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The Effects of Interactions between Federal and State Climate Policies

by

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Abstract

In the absence of a federal policy to cap carbon emissions many states are moving forward with their own initiatives, which currently range from announcements of commitments to reduce greenhouse gases to a regional multi-state cap-and-trade program slated to begin in 2009. While federal legislation is expected in the next few years, it is unclear how such legislation will define the relationship between a federal cap and trade program and other state regulations. Assuming the introduction of a cap-and-trade program at the federal level, this paper analyzes the economic and environmental impacts of the range of possible interactions between the federal program and state programs. We find that the impacts of interaction depend on relative stringency of the federal and state program and overlap in source coverage. Where state programs are both duplicative of and more demanding than the federal cap, the effect is entirely redistributive of costs and emissions, with in-state sources facing higher marginal abatement costs. Also, differing marginal abatement costs among states create economic inefficiencies that make achievement of the climate goal more costly than it need be. These redistributive effects and the associated economic inefficiency are avoided under either federal preemption of duplicative state programs or a 'carve out' of state programs from the federal cap with linkage to the federal allowance market.

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I. Introduction

In the absence of a federal policy to cap greenhouse gas (GHG) emissions many states are moving forward with their own initiatives to reduce these emissions. These initiatives vary greatly in both their range of development and the extent to which they actually mandate emission reductions. For example, some of these initiatives take the form of official GHG emission reduction targets, but for which no specific legislative or regulatory requirements have been enacted. Others, however, are more specific and will impose emission reduction requirements through regional cap-and-trade programs, emission rate limits for power plants located within the state, or renewable electricity generation and end-use energy efficiency requirements. While federal legislation – most likely in the form of a national cap-and-trade program – is expected in the near future, it is unclear how such legislation will define the relationship between a federal program and existing state programs, particularly when state programs involve cap-and-trade. Absent federal legislation, questions remain as to how EPA might cap GHG emissions under the existing Clean Air Act.[1, 2] While the interactions between state and federal programs will have important implications for the economic and environmental impacts of climate policy in the U.S., research has provided very limited treatment of this point. Further, the treatment of state programs under a federal cap-and-trade bill appears likely to be a point of contention as federal climate legislation moves forward. While a bill passed out of the Senate Environment and Public Works Committee in December 2007 explicitly retains state authority to enact GHG reduction requirements that are at least as stringent as the federal requirement, the bill being formulated in the House committee with primary jurisdiction is expected to include federal preemption of comparable state programs.[3]

In light of this debate, this paper analyzes the economic and environmental impacts of the range of possible relationships between federal and state climate policies, focusing on both aggregate and distributional outcomes. It assumes the introduction of a "simple" cap-and-trade program at the federal level, and considers both cap-and-trade and other regulatory programs at the state level.[4] Two attributes drive the impacts of interaction between the federal and state programs: 1) the relative stringency of the state and federal programs and 2) the overlap, or the extent to which the federal and state programs cover the same sources. Other design features, such as the allocation method, offsets, or safety valves, may change the economic and environmental effects but they do not alter the basic interaction when the two programs co-exist.

The paper proceeds as follows. Section II discusses existing precedents for the interaction between federal cap-and-trade programs and state policies. Section III characterizes the major types of existing state efforts to address climate change, highlighting specific examples of state programs. Sections IV and V analyze the

[1] 42 USC 7401. Also available online: http://www.epa.gov/air/caa/.
[2] Point Carbon. 2008. US to have "tough time" regulating carbon without climate bill: EPA. April 3.
[3] Point Carbon. 2008. US legislators to disagree over federal preemption for cap and trade. January 23.
[4] Although federal climate legislation might include more than a cap-and-trade program, we ignore those other possibilities in this paper and focus on the interaction between a "simple" federal cap-and-trade program, unencumbered by other federal mandates, and state programs that could include cap-and-trade as well as other regulatory measures affecting sources covered by the federal program.

economic impacts of the coexistence of a federal cap-and-trade program with state cap-and-trade programs and other state regulations, respectively. Section VI considers the impacts of two other potential relationships between federal and state cap-and-trade programs: federal preemption, and what we call a 'carve-out,' where a state-cap-and-trade program exists separately from and substitutes for the federal program. Finally, Section VII concludes and puts forth some additional considerations for policymakers.

II. Policy and Legal Precedents for State and Federal Climate Policy Interactions

Discussion of the potential federal-state relationship in U.S. climate policy can be informed by treatment of federal-state relations under existing statutes relevant to emissions control, as well as legal doctrine that addresses this relationship. First, under the Clean Air Act, states retain the authority to impose emission control requirements on stationary sources that are additional to what may be required by federal legislation or regulation. Three cap-and-trade programs under the Act – the Acid Rain Program for SO_2 emissions, the NO_x Budget Trading Program, and the recently vacated Clean Air Mercury Rule – provide distinct examples of how federal and state governments might interact in the context of a national cap on GHG emissions. Second, with respect to mobile sources, the Clean Air Act provides an example of statutory preemption of state vehicle emission standards that are more stringent than federal regulations, though it provides special consideration for California. Likewise, the Energy Policy and Conservation Act (EPCA), which established the Corporate Average Fuel Economy (CAFE) program, expressly prohibits state regulation of vehicle fuel economy where federal requirements exist.[5] Finally, potential restrictions on state authority to implement GHG regulations that could arise from a number of potential legal hurdles may have indirect implications for the interaction of state and federal climate programs.

First, the Acid Rain Program provides an example of federal legislation establishing a new cap-and-trade program without federal preemption of state regulation of emissions that contribute to acid rain. This program, established by Title IV of the Clean Air Act Amendments of 1990[6], imposes a nationwide cap on SO_2 emissions from the power sector.[7] The statute provides for direct regulation of sources by the EPA and codifies source-level allowance allocations. While Title IV sets a minimum level of control of electricity sector SO_2 emissions, it does not preempt state authority to impose more stringent controls on these emissions.[8] Prior to the start of the federal program on January 1, 1995, several states, notably, Massachusetts, New York and Wisconsin, had already implemented state programs that imposed specific emission rate limits on SO_2

[5] See 49 USC § 32919(a)
[6] 42 USC 7651
[7] Title IV also sets NOx emissions rate requirements for affected sources and allows "averaging" or trading among sources under common ownership.
[8] This precedent is arguably more germane to climate legislation in that the justification concerns a problem that transcends state boundaries in contrast to the local attainment of the National Ambient Air Quality Standards (NAAQS) for SO_2 and for particulate matter of which SO_2 is a precursor. The latter are primarily within-state concerns for which the Clean Air Act grants states the authority to impose controls of whatever stringency required to meet the national NAAQS.

emissions that contribute to acid rain, and those programs continued in force after the federal program went into effect.

