0800/ab_758_bill_20091011_chaptered.html.

¹² For a list of states with Renewable Portfolio Standards, see *Renewable & Alternative Energy Portfolio Standards*, PEW CTR. ON GLOBAL CLIMATE CHANGE, http://www.pewclimate.org/what_s_being_done/in_the_states/rps.cfm (last updated Jan. 20, 2012).

¹³ California led the country in adopting the first greenhouse gas emissions standards for automobiles when it passed Assemb. B. 1493 in 2002. Assemb. B. 1493, 2001–2002 Legis. Sess. (Cal. 2002), available at <http://www.arb.ca.gov/cc/cms/documents/ab1493.pdf>. Through a lengthy process the Obama Administration has adopted the California standards and applied them nationwide. For an explanation of the state and federal standards, see Ann E. Carlson, *Iterative Federalism and Climate Change*, 103 NW. U. L. REV. 1097, 1125–28 (2009).

pliances¹⁴ and stationary sources to reduce greenhouse gas emissions or improve energy efficiency.¹⁵

The enactment of both cap-and-trade and complementary policies to cut greenhouse gas emissions raises a potential tension that to date has received little sustained analysis. The general theoretical underpinning of cap-and-trade is to harness market forces to find the cheapest greenhouse gas emissions reductions by allowing emitters to trade allowances in search of the most efficient reductions.¹⁶ Complementary policies, by contrast, designate in advance which sources greenhouse gas emissions reductions should come from (e.g. renewable energy supplies, building energy efficiency improvements); often specify the degree of emissions reductions from those sources; and sometimes even set forth how emitters should achieve those reductions.

Ample reasons may justify enacting some complementary policies alongside a cap-and-trade system; reasons that I will suggest in this article. But I also argue that the debate about climate policy has in large measure ignored the tension between harnessing market forces through cap-and-trade versus directing how greenhouse gas emissions reductions are to be achieved through complementary policies. If the central premise behind cap-and-trade is to allow market mechanisms to work in as unfettered a manner as possible in order to find the most cost-effective emissions reductions, complementary policies that designate in advance which emissions should occur will interfere with that premise. Though complementary policies, if well structured, can and will lead to reductions in carbon emissions, the point of cap-and-trade is to rely on market forces to find the cheapest emissions reductions without undue governmental interference. If the government enacts a cap-and-trade scheme—but independently regulates through complementary policies a significant percentage of the emissions that would otherwise be subject to cap-and-trade—the opportunities for reductions of emissions covered by cap-and-trade will be reduced. Moreover the emissions reductions occurring because of complementary policies may be more expensive than reductions a cap-and-trade scheme would produce independently—the point of cap-and-trade is to find the cheapest cost reductions, and those may be different reductions than the ones required by complementary policies. Again there may be good reason to pay the cost of less market flexibility in order to achieve certain emissions reductions. But in designing a comprehensive climate policy I argue that we should acknowledge and examine that cost—as

¹⁴ The federal government largely preempts states from issuing their own appliance efficiency standards. 42 U.S.C. § 6297(c) (2006). For a history of federal regulation in the area, see Ann E. Carlson, *Energy Efficiency and Federalism*, 1 SAN DIEGO J. CLIMATE & ENERGY L. 11, 14–18 (2009). President Obama has made improved appliance efficiency standards a priority as part of his energy and climate policy, ordering the Department of Energy to issue new standards expeditiously. See *Appliance Efficiency Standards*, 74 Fed. Reg. 6537 (Feb. 9, 2009).

¹⁵ See *Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule*, 74 Fed. Reg. 55,292 (proposed Oct. 27, 2009) (to be codified at 40 C.F.R. pt. 51, 52, 70, 71).

¹⁶ See STAVINS, *supra* note 10, at 8.

well as analyze the benefits from any given complementary policy—in order to determine the appropriate policy balance. To illustrate this, the simultaneous implementation of an economy-wide cap-and-trade program with a renewable portfolio standard¹⁷ could lead to energy prices twenty-five percent higher than the implementation of cap-and-trade alone, according to one study, while achieving the same level of reductions in greenhouse gas emissions.¹⁸

In order to frame my analysis, I begin my discussion in Part II with an overview of cap-and-trade, including background about how and why it has become the dominant policy choice in controlling greenhouse gas emissions. I also analyze why many policy analysts and policymakers believe that a well-structured cap-and-trade is particularly well-suited to tackle the problem of climate change. Given the nature of the problem of climate change and anthropogenic greenhouse gas emissions, there are strong economic reasons to believe that cap-and-trade (if well-designed) is an effective way to meet the environmental goal of reducing greenhouse gas emissions by a predictable amount (the cap). This is largely because greenhouse gas emissions create a global, not a local, problem, so that the location in which emissions are reduced does not matter to environmental success. In this section I also discuss potential design flaws in a cap-and-trade scheme that could undermine its effectiveness, making the case in favor of many complementary policies much stronger.

I then turn in Part III to two prominent policy options—a renewable portfolio standard and energy standards for buildings and appliances—that policymakers have frequently proposed to reduce carbon emissions. I first explain what I mean by complementary policies and analyze these policy options to provide an initial basis for determining the trade-offs at issue between the adoption of the policy and the limiting of cap-and-trade flexibility. With respect to energy building and appliance standards, for example, there are good reasons to believe that many energy efficiency measures are cost-effective but may not occur even in the presence of a well-functioning cap-and-trade system because of well-known and well-understood market failures. Thus the trade-off appears to be justifiable. With respect to renewable portfolio standards, the case for their adoption is more complex but is probably strongest if there are reasons to believe that cap-and-trade may not send a strong enough price signal to induce early investment in alternative technologies. But if a robust cap-and-trade market exists, the case for a renewable portfolio standard (“RPS”) as a mechanism to reduce carbon emissions is significantly weaker. Moreover, adoption of an RPS could significantly

¹⁷ A Renewable Portfolio Standard requires utilities to procure a certain percentage of their power generation from alternative, renewable sources. See discussion *infra* notes 129–134 and accompanying text.

¹⁸ JENNIFER F. MORRIS, JOHN M. REILLY & SERGEY PALTSEV, MIT JOINT PROGRAM ON THE SCI. AND POLICY OF GLOBAL CHANGE, COMBINING A RENEWABLE PORTFOLIO STANDARD WITH A CAP-AND-TRADE POLICY: A GENERAL EQUILIBRIUM ANALYSIS 7 (2010).

increase the cost of reducing emissions without a corresponding payoff in improved greenhouse gas emissions performance. I conclude in Part IV by suggesting a framework for analyzing other potential complementary policies and their relationship to cap-and-trade.

II. CAP-AND-TRADE

A. Greenhouse Gases and Cap-and-Trade

The greenhouse effect is a non-controversial and well-articulated phenomenon¹⁹ that I describe here in order to explain why market mechanisms to control greenhouse gas emissions have become the dominant policy response and why such mechanisms are likely to deliver the most cost-effective emissions reductions.

Greenhouse gases—the most common of which is carbon dioxide²⁰—make up a small but crucial percentage of the earth’s atmosphere and trap heat from the sun.²¹ These gases essentially “blanket” the globe, trapping heat everywhere and helping to maintain the Earth’s temperature at about thirty degrees Celsius²² higher than it would be in the absence of the gases.²³ Thus, *natural* greenhouse gas concentrations help make the Earth habitable. The problem, of course, is the unsustainable amount of greenhouse gases that humans are *artificially* adding to the atmosphere each year. With near-unanimity, atmospheric and climate scientists believe that increasing concentrations of greenhouse gas emissions, due principally to the burning of fossil fuels, are adding to the greenhouse effect and causing the earth to warm rapidly.²⁴ Mean global surface temperatures have increased by 0.74 (plus or minus 0.18 degrees Celsius²⁵ in the last 100 years.²⁶ The Fourth

¹⁹ See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *FAQ 1.3 What is the Greenhouse Effect?*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, http://www.ipcc.ch/publications_and_data/ar4/wg1/en/faq-1-3.html (last visited Mar. 16, 2012).

²⁰ For a summary of other heat-trapping gases, see U.S. GLOBAL CHANGE RESEARCH PROGRAM, *GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES 14–15* (2009), available at <http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf>.

²¹ See *FAQ 1.3 What is the Greenhouse Effect?*, *supra* note 19.

²² Eighty-six degrees Fahrenheit.

²³ For an excellent description of the greenhouse gas effect and why it raises such a policy conundrum, see Richard J. Lazarus, *Super Wicked Problems and Climate Change: Restraining the Present to Liberate the Future*, 94 CORNELL L. REV. 1153, 1161–72 (2009).

²⁴ See, e.g., INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *CLIMATE CHANGE 2007: SYNTHESIS REPORT 5* (2007) (“Most of the observed increase in global temperature averages since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations.”); NAT’L ACADS. OF SCI., *ADVANCING THE SCIENCE OF CLIMATE CHANGE 17* (2010) (“[T]here is a strong, credible body of evidence, based on multiple lines of research, documenting that climate is changing and that these changes are in large part caused by human activities.”); U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 20, at 9 (“Observations show that warming of the climate is unequivocal. The global warming observed over the past 50 years is due primarily to human-induced emissions of heat-trapping gases.”).

²⁵ Between 1.01 and 1.66 degrees Fahrenheit.

Assessment of the IPCC predicts continuing temperature increases of between 1.3 and 1.8 degrees Celsius²⁷ by mid-century, depending on trends in greenhouse gas emissions.²⁸

The largest sources of anthropogenic greenhouse gases are from the electricity generating, transportation and industrial sectors, although deforestation—particularly in the developing world—also contributes to climate change by releasing carbon stored in plants and soil.²⁹ Thus the reduction of emissions from the generation of GHGs implicates virtually all aspects of the economies of the developed and developing worlds. Historically, for the most part, the environmental externalities created by greenhouse gases have not been regulated (though many countries regulate other pollution externalities from the burning of fossil fuels, including air and water pollution). Only recently have some countries—most notably the members of the European Union—began to regulate greenhouse gases through cap-and-trade.³⁰

Greenhouse gas regulation could take a number of forms, including direct emissions controls on large sources, the subsidization of zero emissions sources of energy such as solar and geothermal, or the imposition of a price on carbon emissions that requires greenhouse gas emitters to internalize the cost of the harms resulting from their contribution to climate change.³¹ The price could take the form of a tax on carbon or emerge through the establishment of cap-and-trade. The tax should “force [emitters] to consider the full set of consequences from emissions.”³² Though a robust debate exists about whether a carbon tax or cap-and-trade is the preferable regulatory choice,³³ I concentrate here on cap-and-trade because of its—to date—dominance as a policy choice. The analytic question about whether policy-makers should

²⁶ See *Global Warming, Frequently Asked Questions*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., <http://www.ncdc.noaa.gov/oa/climate/globalwarming.html> (last updated Aug. 20, 2008). For comparison, “[a]verage Northern Hemisphere temperatures during the second half of the 20th century were *very likely* higher than during any other 50-year period in the last 500 years and *likely* the highest in at least the past 1,300 years.” INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS 9 (2007), available at <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf>.

²⁷ Between 2.34 and 3.42 degrees Fahrenheit.

²⁸ See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS, *supra* note 26, at 749.

²⁹ See *Global Greenhouse Gas Data*, U.S. ENVTL. PROT. AGENCY, <http://www.epa.gov/climatechange/emissions/globalghg.html> (last updated Apr. 14, 2011). For the most recent U.S. data, see *2011 U.S. Greenhouse Gas Inventory Report*, U.S. ENVTL. PROT. AGENCY, <http://epa.gov/climatechange/emissions/usinventoryreport.html> (last updated Aug. 5, 2011).

³⁰ See *supra* notes 1–3 and accompanying text.

³¹ For an overview of regulatory options in the environmental field, see generally Nathaniel O. Keohane, Richard L. Revesz & Robert N. Stavins, *The Choice of Regulatory Instruments in Environmental Policy*, 22 HARV. ENVTL. L. REV. 313 (1998).

³² Gilbert E. Metcalf & David Weisbach, *The Design of a Carbon Tax*, 33 HARV. ENVTL. L. REV. 500, 500 (2008).

³³ See, e.g., Reuven S. Avi-Yonah & David M. Uhlmann, *Combating Global Climate Change: Why a Carbon Tax is a Better Response to Global Warming than Cap-and-Trade*, 28 STAN. ENVTL. L.J. 3 (2009); *The Debate Zone, Carbon Tax v. Cap and Trade*, MCKINSEY & Co., http://whatmatters.mckinseydigital.com/the_debate_zone/carbon-tax-vs-cap-and-trade#ab (last visited Feb. 26, 2012).

complement a price on carbon with regulatory policies should apply with equal force, however, to a carbon tax.

Cap-and-trade (and any form of regulation to reduce greenhouse gases) is designed to correct a market failure. In the absence of the regulation of emissions, emitters do not pay the full social cost of their activities; those costs are instead borne by those harmed by climate change.³⁴ By capping emissions at a level thought necessary to reduce the effects of climate change and then distributing allowances to allow emissions up to the amount of the cap, allowance prices should reflect the marginal cost of abatement and emitters should find the means to reduce emissions that fall below that cost.³⁵

For the purpose of regulating the emission of greenhouse gases, several qualities of the gases and the resulting problem of global warming make them especially amenable to market-based regulatory solutions. Most importantly, the problem of climate change is caused by the accumulation of greenhouse gases in the global atmosphere, not in specific locations. A ton of carbon dioxide has the same global effect whether emitted in the Gambia or in New Zealand.³⁶ A corollary of this principle is that *preventing* the release of a ton of carbon dioxide is not location-specific; a reduction in the Gambia has the same effect as a reduction in New Zealand.³⁷ This makes carbon dioxide much more suitable to a cap-and-trade solution than a pollutant like mercury that has serious local effects.³⁸ It also means, given the lack of localized pollution problems, that a well-designed system aimed at finding the cheapest emissions reductions should be just as effective from a climate change perspective as a system aimed at directly regulating particular emissions. The nature of the greenhouse problem also means that there is significant flexibility in the timing of emissions reductions. GHGs accumu-

³⁴ See Metcalf & Weisbach, *supra* note 32, at 501, 511 (describing the optimal tax that will force emitters to internalize the full social cost of their activities).

³⁵ See Nicolas Stern, *What is the Economics of Climate Change?* WORLD ECON., Apr.–June 2006, at 5–8.

