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U.S. Climate Policy Developments

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Abstract

This paper outlines recent developments in U.S. climate policies. Although the United States does not participate in the Kyoto Mechanism, a number of climate policies are being implemented at state level as well as at the federal level. First, we report and compare the federal cap and trade proposals in the 110th Congress. Then, the paper illustrates the current situations of state level climate policies, such as the Regional Greenhouse Gas Initiative in the northeastern states or AB32 in California. We analyze these proposals from the viewpoint of technology policies and impacts on international markets. It is found that technology policies play important roles in the cap and trade proposals and that there is a great expectation for carbon capture and sequestration (CCS) technology. In terms of the impacts on international markets, several federal proposals as well as regional programs permit trading in international markets. As emission targets become more stringent in the future, U.S. GHG emitters are more likely to interact with these markets. Thus, despite the lack of U.S. participation in the Kyoto Protocol, U.S. markets will be linked to foreign markets, at least, in an indirect way.

Key Words: United States, climate policy, cap and trade, the Kyoto mechanism, technology policy

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Introduction

Broadly speaking, U.S. climate policy takes two approaches to climate change issues.¹ The first approach, which is garnering more attention lately, is a regulatory structure based on economic incentives, typically employing cap-and-trade carbon dioxide (CO₂) emissions permit systems or CO₂ taxes.² Although the idea of an economy-wide cap-and-trade system seems to have a good deal of political support, many important design elements have yet to be decided. Because the United States has not ratified the Kyoto protocol, it has not participated in international CO₂ emissions trading. The highly successful U.S. sulfur dioxide (SO₂) policy passed in 1990, however, has yielded valuable experience in designing and implementing cap-and-trade systems.

The second approach toward climate change issues is to rely on more conventional, prescriptive regulatory approaches (e.g., energy efficiency standards). The ENERGY STAR program pioneered by the U.S. Environmental Protection Agency (EPA) relies on appliance labeling to help consumers better understand the energy efficiency of the appliances they purchase (see ENERGY STAR 2007). A second example of prescriptive regulation is the Corporate Average Fuel Economy (CAFE) standards used to promote the energy efficiency of motor vehicles.

Prescriptive regulation and incentive-based regulation are generally viewed as alternative approaches to the control of CO₂, meaning that we would choose one approach or the other. Currently, though, some legislative proposals combine the two approaches. The economic efficiency of such hybrid approaches has not yet been assessed, and it is unclear at this point

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¹ In contrast to Japan, which has *Ondanka Taikou*, there is no single, comprehensive law on which all U.S. climate policies are based.

² Similar in many respects to the European Union Greenhouse Gas Emission Trading Scheme (EU ETS).

whether the United States will proceed with a pure cap-and-trade approach, a pure prescriptive approach, or some hybrid of the two.

Federal cap-and-trade proposals are commonly presented with complementary R&D or technology policy. Government support for carbon capture and sequestration (CCS) technologies is explicitly mentioned in some proposals. For example, the Climate Stewardship and Innovation Act proposed by Senators Lieberman and McCain includes a plan to support programs of widespread deployment of CCS technologies.³

The dynamics of environmental policy in the United States differ from those of many other nations. State governments sometimes implement more advanced environmental regulations before the federal government acts. Despite the lack of federal action to control CO₂, a group of northeastern states has already established a mandatory, regional cap-and-trade system for CO₂. This regional program, known as the Regional Greenhouse Gas Initiative (RGGI), will begin in 2009.⁴

In addition to the multistate RGGI, several individual states have implemented climate policies. California is known as a leader in the development of environmental policy. Regulations developed and deployed by California often serve as “templates” for federal policy. As a result, understanding actions currently taking place in California can be important to comprehending how policy is developed at the federal level.

In this discussion paper, we present an overview of recent developments in the design and implementation of domestic policy to control the emissions of greenhouse gases (GHGs). We focus on the development of economy-wide cap-and-trade systems. For each such proposal currently being debated in the U.S. Congress, we discuss carbon prices and their effect on the economy. We also discuss the possible effect such programs might have on the international GHG market—for example, the market for Clean Development Mechanism (CDM) or European Union Greenhouse Gas Emission Trading Scheme (EU ETS). Moreover, potential influences on and of other nations are discussed, along with other climate policies that are often presented with cap-and-trade proposals.

³ To enhance the readability of the text, we have compiled the full names of the lawmakers mentioned in this paper, along with the states they represent and their party affiliations, in Table A1

⁴ Note that a private and strictly voluntary nongovernmental greenhouse gas trading system, the CCX, already exists in the United States.

The next section of this paper describes federal cap-and-trade proposals under consideration in Congress. We follow this discussion with a section that describes climate policy movements at the regional or state level, i.e., RGGI or California. Next, we cover a voluntary market, the Chicago Climate Exchange (CCX), with an associated discussion of renewable portfolio standards (RPSs). In the last section, we offer conclusions based on our review of U.S. climate policy developments.

Federal Policies

Here, we describe climate policies at the federal level, including market-based climate change proposals under consideration in the U.S. Congress. We end this section with brief descriptions of current federal policies relevant to climate issues.

Federal Market-Based Climate Change Proposals

Climate change issues have recently gained increased attention at the federal level. During the 109th Congress (2005–2006), the number of bills, resolutions, and amendments concerning global climate change and GHG emissions reached 106 (Pew Center on Global Climate Change undated b). Several cap-and-trade proposals were included. According to Kopp and Pizer (2007), major proposals included Jeffords (S. 150), Leahy (S. 730), Waxman (H.R. 1451), Carper (S. 2724), Bass (H.R. 1873), Udall-Petri (H.R. 5049), McCain-Lieberman (S. 1151), and Bingaman (S.A. 868).

The 110th Congress has seen several new and modified proposals on emissions cap and trading, for example, Sanders-Boxer (S. 309), Feinstein-Carper (S. 317), Lieberman-McCain (S. 280), Kerry-Snowe (S. 485), Alexander-Lieberman (S. 1168), Bingaman-Specter (S. 1766), and Waxman (H.R. 1590). Moreover, drafts of cap-and-trade proposals by Udall-Petri⁵ and Lieberman-Warner⁶ have been distributed. The Sanders-Boxer proposal is a reintroduction of Jeffords's proposal in the 109th Congress, and the Waxman proposal is a reintroduction of his own previous bill. The Lieberman-McCain proposal (S. 280) is also a reintroduction of previous proposals from the 108th and 109th Congresses. All proposals to date incorporate a flexible allowance trading mechanism, except Sanders-Boxer, which permits trading but does not require it. In addition to these cap-and-trade bills, two proposals on a carbon tax have been introduced: Stark (H.R. 2069) and Larson (H.R. 3416) each propose an economy-wide carbon tax system.

⁵ Based on May draft.

⁶ Based on "Annotated Table of Contents" issued on August 2, 2007 released by Senators Lieberman and Warner.

We can point to some trends in the new proposals in the 110th Congress. They tend to have more stringent long-run emissions reduction targets than those in the 109th Congress. Further, more senators are involved in the new proposals, and more focus is on auction of allowances rather than grandfathering. This may be the influence of RGGI: Vermont, Maine, Connecticut, Massachusetts, and New York have already declared 100 percent auction of allowances.

The 110th Congress proposals are converging. Notably, the Bingaman-Specter draft proposed in January had intensity targets and a much weaker emissions target; the new Bingaman-Specter proposal, issued in July, has an absolute cap and an emissions target closer to the Lieberman-McCain target. In addition, the safety valve price⁷ in Bingaman-Specter, which was \$7 per metric ton in the 109th legislation, is now \$12 per metric ton.

Broadly speaking, we can categorize these proposals into two groups based on their level of detail. The first group has few details. Among the cap-and-trade proposals in the 110th Congress, Kerry-Snowe, Sanders-Boxer, and Waxman fall into this group; they set an overall goal—the cap—and leave most of the implementation details to the discretion of regulators—typically the president or the EPA. If this type of proposal is passed, it is likely to be some time before regulations are in place because many implementing regulations will have to be promulgated. Historically, for instance, the 1970 Clean Air Act (CAA) was subject to this approach. Thus, a period of rulemaking and litigation preceded its implementation. As we discuss later, California's new GHG emissions law—Assembly Bill 32—can be categorized in this group.

The second set of proposals spells out implementation measures in greater detail. These bills may take more time to pass because of the numerous issues to be discussed, and reaching agreement may be more difficult. If one of these bills is passed, however, implementation may follow faster than under the first approach. For example, the 1990 CAA Amendments had several specifics on the SO₂ allowance market, allowing it to be implemented relatively quickly. RGGI also falls into this group. Among cap-and-trade proposals, the Bingaman-Specter, Udall-Petri, and Lieberman-McCain bills all broadly fall into this group, and the Lieberman-Warner proposal, when it is released, is expected to as well.

⁷ The concept of the safety valve price is discussed later.

Table A2 summarizes the details of the market-based climate change proposals in the 110th Congress.⁸ We next describe and discuss each aspect—for example, scope, regulated entities, and targets—of the bills.