EPA's second stationary-source cap-and-trade program, the NO_x Budget Trading Program, provides a different model in that it was established under the Agency's existing regulatory authority under the Clean Air Act instead of by specific congressional legislation. This program started as a regional program implemented, with the cooperation of the federal EPA, by the nine member states of the Ozone Transport Commission (OTC), an interstate compact authorized by the Clean Air Act Amendments of 1990 to facilitate the adoption of interstate measures to address attainment of the National Ambient Air Quality Standard (NAAQS) for ozone in the Northeastern U.S.. The OTC adopted a three-phase program that consisted of an initial uniform annual NOx emission limit requiring Reasonably Available Control Technology (RACT) beginning in 1995. This first phase was followed by a progressively more demanding two-phase regional cap-and-trade program that applied to NO_x emissions during the May to September ozone season and which began in 1999 and 2003. In 1998, EPA exercised its existing authority under the Clean Air Act in response to a tightening of the ozone NAAQS to issue the "NO_x SIP Call,"[9] a rulemaking that expanded the OTC cap-and-trade program to include 19 states and the District of Columbia effective in 2003. [10] More recently, EPA's Clean Air Interstate Rule (CAIR),[11] which becomes effective in 2009, followed this precedent in expanding the program to 28 states and adding an annual cap on NOx emissions while maintaining the ozone season cap.[12]

Both the NO_x SIP Call and CAIR use EPA's existing regulatory authority under sections 110 and 126 of the Clean Air Act to assign states NO_X emission budgets, which are effectively state-level caps, and to require them to submit State Implementation Plans (SIPs) laying out the state rules that would achieve the emission reductions required by their respective budgets.[13] In what was a radical innovation, the NOx SIP Call also provided states the option of achieving their state budgets by joining an EPA-administered cap-and-trade program for NO_x, an approach continued in CAIR. While all affected states under both the NO_x SIP call and CAIR have chosen to participate in the NOx Budget Trading Program, participation in the program was voluntary. An affected state could opt to achieve its NO_x budget by implementing conventional prescriptive regulations that would exist separately from the federal trading program. Finally, under the NO_X SIP Call and CAIR, states retain the authority granted by the Clean Air Act to implement requirements more stringent than federal requirements.

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[9] 63 FR 57356

[10] The pre-existing OTC program was folded into this more geographically extensive cap-and-trade program, which was of equivalent stringency to the final 2003 OTC program, and which became the NOx Budget Program.

[11] 70 FR 25162

[12] CAIR also increases the allowance retirement ratio for sources under the Acid Rain Program, in order to promote additional SO2 reductions and compliance with the NAAQS for PM 2.5.

[13] The basic structure of the Clean Air Act requires states to submit and to obtain EPA approval of State Implementation Plans (SIPs) that specify how within-state emissions will be controlled to a level that will ensure attainment of the NAAQS for criteria pollutants specified in the Clean Air Act.

Third, EPA's recently vacated Clean Air Mercury Rule (CAMR) relied upon a regulatory framework to establish a cap-and-trade program under section 111(d) of the Clean Air Act that is analogous to that used for the NO_x Budget Trading Program.[14] Under CAMR, however, states that opposed using cap-and-trade to control mercury emissions or which wished to implement targets more stringent than those put forth by the federal program could and did opt-out and adopt equivalent or more stringent programs that would have remained separate from the federal cap-and-trade program. In addition, states wishing to participate in the federal program but withhold some portion of their state budget, effectively lowering the federal cap, had the option to do so.[15] Nordhaus (2007) has suggested that the regulatory authority used to promulgate the Clean Air Mercury Rule could provide the most promising vehicle for establishing a GHG cap for stationary sources under the Clean Air Act.[16]

While the Clean Air Act generally preserves state authority to regulate emissions from stationary sources to levels more stringent than required by federal rules, it explicitly limits state authority to do so in the transportation sector in order to avoid exposing vehicle manufacturers to an array of varying state standards. Because it preceded the federal government in regulating vehicle emissions for pollution control purposes, California is allowed, under section 209(b)(1) of the Clean Air Act, to petition the Environmental Protection Agency for a waiver allowing the state to implement motor vehicle emission standards that are more stringent than those at the federal level. Other states are permitted to adopt California's standards under section 177 of the Act, but are precluded from developing a different state standard. In contrast to conventionally regulated emissions, such as particulates, reduction of a vehicle's GHG emission rate implies an improvement in fuel economy. As a result, the line between these vehicle emissions standards and fuel economy standards is blurred.[17] For this reason, vehicle manufacturers have argued – thus far unsuccessfully – that state GHG emissions standards for vehicles are not allowed under section 32919(a) of EPCA,[18] which preempts states from setting regulations "related to" fuel economy standards for vehicles covered by fuel economy standards under the Act.[19]

Finally, while express preemption or retention of state authority in a federal statute, such as discussed above in the context of the Clean Air Act, would provide the

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[14] 70 FR 28606. The rule was vacated on the grounds that EPA did not present sufficient analysis to justify delisting mercury, a toxic air pollutant, from the list of pollutants that the Agency must regulate from electricity generating units using a maximum achievable control technology (MACT) standard under Section 112 of the CAA. (*State of New Jersey et al. v. EPA* No. 05-1097 (DC Cir.Feb. 8, 2008)).

[15] In response to state requests to do so, EPA released a statement noting that this approach was permissible under the rule, but cautioning states to consider cost, feasibility, and uncertainty before permanently retiring allowances. See: US EPA. "CAMR Frequent Questions." Online: http://www.epa.gov/airmarkets/progsregs/camr/faq-camr.html.

[16] See Nordhaus, Robert. 2007. "New Wine into Old Bottles: The Feasibility of Greenhouse Gas Regulation under the Clean Air Act." *New York University Environmental Law Journal*. 15 (53-72).

[17] To clarify this distinction, motor vehicle emission standards are specified as grams of pollutant emitted per mile, and fuel economy standards are specified in terms of miles achieved per gallon of fuel.

[18] *Green Mountain Chrysler Plymouth Dodge Jeep v. Crombie*, No. 05-00302 (D. VT, September 12, 2007; and *Central Valley Chrysler-Jeep v. Goldstone* No. CV F 04-6663 (E.D. Cal., Dec. 12, 2007).

[19] See 49 USC § 32919(a).

greatest certainty in terms of the interaction between federal and state climate programs, existing legal doctrine could result in federal preemption of state programs on other grounds. In interpreting the Supremacy Clause of the Constitution, courts have held that a state rule is preempted if a federal law is deemed sufficiently comprehensive so as to imply preemption, or if the state rule is found to conflict with or frustrate implementation of the federal law.[20] In addition, while not specifically questions of preemption, state climate programs could face additional legal challenges to their validity.[21] First, state or regional climate policies could be found to be in violation of the Dormant Commerce Clause to the extent that they are held to discriminate against or to excessively burden interstate commerce. Efforts that attempt to reduce the leakage of emissions from state or regional programs to sources outside of the covered region may be at the greatest risk of such a violation.[22] Second, climate programs constructed as regional agreements could face legal challenges under the Interstate Compact Clause, which prohibits interstate agreements absent congressional consent.

III. Overview of Existing State Climate Regulation and Proposed Federal Legislation

The economic and environmental implications of how state and federal programs interact will depend on the specific actions taken at these different levels of government. Inventories of state climate actions are maintained by a number of organizations.[23] This section provides an overview of the type of state actions that have been taken to date, emphasizing the development of regulatory requirements and the specific design elements within certain state regulations. As Section IV will demonstrate, an understanding of design elements is particularly important where state programs implement cap-and-trade.