³⁶ See JONATHAN L. RAMSEUR, CONG. RESEARCH SERV., RL 34705, ESTIMATING OFFSET SUPPLY IN A CAP-AND-TRADE PROGRAM 1 (2010) (“From a climate change perspective, the location of the reduction, avoidance, or sequestration does not matter: a ton of CO₂ (or its equivalent in another GHG) reduced in the United States and a ton sequestered in another nation would have the same result on the atmospheric concentration of GHGs.”).

³⁷ This corollary has very recently come under challenge, however. In a 2010 study, Stanford Engineering Professor Mark Jacobsen modeled the effects of carbon dioxide “domes” that form over heavily urbanized areas have on air pollution rates and concluded that “local CO₂ emissions in isolation may increase local ozone and particulate matter,” though the results are “uncertain.” Mark Z. Jacobson, *Enhancement of Local Air Pollution by Urban CO₂ Domes*, 44 ENVTL. SCI. & TECH. 2497, 2497 (2010). Jacobson’s findings could make the efficacy of cap-and-trade as a regulatory tool to control greenhouse gas emissions somewhat more controversial. Nevertheless, the corollary remains true with respect to the problem of *climate change*: controlling a ton of carbon dioxide for purposes of reducing the greenhouse effect is not location specific even if controlling carbon dioxide locally could have beneficial effects on air pollution.

³⁸ JAMES E. MCCARTHY, CONG. RESEARCH SERV., MERCURY EMISSIONS FROM ELECTRIC POWER PLANTS: AN ANALYSIS OF EPA’S CAP-AND-TRADE REGULATIONS 14–15 (2006).

late in the atmosphere and linger for many years. Carbon dioxide can last for up to several hundred years, although estimates differ dramatically, and one particularly potent GHG, PFC-14, lasts for 50,000 years.³⁹ Unlike more traditional air pollution problems like ozone, where daily and even hourly emissions levels matter because of immediate health effects,⁴⁰ climate change is a long-term problem of gases accumulating over many, many years. The solution to the problem of accumulating gases is to stabilize atmospheric concentrations over the long run, not to reduce a set amount annually or daily. In pollution control terms, just as we need not worry about spatial GHG hotspots we also need not worry about temporal GHG hotspots that concentrate ambient pollutants at a particular time. The result is more temporal flexibility⁴¹ in reducing emissions than other pollution problems have. A cap-and-trade system to control greenhouse gas emissions can be designed to allow for the banking and borrowing of allowances—if an annual cap exists, for example, banking allows emitters to save allowances for use in a later year while borrowing allows for the use of allowances in an earlier year. The rationale for allowing banking and borrowing is that emitters can time their abatement costs in a manner that makes economic sense—when making regularly scheduled equipment turnover changes, for example.⁴² Moreover, on an economy-wide basis, allowing for temporal flexibility avoids concentrating investment in control technology in a narrow time frame, which can put upward pressure on supply and therefore price.⁴³

Greenhouse gas emissions come from numerous sources, virtually any source that burns fossil fuels.⁴⁴ While the fact that sources are numerous makes control of emissions particularly daunting, cap-and-trade has an advantage over traditional technology-based regulation in that the regulating government need not identify potential control technologies and thus the burden of administering the system should be lower (though the need for measurement and monitoring remains). Instead of government-specified technologies to reduce emissions, GHG emitters bear the burden of identifying appropriate emissions controls. In theory, a robust market-based system should result in the development of new technologies to control emissions.⁴⁵

³⁹ See Lisa Moore, *Greenhouse Gases: How Long Will They Last?*, ENVTL. DEF. FUND BLOG (Feb. 26, 2008), http://blogs.edf.org/climate411/2008/02/26/ghg_lifetimes.

⁴⁰ *Health Effects of Ozone in the General Population*, U.S. ENVTL. PROT. AGENCY, <http://www.epa.gov/apti/ozonehealth/population.html> (last updated Feb. 3, 2012).

⁴¹ JONATHAN B. WIENER, CTR. FOR THE STUDY OF AM. BUS., *DESIGNING GLOBAL CLIMATE POLICY: EFFICIENT MARKETS VERSUS POLITICAL MARKETS* 16 (1997), available at <http://wc.wustl.edu/files/wc/designing.pdf>.

⁴² THOMAS H. TIETENBERG, *EMISSIONS TRADING: PRINCIPLES AND PRACTICE* 198–99 (2d ed. 2006).

⁴³ *Id.* at 199 (“When everyone makes control investments at the same time, it strains the supply capacity of the system and prices will be unnecessarily high.”).

⁴⁴ For an explanation of the various greenhouse gases and their sources, see *Greenhouse Gas Emissions*, U.S. ENVTL. PROT. AGENCY, <http://epa.gov/climatechange/emissions/index.html> (last updated Apr. 20, 2011).

⁴⁵ TIETENBERG, *supra* note 42, at 4–5.

Finally, the sheer magnitude of the global emissions problem—numerous sources contributing emissions from around the globe and scientific recommendations that require a dramatic shift away from traditional fossil fuel-based energy sources—means that the overall cost of controlling emissions is estimated to be huge (though offsetting benefits and the lengthy time frame involved makes overall cost-benefit projections particularly controversial).⁴⁶ Economic studies have shown that cap-and-trade schemes to date have been more cost-effective than traditional systems of regulation in controlling pollution; moreover, design mechanisms within cap-and-trade can dramatically lower costs (e.g. banking and borrowing, offset provisions). Cost-effectiveness is a worthy goal regardless of the environmental problem involved. But in the case of climate change—which to stabilize temperatures over the long-term may require reducing world CO₂ emissions by eighty percent from year 2000 levels before the middle of the century⁴⁷—the dollar savings from a more flexible regulatory approach are likely to be enormous.

In theory, then, cap-and-trade offers a very promising method for economy-wide reductions in greenhouse gas emissions. Because of the widespread prevalence of emissions and their temporal and spatial fungibility, cap-and-trade should work well to deliver emissions reductions more cost-effectively than other regulatory means. It is possible, however, that market mechanisms for controlling greenhouse gas emissions might not be fully socially optimal. Although cap-and-trade is designed to correct a major market failure—emitters do not pay the full social cost of climate change from their polluting activities⁴⁸—other market failures may prevent cap-and-trade from realizing its full potential. These market failures or barriers could limit the strength of the price signal⁴⁹ created through the pricing of allowances.⁵⁰ For example, information barriers about long-term energy prices, split incentives between who pays for investments in energy infrastructure versus who pays for electricity prices, and positive externalities for investments in basic research and development can all hinder the effective operation of cap-and-trade.⁵¹ If there are market failures that prevent cap-and-trade from working

⁴⁶ See generally, e.g., NICHOLAS STERN, *THE ECONOMICS OF CLIMATE CHANGE*, pt. III, 191–348 (2007) (discussing at length the economic challenges of achieving stabilization of greenhouse gases in the atmosphere); William D. Nordhaus, *A Review of the Stern Review on the Economics of Climate Change*, 45 J. ECON. LITERATURE 686 (2007).

⁴⁷ STERN, *supra* note 46, at 223.

⁴⁸ See Metcalf & Weisbach, *supra* note 32, at 501, 511 (describing the optimal tax that will force emitters to internalize the full social cost of their activities).

⁴⁹ IVAN O'NEILL, S. CAL. EDISON, *PRICES TO DEVICES: PRICE RESPONSIVE DEVICES AND THE SMART GRID*, 4–6 (2010), available at <http://www.oasis-open.org/committees/download.php/40684/Prices%20to%20Devices%20White%20Paper%20-%20101229.pdf>.

⁵⁰ See NAT'L ACAD. OF SCI., *LIMITING THE MAGNITUDE OF FUTURE CLIMATE CHANGE* 110 (2010).

⁵¹ See *id.* at 109–10.

to find the lowest cost emissions reductions, then policymakers may need to enact complementary policies to address those market failures.⁵²

But as I argue below, policy-makers may enact complementary policies without any market failure justification. In this case, the promise of cap-and-trade—reduced GHG emissions at the lowest cost—is undermined. Before turning to those arguments, however, I provide an overview of the United States' use of cap-and-trade to control air pollution emissions and how that experience has led to cap-and-trade as the dominant policy mechanism to reduce greenhouse gases.

B. Air Pollution and Cap-and-Trade

Over the last twenty years, the U.S. approach to reducing conventional air pollutants has increasingly relied on cap-and-trade. Traditional pollution control regulation in the United States is characterized by technology-based standards that either mandate or strongly encourage the use of particular control technologies on specific equipment. For example, the Clean Air Act (“CAA”) requires that polluters who emit more than ten tons of a regulated pollutant, if located in the most polluted parts of the country (called extreme non-attainment zones), must install technology that results in the “Lowest Achievable Emissions Rates” (“LAER”).⁵³ So-called LAER technology is recommended by the EPA through “Control Techniques Guidelines,” which specify particular pollution control technologies for different industrial processes. The CAA is replete with these tech-based standards.⁵⁴

In the 1970s, however, Congress began to authorize flexible regulatory approaches that allowed sources of air pollution more discretion in complying with federal air standards by trading of emissions rights. These market-based programs under the Clean Air Act have in turn provided the experiential basis for extending cap-and-trade to regulate greenhouse gas emissions at the international and domestic levels. The first use of emissions trading occurred in the mid-1970s in non-attainment areas of the country (non-attainment with the National Ambient Air Quality Standards).⁵⁵ The problem regulators faced was how to allow economic growth to occur—and the inevitable new emissions such new sources of air pollution create—without

⁵² I address the question of whether complementary policies can produce co-benefits and co-costs *infra* Part III.

⁵³ See 42 U.S.C. § 7501 (2006).

⁵⁴ See, e.g., U.S. ENVTL. PROT. AGENCY, CONTROL TECHNIQUES GUIDELINES FOR FLEXIBLE PACKAGE PRINTING (2006), available at http://www.epa.gov/ttn/caaa/t1/ctg/flex_pack_print_ctg_092906.pdf; U.S. ENVTL. PROT. AGENCY, CONTROL TECHNIQUES GUIDELINES FOR OFFSET LITHOGRAPHIC PRINTING AND LETTERPRESS PRINTING (2006), available at http://www.epa.gov/ttncaaa1/t1/ctg/litho_print_ctg_092906.pdf.

⁵⁵ The EPA is required to publish National Ambient Air Quality Standards (“NAAQS”) for air pollutants that meet certain criteria. See 42 U.S.C. §§ 7408–09 (2006). As of this writing, the EPA has published NAAQS for six pollutants. For details, see *National Ambient Air Quality Standards*, U.S. ENVTL. PROT. AGENCY, www.epa.gov/air/criteria.html (last updated Nov. 8, 2011).

pushing non-attainment areas even further out of compliance with air standards.⁵⁶ The solution was to allow existing sources to reduce their emissions below mandated levels, earn credits for doing so and then sell those credits to new sources coming into the non-attainment zone.⁵⁷ Not only has this so-called “offset policy” resulted in allowing economic growth while maintaining pollution levels, economists have found that the costs of purchasing offsets are lower than the installation of new pollution control technology.⁵⁸ Other market-based programs followed the offset policy, including the phasing out of lead-based gasoline in the mid-1980s,⁵⁹ and the reduction of ozone-depleting chemicals subject to the Montreal Protocol.⁶⁰

By far the most successful and lauded domestic market-based program to date was enacted as part of the 1990 Amendments to the Clean Air Act. The Acid Rain Program capped sulfur dioxide emissions at 8.95 million tons by 2000, with the first cap imposed in 1995 followed by a gradual ratcheting down. Electric utilities were granted allowances per ton of sulfur dioxide based largely on their previous emissions history.⁶¹ By virtually all accounts the Acid Rain Program has achieved three impressive goals: (1) larger emissions reductions than what was required statutorily in the first years of program operation; (2) a significant reduction in surface water acidity in those areas of the country most affected by acid rain; and (3) emissions reductions at significantly lower cost than would have occurred under traditional regulatory schemes.⁶² Most analysts are quite positive about the acid rain pro-

⁵⁶ For an excellent overview of emissions trading and a description of the history of regulatory trading programs see TIETENBERG, *supra* note 42, at 6–17.

⁵⁷ *See id.* at 6–7.

⁵⁸ *See* Daniel J. Dudek & John Palmisano, *Emissions Trading: Why is this Thoroughbred Hobbled?*, 13 COLUM. J. ENVTL. L. 217, 225 n.9 (1988).

⁵⁹ *See generally*, e.g., RICHARD G. NEWELL & KRISTIAN ROGERS, RES. FOR THE FUTURE, THE U.S. EXPERIENCE WITH THE PHASEDOWN OF LEAD IN GASOLINE 2–9 (2003), available at <http://web.mit.edu/ckolstad/www/Newell.pdf> (describing the history and substance of the lead-based gasoline phase out and tradable lead credit program).

⁶⁰ *See generally* Montreal Protocol on Substances that Deplete the Ozone Layer art. 2, Sept. 16, 1987, S. TREATY DOC. 100-10, 1522 U.N.T.S. 28; Clean Air Act Amendments of 1990, Pub. L. No. 101-549, § 602, 104 Stat. 2399, 2648–72 (codified as amended at 42 U.S.C. §§ 7671–71q) (adding a new Title VI to the Clean Air Act to protect stratospheric ozone).

⁶¹ *Cap and Trade: Acid Rain Program Basics*, U.S. ENVTL. PROT. AGENCY, <http://www.epa.gov/airmarkets/cap-trade/docs/arbasics.pdf> (last visited Mar. 16, 2012). For an extensive analysis of the Acid Rain Program, see A. DENNY ELLERMAN ET AL., MARKETS FOR CLEAN AIR: THE U.S. ACID RAIN PROGRAM (2000). For a detailed description of the program, see Jonathan Remy Nash & Richard L. Revesz, *Markets and Geography: Designing Marketable Permit Schemes to Control Local and Regional Pollutants*, 28 ECOLOGY L.Q. 569, 582–86 (2001).