Scope

Most of the current cap-and-trade proposals are economy-wide and cover all six GHGs: CO₂, methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆). These proposals focus on emissions at fixed sources or on the production and processing sources of fuels. Thus, if the regulation is enforced upstream—at producers or processors of fissile fuels—the regulation can affect the transport sector through a gasoline price increase. If the regulation is implemented downstream—at emissions sources—it may leave out the transportation sector. As we discuss later, though, some downstream proposals include other provisions such as strengthened CAFE to regulate emissions from the transportation sector.

A few cap-and-trade proposals, including Feinstein-Carper and Alexander-Lieberman, target only the electricity sector and cover only CO₂. The scope of these two carbon tax bills is economy-wide; both cover CO₂ emissions through a tax on fuels.

Regulated Entities

Entities to be regulated differ even among the proposals with economy-wide targets. Although Udall-Petri would regulate upstream entities (e.g., coal mines, petroleum refineries) primarily, Bingaman-Specter, Lieberman-McCain, and Lieberman-Warner regulate a mixture of downstream emitters as well as some upstream entities. The electricity sector-specific bills regulate downstream emitters (electric generating units). The two carbon tax proposals charge taxes upstream, at the point of production or import of fossil fuels. In the less detailed proposals—Kerry-Snowe, Waxman, and Sanders-Boxer—the point of regulation is to be determined by the president or the EPA.

All the bills require the EPA to set up and administer the cap-and-trade system, except Bingaman-Specter, which assigns this role to the Department of Energy (DOE). The two tax proposals delegate responsibilities to DOE and the Department of Treasury.

⁸ Table A2 is heavily based on a comparison table of market-based climate change bills by Kopp et al. (2007). The information on early actions is also taken from a comparison table by Pew Center (2007b).

Emissions Targets

Emissions targets also differ across market-based policy proposals. Figure A1⁹ exhibits the trajectories of emissions targets for the economy-wide and electricity-sector proposals. In general, the less detailed proposals tend to have more stringent targets: Waxman, Sanders-Boxer, and Kerry-Snowe have the most stringent targets; Bingaman-Specter and Udall-Petri have less stringent targets; and Lieberman-McCain is in between. Lieberman-Warner proposes 2005 emissions levels in 2012, and 10 percent and 30 percent below 2005 levels in 2020 and in 2030, respectively; this is roughly similar to the Lieberman-McCain targets. (The Lieberman-Warner bill is not depicted in the figure because a detailed draft has not yet been released.) Note that the figure depicts the stated emissions goal of each of the bills. In practice the stringency of the regulation will depend not only on the target but also on other aspects of the bill, including the rules for offsets activities or the use of mechanisms such as safety valves or banking and borrowing.

These federal proposals also have long-term targets: most set emissions levels in 2050. These long-term emissions targets are comparable to those recently discussed internationally in the G8; EU, Japan, and Canada will at least halve greenhouse gas emissions by 2050 (EENews [2007]).

The carbon tax proposals set a tax rate, but have no short-term emissions target: in the Larson proposal, the tax is initially set at \$15 per CO₂ metric ton, and increases annually at 10 percent plus inflation; Stark proposes \$3 per CO₂ metric ton, rising by \$3 annually. The Stark proposal does specify a long-term emissions goal: the tax freezes once U.S. CO₂ emissions drop to 80 percent below the 1990 level.

Allowance Allocation and Auction

A crucial issue in the design of a cap-and-trade scheme is how to initially distribute the allowances. One alternative is to give them away, based on some measure of past or current behavior, and another is to distribute them through an auction.

All the cap-and-trade bills except Sanders-Boxers explicitly propose that some portion of allowances be auctioned.¹⁰ In other words, most proposals are mixtures of the two alternatives

⁹ Figure A1 is also taken from the figure by Kopp et al. (2007).

¹⁰ Although the Sanders-Boxer legislation sets an emissions cap, it does not specify that a market-based allowance trading system be used to achieve the capped emissions level.

described. For example, in the Bingaman-Specter proposal, 24 percent¹¹ of allowances would be auctioned initially from 2012 to 2016. In the same period, industry and state governments would receive 53 percent and 9 percent, respectively. Of the remaining allowances, 8 percent are set aside for CCS projects, 5 percent are kept for agricultural sequestration, and 1 percent are reserved for early reduction credits. After 2016, the share auctioned increases annually by 1 percent up to 53 percent and the share to industry decreases at the same rate. Similarly, in Feinstein-Carper, 15 percent of allowances are auctioned initially, and then the share of auctioned allowances increases annually until all allowances are auctioned in 2036. Udall-Petri proposes starting with an 80 percent auction, the largest initial percentage of any of the major proposals.

In contrast, the Kerry-Snowe, Waxman, and Lieberman-McCain proposals specify that the president or an administrative entity develop the allocation plan, including the share auctioned, and so it is not clear how allowances would be allocated. Sanders-Boxers leave the details of allocation to EPA if EPA adopts a cap-and-trade system.

One feature of the federal cap-and-trade proposals is that those who receive the free allowances may not be the regulated entities. Bingaman-Specter proposes using a portion of the auction revenue for low-income assistance to mitigate effects of the regulation. Other proposals—including Lieberman-Warner, Lieberman-McCain, and Udall-Petri—also address the effects of the climate policy on low-income households (Pew Center on Global Climate Change 2007b).

Another common feature in these proposals is that a portion of the revenue from auctions would be used for climate related technology programs. We discuss technology programs later in this section.

Note that the total value of allowances as assets can be enormous. Even with modest prices (\$15 per CO₂ ton), the total value of allowances could be \$1 trillion over a decade. In contrast, the cost of modest GHG emissions reduction is estimated to be much smaller (Pizer 2004). Thus, those who receive free allowances may benefit economically despite the regulation. In fact, under EU ETS, there has been a controversy about electricity producers who are accused of “windfall profits” because of free allocations.

¹¹ In the January draft, the share of auction was 10 percent during 2012–2016; the July draft has greater emphasis on auction .

The revenues from the two tax proposals would be collected by the Internal Revenue Service and go to the U.S. Treasury. The Larson proposal uses a large portion of revenues for payroll tax rebates.

Price Stability and Cost Containment

The cap-and-trade proposals have flexibility mechanisms designed to reduce market volatility and overall costs. Most proposals permit allowance banking; indeed, most allow unlimited banking. Some bills permit allowance borrowing: Lieberman-McCain permits borrowing up to 25 percent of an entity's total allowance submission requirement, and for a maximum of five years; Lieberman-Warner allows borrowing up to 15 percent; and Feinstein-Carper also allows borrowing. Borrowing provisions always include an interest rate for repayment of allowances.

One unique feature of some U.S. cap-and-trade bills is the safety valve, which is a price ceiling for allowances. Once the price of allowances reaches the ceiling, emitters can purchase additional allowances at the ceiling price from the regulator. Though this system may not be rigid on emissions reduction, it can mitigate unpleasant cost surprises as well as price volatility. Bingaman-Specter¹² and Udall-Petri both propose a safety valve that starts at \$12/CO₂ equivalent (CO₂e) metric ton and increases over time. No proposal sets a price floor on allowances.¹³

The Lieberman-Warner proposal has a unique approach to containing costs: establishing a carbon market efficiency board—modeled after the Federal Reserve—to oversee the market. The board would ensure that the allowance market functions efficiently. It could use relief remedies to control adverse impact on the U.S. economy. For example, if the board found the allowance prices to be too high, it could temporarily increase the amount of allowances that regulated entities could borrow.

Early Actions

To encourage efforts to reduce GHG emissions before a regulation takes effect, several proposals give credit for early reduction. For instance, Bingaman-Specter, Lieberman-McCain, Kerry-Snowe, Feinstein-Carper, and Lieberman-Warner all propose giving allowances as rewards for early actions.

¹² In Bingaman-Specter, the safety valve price is referred to as a technology accelerator payment (TAP).

¹³ Allowing entities to bank allowances will act in some respects as a price floor.

Domestic Offsets and Credits

Offsets can be used to achieve emissions reductions in sectors that are difficult to regulate directly, and can expand the pool of low-cost reduction options, thereby lowering the overall cost of a regulatory program. Most proposals have provisions for domestic offsets. These offsets frequently include biological and agricultural sequestration; capture and destruction of methane from landfills, agriculture, and coal mines; and geologic sequestration—known collectively as CCS. Some proposals are more generous than others in the amount of allowances. For example, Bingaman-Specter does not limit the number of eligible allowances from domestic offsets. Udall-Petri allows unlimited geological sequestrations offsets. Feinstein-Carper also allows extensive domestic biological offsets. In contrast, other proposals such as Lieberman-McCain or Lieberman-Warner cap the number of domestic offsets that can be used.

In some proposals, multiple agencies are responsible for the allowance market. For example, Kerry-Snowe proposes that USDA sets rules for domestic biological sequestration and leaves point of regulation at the discretion of the EPA.

The two carbon tax proposals allow domestic offsets through the provision of tax refunds for CCS projects.

Linking with International Programs and Markets

These proposed cap-and-trade systems are domestic. They can, however, affect the international market for emissions credits. A U.S. cap-and-trade system could influence international emissions markets through three channels: international offsets programs, the purchase of allowances in foreign markets such as EU ETS, and programs for developing country engagement.