This section begins with a discussion of the four significant policy developments in regional and state-level emissions trading: the Regional Greenhouse Gas Initiative (RGGI), the Western Climate Initiative (WCI), the Midwest Regional Greenhouse Gas Reduction Accord, and California's Assembly Bill 32 (AB 32). Second, it provides an overview of other state regulatory requirements that directly affect emissions sources, such as power plant performance standards and AB 1493, California's vehicle emission standard. It then provides an overview of state renewable portfolio standards (RPS),

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[20] Pidot. Justin R. 2006. "Global Warming in the Courts: An Overview of Current Litigation and Common Legal Issues." Georgetown Environmental Law & Policy Institute, Georgetown University Law Center.

[21] For brief discussions of the legal hurdles faced by state and local climate policies see: Wiener, J.B. 2007. "Think Locally, Act Globally: The Limits of Local Climate Policies." Duke Law School Working Paper Series, Faculty Scholarship Series Paper 93 (May 2007) and Huffman, Robert K. and Jonathan Weisgall, "Climate Change and the States: Constitutional Issues Arising from State Climate Protection Leadership," available at: http://links.cecollect.com/208/4292/Huffman%20&%20Weisgall.pdf.

[22] This is because in order to prevent emission leakage, a state may have to implement measures that will remove the cost advantage provided to sources outside of the cap, effectively making output from these out-of-state sources more costly.

[23] See, for example, the Pew Center on Global Climate Change http://www.pewclimate.org/what_s_being_done/in_the_states/, and US EPA http://www.epa.gov/climatechange/wycd/stateandlocalgov/index.html.

energy efficiency resource standards, and demand side measures that may affect state GHG emissions. Finally, it provides an overview of the two most prominent federal bills that would establish a federal cap-and-trade program for GHG emissions.

III-1. Overview of Regional and State Emissions Trading Initiatives

Of the four major efforts among states to develop cap-and-trade programs for reducing GHG emissions, RGGI is by far the most developed, with the initial phase of the program scheduled to start on January 1, 2009. Emulating the RGGI process, states in the WCI and Midwest Regional Greenhouse Gas Reduction Accord have embarked upon the initial stages of deciding caps and developing a model rule for their respective regional cap-and-trade programs. Finally, while California is a participant in the WCI, it provides an example of a single state's effort to move forward with development of a cap-and-trade program through the state's requirements under AB 32.

Regional Greenhouse Gas Initiative

RGGI is the result of a process involving stakeholders and state regulatory staff that was initiated by the governors of a number of Northeastern states in 2003. This process resulted in the issuance of a Memorandum of Understanding (RGGI MOU), which was originally signed by seven state governors in December 2005, and now includes ten signatory states in the Northeast.[24] It establishes a cap-and-trade program for CO_2 emissions from the power sector in these states, implementing an annual cap that stabilizes emissions at current levels over the years 2009-2014, and declines by 2.5% annually between 2014 and 2018. States participating in RGGI and their state CO_2 budgets for the years 2009 and 2018 are shown in Table III-1.

Table III-1. CO_2 Emissions Budgets for RGGI States, 2009 and 2018

State	2009 Budget (short tons)	2018 Budget (short tons)
CT	10,695, 036	9,625,532
DE	7,559,787	6,803,808
ME	5,948,902	5,354,012
MD	37,503,983	33,753,585
MA	26,660,204	23,994,184
NH	8,620,460	7,758,414
NJ	22,892,730	20,603,457
NY	64,310,805	57,879,725
RI	2,659,239	2,393,315
VT	1,225,830	1,103,247
Total	177,381,940	169,269,279

Source: RGGI MOU and individual state rules.

[24] Regional Greenhouse Gas Initiative. "Memorandum of Understanding." December 20, 2005. Available online: http://www.rggi.org/docs/mou_12_20_05.pdf. The RGGI states include CT, DE, MA, MD, ME, NH NY, NJ, RI,, and VT. Although Massachusetts and Rhode Island participated in the RGGI process, their governors did not sign the original MOU, but they have since done so, as has Maryland.

Because the regional agreement must be implemented under the authority of each individual state, the RGGI stakeholder process released a model rule in August, 2006, which RGGI states are currently using as a basis for drafting and promulgating their individual regulations.[25] Key provisions of the RGGI model rule are presented in Table III-2. Two areas of the model rule provide for individual state discretion. The first is the option to exempt sources whose output to the grid is restricted by permitting conditions. The second is allowance allocation, where the model rule requires only that at least 25% of allowances be allocated for a "consumer benefit or strategic energy purpose."[26]

Table III-2. Overview of Key Design Elements in the RGGI Model Rule

Design Element	Approach taken in RGGI
Applicability	Existing (operational before 1/1/05) electricity generating units ≥ 25 MW with >50% of heat input from fossil fuels. New electricity generating units ≥ 25 MW with > 5% of heat input from fossil fuels. States can choose to exempt units that sell less than 10% of their electricity output to the grid.
Length of compliance period	3 years, extended to 4 if offset price exceeds $10 threshold.
Allowance allocation	At states' discretion, though at least 25% must be to 'consumer benefit or strategic energy purpose.'
Allowable offsets	Landfill methane capture and destruction; sulfur hexafluoride emissions reductions; afforestation; avoided CO_2 emissions from natural gas, oil, or propane through energy efficiency; and avoided agricultural methane emissions
Offset use	Limited to 3.3% of total compliance allowances; increased to 5% if allowance price exceeds $7 per ton, and 10% if allowance price exceeds $10 per ton, for the duration of the compliance period.[a]
Banking	Unlimited
Borrowing	None
Safety valve	Provided via relaxation of offset limit
Early Reduction Credits	May be awarded for reductions occurring in 2006, 2007, and 2008

a. Prices are adjusted annually for inflation.

[25] Regional Greenhouse Gas Initiative. "Model Rule – 1/5/07 final with corrections." Online: http://www.rggi.org/docs/model_rule_corrected_1_5_07.pdf.

[26] Examples of such purposes are the promotion of energy efficiency, the direct mitigation of electricity ratepayer impacts, promotion of renewable or non-carbon-emitting energy technologies, the stimulation and rewarding of investment in developing innovative carbon emissions abatement technologies, and administration of the program. See Ibid., page 44.

The cap-and-trade program under RGGI is scheduled to begin on January 1, 2009. The first auction of RGGI allowances is currently planned for September 2008.[27] Accordingly, RGGI states are moving forward with the development of legislation and regulation that will allow them to implement the program. Currently, only Massachusetts and Maine have finalized the necessary legislation and regulations to implement a CO_2 trading program under RGGI, with other RGGI states at varied levels of completion of their own processes.[28] The significant deviation from the model rule that has emerged in proposed legislation and regulation is the intention of RGGI states to auction close to 100 percent of state emission allowances, with some reserving small set-asides for combined heat and power (CHP) facilities, allowance retirement for voluntary renewable energy purchases, or other policy goals.[29]

Finally, the RGGI MOU, while not legally enforceable, does express the RGGI member states' intent with respect to interaction with a federal cap-and-trade program. The MOU notes that RGGI states will "advocate for a federal program that rewards states that are first movers."[30] In addition, the MOU notes that RGGI states will "transition into" a federal program that is deemed "comparable" to RGGI, though the mechanism for doing so is not described.[31] However, among RGGI state rulemakings there are two examples of states withdrawing existing state rules in order to eliminate overlapping requirements on state sources subject to RGGI. Massachusetts, in its RGGI regulation, and New Hampshire, in its proposed legislation, include provisions that would allow RGGI to supersede their respective existing state regulations for CO_2 emissions from the power sector.