⁶² *See* ELLERMAN ET AL., *supra* note 61, at 111, 292; ENVTL. DEF., FROM OBSTACLE TO OPPORTUNITY: HOW ACID RAIN EMISSIONS TRADING IS DELIVERING CLEANER AIR 1 (2000), available at http://apps.edf.org/documents/645_SO2.pdf; Jeffrey S. Kahl et al., *Have U.S. Surface Waters Responded to the 1990 Clean Air Act Amendments?*, 38 ENVTL. SCI. & TECH. 484, 486 (2004). Although some observers are concerned that the Acid Rain Program may create acid rain “hotspots,” to date such concerns appear largely unsupported. *See* Nash & Revesz, *supra* note 61, at 587; *see also* DALLAS BURTRAW & ERIN MANSUR, RES. FOR THE FUTURE, DISCUSSION PAPER NO. 99-25, THE EFFECTS OF TRADING AND BANKING IN THE SO₂ ALLOW-

gram, though some believe that the program's early successes were fortuitous in that western low sulfur fuel—which produces significantly less sulfur dioxide when burned—became much less expensive for Midwestern coal-fired power plants just as the Acid Rain Program was implemented because of the deregulation of the railroads and consequent lower transportation costs.⁶³ Thus the economics of switching to a cleaner fuel drove at least some of the emissions reductions.⁶⁴

In the wake of the sulfur dioxide program, the United States has continued to experiment with market-based programs with some significant successes and some less promising attempts. Most successful have been regional programs to control ozone through the oxides of nitrogen (“NO_x”) Budget Program, adopted by a group of eastern states under the auspices of the Ozone Transport Commission.⁶⁵ The NO_x Budget Program was a cap-and-trade program that capped emissions from utilities in the region and permitted utilities to trade allowances. It was sufficiently successful—achieving double digit reductions in ozone pollution each year of the program, including during peak ozone season⁶⁶—that the EPA expanded it to include a larger number of states under a program called the NO_x SIP call.⁶⁷ The NO_x SIP call has similarly succeeded in reducing ozone each year it has operated.⁶⁸ The EPA then replaced the NO_x SIP call with the Clean Air Interstate Rule (“CAIR”)⁶⁹ to include additional pollutants in a trading program,

ANCE MARKET 2 (1999), available at <http://www.rff.org/rff/Documents/RFF-DP-99-25.pdf> (“[T]he geographic consequences are not consistent with the fears of program critics.”).

⁶³ Lauraine G. Chestnut & David M. Mills, *A Fresh Look at the Benefits and Costs of the US Acid Rain Program*, 77 J. ENVTL. MGMT. 252, 255 (2005).

⁶⁴ *Id.* at 254–55.

⁶⁵ The 1990 Amendments to the Clean Air Act established the Ozone Transport Commission. 42 U.S.C. § 7511c(a) (2006). The Commission includes Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and the District of Columbia. *Id.*

⁶⁶ ANDREW AULISI ET AL., WORLD RES. INST., GREENHOUSE GAS EMISSIONS TRADING IN U.S. STATES: OBSERVATIONS AND LESSONS FROM THE OTC NO_x BUDGET PROGRAM 11–12 (2005), available at http://pdf.wri.org/nox_ghg.pdf.

⁶⁷ A State Implementation Plan (“SIP”) is a plan promulgated by each state to comply with the National Ambient Air Quality Standard (“NAAQS”) issued by EPA for a specific pollutant. See 42 U.S.C. § 7410(a) (2006). For information on how NAAQS are promulgated, see *id.* § 7409. Note that, if a state fails to produce an adequate SIP to comply with a particular NAAQS, the federal government can substitute a Federal Implementation Plan (“FIP”). See *id.* § 7410(c)(1) (listing conditions that require a FIP).

⁶⁸ See ENVTL. PROT. AGENCY, THE NO_x BUDGET TRADING PROGRAM: 2008 HIGHLIGHTS 3 (Oct. 2009). For a detailed description of the history of the Ozone Transport Commission and the NO_x emissions programs, see Carlson, *supra* note 13, at 1145–51.

⁶⁹ For the final rule, see Clean Air Interstate Rule, 70 Fed. Reg. 25,162 (May 12, 2005) (codified at 40 C.F.R. pt. 51, 72, 73, 74, 77, 78, 96). For a list of the affected states, see *id.* at 25,167. The final rule specified emissions reductions requirements for each affected state. See *id.* at 25,230 tbl.V-1 (sulfur dioxide budgets); *id.* at 25,233 tbl.V-4 (NO_x budgets). The rule also established a model multi-state cap-and-trade program for NO_x and sulfur dioxide that the affected states were free to adopt. See *id.* at 25,274–75 (describing the multi-state cap-and-trade program). Subsequently, EPA adopted the multi-state trading program for all affected states “until States have approved State implementation plans (SIPs) to achieve the [required] reductions.” Federal Implementation Plans, 71 Fed. Reg. 25,328, 25,328 (Apr. 28, 2006) (to be

though the legal status of CAIR was jeopardized by an adverse appellate court ruling limiting the EPA's ability to use trading programs under particular provisions of the Clean Air Act.⁷⁰ EPA revised the CAIR in response, renaming the program the "Cross-State Air Pollution Rule."⁷¹ This rule is also under legal attack.⁷²

In contrast to the Acid Rain Program and the ozone cap-and-trade systems, several state-based programs and one federal program have run into significant difficulty, providing learning feedback for successful cap-and-trade design. For example, Los Angeles has adopted a program called the Regional Clean Air Incentives Market ("RECLAIM") to limit NO_x and sulfur emissions through trading.⁷³ The program has had two significant setbacks. First, between 1993 and 1999, an excess number of allowances (allowing polluters to emit one ton of pollution per allowance/credit) were made available, leaving companies with allowances in excess of their emissions.⁷⁴ The result was that the market for allowances never developed robustly. But then, during California's electricity crisis in 2000, prices for allowances spiked dramatically because of huge increases in electricity demand and a corresponding increase in output from older, more polluting plants. Utilities were ill-equipped to act and lacked the appropriate number of allowances to cover their emissions cost-effectively. Allowance prices in-

codified at 40 C.F.R. pt. 51, 52, 72, 73, 74, 78, 96, 97). EPA found that the affected states had failed to adopt the necessary SIPs on April 25, 2005, Finding of Failure to Submit State Implementation Plans, 70 Fed. Reg. 21,147, 22,148 (Apr. 25, 2005) (to be codified at 40 C.F.R. pt. 52), which enabled EPA to promulgate FIPs at any time within two years, 42 U.S.C. § 7410(c)(1) (2006).

⁷⁰ *North Carolina v. U.S. Env'tl. Prot. Agency*, 531 F.3d 896, 910–11 (D.C. Cir. 2008). This portion of the litigation hinged on 42 U.S.C. § 7410(a)(2)(D)(i)(I) (2006), which requires SIPs to prohibit emissions that "contribute significantly to non-attainment [of the applicable NAAQS] in, or interfere with maintenance by, any other State." The court found that CAIR's multi-state trading program for sulfur dioxide and NO_x, as distinct from a separate cap-and-trade program in each state, violated this statutory requirement. *North Carolina*, 531 F.3d at 910–11 ("Because EPA . . . does not give independent significance to the 'interfere with maintenance' language to identify upwind states that interfere with downwind maintenance, it unlawfully nullifies that aspect of the statute and provides no protection for downwind areas that . . . still find themselves struggling to meet NAAQS due to upwind interference."); *see also id.* at 907 ("EPA did not purport to measure each state's significant contribution to specific downwind nonattainment areas and eliminate them in an isolated, state-by-state manner.").

⁷¹ *Cross-State Air Pollution Rule (CSAPR)*, U.S. ENVTL. PROT. AGENCY, <http://www.epa.gov/airtransport> (last updated Mar. 7, 2012) ("This rule replaces EPA's 2005 Clean Air Interstate Rule (CAIR).").

⁷² *See EME Homer City Generation, L.P. v. EPA*, No. 11-1302 (D.C. Cir. filed Aug. 23, 2011). The D.C. Circuit stayed enforcement on December 30, 2011, pending adjudication of the program's validity. Order at 2, *EME Homer City Generation, L.P.*, No. 11-1302 (Dec. 30, 2011), available at <http://www.epa.gov/crossstaterule/pdfs/CourtDecision.pdf>. EPA has expanded the stay to cover additional components of the new rule. *See Interstate Transport of Ozone: Effect of Stay of Transport Rule*, 77 Fed. Reg. 5,710, 5,711 (Feb. 6, 2012) (EPA extending the stay to other components of the program).

⁷³ *See Regional Clean Air Incentives Market*, S. COAST AIR QUALITY MGMT. DIST. (Feb. 14, 2008), <http://www.aqmd.gov/reclaim/reclaim.html>.

⁷⁴ *See TIETENBERG, supra* note 42, at 12.

creased more than tenfold and led Los Angeles air regulators to pull electric utilities out of the program.⁷⁵

Chicago has also experimented—not very successfully—with a cap-and-trade system to control volatile organic matter (“VOM”), an ozone precursor. One major design flaw in the Chicago program appears to be not in the cap-and-trade program itself but in the fact that VOM is also regulated through a series of more traditional regulatory programs aimed at hazardous air pollutants.⁷⁶ Thus, the emissions reductions that have occurred have been the result of those regulations, not due to an effective market-based system.⁷⁷

Finally, the Bush Administration attempted, unsuccessfully, to enact a cap-and-trade program for the control of mercury, principally from utilities.⁷⁸ The mercury rule was successfully challenged by states and environmental groups as inconsistent with the Clean Air Act.⁷⁹ The central concern of these groups was that mercury is ill-suited for regulation under a market-based trading scheme because its harmful effects are highly localized. Under cap-and-trade, a large mercury polluter could avoid reducing its emissions altogether and instead buy allowances from emitters in other localities who reduce their emissions below their allocations. This can allow “hotspots”—localized highly polluted areas—to continue to go unregulated.

The combined experience of successful and unsuccessful experiences with cap-and-trade under the Clean Air Act helped propel that regulatory option to the forefront as the dominant policy choice for regulating greenhouse gases both internationally and domestically. The experiences demonstrated that when effectively designed, and when aimed at the right type of pollutants, cap-and-trade can deliver significant emissions reductions more cost-effectively than more traditional command and control or technology-based regulatory schemes. By the same token, experience has demonstrated potential difficulties with cap-and-trade systems. Most predominantly the use of cap-and-trade for pollutants that have highly localized effects can create pollution hotspots; the overlaying of traditional regulation on top of cap-and-trade can undermine the effectiveness of market mechanisms; restrictions on the geographic reach of a cap-and-trade program can limit the

⁷⁵ *Id.*; see also W. BOWMAN CUTTER ET AL., RULES OF THE GAME: EXAMINING MARKET MANIPULATION, GAMING, AND ENFORCEMENT IN CALIFORNIA’S CAP-AND-TRADE PROGRAM 43–44 (2011), available at http://cdn.law.ucla.edu/SiteCollectionDocuments/Centers%20and%20Programs/Emmett%20Center%20on%20Climate%20Change%20and%20the%20Environment/Rules_of_the_Game.pdf.

⁷⁶ See generally DAVID A. EVANS & JOSEPH A. KRUGER, RES. FOR THE FUTURE, DISCUSSION PAPER No. 06-36, TAKING UP THE SLACK: LESSONS FROM A CAP-AND-TRADE PROGRAM IN CHICAGO 16–20 (2006), available at <http://www.rff.org/rff/Documents/RFF-DP-06-36.pdf>.

⁷⁷ See *id.* at 16–19.

⁷⁸ For a summary of the proposal, see generally *New Jersey v. U.S. Env’tl. Prot. Agency*, 517 F.3d 574, 579–80 (D.C. Cir. 2008).

⁷⁹ See *id.* at 577, 580 (finding that Congress, in specifying how hazardous air pollutants are to be regulated under the Clean Air Act, limited the EPA’s power to control mercury emissions through a cap-and-trade program).

capacity of trading to reduce overall costs; and the establishment of a cap that is too high can result in a lack of environmental effectiveness.⁸⁰

C. Climate Change and Cap-and-Trade to Date

Because of positive experience with the Acid Rain program and strong theoretical and experiential evidence that regulating greenhouse gas emissions is particularly amenable to a market-based solution, cap-and-trade has become the preferred solution to the problem of how to control GHG emissions.⁸¹ Central to cap-and-trade's popularity was the position of the U.S. delegation to the Kyoto climate negotiations in the mid-1990s to press hard for a commitment in the ultimate treaty for market-based approaches to reducing greenhouse gas emissions. Not only did the Clinton Administration support such an approach but so did some environmental non-governmental organizations, most prominently the Environmental Defense Fund. As described below, the United States was successful: the Kyoto Protocol contains three "flexible market-based mechanisms."

The Kyoto Protocol, agreed to in 1997 to take effect in 2005⁸² and ratified by most major countries with the very notable exception of the United States,⁸³ requires what are known as "Annex B" countries (developed/industrialized countries) to commit to greenhouse gas emissions caps of varying stringency but in sum equal to a five percent reduction below 1990s levels.⁸⁴ In order to meet those caps, the Kyoto Protocol authorizes three separate

⁸⁰ For an argument that most cap-and-trade programs have been ineffectual because regulators and policymakers set the cap too high, see Lesley K. McAllister, *The Overallocation Problem in Cap-and-Trade: Moving Toward Stringency*, 34 COLUM. J. ENVTL. L. 395 (2009).

⁸¹ See U.S. ENVTL. PROT. AGENCY, *2011 U.S. Greenhouse Gas Inventory Report*, *supra* note 29; U.S. ENVTL. PROT. AGENCY, *Global Greenhouse Gas Data*, *supra* note 29.

⁸² See Kyoto Protocol to the United Nations Framework Convention on Climate Change art. III, § 2, Dec. 11, 1997, 37 I.L.M. 22 [hereinafter Kyoto Protocol] ("Each Party included in Annex I [of the United Nations Framework Convention on Climate Change] shall, by 2005, have made demonstrable progress in achieving its commitments under this Protocol."); *id.* art. I, § 2 (defining "Convention" as The United Nations Framework Convention on Climate Change); *id.* art. I, § 7 (defining "Annex I" as Annex I to the Convention). Annex I contains developed countries and countries "undergoing the process of transition to a market economy." See United Nations Framework Convention on Climate Change Annex I, *ratified* Oct. 7, 1992, S. Treaty Doc. No. 102-38, 1771 U.N.T.S. 107.

⁸³ President Bush rejected the prospect of the United States participating in the Kyoto Protocol in a March 13, 2001 letter to U.S. Senators Larry Craig (R-Idaho), Chuck Hagel (R-Neb.), Jesse Helms (R-N.C.), and Pat Roberts (R-Kan.). Letter to Members of the Senate on the Kyoto Protocol on Climate Change, 1 PUB. PAPERS 235, 235 (Mar. 13, 2001) ("As you know, I oppose the Kyoto Protocol because it exempts 80 percent of the world, including major population centers such as China and India, from compliance, and would cause serious harm to the U.S. economy."). On February 14, 2002, the President announced an alternative program based largely on voluntary commitments and with reductions measured relative to economic activity. See Remarks Announcing the Clear Skies and Global Climate Change Initiatives, 1 PUB. PAPERS 226, 228-29 (Feb. 14, 2002).