The first possibility is CDM or other carbon mitigation projects in developing countries. Feinstein-Carper permits allowances from CDM.¹⁴ Lieberman-McCain allows up to 30 percent of allowance submission requirements to be satisfied through offsets projects in developing countries. In the Bingaman-Specter proposal, international offsets projects are permitted if the president sets up a program for these projects based on the results of the initial interagency review that will take place no later than January 2016.

The second channel is foreign projects similar to Joint Implementation (JI). Feinstein-Carper permit credits from projects in countries with mandatory GHG limits. Because countries

¹⁴ The January draft of Bingaman-Specter had this provision on CDM.

facing such a GHG cap are likely to have ratified the Kyoto Protocol, projects assumed in the proposal can be eligible as JI under the Kyoto Protocol.

Finally, foreign GHG markets could potentially be linked to the U.S. cap-and-trade system. Bingaman-Specter permits the use of international credits if approved by the president based on the initial interagency review. Lieberman-Warner also allows the use of foreign credits if the foreign market has comparably rigorous monitoring, compliances, and enforcement methods. Though the definitions in these proposals are to be finalized during the development of the U.S. market, emissions credits from EU ETS or other countries might be eligible for the use in the U.S. market.

Provisions for Other Nations

Bingaman-Specter has a program to promote GHG reduction in developing countries. The bill establishes an International Energy Technology Deployment Fund to help deploy low-carbon technologies in developing countries. The fund would be established using the auction revenue.¹⁵ It would deploy energy technologies with low or no GHG emissions in key developing countries. The Udall-Petri proposal has a similar proposal on the use of auction revenue. They propose that 10 percent of the auction revenue go to developing countries. Sanders-Boxer also proposes support for low-carbon technologies in developing countries.

Some proposals also include provisions to encourage regulatory actions among other nations. Bingaman-Specter proposes that, after 2020, the president could require importers of carbon intensive goods—iron, steel, aluminum, or cement, for example—to submit allowances for a product’s carbon content if the country of origin does not have a climate policy comparable to the U.S. policy. This mechanism could give foreign countries incentives to implement carbon reduction policies; it could also reduce the problem of carbon leakage. The Lieberman-Warner proposal contains a similar policy. Udall-Petri addresses this issue through the safety valve: if the developing countries with the largest emissions do not adopt comparable climate policies, escalation of the safety valve price can be delayed. Both carbon tax proposals consider international actions by applying the carbon tax to both domestic fossil fuels and imports.

Provisions for Advanced Technology and Related Programs (including CCS)

All proposals except Stark have technology components. For instance, Feinstein-Carper proposes that 65 percent of the auction proceeds be used for R&D and deployment of technology

¹⁵ The proceeds from the U.S. importer requirement, which is explained later, are also to be used for this purpose.

to reduce GHG emissions. Bingaman-Specter proposes that about half of the revenue from the auction goes to the proposed Energy Technology Deployment Fund to promote technological innovation to reduce GHG emissions. In the carbon tax proposal by Larson, one sixth of tax revenues would be used for clean energy technology R&D.

One noteworthy feature of technology policy in these proposals is the high expectations for CCS technology. Proceeds from auctions are often used for CCS-related programs. Bingaman-Specter proposes that 28 percent of the Energy Technology Deployment Fund go to advanced coal and sequestration technologies, 7 percent to biofuels (cellulosic biomass ethanol and municipal solid waste technology), and 20 percent to advanced technology vehicles.¹⁶ Bingaman-Specter further proposes bonus allowances for CCS.

One can see other types of support for CCS: Udall-Petri specifically permits CCS projects as domestic offset projects, and Sanders-Boxer proposes grants for CCS deployment.

These mechanisms also consider the issue of high cost of CCS, which is an obstacle to its deployment. Liability issues, however, are also associated with CCS. For example, geological sequestration could cause well blowouts or pipeline ruptures. Further, CO₂ dissolved in subsurface waters could affect the stability of metal-organic complexes within the substrate by altering pH (Wilson et al. 2003). Most of proposals do not approach this issue because CCS is still considered to be at the R&D stage. Lieberman-Warner, however, does specifically discuss the legal framework for CO₂sequestration.

In addition to the technology and R&D policies just discussed, Sanders-Boxer, Waxman, and Kerry-Snowe proposals also discuss other regulatory climate policies such as efficiency standards or RPSs.

Sanders-Boxer and Kerry-Snowe include provisions for vehicle emissions standards. Although other proposals have no direct regulation on the transportation sector, Bingaman-Specter, Lieberman-McCain, and Lieberman-Warner indirectly regulate the transportation sector through increases in gasoline prices, which is induced by upstream regulation in their cap-and-trade proposals.

¹⁶ The rest of the fund is used to carry zero- or low-carbon energy technology such as high efficiency consumer products.

Carbon Prices and Impacts on Economy

Now we turn to the implications of these proposals for carbon prices and their impacts on the U.S. economy. The Energy Information Administration (EIA) and National Commission of Energy Policy (NCEP) have analyzed the new proposals in 110th Congress. EIA (EIA, 2006) has also conducted several analyses of impacts of proposals in previous congresses. Table A3 exhibits a comparison of the impacts of Bingaman-Specter and Lieberman-McCain, and also the Udall-Petri proposal from the 109th Congress.

One should bear in mind that the model prediction has uncertainty related to a few aspects. One is the uncertainty related to availability of the international offsets. Also, each analysis has different assumptions on baseline and fuel prices because the analyses were conducted in different years. Further, the NCEP analysis assumes reduced energy demand and efficiency gains as a result of technology policy using auction revenues. Although these analyses give a reference point, we must use caution in a simple comparison of the impacts of the bills because the analyses use different assumptions.

Concerning the CO₂ price, EIA (2007) estimated the allowance price (in 2005\$ per metric ton/CO₂e) under Lieberman-McCain to be between \$31 and \$58 in 2030. The allowance price in Bingaman-Specter is estimated to be \$24 (in 2005\$ per metric ton/CO₂e) in 2030 according to NCEP (2007). The prices differ because of the differences in the stringency of the cap and the assumption of the model. NCEP assumes that technology policies using the auction revenue will increase energy efficiency and reduce demand for energy.

A Massachusetts Institute of Technology (MIT) group¹⁷ also predicts the allowance prices using their Emissions Prediction and Policy Analysis model (Palstev et al. 2007). Instead of focusing on particular proposals, they estimated the effect of cap-and-trade programs under three scenarios based on cumulative allowances available from 2012 to 2050. The most stringent scenario is close to Sanders-Boxer or Kerry-Snowe. The medium stringency scenario is close to Lieberman-McCain. Finally, the least stringent target is close to Udall-Petri from the 109th Congress. Under the three scenarios, the allowance price ranges from \$22 to \$65 (2005\$ per metric ton/CO₂e) in 2020 and from \$70 to \$210 in 2030.

Estimated impacts on gross domestic product (GDP) vary across the proposals. On one hand, Lieberman-McCain is expected to decrease GDP by 0.3 percent in 2020. On the other

¹⁷ See Aldy (2007) for discussion of the characteristics of the EIA model and the MIT model.

hand, the impact of Bingaman-Specter is +0.12 percent. This positive impact estimate by NCEP is due to the various policies inducing efficiency gains and technological changes.

To elucidate the effect on households, we show the effects on electricity prices in Table A3. Lieberman-McCain's proposal increases the price by 10 percent in 2020. The effect of Bingaman-Specter on electricity price is estimated to be an increase of 7 percent in 2020. The estimated impacts of the proposals are modest compared to the recent fluctuations in electricity prices owing to increases in natural gas price.¹⁸

Discussion: Impacts on International Markets

Finally, we discuss the impacts of U.S. cap-and-trade proposals on international markets of GHG. By international markets, we refer to markets of CDM credits, JI credits, and EU ETS credits. First, we describe theoretical possibilities in the cap-and-trade proposals. Then, we discuss the impacts in two periods: the first commitment period of the Kyoto Protocol (2008–2012) and after the Kyoto period (2013 on).

As described previously, some proposals permit credits from CDM or projects in developing countries. If the price of GHG allowances goes up, regulated entities in the United States would heavily rely on international credits originated in developing countries. In this case, there could be demand for projects that would reduce GHGs in developing countries. Thus, theoretically, a U.S. cap-and-trade system would increase the price of CDM credits.

A U.S. cap-and-trade system potentially could spur competition for JI projects as well. Although the details of the regulations in Feinstein-Carper are up to EPA, their proposal may permit credits from JI.

Finally, a U.S. cap-and-trade system can theoretically influence EU ETS if the use of credits from EU ETS is permitted, as suggested in Bingaman-Specter, Lieberman-Werner, and Feinstein-Carper. If the price of an EU ETS allowance is less than a U.S. allowance, regulated entities in United States will purchase credits from EU. But a U.S. emitter could sell its extra allowances if the allowance price were higher in EU ETS than in United States, provided that EU accepts U.S. allowances.

¹⁸ In deregulated states, the price of electricity is calculated using marginal cost rather than conventional average cost. Most RGGI states are deregulated, except for Vermont. Because the natural gas is used at the margin, its price usually determines the marginal cost. Hence, the price of natural gas has a strong influence on electricity prices in deregulated areas.