Western Climate Initiative

The governors of Arizona, California, New Mexico, Oregon, and Washington established the Western Climate Initiative (WCI) in February 2007.[32] Utah, Montana and the Canadian provinces of British Columbia, Manitoba and Quebec have since joined the initiative.[33] Participating states and provinces have set a collective GHG emissions goal in August 2007 of 15% below 2005 levels by 2020. This goal represents an aggregate reduction that was calculated based on the individual GHG emission targets of participating states and provinces. WCI participants are scheduled to complete

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[27] Point Carbon. 2008. "First RGGI Auction Moved to 10 September." March 17, 2008.
[28] In the RGGI MOU, the governors of the Signatory States committed "to seek to establish in statute and/or regulation" their respective components of the regional program as soon as practicable but not later than 12/31/2008 so that the program can launch on the intended start date of 1/1/2009. Accordingly, there are no penalties for failure to establish a particular state's component of the regional program and Maine's legislation is explicitly conditioned on the participation of a sufficient number of other RGGI states.
[29] To date, only Delaware has not completed a legislative or regulatory proposal indicating the share of allowances to be auctioned. The Delaware Department of Natural Resources and Environmental Control has recommended that the state auction 60 percent of the state's allowances. Point Carbon. 2008. Delaware to introduce RGGI legislation. May 5.
[30] See RGGI, *supra* note 24.
[31] Ibid.
[32] See http://www.westernclimateinitiative.org/.
[33] Alaska, Colorado, Idaho, Kansas, Nevada, and Wyoming, are participating as observers, as are the Canadian provinces of Ontario and Saskatchewan, and six Mexican states.

recommendations for the design of a regional cap-and-trade program, including consideration of multiple sector participation and coverage of multiple GHGs, by August, 2008. The governors' agreement does not comment on how programs under the WCI should relate to an eventual federal cap

Midwest Regional Greenhouse Gas Reduction Accord

On November 15, 2007, governors from the six Midwestern states of Wisconsin, Minnesota, Illinois, Iowa, Michigan, Kansas, as well as the premier of the Canadian province of Manitoba signed an accord agreeing to develop regional GHG emission reduction targets and a multi-sector cap-and-trade program to enable the achievement of these targets.[34] Indiana, Ohio, and South Dakota are participating in the process as observers. Participants have agreed to develop GHG reduction targets and timelines consistent with their individual jurisdictional goals within eight months of the date of the accord. Further, participants intend to propose a cap-and-trade program and to complete a model rule within twelve months of the date of the accord, that is, by November 2008. Finally, the accord specifies that the resulting cap-and-trade program should address interaction or integration with an eventual federal program.

Assembly Bill 32

AB 32 was signed into law in California on September 27, 2006.[35] It requires that California's GHG emissions be reduced to 1990 levels by 2020, through regulations developed by the California Air Resources Board (CARB). In compliance with AB 32, on December 6, 2007, CARB approved a GHG emissions inventory for 1990 and a 2020 emissions limit of 427 million metric tons of CO_2 equivalent.[36]

AB 32 requires that CARB adopt regulations by January 1, 2011, to achieve the 2020 target and notes that these regulations may include market-based mechanisms and declining emissions caps.[37] CARB is currently in the process of developing a scoping plan to evaluate policy options and make recommendations, a process that AB 32 requires be completed by January 1, 2009. While a cap-and-trade program is expected to be the primary regulation driving emissions reductions in California, the form that such a program will take remains uncertain. The California Public Utilities Commission (CPUC) and the California Energy Commission (CEC) have jointly recommended a cap-and-trade program for electricity generators that would place the regulatory obligation to surrender allowances on the deliverer of power to the California grid.[38] The term "deliverer" is used instead of the emitting source, as is usual in cap-and-trade programs, in an attempt to prevent emissions leakage by including emissions embodied in imported power under the cap. However, opponents of such a system, which include investor-owned utilities, argue

[34] See http://www.midwesterngovernors.org/resolutions/GHGAccord.pdf.
[35] The text of AB 32 is available online: http://www.arb.ca.gov/cc/docs/ab32text.pdf.
[36] See http://www.arb.ca.gov/board/ms/2007/ms120607.pdf.
[37] Ibid., see section 38562(c).
[38] California Public Utilities Commission. 2008. Interim Opinion on Greenhouse Gas Regulatory Strategies. March 13, 2008. Online: http://docs.cpuc.ca.gov/PUBLISHED/AGENDA_DECISION/80074.htm.

that it would complicate emissions accounting, be vulnerable to manipulation by load-serving entities, and be complicated to integrate with other federal or regional programs, which would likely be entirely source-based.[39]

III-2. State Regulation of Emissions Sources

A number of states have adopted legislation or regulation imposing direct emission requirements, thus far targeting power plants and vehicles. Power plant standards include emission caps, emission rate requirements, and sequestration requirements for new facilities. State vehicle standards are based on the California's AB 1493, the implementation of which remains uncertain, subject to resolution of litigation at the Federal level.

Power Sector

Six states have existing legislation or regulations that impose restrictions on power plant emissions of CO_2. These requirements vary significantly in the extent of their applicability and chosen regulatory instrument. They are summarized below in Table III-3.

[39] Point Carbon. 2007. California power companies split over cap-and-trade design. December 18, 2007.

Table III-3. Summary of State GHG Emissions Requirements for Power Plants

State	Type of Standard	Major Provisions	Comments
CA	Emissions performance standard (SB 1368, 2006)	Prohibits new long-term (more than 5 years) financial commitments for, or new ownership interests in, baseload generation with plants that exceed 1100 lbs/megawatt-hour (MWh) of CO_2. Does not allow for offsets.	Requires CPUC and CEC to reevaluate standard when enforceable cap is established.
MA	Emissions cap and standard. (310 CMR 7.29, 2001)	Affected facilities to meet annual CO_2 emissions cap standards beginning January 1, 2006, and an annual CO_2 rate standard of 1,800 pounds CO_2 /MWh beginning January 1, 2008. Off-site reductions permissible.	To be superseded by RGGI beginning January 1, 2009.
MT	Technology standard and offset requirement (HB 25, 2007)	Prohibits state PUC from approving coal-fired electricity generating units (EGUs) after January 1, 2007 unless at least 50% of CO_2 is captured and sequestered. Also requires "cost-effective" offsets for new (post 1/1/07) gas/syngas units.	
NH	Emissions cap on public utility (HB 284, 2002; Env-A-2900)	Cap achieves 1990 levels by 2006. Affects 6 fossil-fuel fired EGUs. Trading, banking.	Pending legislation would replace standard with RGGI.
OR	Emissions standard for new power plants. (Division 24, OAR 345-024-0500, 1997)	New baseload and non-baseload EGUs must meet rate standard of 0.675 lbs CO_2/KWh. Compliance can be through offset purchase.	
WA	GHG Mitigation Rule (WAC Ch. 173-407, 2004)	New plants and existing plants increasing emissions by >15% must develop CO_2 mitigation plan to offset 20% of emissions over 30 years.	
WA	Emissions performance standard (Substitute Senate Bill 6001, 2007).	Beginning July 1, 2008, requires all new long-term financial commitments for baseload generation be with plants that do not exceed 1100 lbs/MWh of CO_2. Verifiable emissions reductions allowed if sequestration plan cannot be implemented.	