⁸⁴ See Kyoto Protocol, *supra* note 82, art. III, § 7 (describing parties' GHG emission reduction obligations); *id.* Annex B, 37 I.L.M. at 42-43 (quantifying the emission limitations and reduction commitments of particular nations by percentage of base year or period).

market-based mechanisms. First, for Annex B countries that cut emissions below their agreed-to limits, the protocol authorizes the trading of excess emissions to countries who cannot meet their limits.⁸⁵ Emissions trading is to be tracked and monitored under registry systems established under the Kyoto Protocol.⁸⁶ Second, the Clean Development Mechanism (“CDM”) allows countries subject to limits to establish projects in non-limit (developing) countries that reduce greenhouse gas emissions.⁸⁷ These projects can then produce certified emissions reduction credits (“CERs”) equivalent to one ton of carbon dioxide that can be used to meet emissions targets in developed countries.⁸⁸ Finally, Joint Implementation Projects allow one Annex B country to work cooperatively with another Annex B country to reduce greenhouse gas emissions in the second country but have it count toward the first country’s emissions limit.⁸⁹

As a result of the Kyoto Protocol,⁹⁰ the European Union has adopted the most extensive cap-and-trade program to lower greenhouse gas emissions to date.⁹¹ Known as the E.U. Emissions Trading System (“ETS”), the ETS began operations in 2005 and began carbon trading in 2008.⁹² The ETS covers thirty different countries,⁹³ accounting for approximately forty percent of European Union emissions.⁹⁴ The ETS covers carbon dioxide emitted from electric utilities and most major industries.⁹⁵ Though the results of the ETS are by definition preliminary given the short operation of the system, observ-

⁸⁵ See *id.* art. XVII (“The Conference of the Parties serving as the meeting of the Parties to this Protocol shall, at its first session, approve appropriate and effective procedures and mechanisms to determine and to address cases of non-compliance with the provisions of this Protocol. . . .”); Decision 11/CMP.1 Annex, *in* Conference of the Parties Serving as the Meeting of the Parties to the Kyoto Protocol, Montreal, Can., Nov. 28–Dec. 10, 2005, *Action Taken by the Conference of the Parties*, U.N. Doc. FCCC/KP/CMP/2005/8/Add.2 (Mar. 30, 2006) (specifying modalities, rules, and guidelines for emissions trading under Article 17 of the Kyoto Protocol).

⁸⁶ Decision 11/CMP.1 Annex, *supra* note 85, § 2(d), at 18 (specifying that parties must “ha[ve] in place a national registry in accordance with Article 7, paragraph 4” of the Kyoto Protocol in order to trade emissions).

⁸⁷ See Kyoto Protocol, *supra* note 82, art. XII (describing the CDM).

⁸⁸ See *id.* art. XII, § 7 (authorizing the Conference of the Parties serving as the meeting of the Parties to “elaborate modalities and procedures” for the CDM); Decision 3/CMP.1, *in* Conference of the Parties Serving as the Meeting of the Parties to the Kyoto Protocol, Montreal, Can., Nov. 28–Dec. 10, 2005, *Action Taken by the Conference of the Parties*, *supra* note 85, U.N. Doc. FCCC/KP/CMP/2005/8/Add.1, at 6 (adopting the modalities and procedures for the CDM contained in the Annex); Decision 3/CMP.1 Annex, *in* Conference of the Parties Serving as the Meeting of the Parties to the Kyoto Protocol, *supra* note 85, U.N. Doc. FCCC/KP/CMP/2005/8/Add.1, § 1(b), at 7 (defining the term “certified emission reduction”).

⁸⁹ See Kyoto Protocol, *supra* note 82, art. VI, § 1 (authorizing parties with GHG emission reduction commitments to participate in Joint Implementation Projects).

⁹⁰ See, e.g., A. Denny Ellerman, *The EU Emission Trading Scheme: A Prototype Global System?* 3 (Harvard Project on Int’l Climate Agreements, Working Paper No. 02, 2008), available at <http://belfercenter.ksg.harvard.edu/files/Elleman11.pdf>.

⁹¹ *Id.* at 1.

⁹² *Id.* at 3.

⁹³ *Id.*

⁹⁴ *Id.*

⁹⁵ *Id.*

ers generally agree that the cap-and-trade system has succeeded in establishing a price for carbon that is factored into the investment decisions of covered facilities.⁹⁶

Domestically, one United States-based cap-and-trade system for carbon dioxide emissions, the Regional Greenhouse Gas Initiative (“RGGI”), is up and running. RGGI includes electric utilities in ten northeast and Mid-Atlantic states and caps their carbon dioxide emissions by 2018 at ten percent below 2008 emissions.⁹⁷ California is currently developing regulations to implement an economy-wide cap-and-trade program to comply with its landmark legislation⁹⁸ requiring the state to cut emissions to 1990 levels by 2020.⁹⁹ The cap-and-trade program took effect January 1, 2012.¹⁰⁰ And to date, each of the proposed major federal bills to cut carbon emissions contains as its centerpiece a cap-and-trade system.¹⁰¹

D. *Potential Design Flaws in Cap-and-Trade*

My central thesis is that, if cap-and-trade is to be the centerpiece of climate policy, we should acknowledge that the enactment of complementary policies to reduce carbon emissions will reduce the market flexibility inherent in cap-and-trade and may prove more expensive. We should then examine whether the gains from a complementary policy are worth the tradeoff in reduced market flexibility. It is worth stressing, however, that my thesis is dependent on a somewhat heroic assumption: that a cap-and-trade program is well-designed and well-functioning. If, instead, a cap-and-trade program has one of several potential design flaws, the program could fail to send an appropriately strong price signal to induce significant emissions reductions.

For example, a jurisdiction could include a poorly designed offset program that significantly undermines the capacity of cap-and-trade to produce real and cost-effective carbon emissions reductions. If a cap-and-trade program that allows for offsets does not achieve real and verifiable emissions reductions, then complementary policies may be an appropriate safeguard to achieve the cap.

⁹⁶ See, e.g., Ellerman, *supra* note 90 at 12 (“[T]he trial period did succeed in imposing a price on CO₂ emissions over about half of the emissions in Europe and in creating a mechanism for effecting greater reductions in the future.”).

⁹⁷ REGIONAL GREENHOUSE GAS INITIATIVE WEBSITE, *supra* note 2.

⁹⁸ For the text of the enacted bill, see California Global Warming Solutions Act, Assemb. B. 32, 2005–2006 Legis. Sess. (Cal. 2006), available at http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_0001-0050/ab_32_bill_20060927_chaptered.pdf.

⁹⁹ See generally CAL. AIR RES. BD., *AB 32 Scoping Plan*, *supra* note 3 and sources cited therein.

¹⁰⁰ CAL. AIR RES. BD., CLIMATE CHANGE SCOPING PLAN 1 (2008), available at http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf.

¹⁰¹ For a summary of federal legislation, see *supra* note 7.

Offsets are carbon reduction projects from reductions that are not otherwise covered by the cap. In most of the domestic cap-and-trade programs or proposals, for example, entities that are covered by the cap can meet their allowance requirements by paying for the reduction of greenhouse gas emissions from certified forestry or agricultural sources.¹⁰² The major congressional proposals allow offsets from both domestic and international sources.¹⁰³ Real and credible reductions from offsets are consistent with the overall market-based theory underlying cap-and-trade: since it does not matter geographically where a ton of carbon dioxide reduction comes from, in order to achieve maximum cost-effectiveness an emitter should be allowed to find the cheapest emissions reductions available regardless of industry sector or geographic location.

International offset programs provide several good examples of this principle. The CDM under the Kyoto Protocol allows countries covered by emissions caps to sponsor offset projects in non-covered, developing countries in lieu of making domestic reductions.¹⁰⁴ The Joint Implementation (“JI”) program, which allows projects in other countries covered by emissions caps, works on a similar basis.¹⁰⁵ The European Union ETS program allows approved CDM and JI projects to be used to meet emissions goals.¹⁰⁶

Offsets have great political appeal in large measure because they significantly lower overall compliance costs.¹⁰⁷ The difficulty with generous offset provisions, however, is establishing that emissions reductions from offsets are actually “additional.” Offsets are considered to be “additional” if they result in real emissions reductions that would not have occurred in the absence of the offset program. Establishing the baseline, however, is much

¹⁰² See, e.g., H.R. 2454, 111th Cong. § 311 (2009) (adding a new Title VII to the Clean Air Act, including new sections 728–43 setting rules for offsets); S. 1733, 111th Cong. § 101 (2010) (adding a new Title VII to the Clean Air Act, including new sections 731–44 setting rules for offsets); *An Overview of ARB Emissions Trading Program Overview*, CAL. ENVTL. PROT. AGENCY (Jan. 21, 2011), http://www.arb.ca.gov/cc/factsheets/emissions_trading_program.pdf.

¹⁰³ H.R. 2454 § 311 (adding a new section 733(a)(1) to the Clean Air Act that would require EPA’s Administrator to establish a list of eligible offset projects); *id.* (adding a new section 743 to the Clean Air Act that would create additional requirements for international offset credits); S. 1733 § 101 (adding a new section 732 to the Clean Air Act that would require the President to establish an offset program); *id.* (adding a new section 744 to the Clean Air Act that would create additional requirements for international offset credits).

¹⁰⁴ See *Clean Development Mechanism*, U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/kyoto_protocol/mechanisms/clean_development_mechanism/items/2718.php (last visited Mar. 21, 2012); see also *supra* notes 87–88 and accompanying text.

¹⁰⁵ See *Joint Implementation*, U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/kyoto_protocol/mechanisms/joint_implementation/items/1674.php (last visited Mar. 21, 2012); see also *supra* note 89 and accompanying text.

¹⁰⁶ See *Linking the EU ETS to Other Emissions Trading Systems and Incentives for International Credits*, EUROPEAN COMM’N. (Nov. 8, 2010), http://ec.europa.eu/clima/policies/ets/linking/index_en.htm.

¹⁰⁷ See, e.g., U.S. ENVTL. PROT. AGENCY, PRELIMINARY ANALYSIS OF THE WAXMAN-MARKET DISCUSSION DRAFT 3 (2009) (showing that allowance costs under the cap-and-trade program would increase ninety-six percent without offsets).

more difficult than it appears. For example, is wind energy expanding rapidly in China because of subsidies under the CDM or because of direct Chinese government subsidies? Even more troubling is evidence that in the early phases of the CDM a significant percentage of offsets were granted to reduce gases that were created for the purposes of obtaining offset credit.¹⁰⁸

As long as the offsets are real and verifiable then offsets do not undermine the integrity of the cap. But if there are reasons to believe that offsets are likely to produce significant gaming or lack appropriate regulatory control then complementary policies may be necessary to produce real and meaningful reductions that the cap could not ensure.¹⁰⁹

Another significant design flaw is to set the overall cap on emissions too high so that environmental gains from a cap-and-trade program are modest or even non-existent.¹¹⁰ Lesley McAllister describes three potential problems with a cap that is too generous: low allowance prices, delays in emissions reductions, and accumulating allowances that—if banking of emissions is allowed—can further delay innovation and emissions reductions.¹¹¹ Again if a cap is set too high, complementary policies may be necessary to spur emissions reductions and force technological innovation.

But my assumption for purposes of analyzing the potential tradeoffs between cap-and-trade and complementary policies assumes that a cap-and-trade program is well-designed, creating a price on carbon that will begin to induce real reductions in greenhouse gas emissions.

III. A FRAMEWORK FOR DETERMINING THE NEED FOR COMPLEMENTARY POLICIES

I now turn to developing a framework for determining whether or not policy makers should adopt complementary policies in conjunction with a cap-and-trade program to reduce greenhouse gases. My central contention is that complementary policies are unnecessary unless evidence exists that a market failure will prevent cost-effective emissions reductions from occurring under the cap-and-trade program.

For purposes of my analysis, when I describe and analyze complementary policies, I mean policies that have the effect of requiring emitters of

¹⁰⁸ Michael Wara, *Measuring the Clean Development Mechanisms Performance and Potential*, 55 UCLA L. REV. 1759, 1783–84 (2008).

¹⁰⁹ Waxman-Markey, for example, would have granted authority for implementing and approving certain categories of offsets to the U.S. Department of Agriculture (“USDA”) rather than the EPA. See H.R. 2454, 111th Cong. §§ 501(a)(14), 502 (2009) (“[T]he Secretary [of Agriculture] shall establish a program governing the generation of offset credits from domestic agricultural and forestry sources.”). If the USDA had done a poorer job than the EPA in administering the offset program, leading to offsets that may not actually represent new emissions reductions, then the integrity of the overall cap would have been in question.

¹¹⁰ For example, Los Angeles’s RECLAIM program encountered this problem. See *supra* notes 73–74 and accompanying text.

¹¹¹ McAllister, *supra* note 80, at 396.

carbon dioxide and other greenhouse gases to reduce their emissions in a proscribed or directed manner and where the emissions would otherwise be subject to a cap-and-trade program. For example, emitters may be required to meet a particular performance standard for greenhouse gas emissions, adopt a standard for energy efficiency, or purchase or utilize a particular type of fuel that reduces carbon emissions. I include in my definition all such policies even when they were adopted for reasons other than or in addition to reducing carbon emissions. Policy-makers may have enacted some of what I call complementary policies for reasons that have little to do with climate policy—renewable portfolio standards, for example, are often adopted in order to increase economic development or decrease energy instability.¹¹² However, I include policies that have as a significant effect the reduction of carbon emissions, and those emissions would also be subject to a cap-and-trade program.

For example, the Waxman-Markey Bill, the only climate bill to have passed a house of Congress, contained performance standards for new coal-fired power plants even though electric utilities are covered by the cap-and-trade provisions.¹¹³ Similarly, the bill contained a proposal to mandate that utilities purchase up to twenty percent of their energy from alternative sources by 2020.¹¹⁴ Standards for appliances are aimed at emissions that are also subject to the cap, again through the regulation of electric utilities. Waxman-Markey also contained national building standards to mandate energy efficiency in the construction of new buildings for the first time in American history.¹¹⁵

Similarly, California has adopted the country's most ambitious and comprehensive program to reduce economy-wide emissions to 1990 levels by 2020.¹¹⁶ The State has also committed, via Executive Order, to further reduce its emissions to eighty percent of 1990 levels by 2050.¹¹⁷ As with Waxman-Markey, the State's approach to greenhouse gas emissions is multifaceted but it includes as its centerpiece a cap-and-trade program.¹¹⁸ The State also, however, prescribes how some of those reductions should be achieved, including through a very aggressive renewable portfolio standard requiring that the State's utilities produce thirty-three percent of their energy from alternative sources by 2020.¹¹⁹ Moreover, California has adopted legis-

¹¹² See BARRY G. RABE, RACE TO THE TOP: THE EXPANDING ROLE OF US STATE REVERSIBLE PORTFOLIO STANDARDS 6 (Pew Ctr. on Global Climate Change ed., 2006).