Now, we discuss impacts during the Kyoto commitment period. A trading system is expected to start from 2011 at the earliest in the proposals, whereas the Kyoto commitment period is from 2008 to 2012. Thus, the first commitment period of Kyoto protocol would nearly be over by the time a U.S. cap-and-trade system starts. Moreover, the U.S. reduction targets are less stringent in the early years than in later years. Thus, the impacts on the international markets would be limited. On the other hand, some reports suggest that the competition for CDM credits might intensify in anticipation of the U.S. federal cap-and-trade system (Greenwire 2007).

One could point out that, with banking incorporated in a trading system, regulated entities could have incentives to obtain offset credits early in the Kyoto period and use the credits for compliance with stringent targets in later years. In this sense, banking promotes competition in international markets. The size of impact will depend on how the rule on banking is set.

In the post-Kyoto commitment period, U.S. cap-and-trade programs will have a greater impact on the international markets. As seen in Figure A1, the emissions reduction target is more stringent in later years. Thus, in the long term, regulated entities are likely to rely on offset programs. If the projects in developing countries are less costly than domestic projects (which is likely), there will be a large demand for offsets projects from developing countries.

The size of this potential impact would depend on how rules on the use of international credits are set. In Lieberman-McCain and Feinstein-Carper, the detailed procedure for crediting offsets is at the discretion of EPA. Bingaman-Specters lets the president promulgate rules establishing an international program based on the review by the interagency group. If the associated transaction costs in the international offsets program are low, there could be great demand for these offsets projects. Moreover, Lieberman-McCain does not restrict international credits from developing countries to CDM credits. If the rules of international offsets in a U.S. cap-and-trading system are simple enough, the potential sellers of CDM projects in developing countries could sell those projects to U.S. buyers directly. Then the supply of credits from CDM projects to Kyoto Protocol participants will decrease. This competition between U.S. buyers and Kyoto participants may increase the price of CDM credits, especially in later years when a U.S. cap becomes more stringent.

Direct effects on the EU ETS market could be limited. If the price of allowances in EU ETS were smaller than in the U.S. market, there would be a demand of EU ETS allowances by U.S. entities in the long run. Given, however, the stringent target EU recently announced, it is not clear if allowances in EU will be less costly than those in the United States.

The U.S. importer requirements in Bingaman-Specter and Lieberman-Werner will affect international markets whether or not the importer is required to submit allowances. On one hand,

if a major trading partner or emitter does not have a comparable policy, U.S. importers are required to submit allowances. Bingaman-Specter allows U.S. importers to submit foreign allowances. Thus, this requirement can increase demand for foreign markets in a direct way. On the other hand, if all major trading partner or emitters have comparable policies, the supply of the international credits will be decreased. If a major U.S. partner such as China adopts a domestic regulation in response to this provision, emissions reduction projects in China will be used for domestic purposes. Because China is a great source of CDM credits (Lecocq and Ambrosi 2007), the introduction of a domestic regulation in China reduces the supply of international offsets projects.¹⁹ Thus, in any event, the U.S. importer requirement can increase allowance prices in the international market.

One point to be made is that domestic allowance markets are likely to be, at least weakly, linked to foreign markets even without an international agreement among major emitters. In the long run, the emissions target becomes more stringent, increasing demand for international offsets projects. If developed countries adopt domestic cap-and-trading systems like that of the EU, they are also likely to use international offsets, mostly in developing countries. In the long run, then, there may be greater competition for CDM or offsets projects in developing countries. Consequently, different domestic markets could be linked indirectly through competition for offsets projects in developing countries.

Other Federal Climate Policy

Although cap-and-trade proposals in Congress will require at least several years before they are implemented, some federal climate policies are being implemented. We briefly describe current federal policies relevant to climate issues especially in the context of the cap-and-trade proposals.

Mandatory Appliance Standard

Federal standards for the minimum energy efficiency of appliances started during the mid-1970s energy crisis, when high prices and increased environmental concerns drove many states to consider ways to reduce growing energy demand. California passed legislation that paved the way for New York and other states, and manufacturers soon pushed for uniform federal standards.

¹⁹Most proposals prohibit double counting of foreign credits.

Early efforts to set national standards were largely ineffective until a collaboration of manufacturers and energy efficiency advocates resulted in the 1987 National Appliance Energy Conservation Act. This act established national standards for 15 categories of household appliances: refrigerators, freezers, clothes washers, clothes dryers, dishwashers, kitchen ranges, kitchen ovens, room air conditioners, direct heating equipment, water heaters, pool heaters, central air conditioners, central heat pumps, furnaces, and boilers. These initial standards have been updated several times, and in 1988 standards were added for showerheads and fluorescent light ballasts. The next major energy efficiency legislation was the 1992 Energy Policy Act, which extended standards to induction motors, many kinds of lamps, and most types of commercial heating and cooling equipment (Gillingham et al. 2006).

ENERGY STAR²⁰

In addition to the mandatory appliance standards, a federal voluntary program, ENERGY STAR, promotes energy efficiency of business and individuals. Thus, ENERGY STAR addresses the climate issue by reducing energy consumption. A joint program by DOE and EPA, it has several programs. A program on products sets energy efficiency standards for products in more than 50 categories. Qualified products can have an ENERGY STAR label, which helps consumers identify energy efficient products. The home improvement program gives technical assistance to improve efficiency in heating and cooling. The third program helps build new energy-efficient homes. The fourth improves energy performance of buildings and plants through energy management; qualified buildings and plants can become an ENERGY STAR partner.

As we describe later, this program is influenced by state level movements in efficiency standards. It is also mentioned in a recent federal cap-and-trade proposal by Feinstein-Carper.

CAFE

The CAFE regulation is another well-known regulation that addresses climate change issues. CAFE regulates the sales-weighted average fuel economy of motor vehicles sold by a company. Roughly speaking, CAFE can be considered an emissions standard for CO₂ at the auto company level. The program is run by National Highway Traffic Safety Administration and EPA.

CAFE was first enacted in 1975 to enhance energy security; its purpose is to reduce energy consumption, not GHGs per se. But it contributes to reduce GHG emissions through

²⁰ See <http://www.energystar.gov/index.cfm?c=home.index>

reduced fuel consumption. Recently, there has been an effort to raise CAFE standards in Congress. There is also a discussion about allowing automakers to trade credits if they improve fuel economy more than required. Several recent cap-and-trade proposals recommend emissions standards for vehicles.

CCS Policy

CCS is an advanced technology to capture and to store CO₂ safely. DOE has several CCS R&D programs and initiatives (see DOE, 2007). The Carbon Sequestration Leadership Forum, an international ministerial-level panel, meets regularly to discuss current research on CCS. Regional Sequestration Partnerships is a national network of public-private sector partnerships that conduct field tests of carbon sequestration across states. The FutureGen Initiative is a project intended to create the first zero-emissions fossil fuel plant with a budget of \$1 billion. The Carbon Sequestration Core Program is developing a portfolio of new CCS technologies that includes carbon capture R&D, geologic sequestration, ocean sequestration, and terrestrial sequestration.

The keys to the success of CCS are reducing the cost for capture and increasing the safety and security of sequestration. Also critical is gaining public acceptance of storage; this involves having regulatory systems in place that the public can trust. Recent cap-and-trade proposals in Congress often have provisions to assist development and deployment of CCS technology.

Regional Programs and Others

In the United States, state environmental regulations are often more advanced and more stringent than federal regulations. The climate policy is not an exception. For example, 12 states have emissions targets for GHGs despite the absence of federal level targets. Here we outline recent developments in climate policy at regional and state levels. We first describe an initiative in the northeastern states, known as RGGI, and then explain California initiatives, including AB32. We also discuss the private sector initiative CCX and state RPSs.

Initiatives in the Northeastern States: RGGI

The RGGI was launched in April 2003 when New York Governor George Pataki sent letters to 11 governors from Maine to Maryland encouraging the development of a regional strategy to combat global climate change. The discussions centered on a regional cap-and-trade program to regulate carbon dioxide emissions from power plants, the first of its kind in U.S. history.

Even before Governor Pataki's letter, many of the northeastern and mid-Atlantic states were already studying or implementing programs to reduce GHG emissions. For example, in April 2000, New Jersey adopted a plan to reduce GHG emissions by 3.5 percent from 1990 levels by 2005 (RGGI 2006). In 2001, New England and the eastern Canadian provinces issued a Climate Change Action Plan that targeted a reduction of greenhouse gases by 2020 of 10 percent below 1990 levels. New York's State Energy Plan also intends to reduce carbon emissions by 2020.

The governor's letter initiated a process involving many stakeholder meetings, collaboration among staff from the involved states, hundreds of one-on-one meetings, and a comprehensive Web site. In December 2005, the governors from seven states (Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York, and Vermont) entered into a memorandum of understanding (MOU) that specified the general framework of the program. The model rule serves as a starting point for each state to obtain legislative or regulatory approval of the program (RGGI 2006).