Source: Pew Center on Global Climate Change and individual state rules.

Transportation Sector

California has attempted to utilize its waiver provision under section 209 of the CAA in order to implement AB 1493, the Clean Car Law, which was signed into law in July 2002, and followed by standard-setting regulations in December 2004. The

regulations under this law, implement declining CO_2-equivalent emission rate standards for new passenger cars and light duty trucks beginning in 2009. The rates are calculated on a fleet average, and allow for the banking and trading of emission rate reduction credits. These rules are projected to result in a 22% reduction in GHG emissions from new cars by 2012 relative to the 2002 fleet, and a 30% reduction by 2016.[40]

While California and sixteen other states have moved forward with statutory and regulatory processes to implement Clean Car laws[41], their legal authority to do so remains uncertain. The rules were challenged by the automobile industry in federal courts in Vermont and California partly on the grounds that, even if a waiver is granted to California by EPA, they would be preempted under EPCA.[42] While the courts held that this is not the case, these rulings are being appealed. Further, in December of 2007 EPA denied California's petition for a waiver that would allow it (and ultimately other states) to move forward with the standards set under AB 1493. This action is currently being appealed by California and a number of other states.

III-3. State Actions Indirectly Affecting GHG Emissions

Renewable Portfolio Standards

At present, 26 states and the District of Columbia have promulgated renewable portfolio standards (RPS), which require that some percentage of electricity sold within the state come from renewable electricity generating sources. Most states allow that the standard be met through the submission of tradable renewable energy credits (RECs).[43] In some cases where multi-state power pools exist, the Independent System Operator has adopted an accounting system that allows interstate trading of RECs. As is demonstrated in Table III-4, RPSs vary across states in their definition of what counts as renewable generation – often to coincide with resources that state governments wish to promote or develop – as well as stringency and timing. The differing RPS targets also reflect the existing "base" of hydro power, which can vary from none to a significant share of generation. Thus, their impacts on GHG emissions are expected to vary by state as well, depending on the extent to which fossil fuel generation is displaced or avoided.

[40] See http://www.arb.ca.gov/cc/factsheets/cc_newfs.pdf.
[41] See http://www.pewclimate.org/what_s_being_done/in_the_states/vehicle_ghg_standard.cfm.
[42] See *supra* note 18 and the associated discussion in the text.
[43] An REC typically represents 1 MWh of generation from a renewable source, and characteristics such as location and emissions (if any).

Table III-4. Summary of State Renewable Portfolio Standards

State	Target at Full Implementation
AZ	15% by 2025
CA	20% by 2010
CO	20% by 2020 for large investor-owned utilities, with 4% from solar. 10% by 2020 for municipal utilities and rural providers.
CT	27% by 2020
DC	11% by 2022
DE	2% solar PV by 2019; 18% other renewable by 2019
HI	20% by 2020
IA	105 MW
IL	25% by 2025
MA	4% new renewables by 2009, increasing by 1% annually thereafter.
MD	2% solar by 2022 7.5% other renewable by 2022
ME	30% by 2000; increase new (post 10/05) renewable capacity by 10% by 2017
MN	25% by 2025; Xcel Energy must produce 30% by 2020
MO	11% by 2020
MT	15% by 2015
NC	Public utilities: 12.5% by 2021 Municipalities and Cooperatives: 10% by 2018
NH	25% by 2025
NJ	22.5% by 2021, at least 2% solar
NM	20% by 2020
NV	20% by 2015, at least 5% solar
NY	25% by 2013
OR	25% by 2025
PA	18.5% by 2020
RI	16% by 2020
TX	5,880 MW by 2015
VA	12% of 2007 sales by 2022
VT	Equal to the % load growth between 2005 and 2012
WA	15% by 2020 for major utilities
WI	10% by 2015

Source: Pew Center on Global Climate Change.
http://www.pewclimate.org/what_s_being_done/in_the_states/rps.cfm

Energy Sector Demand Reduction Measures

Many states have implemented measures designed to reduce electricity demand and delay investment in new capacity. Such measures include system benefits charges to fund investment in energy efficiency, energy efficiency resource standards, increased

building code stringency, and appliance efficiency standards. These programs would be expected to reduce electricity and heating fuel demand growth, and thus GHG emissions, relative to a counterfactual without such measures. The range of existing programs found in individual states is discussed below.

Energy Efficiency Resource Standards.

Energy efficiency resource standards (EERS) set an energy savings target for a state's electric and sometimes gas utilities, and typically allow for trading and banking of energy efficiency gains. Permissible compliance options may include end-use efficiency, supply side efficiency, and the use of combined heat and power. These standards vary across states both in requirements and manner of implementation. In some states, such as Connecticut, EERS are implemented as part of an RPS. In such a scenario, the EERS will provide some level of GHG reductions that are captured within the total quantity of GHG reductions achieved by the RPS. Existing EERS standards are summarized in Table III-5, below.

Table III-5. Summary of State Energy Efficiency Resource Standards

State	Description
CT (Public Act 05-01, 2005)	Incorporated into RPS. Requirement for energy efficiency and CHP increases from 1% to 4% of requirement over 2007-2010
HI (Act 95 SLH 2004)	Energy efficiency qualifies under state RPS
IL (PA 095-0481, 2007)	Increasing electricity savings requirement: 0.2% in 2008 to 2.0% in 2015 and thereafter. Dept. of Commerce and Economic Opportunity to provide assistance to utilities.
MN (SF 145, 2007)	Annual savings of electricity and gas equal to 1.5% in retail sales, at least 1% of which must be from energy efficiency.
NC (SB 3, 2007)	Included in RPS. Energy efficiency can be up to 25% of requirement through 2018, and 40% thereafter.
NJ	In development. Board of Public Utilities authorized to adopt EERS with goals up to 20% savings by 2020.
NM (HB 305, 2008)	Energy-efficiency savings of at least 5% of 2005 sales by 2014, and 10% of 2005 sales by 2020.
NY	In development. In 2007, Gov. Spitzer called for 15% of total forecasted sales by 2015.
PA (Act 213, 2004)	Energy efficiency qualifies as a resource under state Alternative Energy Portfolio Standard
TX (HB 3693, 2007)	Requires utilities to offset 20% of load growth through energy efficiency
VA (HB 3068, 2007)	Statutory target of 10% energy savings target for utilities by 2022
VT (30 VSA § 209)	Authorized Public Service Board to establish Efficiency Vermont, a state-run energy efficiency utility
WA (CR 102, 2006)	Draft regulation; utility efficiency targets not yet set.