¹¹³ See H.R. 2454, 111th Cong. § 812 (2009).

¹¹⁴ *Id.* § 101.

¹¹⁵ *Id.* § 201.

¹¹⁶ CAL. HEALTH & SAFETY CODE § 38550 (West 2011).

¹¹⁷ Cal. Exec. Order No. S-3-05 (June 1, 2005), available at <http://www.dot.ca.gov/hq/energy/ExecOrderS-3-05.htm>.

¹¹⁸ CAL. AIR RES. BD., CLIMATE CHANGE SCOPING PLAN, *supra* note 100, at 27–28.

¹¹⁹ CAL. PUB. RES. CODE § 25740 (West 2011).

lation to impose performance standards on baseload electricity generators,¹²⁰ including those from out-of-state. The legislation, known as S.B. 1368, prohibits electric utilities from entering into contracts that are five years or longer in duration for baseload electricity generation that exceeds a performance standard for greenhouse gases that is equivalent to “the rate of emissions of greenhouse gases for combined-cycle natural gas generation.”¹²¹ The result will be that—in the absence of major technological advances—coal-fired power plants will not be able to meet this standard.¹²² Whether these complementary policies are a good idea in the presence of a well-designed cap-and-trade system is the subject of surprisingly little analysis. My aim is to fill that gap.

If the theoretical and experiential evidence, as set forth above, is accurate in suggesting that market mechanisms are the most cost-effective means to regulate greenhouse gas emissions, and if cap-and-trade emerges over a carbon tax as the central policy choice to control emissions, then allowing cap-and-trade to work in as unfettered a way as possible seems important for allowing the most cost-effective emissions reductions to occur. And yet many proposed complementary policies substitute regulatory choices for market choices in advance that favor certain types of reductions over others. The example below should illustrate this point.

Take Utility A, a utility that has a mix of energy sources but is predominantly dependent upon coal and natural gas to serve its customers.¹²³ Suppose that Utility A emits seventeen million tons of carbon emissions annually¹²⁴ and that with the adoption of cap-and-trade it will receive or purchase at auction allowances that will require it to cut its emissions on a gradually accelerating basis over the next ten years. Under cap-and-trade, the utility has three options: it can cut its own emissions equal to the amount of its allowances, it can reduce its emissions below the amount of its allowances and sell the excess allowances to emitters that need additional ones, or it can purchase additional allowances on the carbon market.¹²⁵ The utility can also take advantage of banking and borrowing provisions in the

¹²⁰ The baseload requirement of an electrical supply system is the minimum level of demand for electricity experienced by that system over a twenty-four hour period. MATTHEW CORDARO, N.Y. AFFORDABLE RELIABLE ELEC. ALLIANCE, UNDERSTANDING BASE LOAD POWER 2 (2008), available at <http://www.area-alliance.org/documents/base%20load%20power.pdf>.

¹²¹ CAL. PUB. UTIL. CODE §§ 8340–41 (West 2011) (contains the baseload generation performance standard).

¹²² Seth Hilton, *The Impact of California's Global Warming Legislation on the Electric Utility Industry*, 19 ELECTRICITY J. 10, 14 (2006).

¹²³ See generally Ann E. Carlson, *Implementing Climate Change Reductions in the Utility Sector: A Case Study of the Los Angeles Department of Water and Power*, 55 UCLA L. REV. 1479 (2008) (analyzing a utility's energy mix and the challenges in reducing greenhouse gases).

¹²⁴ See *id.* at 1490 (showing that the Los Angeles Department of Water and Power, the country's largest municipally owned utility, emitted 17.7 million tons of carbon dioxide in 2006).

¹²⁵ See STAVINS, *supra* note 10, at 8.

cap-and-trade system to time when it is optimal to make emissions reductions.¹²⁶ Given that in the early years of the cap-and-trade scheme the cap will be the highest, with gradual tightening over the years, reductions may be cheaper to make in early years, leading the utility to bank allowances now for use in future years when allowance prices are likely to rise. On the other hand, if the utility has plans to replace capital stock five years hence, it may make sense to time emissions reductions to coincide with capital stock replacement. The point is that cap-and-trade provides the utility with the spatial and temporal flexibility to optimize its emissions reductions choices by allowing it to, for example, bank allowances now to save for a large-scale capital project later or purchase allowances to allow another emitter to make reductions more cheaply.

In addition to the choices of when to make emissions reductions, Utility A also has a number of choices to make about how and whether to reduce its emissions. The utility might, for example, attempt to reduce consumer demand for peak hour electricity by pricing peak usage higher than off-peak usage (peak usage often requires utilities to rely on all available sources of energy, including the most carbon-intensive, so that reductions in peak demand can allow the utility to rely on cleaner sources more frequently).¹²⁷ The utility might provide incentives for consumers to install energy efficient equipment, including light bulbs and appliances, in order to reduce overall energy demand. The utility might begin to plan to shift the mix of its energy supply away from coal to cleaner sources like natural gas, or renewable sources like solar and wind. Or the utility might find methods to increase the efficiency of its existing plants through the installation of new equipment to minimize emissions. The utility might also invest in offset projects either internationally or domestically. Whether the utility will adopt any of these strategies to reduce emissions should be driven by the allowance market established under cap-and-trade. If the utility finds that the marginal cost of reducing emissions is higher than the price the utility could pay for allowances through the cap-and-trade market, it should purchase allowances rather than making the reductions. If instead the marginal cost of reducing emissions is lower than the allowance price on the open market, it should make the choice to reduce its emissions. Again, the point is that the price of allowances should provide the necessary signal to the utility to guide its behavior. Those reductions that are cost-effective should be made; otherwise other emitters that can make cheaper reductions should make the reductions.

But Utility A may be constrained in the choices it makes to reduce emissions by complementary policies that require the utility to undertake certain mandated actions to reduce greenhouse gases. For example, the util-

¹²⁶ *Id.*

¹²⁷ Peak demand requires an “all hands on deck,” all generating capacity approach. Reducing consumption during peak demand (through pricing), for example, lets the utility avoid turning on the very worst-emitting sources. KEISUKE HANAKI, URBAN ENVIRONMENTAL MANAGEMENT AND TECHNOLOGY 189 (2008).

ity may be required to purchase a certain percentage of its energy from alternative sources like solar, wind, or geothermal under a renewable portfolio standard. Alternatively, the utility may be required to install particular technology to reduce GHG emissions from coal-fired power plants via performance standards. In another example, the utility might meet its allowance target because of a third party's actions, such as electricity consumers who reduce their energy consumption by purchasing appliances that comply with an appliance efficiency mandate. These third party actions will be required even if on a per ton of carbon dioxide basis they are significantly more expensive than alternative ways of meeting the emissions reduction requirement, including allowance trading.

There may be good reason to require Utility A to engage in some of the complementary regulatory policies described above. Consumers may, for example, fail to install energy-efficient equipment in new or renovated homes or when replacing old stock because the up-front costs are too high, even if the per ton carbon dioxide savings are quite high. Utilities may fail to invest in alternative energy because of problems in transmitting the energy from the alternative energy site to their customers, even if the cost per ton of reducing carbon dioxide is low. But the opposite may also be true. Utility A may be required to meet a complementary regulatory requirement even if more cost-effective emissions reductions are available. Thus, the complementary policies may constrain the choices of Utility A, forcing them to make a less cost-effective choice.

In the next section, I turn to detailed analyses of whether two of the most commonly proposed complementary policies can be justified as necessary, either because impediments to their adoption through a working carbon market exist or for alternative policy reasons that override cost-effectiveness as a consideration. In analyzing these complementary policies, I confine my comments to the costs and benefits of reducing greenhouse gases from the perspective of effective climate policy. In other words, my analysis asks—and attempts to begin to answer—whether we are more likely to achieve greenhouse gas emissions reductions in the most cost-effective manner in the presence or absence of the complementary policy. I do not focus on ancillary benefits or costs that may arise as a result either from an unfettered cap-and-trade policy or from adopting the complementary policy. For example, some complementary policies may produce a co-benefit of reduced air pollution or increased energy security by, for example, displacing energy from a source that emits conventional pollutants and depends on imported fuel. Such policies may also produce additional environmental costs through, for example, the siting of an alternative energy facility in endangered habitat or through increased bird kills from wind turbines.¹²⁸ Cap-and-trade may have similar co-benefits or co-costs from, say, a utility's choice to shift to a

¹²⁸ For example, federal officials have found eight endangered golden eagles recently at The Pine Tree Wind Farm near Mojave, California. See *Golden Eagle Death Prompts Monitor-*

cleaner burning fuel. I put aside all of those co-benefits and co-costs in my analysis primarily because my focus here is on the design of policies to address climate change and because the complexity of the analysis would increase dramatically. I recognize that a complementary policy may, in fact, be justifiable based on considerations that are largely unconnected to climate policy, again including increased energy independence or promoting economic development. These considerations are beyond the scope of my analysis here. Instead I aim to provide analytic clarity on the effective balance between a cap-and-trade program and complementary policies in a manner that will maximize greenhouse gas emissions reductions in the most cost-effective manner possible. I turn first to Renewable Portfolio Standards and then evaluate energy efficiency measures.

A. Renewable Portfolio Standard

From a carbon emissions reduction perspective, if a jurisdiction enacts a well-functioning cap-and-trade program, does it make sense to also enact a Renewable Portfolio Standard (“RPS”)? An RPS requires utilities to procure a certain percentage of their power generation from alternative, renewable sources. Electric utility generation is responsible for almost forty percent of total U.S. greenhouse gas emissions.¹²⁹ Replacing high carbon fuels with lower or zero emissions fuels—or figuring out how to sequester carbon economically—is therefore crucial to meeting overall emissions targets.

More than half of all states have enacted RPSs since the 1990s, ranging in stringency from quite small (about five percent by 2015 in Texas) to very ambitious (California’s thirty-three percent by 2020).¹³⁰ State programs vary in what sources are considered renewable, from geothermal, wind, and solar to biomass and small scale hydroelectric projects.¹³¹ Congress has considered enacting an RPS; the Waxman-Markey Bill contained a proposed twenty percent RPS by 2020.¹³² Many RPS programs, including the proposed national RPS contained in Waxman-Markey, afford utilities some flexibility in how they meet their obligations under the program by authorizing utilities to purchase credits from providers of renewable energy rather than developing

ing, Worry at Pine Tree, 89.3 KPPC (Feb. 18, 2012), <http://www.scpr.org/news/2012/02/18/31294/golden-eagle-deaths-prompt-monitoring-worry-pine-t/>.

¹²⁹ U.S. ENVTL. PROT. AGENCY, *Executive Summary* to INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS, 1990–2009, at 5 (2011).

¹³⁰ Renewable & Alternative Energy Portfolio Standards, CTR. FOR CLIMATE & ENERGY SOLUTIONS (Jan. 20, 2012), http://www.c2es.org/what_s_being_done/in_the_states/rps.cfm.

¹³¹ *Id.* (describing qualifying sources for each state).

¹³² See H.R. 2454, 111th Cong. § 101 (2009) (adding a new section 610 to the Public Utility Regulatory Policies Act of 1978). The proposed section 610(b) would have established compliance obligations for each year from 2012 until 2039, while section 610(d) defined the annual combined target that each retail electric supplier would have had to meet, for example twenty percent in 2020. *Id.* In contrast, the Boxer-Kerry Bill, the lead bill in the Senate, did not contain a national RPS. See S. 1733, 111th Cong. § 161(a)(2) (2009) (defining “Renewable Portfolio Standard” to include only state statutes).

their own renewable sources.¹³³ Waxman-Markey would have created a national Renewable Portfolio Credit market that could help harmonize disparate state programs.¹³⁴

In addressing the question of whether it makes sense to enact an RPS if Congress also enacts a cap-and-trade program, again I attempt to put aside arguments about whether an RPS is justifiable on other grounds—job creation, for example, or alternative environmental grounds such as reduced air and water pollution. Instead my focus is on an RPS's efficacy as a carbon-reducing mechanism in conjunction with a cap-and-trade system.

I assume in analyzing this question that the central goal of cap-and-trade is to reduce carbon emissions at the most cost-effective price. One way to think about whether a complementary policy is necessary from a carbon reduction emissions perspective, then, is to ask whether the reductions that would be achieved through a complementary policy would not occur—even though cost-effective—in the face of a cap-and-trade system that places a price on carbon emissions. To return to our example of Utility A, above, are there reasons to believe that even if the marginal cost of investing in alternative energy with zero or very low emissions is lower than purchasing allowances on a carbon market or making a different emissions reduction choice, the utility would nevertheless fail to make the investment in alternative energy sources? In more mainstream economic parlance, are there predictable market failures that would explain why rational investments in alternative energy would not occur even with a carbon price in place? Or is an alternative explanation at work: that investments in alternative energy might not occur at high levels even with a functioning cap-and-trade program in place not because of market failures but simply because alternative energy is more expensive than other carbon reducing investments?

Kenneth Gillingham and James Sweeney have analyzed both the extent to which market failures could, in theory, exist in the renewable energy market and the policies governments could adopt to address those failures.¹³⁵ They identify several potential market failures: (1) information market failures; (2) imperfect foresight about future energy prices; (3) economies of scale; (4) environmental externalities; (5) and national security externalities—though they also recognize that to date the empirical evidence of such failures has for the most part yet-to-be examined or developed.¹³⁶ Gillingham and Sweeney then match the regulatory options available to combat each market failure and suggest that direct regulation such as a renewable portfo-

¹³³ See K.S. CORY & B. G. SWEZEY, NAT'L RENEWABLE ENERGY LAB., RENEWABLE PORTFOLIO STANDARDS IN THE STATES: BALANCING GOALS AND IMPLEMENTATION STRATEGIES 3–9 (2007).

¹³⁴ See generally H.R. 2454, 111th Cong. § 101 (2009) (adding a new section 610 to the Public Utility Regulatory Policies Act of 1978).

¹³⁵ Kenneth Gillingham & James Sweeney, *Market Failure and the Structure of Externalities*, in HARNESSING RENEWABLE ENERGY IN ELECTRICAL POWER SYSTEMS: THEORY, PRACTICE, POLICY 69, 69 (Boaze Moselle, Jorge Padilla & Richard Shmalensee eds., 2010).