Massachusetts and Rhode Island temporarily moved to observer status in December 2005 when the governors declined to sign the MOU, but they have since decided to rejoin (<http://www.rggi.org/>). In April 2006, Maryland passed a law that required it to join RGGI by June 2007, and in April 2007 Maryland officially became the tenth state to join RGGI. The District of Columbia, Pennsylvania, and the eastern Canadian provinces, including New Brunswick, are currently observers in the process.

The RGGI cap and trade will start in 2009 and include coal fired, oil fired, and gas fired electric generating units with a capacity of 25 megawatts or more. In 2009, among the nine original states in RGGI (excluding Maryland), the initial distribution of allowances for emissions of CO₂ from power plants will be capped at approximately current levels (i.e., 150 million tons annually). (Currently, Maryland is second to New York for the amount of annual emissions.) This limit will remain in place until 2015. Over the next four years, the number of allowances put into the market will be reduced incrementally to achieve a 10 percent reduction by 2019. One allowance, or permit, will be issued for each ton of CO₂ emissions allowed under the cap. Plants will need an allowance for each ton of CO₂ emitted and can buy or sell allowances. Allowances can also be banked for use in future years. On average, over the life of the program, the total annual amount of allowances available will be equal to the yearly emissions cap for the region. Although the cap-and-trade program is regional, states will receive an annual emissions budget. Compared to a baseline that includes emissions increases without RGGI, the cap-and-trade program "will result in an approximately 35 percent reduction by 2020" (RGGI 2006).

The RGGI model rule also requires that a minimum of 25 percent of a state's allowances be "dedicated to strategic energy or consumer benefit purposes, such as energy efficiency, new clean energy technologies and ratepayer rebates" (RGGI 2006). Alternatively, states can allow power plants to purchase these allowances and use the funds from the sales for beneficial energy programs such as energy efficiency, new clean energy technologies, and ratepayer rebates. The most likely outcome will be an auction of these emissions allowances, with revenues collected under the auction to be dedicated to the strategic energy or consumer benefit purposes.

So far five RGGI states—Vermont, New York, Maine, Massachusetts, and Connecticut—have announced that they intend to increase the percentage of allowance value going to public purposes to 100 percent. No other state has made a declaration, with the exception of New Jersey, which stated it may auction "up to 100 percent."

In contrast, in the EU ETS, the member states are precluded from auctioning any more than 5 percent of the allowances for CO₂ during the first phase of that program (2005–2007) and no more than 10 percent in the second phase (2008–2012). That rule has proven very controversial. It has led to allegations that electricity producers are earning extra-normal profits because they are charging electricity customers for the value of emissions allowances even though they receive the majority of allowances for free. In other words, producers can realize an increase in revenues that exceed their increase in costs.

The electricity markets within RGGI states and in much of the surrounding region have market-based electricity prices. Consequently, electricity prices should not change whether allowances are given away or auctioned. There is a difference, however, in who captures the newly created value of allowances that is created by the program. Under an auction, this value would remain in the public sector.

A second crucial issue is what should become of the value from the portion of allowances that are auctioned. The RGGI rule stipulates that proceeds from the auction should go to public benefit (e.g., energy efficiency programs). This decision has important implications for the analysis of economic impact.

Offsets

Under the RGGI program, power plants offset GHG emissions from outside the electricity sector with credits for measures taken in other sectors or outside the region. These offsets can account for up to 3.3 percent of their emissions, which translates to approximately 50 percent of their compliance obligation under RGGI (RGGI 2005). The maximum offset can be larger if the cost of permits increases. If the cost reaches \$7 per ton, sources can cover up to 5

percent of emissions with offsets allowances. At an allowance price above \$10 per ton, offsets allowances can account up to 10 percent of emissions (RGGI 2005). Offsets credits can come from outside the region, but states or other U.S. jurisdictions not in RGGI would need to enter into an MOU with RGGI state agencies to ensure the credibility of the offsets projects (RGGI 2006). In addition, at CO₂ permit prices greater than \$10, sources in RGGI could purchase certified emissions reductions (CERs) from the international CDM process. Examples of offsets projects are natural gas end-use efficiency, landfill gas recovery, reforestation, and methane capture from farming facilities.

Linkages

RGGI does currently not allow formal linkages with the EU ETS program. So sources in the RGGI region cannot purchase ETS CO₂ emissions allowances for compliance and RGGI allowances are not accepted for compliance in the EU.

Leakage

A natural concern about implementing a regional CO₂ emissions cap is that regional emissions will be displaced to other states not covered by the CO₂ cap, either through increased imports of power or export of economic activity from the region. The early RGGI modeling analysis found that the amount of leakage depends on the assumptions made about natural gas price projections and other factors. CO₂ emissions leakage could range from 20 percent to more than 30 percent of emissions reductions in the RGGI region (RGGI Multi-State Staff Working Group 2007). Another study found the leakage could range from slightly less than 20 percent to more than 40 percent, with 30 percent a likely outcome (Burtraw et al. 2005). Both studies conclude that insufficient information exists to allow precise estimates of the potential emissions leakage that could occur over the course of the program. Leakage from RGGI will depend on relative power prices inside and outside RGGI, the amount of available transmission capacity, and other market dynamics such as line loss effects. In another recent report, the Staff Working Group outlined a set of strategies for monitoring emissions from unregulated generators that serve customers in the RGGI region and reviewed policy options that could reduce leakage (RGGI Multi-State Staff Working Group 2007).

CO₂ Emissions

The emissions target is moderate, and allows for some economic growth. Taken as a group, for the nine participating states (excluding Maryland, which joined more recently), emissions in 2004 were 95 percent of the RGGI total cap on CO₂ emissions of 150,572,993 short

tons (Table 1). Based on RGGI's estimates for 2004, only one state, New Hampshire, had CO₂ emissions that exceeded its allotment.

Table 1. CO₂ Emissions (short tons) in Nine RGGI States Excluding Maryland

State	MOU Caps	2004 Estimate
Nine RGGI States	150,572,993	143,291,911
CT	10,695,036	9,884,343
ME	5,948,902	4,719,458
NH	8,620,460	8,812,538
VT	1,225,830	378,408
NY	64,310,805	62,240,867
NJ	22,892,730	21,133,145
DE	7,559,787	7,534,152
MD	37,503,983	31,984,000
MA	26,660,204	26,370,000
RI	2,659,239	2,219,000
PA	<i>na</i>	130,540,000

Sources: CIER (2007) and Second Amendment to Memorandum of Understanding (see <http://www.rggi.org/agreement.htm>).

Building additional fossil fuel generation or reinstating retired fossil fuel capacity in reaction to demand growth would easily push several states above the cap. But retiring existing high emitting facilities could have the opposite effect, particularly if the generation lost from these facilities were replaced by generation from lower emitting units.

Carbon Prices and Impacts on Economy

First, we report the expected price of allowances. RGGI has its own formal modeling analysis, and the results are available on its Web site (<http://www.rggi.org>). RGGI estimated prices with different scenarios. They assume the following package: First, the use of offsets is limited to 50 percent of the required reduction. Second, GHG emissions are capped after 2020. Finally, different from the EIA analyses reported previously, the RGGI analysis incorporates end-use efficiency programs, assuming that the current levels of annual state expenditures for public benefit programs continue through 2025 and that the effects of these programs are not already accounted for in their underlying electricity demand forecasts.

In addition to this package, the analysis was conducted with and without U.S. and Canadian national carbon policies. More specifically, the U.S. national policy scenario assumes the stabilization of U.S. GHG emissions at projected 2015 levels starting in 2015. Without the

federal cap, the allowance price is expected to increase from \$2 in 2010 to \$5 in 2024. With the federal mandate, the price is expected to rise from \$5 in 2010 to \$12 in 2024.

In addition to RGGI's own prediction, RFF also estimated the price of allowances using their electricity market model known as Haiku. In their prediction, the allowance price is expected to increase from \$4 in 2010 to \$11 in 2025 (CIER 2007).

RGGI's prediction is that the change in electricity prices for residential use will be negligible without the federal mandate and 4 percent with the federal mandate in 2015. The impact is slightly greater in later years. In 2021, the electricity price increase is predicted to be 0.5 percent without the federal mandate and 5 percent with the federal mandate. This size of increase is smaller than the recent increase in electricity price, which was the result of fluctuations in natural gas prices.

Modeling work by RFF finds that RGGI leads to roughly a 3 percent increase in the average price of electricity to all consumers, including residential, commercial, and industrial, in the nine state original RGGI region in 2010 and 2020, and a slightly higher increase in 2025. This analysis also shows that as the region expands to include Maryland, the effect of the program on average electricity price in the original RGGI region does not change. Joining RGGI also has virtually no effect on the average price of electricity for all consumers in Maryland.

RGGI also estimated macroeconomic impacts of the cap-and-trading system on gross regional products and employment, and found that economic impacts of RGGI policies in both measures are small, roughly one-hundredth to one-tenth of 1 percent.

Discussion: Impacts on International Markets

In RGGI, international offsets are allowed only after the allowance price reaches \$10.00. Without the federal mandate, the RGGI analysis found that the allowance price would not reach \$10.00, so there would be no impact on the international markets. With the federal mandate, the allowance price would reach \$10 in 2019, but the role of the RGGI program is uncertain. Even in this case, there would be no demand for CDM during the compliance period of the Kyoto Protocol. It is only in much later years after the Kyoto period when international credits can be demanded in RGGI. Similarly, in the RFF analysis, demand for international offsets does not play a role until 2020, and when Maryland joins RGGI, international offsets are not demanded until 2025.