Source: Pew Center on Global Climate Change and individual state rules.

System Benefits Charges

System benefits charges, also called "public benefit funds" have been implemented in roughly half of the states, typically as part of the process of electricity deregulation. Funds are supported by a surcharge on customers' electric bills, and are designated for investment in end-use energy efficiency, renewable energy development, or low-income energy assistance. Some states, such as MN, require a minimum rate of investment in energy efficiency.[44] It is important to note that, to the extent that a state with a system benefits charge has either an RPS that allows energy efficiency as a

[44] See MN Statutes 216B.241, online: http://www.revisor.leg.state.mn.us/bin/getpub.php?pubtype=STAT_CHAP&year=current&chapter=216B#stat.216B.241.0.

resource or a separate energy efficiency resource standard, the system benefit charge will not provide additional GHG emission reductions, unless it drives energy efficiency resource development in excess of what is required by those standards.

Building Code Upgrades

State building codes can be modified to increase or establish minimum energy efficiency requirements for new residential or commercial buildings. Many states have included updating building codes to increase energy efficiency requirements as part of their climate action plans, and a few have moved forward with legislation to adopt such measures. Many states appear to be basing building code updates on the International Energy Conservation Code standards, which are updated every three years.[45] In addition, a number of states have set green building standards requiring new or renovated government buildings to obtain LEED certification.[46]

Appliance Efficiency Standards

States are preempted from establishing efficiency standards for appliances for which a federal standard exists under the 1987 National Appliance Energy Conservation Act.[47] However, states may establish standards for appliances for which a federal standard does not exist. A number of states on the west coast and in the northeast have enacted energy efficiency standards for an assortment of appliances such as commercial freezers, refrigerators, and ice machines. California's standards, for example, currently cover energy use from twenty two categories containing appliances not regulated at the federal level.[48]

III-4. Overview of Proposed Federal Cap and Trade Legislation

While there have been a number of bills proposed in the Senate and House to cap national GHG emissions, varying in both cap-levels and coverage, the two most prominent bills cover the majority of emissions in the U.S. economy.[49] The first is the S. 1766, the Low Carbon Economy Act of 2007 (hereafter Bingaman-Specter), introduced in July 2007. The second is S. 2191, the American Climate Security Act of 2007

[45] See, for example, http://www.massclimateaction.net/Legislation.
[46] LEED stands for Leadership in Energy and Environmental Design, and is a nationwide benchmark for 'high-performance' green buildings.
[47] The Energy Independence and Security Act of 2007 (PL 110-140) updates a number of federal appliance efficiency standards and allows the Department of Energy to establish standards that vary regionally for heating and air conditioning equipment.
[48] See California Energy Commission, "2007 Appliance Efficiency Standards." CEC-400-2007-016-REV1. December 29, 2007. Online: http://www.energy.ca.gov/2007publications/CEC-400-2007-016/CEC-400-2007-016-REV1.PDF.
[49] While a handful of other bills have been introduced, Bingaman-Specter and Lieberman -Warner have emerged as the front-running proposals. It is important to note that some of the other proposed cap-and-trade bills would cap a smaller portion of emissions from the national economy. For example, the Electric Utility Cap and Trade Act of 2007 (S. 317, introduced by Senators Feinstein and Carper) would apply only to electric generating units.

(hereafter Lieberman-Warner), introduced in October 2007, and passed out of the Senate Committee on Environment and Public Works in December 2007. The major provisions of these two bills are summarized in Table III-6, below. Notably, in its current form, Lieberman-Warner retains state authority to enact GHG caps and standards that are more stringent than the federal cap.[50] The most recent version of Bingaman-Specter is silent on the treatment of state programs.

[50] See S. 2191, section 9004.

Table III-6. Summary of Major Provisions in the Bingaman-Specter and Lieberman-Warner Bills.

	Bingaman-Specter (S. 1766, 110th Congress)	Lieberman-Warner (S. 2191, 110th Congress)
Cap	Declines annually to achieve 2006 emission levels by 2020; 1990 levels by 2030.	Declines annually to 19% below 2005 levels by 2020; 71% below 2005 levels by 2030. Hydrofluorocarbons covered in separate cap.
Applicability	Coal-fired power plants (gas and oil plants covered upstream), petroleum refineries, natural gas processing plants, LNG facilities, importers of liquid fossil fuels and non-CO_2 GHGs, and other industrial facilities consuming > 5000 tons of coal. Covers about 88% of national emissions.	Coal-fired power plants (gas and oil plants covered upstream), petroleum refineries, fossil-fuel importers, natural gas processing plants, LNG facilities, industrial facilities, producers or importers of non-fuel chemicals. Exempts small business-owned facilities and facilities or importers responsible for emissions < 10,000 tons CO_2 eq/year. Covers about 87% of national emissions.
Cost containment	Unlimited banking; safety valve (Technology Accelerator Payment) set at $12 per ton, increasing by 5% above inflation annually thereafter.	Unlimited banking; up to 15% of annual compliance obligation can be borrowed from the Administrator, and repaid with an interest penalty. Borrowing limit may be increased if early allowance prices are higher than projections from analysis.
Offset use	No limit on domestic offset use. Categories to be determined by regulation, but including: landfill methane use projects; animal waste or municipal wastewater methane use projects; SF_6 reductions from transformers; and coal mine methane use projects. President may allow use of international emission allowances up to 10% of compliance obligation.	Use limited to 15% of compliance obligation per year. Specific categories of offsets to be determined by regulation, but include agricultural, forestry, and other land-use related projects. An additional 15% of compliance obligation can be met by international emission allowances.
Allowance allocation	53% gratis to affected sources, generally based on proportional share of baseline emissions; declines by 2% each year starting in 2017. 9% allocated to states. 12% auctioned, increasing by 1% annually starting in 2017.	40% gratis to affected sources, generally based on proportional share of baseline emissions, declines by 2% annually beginning in 2017; allocations to early actors and for CCS; 30.5% to states, load-serving entities, farms and forests, coal mines, others; 26.5% auction beginning in 2012 (including early auction provision); base auction increases by 3% annually to 69.5% in 2031.

Source: S. 1766, S. 2191 and Pew Center on Global Climate Change.

The key features to keep in mind for the subsequent discussion of the interaction with state or regional programs is that 1) both proposals are comprehensive in including

all sources, mobile (through upstream coverage of petroleum refineries) and stationary; 2) both employ mixed auctioning and free allocation with the share of the latter declining over time, 3) both would allocate some allowances directly to states for auctioning to fund specified programs, and 4) Bingaman-Specter contains a safety valve that would probably cause it to be less constraining than the projected cap trajectory.

IV. The Impacts of Co-existence of a Federal Cap-and-Trade Program with State or Regional Cap-and-Trade Programs

The white paper released by the House Committee on Energy and Commerce in February 2008 [51] addresses the implications of coexisting federal cap-and-trade and state or regional emissions programs for total compliance cost and emissions. Its purpose is to inform discussion of the appropriate distribution of regulatory authority between the federal and state or local governments under federal climate legislation. The Committee staff analysis finds that where a state and federal program coexist, additional reductions will be achieved under the state program only where it covers emissions not included under the federal cap. In addition, implications for total costs will depend on whether the emissions reductions achieved under the state program would have been achieved under the federal cap-and-trade program alone. While we arrive at the same basic results in the analysis that follows, we go beyond the analysis presented in the white paper by focusing in greater detail on allowance market interactions, distributional impacts, and the role of specific design elements.