¹³⁶ *Id.* at 72–80.

lio standard or a cap-and-trade program would address only environmental or national security market failures.¹³⁷ Any other kind of market failure would need to be addressed through a different policy option—information failures through, e.g., information programs or transparency rules, and economies of scale through production subsidies or feed-in-tariffs.¹³⁸ Thus at least in Gillingham and Sweeney's analysis, the only types of market failures for which an RPS might be appropriately targeted are externalities from pollution (including greenhouse gas emissions) and national security.¹³⁹ Theoretically, if the cap in a cap-and-trade program is set to eliminate the correct number of tons of the regulated pollutant, then the environmental externality from the regulated pollutant should disappear (be internalized). Thus if a greenhouse gas cap-and-trade program is well-designed, the assumption of my analysis here, an RPS should not be necessary to eliminate environmental externalities related to climate change because the cap-and-trade program causes internalization of those externalities.

The same logic would hold true for a national security externality: if a producer of a good (energy produced by conventional fossil fuels, for example) is creating a national security problem for the rest of the country, government regulation to eliminate the externality by either pricing it or otherwise making the producer eliminate it should suffice. Since my analysis here is limited to whether a cap-and-trade program will appropriately address the problem of greenhouse gas emissions, without considering other co-benefits or co-costs, at least under Gillingham and Sweeney's formulation there does not appear to be a market failure that would prevent a price on carbon from stimulating cost-effective development of renewable energy.

Yet policymakers may be risk averse and enact an RPS for reasons that are related to but do not necessarily rise to the level of a true market failure. For example, financing for renewable projects may be riskier and therefore more difficult to acquire than financing for conventional sources due to lack of experience or long-term uncertainties about fuel prices, even if investments in those projects should pay off if carbon has a price placed on it.¹⁴⁰ Renewable projects tend to have higher up-front capital costs than conventional projects, making investors more reluctant to put up large amounts of capital.¹⁴¹ An RPS can assure investors that utilities will be required to purchase energy produced from the financing of the project and therefore can make more financing available. This is not a true market failure in that a decision not to invest in a renewable project because it is considered more risky than other investments is simply the result of balancing costs against benefits and choosing the safer project. One important and open question in

¹³⁷ *Id.* at 82–87.

¹³⁸ *Id.*

¹³⁹ *Id.*

¹⁴⁰ See CORY & SWEZEY, *supra* note 133, at 20–21.

¹⁴¹ See *id.* at 20.

assessing if an RPS is needed in conjunction with a functioning cap-and-trade system, then, is whether a price on carbon emissions as a result of cap-and-trade would be sufficient to provide enough security to financiers of renewable projects to allow them to go forward if otherwise cost-effective or whether some mechanism beyond price would stymie investment activity.

Another concern for policymakers may be that if a cap-and-trade system has relatively weak price signals initially, large sources may make commitments—particularly in building capital stock—that lock in a particular course of action that results in larger overall carbon emissions than would occur under an alternative path dependent on cleaner energy sources. The lock-in that would occur by committing to expensive investments in particular sources of energy could in turn make overall long-term emissions targets tougher to achieve. To return to our hypothetical Utility A, Utility A could decide to build a new coal-fired power plant today even with a cap-and-trade system in place and rely on that plant for forty to sixty years hence. Given institutional path dependence—the idea that one policy choice historically can then make “the costs of reversing previous decisions increase, and the scope for reversing them narrow[] sequentially”—one might adopt an RPS in addition to cap-and-trade in order to avoid this “carbon lock-in” possibility.¹⁴² So in deciding whether an RPS might be justified as a policy to adopt in conjunction with a cap-and-trade program, one would want to know whether investments in the early phase of a cap-and-trade program without a complementary RPS in place are more likely to be in dirtier fuels like coal and less likely to be in alternative energy, and also whether the combined RPS-cap-and-trade program would result in lower overall emissions over time than a cap-and-trade program alone.

It is worth noting that there may be additional barriers to the provision of renewable energy that neither a cap-and-trade program nor an RPS directly addresses. For example, the most abundant sources of renewable energy—consistent sun and wind, geothermal resources—tend to be located far from population centers.¹⁴³ These abundant sources also tend to lack transmission lines necessary to make renewable energy available to consumers. It is conceivable that increased demand for renewable energy—driven by an RPS, for example—could incentivize the construction of additional transmission lines. But numerous obstacles exist to the siting and financing

¹⁴² See Edwin Woerdman, *Path-Dependent Climate Policy: The History and Future of Emissions Trading in Europe*, 14 EUR. ENV'T. 261, 263–71 (2004).

¹⁴³ See FRANK A. WOLAK, REGULATORY BARRIERS TO LOWERING THE CARBON CONTENT OF ENERGY SERVICES 1 (2010), available at http://iis-db.stanford.edu/pubs/22908/Regulatory_Barriers_to_Lowering_the_Carbon_Content_of_Energy_Services_Wolak_May2010.pdf; Hannah Wiseman, Lindsay Grisamer & E. Nichole Saunders, *Formulating a Law of Sustainable Energy: The Renewables Component*, 28 PACE ENVTL. L. REV. 827, 854 (2011) (citing Aaron Bennett, Eng'r of Reliability Assessments, N. Am. Elec. Reliability Corp., Presentation at the American Wind Power Transmission Workshop: Integration of Variable Generation Task Force 6 (Mar. 17, 2009)) (“[W]ith the exception of Texas, only seven percent of the U.S. population lives in the ten states with the highest wind capacity.”).

of transmission lines, including overlapping and fragmented regulatory oversight over the siting process and complex financing disincentives as a result of a clash between regional transmission needs and state-specific rate setting for transmission financing.¹⁴⁴ Thus one important component of effective climate policy—measures to encourage the siting and investment of transmission lines—has little direct relationship with using an RPS to incentivize renewable energy production.

Though it is difficult to know with certainty how a cap-and-trade program with or without the adoption of an RPS will affect price and the provision of alternative energy versus dirtier fuels, at least two recent studies have attempted to answer those questions. California's Public Utilities Commission has also estimated the cost of greenhouse gas emissions reductions through the state's thirty-three percent RPS and that estimate also provides evidence about the wisdom of enacting an RPS in conjunction with cap-and-trade.

The MIT Joint Program on the Science and Policy of Global Change used the Waxman-Markey targets—an overall cap of 167 billion metric tons of carbon dioxide equivalent emission (“167 bmt CO₂-e[quivalent]”) by 2050 and a twenty percent RPS standard beginning in 2015 and staying flat until 2050—to predict the cost of emissions reductions under a cap-and-trade program alone and one with an RPS.¹⁴⁵ The study's principal conclusion was that “an RPS combined with a cap-and-trade policy achieves the same emissions as a cap-and-trade only policy but at a greater cost.”¹⁴⁶ More specifically, a twenty percent RPS in combination with cap-and-trade results in emissions reductions that are twenty-five percent more expensive than a cap-and-trade program alone.¹⁴⁷ Most of the increase in cost occurs in the

¹⁴⁴ See LETHA TAWNEY, RUTH GREENSPAN BELL & MICAH S. ZIEGLER, WORLD RES. INST., *HIGH WIRE ACT: ELECTRICITY TRANSMISSION INFRASTRUCTURE AND ITS IMPACT ON THE RENEWABLE ENERGY MARKET* 3–4 (2011) (“United States electricity generation and transmission planning and siting are managed in a highly local and fragmented manner . . . complicating broader regional planning for renewable electricity generation and supporting transmission. . . . Cost allocation negotiations are also a significant challenge for proposed transmission projects, particularly those that cross utilities and/or states. Methods for allocating costs exist but cost allocation disputes between transmission companies or their regulators jeopardize large-scale transmission projects, particularly those not directly related to improved system reliability.”); WOLAK, *supra* note 143, at 1–4 (detailing barriers to provision of adequate transmission). See also generally Sandeep Vaheesan, *Preempting Parochialism and Protectionism in Power*, 49 HARV. J. ON LEGIS. 87 (2012).

¹⁴⁵ MORRIS ET AL., *supra* note 18, at 7.

¹⁴⁶ *Id.* at 8.

¹⁴⁷ Altering the assumptions about the costs of renewable energy can obviously increase or decrease the twenty-five percent figure. For example, if renewable energy costs turn out to be twenty-five percent more expensive, costs increase by forty-eight percent over the life of the cap. If renewable energy costs turn out to be significantly less expensive, the increase is only four percent. The twenty-five percent case is the authors' best estimate of what actual costs will be. See *id.* at 15.

first fifteen years of the program as up-front investments in renewable energy facilities are made.¹⁴⁸

Somewhat counter-intuitively, a cap-and-trade program with an RPS results in *lower* overall allowance prices than if Congress adopts a cap-and-trade program alone.¹⁴⁹ This occurs for several reasons. First, because under an RPS a set percentage of renewable energy must be purchased independent of the cap (although the greenhouse gas emissions reductions themselves count toward the total reductions that must occur under the cap), there are, therefore, fewer emissions to reduce, which results in lower allowance prices.¹⁵⁰ Moreover, electricity prices increase more rapidly with a higher reliance on alternative energy, reducing energy demand. This demand in turn reduces the cost of fuel, further lowering prices.¹⁵¹ Although the allowance price is lower, the overall costs of complying with the combined cap-and-trade program and the RPS are higher than under a pure cap-and-trade because the reductions through the RPS are relatively higher cost than those that would be achieved under a pure cap.¹⁵²

The MIT study also provides evidence about whether a combined RPS/cap-and-trade will result in earlier and larger investments in alternative/renewable sources than a pure cap-and-trade program. The authors conclude that the combined program does in fact result in more renewable energy production compared to overall production, particularly wind energy with natural gas used as a backup when wind is intermittent.¹⁵³ The study also shows that earlier investments in wind energy make the overall welfare losses that result from the higher expense of a combined RPS/cap-and-trade program lower in later years because the early investments lower costs in later years.¹⁵⁴ A pure cap, by contrast, achieves more of its reductions through overall reductions in electricity use and increased reliance on the natural gas combined cycle.¹⁵⁵ Both approaches result in fairly similar reductions in reliance on coal, with each approach essentially eliminating reliance on coal by 2050.¹⁵⁶ Both policies also achieve the same overall emission reductions by 2050—an eighty percent reduction below 1990 levels.¹⁵⁷

A National Renewable Energy Lab (“NREL”) modeling project that also used the targets contained in the Waxman-Markey legislation reached

¹⁴⁸ See *id.* at 12.

¹⁴⁹ LORI BIRD, CAROLINE CHAPMAN, JEFF LOGAN, JENNY SUMNER & WALTER SHORT, NAT'L RENEWABLE ENERGY LAB., EVALUATING RENEWABLE PORTFOLIO STANDARDS AND CARBON CAP SCENARIOS IN THE U.S. ELECTRIC SECTOR 9 (2010), available at <http://www.nrel.gov/docs/fy10osti/48258.pdf>.

¹⁵⁰ See email correspondence between Jennifer Morris (MIT) and Ann Carlson, (June 28, 2011) (on file with author.)

¹⁵¹ *Id.* at 9.

¹⁵² See MORRIS ET AL., *supra* note 18, at 15.

¹⁵³ See *id.* at 4, 13.

¹⁵⁴ See *id.* at 14.

¹⁵⁵ See *id.* at 14.

¹⁵⁶ See *id.* at 7.

¹⁵⁷ See *id.* at 14.

somewhat different results about both the overall costs of cap-and-trade versus cap-and-trade with an RPS, and about the relative energy mix that would result from each.¹⁵⁸ The two modeling efforts are not, however, completely comparable and thus their different results may be because of the different approaches. Most importantly, the NREL study considered a pure cap-and-trade program, a cap-and-trade program with energy efficiency mandates, an RPS program with energy efficiency mandates, and the simultaneous operation of the RPS and cap-and-trade proposals.¹⁵⁹ Thus the NREL study, in combining the RPS with energy efficiency measures, is somewhat less useful for my analytic purposes than the MIT study, since it is somewhat difficult to untangle the effects of the RPS versus the effects of the energy efficiency measures on the study's outcome. Another difference between the NREL and MIT studies is that the NREL study focuses on and models RPS of both fifteen percent and twenty-five percent whereas the MIT study models the Waxman-Markey RPS of twenty percent.

With that said, the NREL study concludes that, overall, electricity prices do not increase dramatically with either the pure cap-and-trade or with the combined program as long as both approaches include energy efficiency mandates comparable to those included within Waxman-Markey.¹⁶⁰ The NREL study accords with the MIT study's finding that overall allowance prices would decrease with the RPS or energy efficiency measures added as compared to a pure cap-and-trade approach, though the NREL study is limited to the electricity sector,¹⁶¹ whereas the MIT study uses a global economy-wide model.¹⁶² As I explain in more detail below,¹⁶³ a larger allowance price is likely to spur less technological innovation than a higher price, which would induce entities to seek new and cheaper ways to reduce emissions. The NREL estimates that a pure cap would result in a carbon allowance price of fifty-two dollars in 2020 and a seventy-five dollar price in 2030; a fifteen percent RPS (including efficiency measures) plus cap would result in a carbon price of forty-eight dollars in 2020 and seventy dollars in 2030; a twenty-five percent RPS (including efficiency measures) plus cap would result in a carbon price of twenty-five dollars in 2020 and seventy-seven dollars in 2030.¹⁶⁴

¹⁵⁸ See BIRD ET AL., *supra* note 151, at v–vii.

¹⁵⁹ See *id.* at 1–4 (describing methodology); *id.* (“The effect of load reduction attributable to energy-efficiency provisions in the Waxman-Markey bill is also captured in the RPS and cap scenarios as an input to the model, except where noted”); *id.* at 12–13, 13 tbl.4 (summarizing results). For a summary of the individual RPS and cap-and-trade scenarios considered, see *id.* at 4 tbl.1. Note that under each RPS scenario, the “[l]oad [is] reduced to reflect efficiency provisions in H.R. 2454,” *id.*, while the load reduction is “assumed to be [eight percent] in 2020 and [five percent] in 2030,” *id.* at 3.

¹⁶⁰ See *id.* at 9.

¹⁶¹ See *id.* at 12 n.10.

¹⁶² See MORRIS ET AL., *supra* note 18, at 3–4.

¹⁶³ See generally discussion *infra* Part II.

¹⁶⁴ See BIRD ET AL., *supra* note 149, at 13.