Initiatives in California and the Western States

When it comes to state level environmental policy, California has played crucial roles in many respects. California leads other states as well as the federal government in environmental regulations such as renewable portfolio standards and efficiency standards. Thanks to innovative climate and energy related policies, “Since 1975, electricity use per capita in California has not increased at all, whereas it has increased *nationally* by about fifty percent” (Hanemann 2007).

AB32 (California Global Warming Solutions Act, September 2006)

One recently adopted climate policy in California is the well-known California Global Warming Solutions Act, AB32. The act sets the statewide GHG emissions target. More specifically, it requires that GHG emissions from California be lowered to 1990 levels by 2020. In the cap-and-trading proposals in the 110th Congress, this target is comparable with stringent targets such as those of Kerry-Snowe, Sanders-Boxer, or Lieberman-McCain. The act covers all six GHGs, as in the recent federal proposals.

AB32 leaves the details of the regulation to the California Air Resources Board (CARB). The act has not specified how to achieve the target. This is not, however, an unusual structure for the development of regulations in California. Historically the legislature has given the state agencies in California strong mandates and great discretion in designing regulations and other programs to achieve environmental goals. Not all goals have been accomplished, but in general the resulting regulations have been very effective. AB32 allows for a market-based compliance mechanism such as cap and trading as one alternative policy strategy. But CARB can adopt other approaches as well, and both market-based and regulatory approaches are likely to contribute significantly.

The schedule for implementation of AB32 is still unfolding. On or before January 1, 2009, the state board must prepare and approve a scoping plan. The statute specifies that on or before January 1, 2011, the state board must adopt GHG emissions limits and emissions reduction measures. Also, the legislation specifies that by January 1, 2011, CARB may adopt a regulation that establishes a system of market-based declining annual aggregate emissions limits, applicable from January 1, 2012, to December 31, 2020. This language enables CARB to establish such a program, but it is not certain. Moreover, it is possible that such a program could be established before this timeline.

In most program proposals, the electricity sector is expected to contribute the largest share of emissions reductions. But in California the electricity sector is relatively low emitting; the state has no coal plants. Although roughly 20 percent of California’s electricity consumption comes from generation in other states, about one-half of the emissions associated with electricity

consumption come from imported power; the leakage issue is a natural question. In this regard, AB32 clearly defines the “statewide greenhouse gas emissions” to include emissions from “generation of electricity delivered to and consumed in California”(AB32). Thus, even if electricity is produced in other states, it is counted as emissions in California if it is consumed there.

One state policy related to electricity but with a clear motivation aimed at achieving climate-related goals is California Senate Bill 1368, which establishes a GHG performance standard to ensure that new, long-term financial commitments in baseload power plants by electric load-serving entities have GHG emissions that are as low, or lower, than emissions from a combined-cycle natural gas power plant. Effectively this precludes financial commitments with uncontrolled coal plants. This standard applies whether the power is generated within state borders or imported from plants in other states. The standard is expected to drive the development of less carbon-intensive technologies for generating electricity, including research and investment in coal power plants that capture and store CO₂, as generators in states that export electricity will seek to comply to be able to continue to serve the large California market. This standard will interact with a potential cap-and-trade program by limiting any expected leakage.

Details of the potential cap-and-trade program are yet to be determined. AB32 does not specifically use the term safety valve, but it does specify that the governor can adjust applicable deadlines for the regulations to the earliest feasible date. Thus, this could be considered a safety valve (Hanemann 2007).

An initial step toward the potential creation of a cap and trade program was taken when the governor directed the state’s secretary for environmental protection to create the Market Advisory Committee (MAC). In June 2007 the MAC delivered its recommendations to CARB (MAC 2007). Key MAC recommendations included the following program design features:

- The program should eventually include all major GHG-emitting sectors of the economy. The MAC estimated this would include transportation and refining and would cover about 83 percent of emissions in the state.
- Because of the special challenges associated with electricity generation, the MAC recommended a first seller approach: the entity that first sells electricity in the state is responsible for meeting the compliance obligation. For electricity generated within California, the owner or operator would be the compliant party, and for imported power it would be the party selling power into the California transmission grid.

- The committee recommended an allocation of some share of free allowances to compliant parties and the remaining allowances would be auctioned. Eventually, all allowances would be auctioned.
- The MAC recommended generous use of offsets, but recommended against a safety valve on the price of emissions allowances.

Efficiency Standard

An efficiency standard for buildings or electric appliances is a common policy to reduce energy use. The history of energy efficiency standards in California is an example of interactions between state and federal regulations. The first efficiency standards in California were the Title 24 building standards issued in 1977. Appliance standards for new refrigerators and freezers were put into effect in the same year. Further, the California government set efficiency standards for various appliances such as fluorescent lamp ballasts, various air conditioning products, heat pumps, furnaces, boilers, wall heaters, and showerheads, and faucets.

It was not until 1987 that the federal government adopted efficiency standards on many major appliances in the National Appliance Energy Conservation Act. Intriguingly, this act had the provision that the federal standards would preempt any state standards. However, this act allows states to set standards for products not subject to the federal standards. For instance, in 2004, California set new energy efficiency standards for 17 different products such as light bulbs or swimming pool pumps.

Low-Carbon Fuel Standard (Executive Order S-1-07)

California has taken an innovative step in the proposed low-carbon fuel standard (LCFS) signed into law by the governor through executive order. The GHG fuel standard on the mix of transportation fuels sold in California is performance based and fuel neutral. Fuel providers would have complete flexibility in choosing which fuels are used and what volumes to sell as long as their average meets the standard. GHG emissions would be measured on a full fuel cycle basis to account for emissions from extraction, production, and transport to market. To enhance flexibility, the standard would include all GHGs. The standard would be expressed as grams of CO_{2e} per unit energy of the mix of fuel sold in California (measured in grams of CO_{2e}/MJ) and would implement a 10 percent reduction in the carbon intensity of transportation fuels in California by 2020.

A key question is whether the state has authority to implement such a measure. California probably does have authority under its air pollution laws to set a GHG standard. Unlike with

motor vehicle GHG standards, there is no conflict with fuel economy laws, which are relegated to federal authority.

A report by two University of California professors (Farrell and Sperling 2007) contained an initial proposal for the design of the program. The study recommends using pessimistic default emissions intensity coefficients for various fuel cycle pathways, but allows entities to claim better performance subject to third party verification. Some of the specific recommendations include that the LCFS should apply to all gasoline and diesel used in California for transportation, including freight and off-road applications. Differences in the drive train efficiencies of diesel and gasoline engines should be accounted for. Upstream emissions would be included all the way to the wellhead. Also, there should be no limit on the ability of any entity to trade or bank credits. Because the LCFS is an intensity target, there is no hard cap on the quantity of emissions from the transportation sector. The authors of this study, along with the MAC, conclude that the LCFS would be complementary to the cap-and-trade program. If emissions were to increase in the transportation sector, even with improved efficiency thanks to the LCFS, the cap would imply that further emissions reductions would have to be achieved elsewhere in the economy.

Chicago Climate Exchange (CCX)

Despite the lack of a mandatory federal cap-and-trading system of GHGs, a private sector initiative is creating a voluntary market of GHGs. CCX is the first and the only ongoing market of GHGs in the United States as of 2007. CCX began with a feasibility study funded by Joyce Foundation in 2000 and conducted by Environmental Financial Products L.L.C. The compliance period of the market started in 2003.

This development of a GHG market is important for several reasons. First, some corporations anticipate a future mandatory cap-and-trade system in US. Thus, hands on experience with CO₂ trading in CCX can help those firms prepare for the future mandatory market. Second, multinational corporations may face a mandatory cap and trading system in EU. Thus, participation in CCX may help those firms gain experience to use in the EU market. Third, the creator of CCX, Environmental Financial Products, played a crucial role in developing the SO₂ allowance market. Thus, the CCX has had credibility since the beginning. Here we describe various aspects of CCX and discuss its international impacts.

Coverage, Unit of Exchange, and Banking

The market covers all six GHGs. In CCX, the unit of exchange is a carbon financial instrument (CFI) contract that permits CO₂ emissions in a designated year or later (the year

designated being the year the seller reduce carbon emissions). Each CFI represent 100 metric tons of CO₂ equivalents.

Regulated Entities

In contrast to the RGGI or the GHG markets proposed in Congress, participation in this market is voluntary, with four categories of participation. CCX Members are the core participants. They have to comply with CCX emissions targets. Among them are various manufacturing companies, electric power companies, corporations, municipalities, and other entities that emit GHGs from facilities in the United States, Canada, or Mexico. CCX Associate Members commit to comply with CCX rules by offsetting GHGs. CCX Participant Members are offsets providers and liquidity providers, and so do not face mandates of emissions reductions. CCX Exchange Participants do not commit to GHG emissions reduction; they do, however, establish a CCX Registry and participate in the market to acquire or retire CCX CFIs.