The nature of the interaction between the federal and state programs will depend principally on two factors: the relative stringency of the two programs from the perspective of emission sources in the state and the extent of overlap in coverage between the federal and state programs.[52] In the discussion that follows, simplified, hypothetical federal and state or regional[53] cap-and-trade programs are presented in order to highlight the primary efficiency and distributional consequences of their interaction, beginning with a basic case where the coverage of the state and federal programs is identical and allowances are distributed entirely through auctions. This basic case provides a starting point for evaluating a reality that is likely to be significantly more complex. Where state and federal cap-and-trade programs co-exist, the interaction between the programs will be affected by differences in program coverage and how allowances are distributed, as well as some other features of program design. Subsequent sections discuss the effect of these variations.

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[51] House Committee on Energy and Commerce staff. 2008. "Climate Change Legislation Design White Paper: Appropriate Roles for Different Levels of Government." February. Online: http://energycommerce.house.gov/Climate_Change/index.shtml.

[52] The stringency of an emissions cap is reflected in the level of emissions and the marginal cost of abatement or the price of an emission allowance. The more stringent program – and thus the one that will drive behavior at the margin – within the state can be understood as the program that would result in lower emissions, and a higher marginal abatement cost and allowance price absent the other program.

[53] To avoid the repetition of 'state or regional," all subsequent references to "state" should be understood to include multi-state, regional programs unless specifically stated otherwise.

IV-1. Programs with Perfectly Overlapping Coverage

The State Program is More Stringent than the Federal Program

A state cap-and-trade program can be said to be more stringent than the federal program if it requires emission reductions from sources within the state beyond what those sources would achieve under the federal cap-and-trade program alone. When both state and federal programs apply and the state program is more stringent, sources face two compliance obligations for the same emissions: obtaining and surrendering both state and federal allowances. In this case of a more stringent state program, the prices of both the state and federal allowances are influenced by the requirements of the other program. For instance, the lower emissions from sources covered by the state program will reduce demand in the federal auction and lead to a lower federal allowance price. At the same time, when faced with the requirement of complying with the federal program, in-state sources will reduce emissions to the extent justified by the federal allowance price. This will reduce demand in the state auction, thereby lowering the state price from what it would otherwise have been. At the end of process, the state and federal allowance prices will adjust to levels such that emissions in the state are equal to the state cap and the sum of the state and federal allowance prices will be what would have been the initial equilibrium price for the state program when considered alone. Appendix A provides a formal demonstration of this result.

A first effect of the interaction of the two programs will be a reduction in auction revenues for both programs, which will be proportionately greater for the state auction because the state allowance price will always fall more than the federal price. A more important effect of the interaction is the resulting discrepancy in the marginal cost of abatement between sources within the state and those in other states under the federal cap. From an emissions standpoint, the effect of this discrepancy is to redistribute emissions from the state with the binding program to other states. The additional emission reduction in the state with the more binding program would be compensated by fewer reductions in other states without any reduction of national emissions beyond that required by the federal cap. From a cost standpoint, the effect of the state program is to impose higher costs on the in-state sources and to reduce the costs for sources in other states. Since marginal costs are not equalized among all sources nationally, economic efficiency is sacrificed and total compliance costs for achieving the national cap are greater than they would be under the national program alone.

The magnitude of the state program's impact on the federal allowance price and the shifting of emissions and costs would depend not only on the relative stringency of the two programs but also on the state's proportion of national GHG emissions. For example, a binding state cap in Texas, which contributes the largest share of U.S. CO_2 emissions annually, would have a larger impact than a state cap of equivalent stringency in Vermont, which contributes the smallest share.

The State Program is Less Stringent than the Federal Program

A less stringent state program would be one that would result in fewer emission reductions from in-state sources than the federal program when each is considered alone. Or stated differently, the allowance price under the federal program would be sufficiently high to induce sources within the state to reduce emissions to a level below the state cap. While in-state sources would still be required to comply with both programs, the demand for allowances in the state auction would be less than the supply so that in the absence of a reservation or minimum price, the additional cost of the state allowance would be zero or nearly so.[54] The marginal cost borne by in-state sources would be more or less the same as those borne by sources in other states and the distribution of emissions among states in the federal program would be largely the same as if the state program did not exist. Because marginal cost would be equated among all sources subject to the federal program, the efficiency loss discussed in the previous scenario is avoided. This interaction would limit the impact of the state program to only the imposition of additional administrative requirements on in-state sources, namely, bidding for or otherwise acquiring the valueless state allowances to meet state compliance requirements, and would result in the loss to the state of any anticipated revenue from the state auction. Federal auction revenues would be virtually unchanged.

IV-2. Imperfectly Overlapping Programs

When the overlap in coverage between state and federal programs is not identical, the interaction between the programs will depend not only on which is the more demanding of the sources subject to both, as before, but also on which is the more comprehensive in coverage of the state's emission sources.

If the federal program is the more comprehensive one and it includes all the sources included in the state program, the analysis just presented for the case of perfect overlap applies. A more stringent state program will lead to higher costs for in-state sources subject to the state cap with the resulting redistribution of costs and emissions to all other sources in the federal program, including in-state sources not subject to the state program. A less demanding state program will have no effect aside from the additional administrative cost imposed by the state program.

When the state cap-and-trade program is the more comprehensive one, more complications arise in the basic analysis. For sources subject to both state and federal programs, the analysis is essentially the same. If the state program is more demanding of these sources than the federal program, their costs will be higher and there will be a redistribution of cost and emissions to both in-state and out-of-state sources, though in this case the effect on each set will differ.

If the more comprehensive state program is less demanding than the federal program, sources with overlapping obligations will face a higher price than they would

[54] The allowances might still retain some *de minimis* value if trading would have to occur in order for allowances to be reallocated amongst sources for compliance with the state program.

under the state program; however, the state program may still have some effect because of its broader coverage. The state program may result in emission reductions that are additional and the cost incurred by sources with overlapping obligations could be higher than that of out-of-state sources subject to the federal program. The reason is that the cost of a state allowance may not be zero, as it would be in the case of perfect overlap when the state program is the less demanding one. Appendix B provides a formal demonstration of the circumstances under which this result will occur. Further, it demonstrates that where the state program remains binding, the total marginal cost faced by sources subject to both the state and federal program will be greater than the marginal cost that would have obtained under the state program alone, rather than equal to it as occurs under perfectly overlapping programs.

Whether the state allowance price would be zero or not will depend on the demand for state allowances from the in-state sources not subject to the federal program. If sources with overlapping obligations reduce their demand for state allowances in response to the federal allowance price by an amount that accommodates the business-as-usual emissions for sources subject only to the state program, the state cap will be non-binding, the state price will be zero, and the state program will have no effect on the state's emissions. However, if that reduction in demand is less such that some emission reduction is required of sources subject only to the state program, the state allowance price will be positive and that additional cost will drive a wedge between the costs of in-state sources subject to both programs and out-of-state sources, with consequent redistribution of cost and emissions. In this case, the more comprehensive state program will cause sources subject only to the state program to reduce emissions in response to the still positive state price of allowances.