The NREL study also draws different conclusions about the relative energy mix that each regulatory approach would produce, though again the RPS percentages differ from the MIT model by including energy efficiency. Interestingly, the pure cap approach produces *more* renewable generation than a fifteen percent RPS plus efficiency/cap approach (800 TWh¹⁶⁵ for cap only, 594 TWh for cap plus fifteen-percent RPS).¹⁶⁶ The pure cap approach also relies less heavily on coal than the fifteen-percent RPS plus cap approach.¹⁶⁷ A twenty-five percent RPS/cap approach produces more renewable generation (864 TWh) than a pure cap (800 TWh).¹⁶⁸ This was because the pure cap approach was not modeled to include energy efficiency, whereas in the fifteen percent plus efficiency cap approach many of the carbon reductions came from energy efficiency, not renewable generation.¹⁶⁹ The authors did not provide sufficient data to determine the relative generation of coal for the pure cap versus twenty-five percent RPS.

Finally, the California Public Utilities Commission (CPUC) has estimated the cost per ton of reducing carbon emissions through the state's renewable energy standard and through the cap-and-trade program. This information provides evidence not of market failures but of the relative costs of emissions reductions through the two policy mechanisms. The CPUC estimates that greenhouse gas emissions reductions as a result of the state's 33 percent renewable portfolio standard will cost \$133 per metric ton as compared with a \$30 per ton estimate through cap-and-trade. Thus the CPUC estimates that the RPS emissions reductions will cost more than four times the reductions that will occur from other measures.¹⁷⁰

The two modeling studies combined with the California estimates, then, help answer our initial question: whether there are reasons to believe that the reductions in carbon emissions that could be achieved through the adoption of an RPS would not occur even if cost-effective under a pure cap-and-trade approach. The MIT study concludes, essentially, that the reason cap-and-trade does not achieve as much alternative energy is not due to a systemic market failure but is instead more straightforward: alternative energy is more expensive than other carbon abatement options, including energy efficiency

¹⁶⁵ A unit of energy equivalent to one billion kilowatt-hours. One kilowatt-hour is enough energy to run a 100-watt light bulb for 10 hours.

¹⁶⁶ See BIRD ET AL., *supra* note 149, at 6.

¹⁶⁷ See *id.* at 6.

¹⁶⁸ See *id.* at 6–7.

¹⁶⁹ See *id.* at 6–7.

¹⁷⁰ See California Public Utilities Commission, Division of Ratepayer Advocates, *DRA Response to Union of Concerned Scientists, Natural Resources Defense Council and Environment California's letter regarding DRA's Renewable Portfolio Standard Cost Chart Discussed at the March 3rd Senate Energy Committee Hearing* available at <ftp://ftp.cpuc.ca.gov/DRAlegis/Position%20Letters/pdfs/DRA%20Response%20to%20Enviro%20Letter.pdf>; see also Energy and Environmental Economics, Inc., *Greenhouse Gas Modeling of California's Electricity Sector to 2020* (March, 2010) (showing the cost of reductions in greenhouse gases from renewable energy standard), available at http://ethree.com/documents/GHG%203.11.10/CPUC_GHG_Revised_Report_v3b_March2010.pdf

and natural gas.¹⁷¹ The California estimates seem to confirm the MIT modeling. If the MIT model and California numbers are correct, the effect of an RPS in combination with cap-and-trade is to subsidize renewable energy at the expense of other carbon abatement options and to make the overall cost of reducing carbon emissions by eighty percent by 2050 more expensive. The NREL study reaches a slightly different conclusion, namely that overall electricity prices would not rise measurably with a cap-and-trade program that also includes energy efficiency programs and an RPS.¹⁷² But the effects of energy efficiency versus RPS are not disentangled in the NREL study. Given that substantial evidence exists that energy efficiency is among the most cost-effective abatement options whereas renewable energy by and large—at least currently—is readily acknowledged to be a more expensive alternative, it seems highly likely that the energy efficiency measures in the NREL model are working to keep electricity prices low, not the RPS.

Both studies also shed light on the relative mix of energy sources that a pure cap-and-trade system versus a cap-and-trade and RPS policy would produce. To the extent that policymakers worry that initial investment decisions could produce carbon lock-in, as described above,¹⁷³ evidence about relative energy mix sheds light on the question. The MIT study finds that a pure cap-and-trade system produces relatively less alternative energy than a cap-and-trade system with an RPS of twenty percent; it is also worth noting, however, that the resulting beneficiaries of a pure cap-and-trade are not coal but natural gas and energy efficiency.¹⁷⁴ Adding an RPS shifts the mix of energy in favor of wind and away from energy efficiency and natural gas.¹⁷⁵ The NREL study accords with the MIT results but also demonstrates that a weaker RPS with a cap-and-trade program—fifteen percent—actually produces less alternative energy than a pure cap-and-trade program.¹⁷⁶ Both modeling efforts assume that the overall cap will be met so that the result of combining a cap-and-trade program with an RPS is not an overall reduction in carbon emissions but instead a different mix in the sources that will supply the United States with energy.

In sum, the models lead to the following conclusions:

- A pure cap-and-trade program produces carbon reductions at a lower cost than a cap-and-trade program combined with an RPS;
- The higher cost of a cap-and-trade program combined with an RPS may be offset by also requiring energy efficiency standards like those proposed in Waxman-Markey;

¹⁷¹ See MORRIS ET AL., *supra* note 18, at 16–17.

¹⁷² See BIRD ET AL., *supra* note 149, at 26.

¹⁷³ See *supra* text accompanying note 142.

¹⁷⁴ See BIRD ET AL., *supra* note 149, at 7.

¹⁷⁵ See MORRIS ET AL., *supra* note 18, at 13.

¹⁷⁶ See *id.* at 13.

- A combined RPS and cap-and-trade program produces more alternative energy than a pure cap-and-trade program as long as the RPS requirement is at least twenty percent;
- A pure cap-and-trade program produces more carbon emissions reductions from energy efficiency and from shifting to natural gas.

A final consequence of the prediction that a combined RPS/cap-and-trade program would result in lower allowance prices than a pure cap-and-trade program is worth noting. Both the MIT and the NREL models conclude that allowance prices would be lower under a pure cap-and-trade program than one including an RPS alone or an RPS plus energy efficiency. The result of this finding is that a combined program would provide fewer financial incentives for emitters—including non-utility emitters that are not subject to the RPS—to innovate to create low carbon technology than a pure cap-and-trade approach would. Again the theory behind cap-and-trade is to put a price on carbon and allow emitters to search for the lowest cost reductions. As the cap tightens and allowances become more expensive, the price on carbon should spur emitters to develop and invest in technology that will, again, produce the cheapest emissions reductions. If allowance prices are lower overall, the incentive to innovate will be lower. It is possible that more innovation will occur under a combined approach in the alternative energy sector since utilities would be mandated to procure a set percentage of their energy from specific sources and thus may try to seek to innovate to lower costs in the alternative energy market. But outside of the alternative energy market the incentive to innovate would be lower due to lower allowance prices.

The question for policymakers, then, is whether the higher prices likely to result from a combined RPS and cap-and-trade are worth the cost. As a carbon reducing mechanism, a pure cap-and-trade program would achieve the same reductions in emissions as a combined program at a lower price, significantly lower if the MIT modeling is accurate. From a pure climate change perspective, then, an RPS plus cap-and-trade appears not to be addressing market failures, but instead to be subsidizing a particular carbon reducing strategy. Again, there may be reasons to engage in such subsidization—job creation or energy independence, or co-benefits from lower emissions of conventional air pollutants. But policymakers should be aware of the very real tradeoffs before committing to such a choice, and should be aware that by committing to certain mandatory emissions reductions they are limiting the theoretical promise that cap-and-trade will result in greenhouse gas emissions at the lowest cost.

B. Energy Efficiency

As with an RPS, my aim here is to shed light on whether it makes sense from a carbon-emissions-reduction perspective to enact measures to mandate energy efficiency in order to complement a well-functioning cap-and-trade program. Energy efficiency mandates are another very popular set of policies that aim to lower the energy usage of appliances and buildings, typically through the establishment of standards that manufacturers and builders must meet. Energy efficiency does not require consumers to reduce their energy usage by consuming less of a particular energy-consuming service (say, raising the thermostat during the summer) but instead is meant to allow for the same level of service while using less energy (delivering a sixty-eight degrees Fahrenheit temperature using an air conditioner that is more energy efficient, for example).¹⁷⁷ Energy conservation, by contrast, means using less energy by changing behavior or using technology that reduces the use of the service (e.g., turning off lights versus installing a light sensor that turns lights off when no motion is detected).¹⁷⁸ Indeed, improvements in energy efficiency can in some instances lead to *increases* in energy consumption rather than lowering overall energy consumption, although the evidence for such a so-called rebound effect for appliance standards appears to be that any such effect is quite modest.¹⁷⁹

A number of regulatory methods attempt to achieve improved energy efficiency, ranging from information-based programs advertising energy savings over the lifetime of a product to mandatory standards. Here, I evaluate mandatory standards because the focus of my analysis is programs that *require* greenhouse gas emitters to follow a specified path to reduce emissions even with a functioning cap-and-trade program. I focus here on efficiency standards for appliances and mandatory efficiency standards for buildings (the same question arises with respect to fuel efficiency standards for vehicles but is beyond the scope of my analysis here). Efficiency standards for appliances and buildings differ in one significant respect from other mandatory standards like an RPS in that, for the most part, they apply not directly to suppliers of energy like utilities but to manufacturers of products that consume electricity such as air conditioners and heaters or to builders of buildings that will include energy-using equipment. Nevertheless, by mandating energy efficiency standards, policymakers are designating in advance how particular greenhouse gas emissions are to be reduced from sources that are covered by the cap (generation of electricity), rather than

¹⁷⁷ CAL. ENERGY COMM'N, ACHIEVING ENERGY SAVINGS IN CALIFORNIA BUILDINGS 1 (2011).

¹⁷⁸ See NAT'L ACAD. OF SCI., *supra* note 50, at 36.

¹⁷⁹ KENNETH GILLINGHAM, RICHARD G. NEWELL & KAREN PALMER, RES. FOR THE FUTURE, ENERGY EFFICIENCY, ECONOMICS AND POLICY 20 (2009) (recognizing the potential for a rebound effect from lowering energy usage through energy efficiency whereby consumers in turn consume more energy).

relying solely on greenhouse emitters to find the cheapest emissions reductions in order to comply with a cap-and-trade system.

To return to our hypothetical Utility A, with a pure cap-and-trade system the utility might evaluate the various ways in which it could meet its obligations under the cap-and-trade scheme. If the price on carbon were sufficiently high, its customers should be spurred to install those energy efficiency measures that result in cost savings from lower energy bills that are greater than the cost of installing the energy efficiency measures. Indeed, under a pure cap-and-trade program a utility might adopt programs to ensure that its customers take advantage of the cost savings energy efficiency could provide as a way of meeting its obligations under program. If, by contrast, Utility A could find cheaper ways to reduce its emissions then it would invest in those methods rather than in promoting energy efficiency. However, another possibility exists. It may be that investments in energy efficiency are cost-effective, but market barriers exist that are sufficiently high that a pure cap-and-trade system might be insufficient to encourage their adoption.¹⁸⁰ In such a case, a complementary policy mandating cost-effective energy efficiency would be consistent with adoption of a cap-and-trade program designed to encourage the cheapest emissions reductions available.

Virtually all jurisdictions that have or are considering cap-and-trade programs have also enacted or proposed enacting mandatory building and/or appliance efficiency standards. The Waxman-Markey legislation, for example, would have for the first time imposed national building efficiency standards for new homes and commercial structures.¹⁸¹ It also included new appliance efficiency standards for a number of products, including outdoor lighting.¹⁸² The bills also would have required natural gas facilities to use a portion of their allocated allowances for energy efficiency.¹⁸³ California, too, is relying heavily on improvements in energy efficiency through tougher building and appliance standards in addition to voluntary programs in conjunction with its proposed cap-and-trade program to achieve its overall emissions reductions goal of returning to 1990 greenhouse gas emissions levels by 2020.¹⁸⁴

To reiterate, the question in designing a cap-and-trade system is whether the system would induce investments in energy efficiency assuming those investments are the cheapest means to reduce carbon emissions or whether some market failure or barrier would prevent emitters from doing so.

¹⁸⁰ For an explanation of market barriers, see *infra* note 195 and accompanying text.

¹⁸¹ CLAYTON CROWNOVER, ALLIANCE TO SAVE ENERGY, ANALYSIS OF H.R. 2454: THE WAXMAN-MARKEY CLIMATE AND ENERGY BILL 2 (2009), available at <http://ase.org/resources/analysis-waxman-markey-climate-and-energy-bill>.

¹⁸² *Id.* Appliance standards are not, of course, a new approach to improving energy efficiency. See Carlson, *supra* note 14, at 65–66.

¹⁸³ See CROWNOVER, *supra* note 181, at 2.

¹⁸⁴ See CAL. AIR RES. BD., CLIMATE CHANGE SCOPING PLAN, *supra* note 100, at 41.

It is worth stressing that energy efficiency in buildings and appliances can result in large reductions in carbon emissions. As of 2008, for example, residential and commercial buildings and the appliances housed within them consumed seventy-three percent of all generated electricity.¹⁸⁵ Within these buildings, space heating, cooling, ventilation and lighting consume the most energy.¹⁸⁶ If buildings and appliances can be made more energy efficient, they will use less energy to conduct the same amount of activity; that lower energy usage will, in turn, result in fewer carbon emissions as long as the energy is produced from carbon-based fuels.

Most energy analysts believe that we could save significant amounts of energy at low or no cost by implementing already available or soon to be available energy efficiency technologies. The National Academy of Sciences, for example, estimates that cost-effective¹⁸⁷ savings from residential and commercial energy efficiency improvements could amount to a twenty-five to thirty percent savings in total energy usage over the next two to two and a half decades.¹⁸⁸ Just to illustrate the potential for savings, if residential, commercial, and industrial users switched all incandescent lamps to compact fluorescent lamps, we could save approximately six percent of all energy generated in the United States.¹⁸⁹ Energy efficiency scholars call this savings potential the “energy efficiency gap,” defined as “the difference between levels of investment in energy efficiency that appear to be cost-effective based on engineering-economic analysis and the (lower) levels actually occurring.”¹⁹⁰

An obvious question, if such large cost savings are available from energy efficiency adoption, is why the market has not responded by adopting such measures. One reason is that energy consumers do not pay the full social cost of energy usage to the degree that energy usage creates externalities. The most obvious externalities for which consumers do not pay are environmental and national security (although some environmental harms are controlled, including some amount of air and water pollutants). If externalities are regulated, either through traditional or market-based means, energy prices should increase to reflect the cost of compliance. This, of course, is one of the premises of cap-and-trade. As energy prices increase, the benefits of energy efficiency increase as well and thus should spur more investment in energy efficiency measures to reduce overall use. Thus a pure cap-

¹⁸⁵ AMERICA'S ENERGY FUTURE PANEL ON ENERGY EFFICIENCY TECHS., REAL PROSPECTS FOR ENERGY EFFICIENCY IN THE UNITED STATES 23 (2010).