As of January 24, 2007, CCX had 55 Members, including municipalities and universities, 44 Associate Members, and 69 Participant Members. The number of membership is still expanding.

Allowance Allocation

Allowance allocation is grandfathering. The allocation is based on a member's emissions baseline and emissions reduction schedule, subject to provisions outlined in the CCX Rulebook. The emissions baseline is the average of annual emissions from 1998 to 2001. The allocation is adjusted to reflect acquisition or disposition of facilities.

Emissions Targets

The trading in CCX consists of two phases. Phase I started in 2003 and ended in 2006. Phase II started in 2007 and will end in 2010. In Phase I, the emissions target reduced from 1 percent below the baseline in 2003 to 4 percent in 2006 by 1 percent annually. Phase II emissions targets are 4.25 percent in 2007, 4.5 percent in 2008, 5 percent in 2009, and 6 percent in 2010 below the baseline.

CCX accepts additional entities as new members for the trade in Phase II. For these new members joining in Phase II, the emissions target reduces from 1.5 percent below the baseline in 2007 to 6 percent in 2010 by 1.5 percent annually.

Offsets

CCX allows offsets for compliance if credits are generated by qualifying mitigation projects and registered with CCX by Participant Members. The initial list of eligible offsets

includes methane destruction, agricultural practices, forestry practices, renewable energy, other GHG emissions mitigation in Brazil, and CDM eligible projects. Thus, offsets projects can be implemented both domestically and internationally. Table 2 shows the increasing trend of offsets provided for CCX.

Table 2. Offsets in CCX*

Year	2003	2004	2005	2006
Offsets Issued	2,073,800	2,252,800	2,872,500	3,142,000

* CO₂ metric ton

Source: CCX 2007.

Other Provisions

Because CCX is a voluntary market, no regulatory programs are enforced with it.

Carbon Prices and Impacts on Economy

Currently, the price of a CFI is equivalent to \$2.50/CO₂ metric ton (October 2007). In terms of trading volume, more recent vintage tends to have more trading volume up to the current vintage. Table 3 suggests that the market has more activity over time.

Table 3. Trading Volumes for Selected Years (to date)

Vintage	2003	2004	2006	2010	Total
Volume	1,405,800	1,695,100	2,298,400	1,706,900	14,001,700

Source: CCX 2007.

No formal study has investigated the impacts of CCX on economies. The impact is, however, considered to be reserved, if it exists at all, for several reasons. First, participants do not have to pay for allowances because CFIs are grandfathered. Second, it is a voluntary program. If the impact is great, those entities are unlikely to participate in CCX.

Discussion: Impacts on International Markets

Theoretically, demand for offset projects in CCX can influence the Kyoto Mechanism such as CDM. Because emissions credits from CDM eligible projects can be used as offsets in CCX, competition could occur between CCX offsets providers and CDM project providers for carbon mitigation projects in developing countries such as China, which is known to host several CDM projects. In fact, fuel switching offsets projects and renewable energy projects were implemented in China and CCX accepted them as offsets.

More important, CCX can be an indispensable trading place for domestic and international credits for any cap-and-trade system at both federal and state levels. Because CCX

has accumulated experience with emissions trading, it is not hard to imagine that buyers or sellers of allowances in any regulatory market would use CCX as a platform for their trading. Further, CCX trades CERs, which are credits from CDM under the Kyoto Protocol. Because some federal cap-and-trade proposals and RGGI permits use CERs to offset emissions, CCX can be an important trading place for the offsets credits in the near future.

State-Level Support for Renewables

The concept of RPSs is one example of environmental policies adopted at the state level, but not at the federal level. Iowa was the first state to enact RPSs in 1991. Since then, RPSs have proliferated: by the middle of 2006, 22 states and Washington, D.C., had adopted them.

RPSs require utilities to supply a specified amount or percentage of power from renewable resources. Therefore, RPSs can reduce emissions of GHGs by replacing fossil fuel with renewable energy, which has lower carbon emissions. Though the definition of renewable resources varies across states, most states include wind energy. We can say that RPSs have enhanced the recent expansion of wind energy.

Many RPSs have flexible mechanisms such as tradable renewable energy credits. Those utilities that produce more than the assigned amount of electricity from renewable energy can have credits for the extra and sell them to those that cannot achieve the assigned amount. Among 23 RPSs, 18 allow such trading.

One trend is the increased level of RPS mandate. For example, the targets in New York and Nevada are 25 percent by 2013 and 20 percent by 2015. More striking, California's target is 30 percent by 2020.

Though RPSs have been implemented in each state independently, several states may soon cooperate. Notably, cooperation among states in the Northeast and Southwest may be possible (Rabe 2006). Because RGGI already exists, the member state may cooperate on RPSs as well. Moreover, as discussed previously, cap-and-trade bills by Sanders-Boxer and Kerry-Snowe in Congress proposed RPSs at the federal level.

Conclusion

This paper has outlined recent developments in U.S. climate policymaking. We described cap-and-trade proposals and programs as well as other regulatory policies pertaining to cap-and-trade systems.

One noteworthy feature of the U.S. cap-and-trade system and proposals is the use of auctions, both at federal and state levels. The share of permits auctioned in these proposals is as high as 100 percent, in contrast to the EU ETS, where the share of the auction is limited to 5 percent in Phase I (2005–2007) and 10 percent in Phase II (2008–2012).

We also reported that other regulatory and technology policies are salient both to the federal cap-and-trade proposals, and to RGGI. The revenue from auctions is slated to promote energy efficiency or technological innovation. Though the role of CCS is limited in the short term of the Kyoto commitment period, it will be a key technology in the middle and long term.

Several federal proposals and RGGI have links with international markets. As emissions targets become more stringent in later years, GHG emitters are more likely to rely on these international credits. Thus, despite the lack of U.S. participation in the Kyoto Protocol, U.S. markets will be linked to foreign markets, at least in an indirect way. CCX can be a convenient trading place for this linkage.

In closing, we note the critical influence of state-level climate regulations on federal policies in the United States. To understand a future U.S. cap and trade system, we cannot ignore the movements in state and regional level policies.

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Table A1. U.S. Lawmakers Concerned with Climate Change Issues

Name	State	House or Senate	Party Affiliation
Alexander, Lamar	Tennessee	Senate	Republican
Bass, Charles	New Hampshire	House	Republican
Bingaman, Jeff	New Mexico	Senate	Democrat
Boxer, Barbara	California	Senate	Democrat
Carper, Tom	Delaware	Senate	Democrat
Feinstein, Dianne	California	Senate	Democrat
Jeffords, James	Vermont	Senate	Independent
Kerry, John	Massachusetts	Senate	Democrat
Larson, John	Connecticut	House	Democrat
Leahy, Patrick	Vermont	Senate	Democrat
Lieberman, Joe	Connecticut	Senate	Independent
McCain, John	Arizona	Senate	Republican
Petri, Tom	Wisconsin	House	Republican
Sanders, Bernard	Vermont	Senate	Independent
Snowe, Olympia	Maine	Senate	Republican
Specter, Arlen	Pennsylvania	Senate	Republican
Stark, Pete	California	House	Democrat
Udall, Tom	New Mexico	House	Democrat
Warner, John	Virginia	Senate	Republican
Waxman, Henry	California	House	Democrat

Table A2. Comparison of Market-Based Climate Change Bills Introduced in the 110th Congress*

Proposed Bill	Regulated Entities	Allowance Allocation and Auction	Price Stability	Early Actions
Bingaman-Specter (S. 1766)	Economy-wide cap: coal and process emissions at emitters; oil refiners, NG processors, and oil/NG importers; and F-gas producers and importers.	55% free to industry (with phaseout); 22% auctioned to support R&D, transition assistance, adaptation; 14% set aside for CCS and sequestration; 9% to states.	\$12/metric ton CO ₂ safety valve, rising at 5% per year above inflation.	From 2012 to 2020, 1% of allowances allocated to those registering GHG reductions prior to enactment.
Udall-Petri (May draft and staff talks)	Economy-wide cap: primarily upstream sources (e.g., producers and importers of fuels).	20% free to industry; 80% auctioned to support RD&D, developing country engagement, adaptation, dislocation aid, sequestration, debt reduction.	\$12/metric ton CO ₂ safety valve, rising at 2%–8% per year above inflation.	—

Proposed Bill	Regulated Entities	Allowance Allocation and Auction	Price Stability	Early Actions
Lieberman-McCain (S. 280)	Economy-wide cap: large downstream at emitter; transport emissions regulated at refinery.	Discretion of EPA, with guidance for some free allocation and an auction to fund R&D, transition assistance, adaptation measures.	Borrowing: up to 25% of allowances for no more than 5 years.	Credit for reductions before 2012.
Kerry - Snowe (S. 485)	Economy-wide cap: point of regulation at discretion of EPA.	Discretion of the president.	No provisions.	Goal to “recognize and reward early reductions.”
Waxman (H.R. 1590)				—
Sanders-Boxer (S.309)	Economy-wide cap: EPA has discretion to implement a market-based allowance program to achieve cap.			
Lieberman-Warner Draft	Economy-wide cap: large downstream at emitter; transport emissions regulated at refinery.	20% to industry, 20% to electricity power (phase out to 0), 10% load-serving entities, 8% to early actions (phase-out to 0), 4% to states, 4% for assistance to coal mining communities, 7.5% to sequestrations, 2% for transportation, auction 24% (increase to 52%).	Borrowing up to 15% per company. Carbon market efficiency board to oversee the market.	8% of allowances for early action in 2012, phasing to zero in 2020.
Feinstein-Carper (S. 317)	Electricity-sector cap: power plants. (S. 1168 also covers utility SO ₂ , NO _x , and mercury emissions.)	85% free to industry, based on generation. Phase out by 2036.	Borrowing up to 10%, for no more than 5 years.	Credit for reductions from 2000-2010, limit 10% of cap.
Alexander-Lieberman (S. 1168)		75% free to industry, based on heat input.	No provisions.	Bonus allowances to first 30 new or modified coal-fired utilities meeting new performance.
Stark (H.R. 2069)	Economy-wide tax: fossil fuels taxed by CO ₂ content at the point of production and import.	100% revenues to U.S. Treasury.	\$3/metric ton CO ₂ , rising \$3 annually.	—
Larson (H.R. 3416)		1/6 of revenues to R&D, 1/12 to industry transition assistance (with phaseout), remainder to payroll tax rebates.	\$16.5/metric ton CO ₂ , rising 10% plus inflation annually.	—

	Domestic Offsets	International Offsets, Credits & Programs	Technology	Competitiveness
Bingaman-Specter (S. 1766)	Unlimited domestic offsets, including methane and SF ₆ . Limits on domestic agricultural offsets (5% of cap).	Limits on international offsets (10% percent of cap). International credits. Fund for low- carbon technology deployment in developing countries.	Detailed technology development programs funded from allowance auction revenues (12%–26% of auction revenues).	Bulk, energy-intensive imports from countries without comparable policy require permits after 10 years.
Udall-Petri (May draft and staff talks)	Unlimited geological sequestration offsets; 5% of allowances set aside to fund biological sequestration and 1% for CCS projects.	10% of allowances for technology in developing countries.	Establishes ARPA-E to fund technology advancement and sequestration projects (30% of auction revenues).	Inaction by developing countries can justify delay in safety valve escalation.
Lieberman-McCain (S. 280)	Sequestration projects (30% cap with international offsets)	International offsets (30% cap with domestic offsets)	Revenues from some auctioned allowances used for RD&D.	No provisions.
Kerry - Snowe (S. 485)	USDA sets rules for domestic biological sequestration.	—	Vehicle emissions rules; efficiency & renewable standards for electric generation; additional bill-specific mandates.	
Waxman (H.R. 1590)	No provisions.			
Sanders-Boxer (S.309)	EPA has discretion to implement a market-based allowance program to achieve cap.	Support for low-carbon and efficiency technologies in developing countries.	Grant for CCS deployment. Vehicle emissions rules; efficiency & renewable standards for electric generation; additional bill-specific mandates.	

Lieberman-Warner Draft	15% limits on use of domestic offsets.	15% limits on use of international credits; 10% auction revenue for international climate change relief measures.	Allowances for sequestration by farmers, foresters, and landowners (p. 10), establishing the legal framework for the CCS on commercial scale.	Allowance requirements for importers of GHG intensive goods from major emitting nations without commensurate actions.
Feinstein-Carper (S. 317)	Extensive domestic biological offsets.	International credits and offsets up to 25% of cap.	Distributes auction revenues to multitude of technology programs.	No provisions.
Alexander-Lieberman (S. 1168)	Domestic offsets in five categories, including methane, SF ₆ , efficiency, and forest sequestration.	—	New NSPS for CO ₂ emissions from electric generation units.	
Stark (H.R. 2069)	Tax refunds for fuel CO ₂ sequestered downstream: CCS, plastics.	—	No provisions.	Tax applied to fossil fuel imports; fossil fuel exports are exempt.
Larson (H.R. 3416)	Tax refunds for domestic sequestration and HFC destruction projects.	—	1/6 of tax revenues up to \$10 billion annually goes to clean energy technology R&D.	

* This table is based on the table by Kopp et al. (2007a). The source of “early action” is Pew Center on Global Climate Change (2007b). The cell with “—” means no information available.

Table A3. Impact Comparison of Federal Proposals

	Udall-Petri	Lieberman-McCain	Bingaman-Specter
Status of Proposal as of January 2007	Proposed in 109th Congress	Proposed in 110th Congress	Proposed in 110th Congress
Sources	EIA (2006)	EIA (2007)	NCEP (2007)*
Cap (Pew Center on Global Climate Change 2007a)	Based on the average emissions from the previous three years before the bill goes into effect (e.g., 2009–2011).	2004 level in 2012. 1990 level in 2020. 20% below 1990 level in 2030.	2012 level in 2012. 2006 levels by 2020. 1990 levels by 2030
Safety Valve Price per ton CO ₂	\$6.82 (nominal) initially and grows with CPI plus 1%–2% .	No	\$12 rising at 5% per year plus inflation
Estimated Permit Price (\$2005/ CO ₂ metric ton)	Reach safety valve price of \$6.8 in 2018. In no safety valve case, \$30 in 2030.	\$14 to \$31 in 2020. \$31 to \$58 in 2030.	\$5.50 in 2012. \$24 in 2030.
Estimated Impact on Real GDP	–0.12% to –0.17% in 2020. –0.16% to –0.21% in 2030.	–0.3% to –0.5 % in 2030	+0.12% in 2030
Electricity Prices	+5.66% to +6.34% in 2020. +6.39% to 8.52% in 2030	+10% in 2020 +21% in 2030	+7% in 2020

*Note:** Efficiency gains and energy demand reductions are assumed as the results of various technology policies in NCEP(2007).

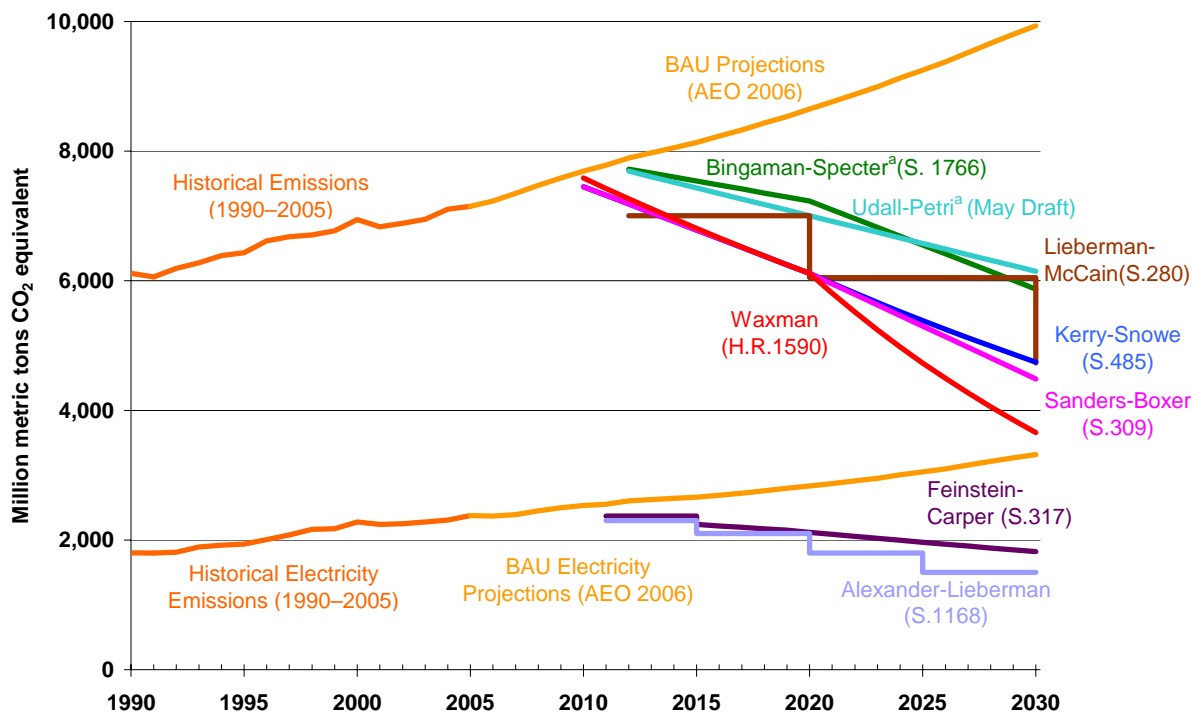


Figure A1. Comparison of Emissions Reduction Goals in Legislative Proposals in the 110th Congress (as of August 13, 2007)

^a Bill contains flexibility mechanisms that allow actual emissions to rise above the target.

Notes: BAU = business as usual., AEO = Annual Energy Outlook(EIA 2006b)

This graph depicts emissions targets from some of the major climate change bills in Congress. Targets are based on comparison with historical year emissions. Kerry-Snowe, Sanders-Boxer, and Waxman specify future emissions as a percentage of 1990 emissions. For Lieberman-McCain, Udall-Petri, and Bingaman-Specter, emissions targets for covered sectors are related to historical emissions for those sectors and total emissions are assumed to match those in the corresponding historical year.

Source: Kopp et al. (2007b).