¹⁸⁶ *Id.* at 6.

¹⁸⁷ The National Academy defines cost-effectiveness as an investment for which the cost of energy savings is lower than the national average electricity and natural gas prices. *Id.* at 35.

¹⁸⁸ *Id.* at 9.

¹⁸⁹ *Id.* at 30.

¹⁹⁰ WILLIAM H. GOLOVE & JOSEPH H. ETO, LAWRENCE BERKELEY NAT'L LAB., MARKET BARRIERS TO ENERGY EFFICIENCY: A CRITICAL REAPPRAISAL OF THE RATIONALE FOR PUBLIC POLICIES TO PROMOTE ENERGY EFFICIENCY 6 (1996).

and-trade program, in putting a price on carbon, should induce more energy efficiency.

But price appears not to be the only reason consumers—both residential and commercial—fail to install energy efficiency measures. Mandatory standards for appliances and new building standards are aimed towards at least some—but by no means all—of these reasons. For example, scholars have long recognized that some energy users face split incentives: in rental dwellings, for example, the person who purchases appliances (the landlord) is not typically the one who pays the costs of running those appliances (the renter). This is true in both housing and commercial buildings. Market penetration of a number of energy efficiency measures (insulated walls and attics, double pane windows, programmable thermostats) is close to double or more in owner-occupied houses as opposed to rental housing in California, for example.¹⁹¹ Lucas Davis, in an analysis of appliance ownership patterns nationwide, found that renters “are significantly less likely to report having energy efficient refrigerators, clothes washers and dishwashers,” even controlling for income, demographics, weather, and so forth.¹⁹² The problem of split incentives is not a trivial one: almost a third of households rent their homes and forty percent of commercial buildings are leased.¹⁹³ And the problem of split incentives is not confined to leasing/rental relationships. Developers of new construction often lack incentives to build energy efficient buildings and install energy efficient appliances, particularly when they will not occupy the buildings they construct and hence will not realize the energy savings themselves.¹⁹⁴

Other market barriers and failures include the fact that consumers frequently miscalculate, fail to understand, or lack information to determine the energy savings that are possible from efficiency measures even in the face of information campaigns.¹⁹⁵ Utility bills, for example, do not break down which appliances are most energy intensive so that consumers frequently lack information about the cost savings available from using more energy efficient heating or light bulbs. One study demonstrates that even after an intense, eight-year campaign to inform residents of the Pacific Northwest of

¹⁹¹ AMERICA’S ENERGY FUTURE PANEL ON ENERGY EFFICIENCY TECHS., *supra* note 185, at 100 (citing CAL. ENERGY COMM’N, CALIFORNIA STATEWIDE RESIDENTIAL APPLIANCE SATURATION STUDY: FINAL REPORT EXECUTIVE SUMMARY 29 (2004)).

¹⁹² Lucas W. Davis, *Evaluating the Slow Adoption of Energy Efficient Investments: Are Renters Less Likely to Have Energy Efficient Appliances?* 2 (Energy Inst. at Haas, Working Paper No. 205, 2010).

¹⁹³ AMERICA’S ENERGY FUTURE PANEL ON ENERGY EFFICIENCY TECHS., *supra* note 185, at 99.

¹⁹⁴ See GOLOVE & ETO, *supra* note 190, at 36–41, for an excellent overview of the incentives to shortchange energy efficiency in new construction.

¹⁹⁵ See AMERICA’S ENERGY FUTURE PANEL ON ENERGY EFFICIENCY TECHS., *supra* note 185, at 97–104, for an extensive overview of potential market failures and barriers. The authors define market failures as failures that “occur if there is a flaw in the way that markets operate.” *Id.* at 97. Market barriers “are not flaws in the way that markets operate, but they limit the adoption of energy efficiency measures nonetheless.” *Id.* at 97–104.

both incentives for and information about CFL light bulbs, almost a third of residents had no knowledge of the bulbs' efficiency.¹⁹⁶ The lack of information means that consumers cannot make rational economic decisions to invest in energy efficiency measures. But even when given accurate information about energy savings from energy efficiency, scholars have found standard and consistent errors in how consumers evaluate energy efficiency measures. These include using implicitly high discount rates to decide whether to invest in energy efficiency and using the wrong units to calculate energy usage.¹⁹⁷ The errors seem consistently to result in the overconsumption of energy.¹⁹⁸ Thus information campaigns may not always be sufficient to induce energy efficient behavior.

And finally, consumers may lack the financing to pay for energy efficiency measures that require significant up-front capital even if the payoff in lower energy savings over a number of years will more than pay back the initial expense. Programs aimed at assisting with this up-front financing are designed to address the liquidity problem.

To be sure, not all observers believe that the energy efficiency gap is actually as large as conventional wisdom assumes. These observers argue, for example, that consumers are sometimes behaving quite rationally in rejecting efficiency investments. Consumers may not invest in new energy efficiency appliances because there is a tradeoff in operational quality (e.g., clothes getting less clean in an efficient washer; light bulbs generating an odd hue, etc.). Energy efficiency may only be available on some products along with other expensive add-ons that a consumer does not wish to purchase. And expected energy savings are calculated for the "average" consumer; if one believes she is a below average user of energy, for example, the investment in energy efficiency may not make sense.¹⁹⁹

Despite these critiques of the energy efficiency gap, after a sweeping review of the available literature, a National Academy of Sciences study released in 2010 concluded that the gap is real and extremely large.²⁰⁰ Thus the best available evidence suggests that significant, cost-effective savings in energy could be achieved through broader use and adoption of existing energy efficiency technology. Moreover, as the National Academy study documents, these savings come from a broad array of technologies for which virtually dozens of studies have been conducted. Thus relatively good data

¹⁹⁶ See *id.* at 101 (citing TAMI RASMUSSEN ET AL., INT'L ENERGY PROGRAM EVALUATION CONFERENCE, DRIVERS OF CFL PURCHASE BEHAVIOR AND SATISFACTION: WHAT MAKES A CONSUMER BUY AND KEEP BUYING?, 897-910 (2005), available at <http://www.iepec.org/2005PapersTOC/papers/096.pdf>).

¹⁹⁷ See ALAN H. SANSTAD & RICHARD B. HOWARTH, CONSUMER RATIONALITY AND ENERGY EFFICIENCY 1.178 (1994), available at <http://eec.ucdavis.edu/ACEEE/1994-96/1994/VOL01/175.PDF>.

¹⁹⁸ See *id.*

¹⁹⁹ See GOLOVE & ETO, *supra* note 190, at 12-18.

²⁰⁰ AMERICA'S ENERGY FUTURE PANEL ON ENERGY EFFICIENCY TECHS., *supra* note 185, at 5-7.

exist about the energy efficiency potential of and cost savings from a wide array of appliances including those used for space heating, cooling, water heating, ventilation, cooking, lighting, refrigeration, computing, and other office work.²⁰¹

What is less clear is how to achieve those savings and whether cap-and-trade alone—in putting a price on the cost of emitting carbon—can significantly close the efficiency gap. Despite the evidence that a large gap exists, one that the National Academy monetized, and despite the recognition of market barriers and failures leading to the gap, we know significantly less about which barriers and failures cause what proportion of the gap. The National Academy study, for example, does not attempt to monetize the respective contributions of the failures and barriers it describes; many explanations of the existence of market failures and barriers call for more research to quantify them. Some research has been conducted but it seems safe to conclude that we lack data sufficient to know precisely what causes the efficiency gap and therefore exactly how to tackle it.

Although we do not know for certain which market failures contribute significantly to the efficiency gap, we do have data about how successful some forms of governmental intervention have been in closing the gap and whether such programs are cost-effective. In a review of major studies of energy efficiency savings in the year 2000, Kenneth Gillingham, Richard Newell and Karen Palmer, concluded that residential and commercial appliance standards saved a bit more than three percent of energy usage in buildings and delivered substantially more benefits—in reduced energy costs—than the standards cost to implement.²⁰² In an original analysis that estimates realized and potential costs and benefits of appliance standards as of 2006, projecting to 2050, researchers Stephen Meyers, James McMahon, and Barbara Atkinson concluded that already existing standards (some of which are being phased in) will reduce carbon dioxide emissions and energy consumed by four percent over baseline levels in 2030.²⁰³ The authors estimated the ratio of consumer benefits to costs at 2.7 to 1 during the entire period covered (1987–2050), with net present benefits totaling \$269 billion by 2045.²⁰⁴

Evidence about the effectiveness of building codes is more limited. Building codes typically require developers of new and sometimes remodeled buildings to meet an overall energy efficiency standard.²⁰⁵ The efficiency standards are modeled to produce estimates of overall costs and

²⁰¹ See *id.* at 70.

²⁰² See Kenneth Gillingham, Richard Newell & Karen Palmer, *The Effectiveness and Cost of Energy Efficiency Programs*, 155 *RESOURCES* 22, 24 (2004).

²⁰³ See STEPHEN MEYERS, JAMES MCMAHON & BARBARA ATKINSON, LAWRENCE BERKELEY NAT'L LAB., *REALIZED AND PROJECTED IMPACTS OF U.S. ENERGY EFFICIENCY STANDARDS FOR RESIDENTIAL AND COMMERCIAL APPLIANCES* 26 (2008).

²⁰⁴ See *id.*

²⁰⁵ See Grant D. Jacobsen & Matthew J. Kotchen, *Building Codes and Energy Policy*, RES. FOR THE FUTURE (Nov. 1, 2010), available at <http://www.rff.org/Publications/WPC/Pages/Building-Codes-and-Energy-Policy.aspx>.

savings, but as Grant Jacobsen and Matthew Kotchen observe, the modeling failed to account for effectiveness of enforcement and for actual operation of the efficiency measures once installed.²⁰⁶ Jacobsen and Kotchen sought to provide on-the-ground evidence of the effectiveness of building codes by examining the effects of changes in Florida's energy code in 2002 that required compliance with energy efficiency standards.²⁰⁷ The authors compared energy bills of residents who live in houses built under the old and new building codes and concluded that the new energy efficiency standards reduced electricity consumption by four percent and natural gas consumption by five percent. The authors also looked at how many years it would take for the cost of the installation of the energy efficient measures to be paid back in cheaper energy bills. Without taking into account the environmental benefits of reduced energy consumption the payback period was 6.4 years; with the social benefits added in the payback period was somewhere between 3.5 and 5.3 years.²⁰⁸

We know, then, that putting a price on carbon through a cap-and-trade program should, at least in theory, make investments in energy efficiency even more economical as energy prices increase to reflect the compliance costs of reducing carbon. We also know that a significant energy efficiency gap exists. We know further that the reasons for that efficiency gap are several. Market barriers beyond the current failure to price environmental externalities exist in implementing energy efficiency measures, including split incentives, information gaps, liquidity problems, and misinformation about energy savings. We do not know, however, the relative contribution of each of these market failures to the efficiency gap. But we do know that appliance standards and building standards appear to produce real reductions in energy usage and hence in emissions reductions and appear to be relatively low cost. Finally, the NREL study modeling the effects of energy efficiency, cap-and-trade and a renewable portfolio standard seem to demonstrate that energy efficiency measures can offset the costs of a renewable portfolio standard and are therefore cost-effective.²⁰⁹

Based on this information, and in a world of uncertainty about the cause of the efficiency gap, how should a policy maker address whether to enact complementary policies to mandate energy efficiency in addition to a cap-and-trade program? Again the goal of cap-and-trade is to allow the market mechanisms cap-and-trade establishes to produce emissions reductions at the lowest cost. Given the evidence that energy efficiency is cost-effective and even cost-saving, and in the absence of strong data about what market failures are most responsible for the efficiency gap, it seems prudent to attempt

²⁰⁶ *Id.*

²⁰⁷ See Grant D. Jacobsen & Matthew J. Kotchen, *Are Building Codes Effective at Saving Energy? Evidence from Residential Building Data in Florida*, REV. ECON. & STATS. (forthcoming), available at <http://environment.yale.edu/kotchen/pubs/codes.pdf>.

²⁰⁸ *Id.* (manuscript at 4).

²⁰⁹ See discussion of NREL study, *supra* notes 158–71.

to eliminate market failures and barriers through complementary policies like appliance and building standards that have to date proven cost-effective.

IV. CONCLUSION

Cap-and-trade has emerged as a promising mechanism to tackle the reduction of greenhouse gases. Its promise stems in large measure from its commitment to market flexibility for emitters subject to the overall cap. By allowing the market to set a price on carbon and then letting emitters decide how to meet their obligations to comply with the cap most effectively, cap-and-trade is meant to reduce greenhouse gas emissions at the lowest overall price. Numerous additional options exist to reduce greenhouse gas emissions that more directly control which sources must reduce their emissions and how they should go about doing so; these so-called complementary policies can also effectively reduce emissions. But to the degree that such policies constrain the choices emitters have in how to reduce their emissions, complementary policies interfere with the market mechanisms cap-and-trade is designed to promote. If a policymaker's sole goal is to establish the most cost-effective greenhouse gas emissions reduction policy (again putting aside additional goals like air pollution reduction, job creation, and energy independence), then we should not use complementary policies in conjunction with cap-and-trade *unless* market failures exist that would inhibit the proper functioning of the cap-and-trade system.

In deciding whether to enact a complementary policy in addition to cap-and-trade to reduce greenhouse gas emissions, then, the central inquiry should be whether a market failure exists that will prevent emitters from actually implementing the lowest cost emissions reductions. The case for a renewable portfolio standard is weak and will likely lead to significantly higher compliance prices if implemented in conjunction with cap-and-trade. Moreover an RPS will lead to lower allowance prices in the cap-and-trade market, reducing the incentive to innovate in order to create lower cost compliance alternatives. In the case of energy efficiency, the research outlined above suggests that such market failures do in fact exist. Complementary policies to require energy efficient appliances and buildings will be necessary.

Policymakers have considered a number of other complementary policies, including standards for new and existing coal-fired power plants, low carbon fuel standards and automobile efficiency standards. Though any and all of these policies might well be justified, we should be aware in adopting them that there are tradeoffs in cost and in technological innovation that come from an unfettered cap-and-trade system absent evidence that the policies are warranted to overcome persistent market failures. Policymakers should be aware of these tradeoffs and should make them explicit when establishing policy.