In all of these cases, in-state sources subject only to the more comprehensive state program benefit from the additional requirement imposed on other in-state sources by the federal program. Their costs will be less by an amount determined by the extent that the federal program reduces the demand for state allowances. So long as the state allowance price is not zero, these sources will incur some cost and reduce emissions, although always less than would be the case for the state program alone. However, if the reduction in demand for state allowances occasioned by the federal program allows these sources' business-as-usual emissions to fit within the state cap, the costs that had been incurred under an antecedent state program, or that would be incurred under a prospective state program, will disappear.

IV-3. Other Design Features

Freely allocated allowances

Economic theory suggests that the method of distributing emission allowances, i.e., through grandfathering or auctioning, will not affect an individual source's output decisions or emissions.[55] The primary reason for this is the opportunity cost associated

[55] This simple result also requires that certain conditions be met, namely, no transaction costs, perfect markets and information, and the absence of cost regulation. While departures from these conditions may

with each allowance that is used for compliance. So long as a freely allocated allowance can be sold in the market, the use of this allowance to cover emissions implies the foregone opportunity of selling the allowance at the market price. Hence a source will consider that cost in making abatement decisions. Further, where sources are subject to both state and federal caps, the total opportunity cost will be the sum of the individual opportunity costs associated with state and federal allowances. The main effect of freely allocating allowances instead of auctioning them is to shift the beneficiary of the scarcity rent or value created by the cap from the government to the recipients of the freely allocated allowances. Thus, freely allocating allowances will make a significant difference to recipients in their net costs of program compliance, but it will not have any effect on the interaction of state and federal programs.

For example, when both the federal and state programs freely allocate all allowances to the owners of the installations subject to the two programs and the state program is more demanding, the overall demand for federal allowances will be less with consequent effects on allowance prices and the distribution of costs and emissions, just as it would be with auctioning. The only difference is that, with free allocation, sources in the state either sell federal allowances to out-of-state sources or purchase fewer allowances from them, while, with an auction, in-state sources are not bidding for as many allowances in the federal auction. The effects on federal and state allowance prices will be the same as in the auctioning case, including the shifting of costs and emissions. What were the effects of the overlapping programs on auction revenues are transferred to the recipients of the free allocation. The value of each allowance endowment, and the opportunity cost associated with each type of allowance, is less than it would be for either allowance if the other program did not exist.

The absence of any effect on the state-federal interaction obtains regardless of whether one program freely allocates all allowances while the other program auctions all allowances, or whether there is a mixed distribution, whereby one or both programs freely allocate some allowances and auction the rest. The effect is only to change the magnitude of total allowance sales and purchases and the recipient of the implied value, depending on which program is freely allocating how many allowances. For instance, if the state program freely allocates allowances and the federal program auctions allowances, the main difference is that in-state sources would be buying or selling state allowances, but the volume and value of transactions would be less than if the state program existed alone. Similarly, if the state program auctions allowances and the federal program freely allocates them, buying and selling of federal allowances among in-state and out-of-state sources would be expected.

Likewise, when the distribution of allowances involves both auctioning and free allocation at either state or federal level or both, the interaction between the programs will be the same. Most sources will need to resort to the auction or the market to meet

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cause emissions and output to be different under free allocation from what would be the case with auctioning, opportunity cost will be the dominating difference. The case of cost-regulated electric utilities will be specifically discussed later in the text.

compliance requirements, but the flow of payments to either or both auctions will be reduced by the value of the free allocations.

Finally, if the state program is less stringent than the federal program, the allocation method again makes no difference whatsoever for the federal-state interaction. State allowances will be worthless and therefore the allocation method is irrelevant. State allowances would still be submitted for compliance with the state program, but the surplus of state allowances created by the federal program would drive their value to zero. In this case, only the federal allowances would impact costs and emissions. Of course, the owners of in-state sources would be better off if the federal allowances were grandfathered since that would make them, rather than the federal government, the recipients of the newly created scarcity rents.

In contrast to the analysis presented above, there is one important exception when the impacts under free allocation could vary from those observed under auctions. This is when the output prices of sources subject to both programs are not determined by the market but instead by a regulatory rate determination based on incurred costs, as is the case for electric utilities in many parts of the country. With auctioning, regulatory treatment is irrelevant since every ton incurs a cost that will be recovered, in theory, either through the market or by appropriate regulatory determination. However, cost-based price regulation typically does not consider opportunity costs. Consequently, when free allocation interacts with conventional electric utility regulation, the only costs that are recovered are those actually incurred for abatement or the purchase of allowances less any revenue from the sale of allowances. In effect, under free allocation, the scarcity value of the allowances is passed on to consumers in lower output prices or electricity rates. As a result, abatement will be less to the extent that higher output prices would reduce demand. The further result of free allocation in this important exception to the rule is that the disparity in marginal cost between in-state and out-of-state sources would be less, as would be the redistribution of costs and emissions between in-state and out-of-state sources.

Safety Valves and Reservation Prices

These design features serve to limit allowance prices on the up-side and down-side, respectively. A safety valve places an upper limit on the marginal cost of abatement by making additional allowances available once the allowance price reaches some predetermined level. A safety valve in either a state or federal program can be seen as providing an upper bound on the price that would be paid or received for allowances whether those allowances are auctioned or freely allocated. A reservation price applies only for auctions (unless the state or federal government makes a standing offer to purchase freely allocated allowances at the reservation price) and it establishes a minimum price to be paid for allowances so long as there is a demand for allowances.

The effect of a safety valve depends of course on the frequency with which it is triggered. Where the programs overlap perfectly and the state program is more demanding, the total cost per ton for sources subject to both programs will not change.

Rather, to the extent that the federal safety valve is triggered, the state component of this cost will be larger and the value of state allowances will be greater whether they are freely allocated or auctioned.[56] Similarly, a safety valve in the state program will serve to limit the state component of the total cost incurred by in-state sources, and therefore the effect on federal allowance value, again to the extent that the state safety valve is triggered. Where two programs interact and a safety valve is triggered in one, the effect of the other program is expressed in a smaller quantity of the first program's allowances sold at the fixed safety valve price level. If the state program is less demanding than the federal program, a state safety valve would be moot since it would never be triggered. Finally, the additive cost aspect of overlapping programs will reduce the likelihood that a safety valve would be triggered if one were present in either the state or federal program, since the interaction of the programs tends to lower each program's allowance price.

A reservation price will be of greater interest in a state program that auctions its allowances.[57] With a reservation price, the state program will always produce revenue and always impose an emissions cost on in-state sources. Consequently, if the state program is less demanding of in-state sources than the federal program and allowances are auctioned, a reservation price will ensure some additional abatement by in-state sources since it would be a cost additional to the federal allowance price. It will also ensure some shifting of costs and emissions with respect to out-of-state sources under the federal program since the marginal costs of emissions from in-state sources will always be greater than those of out-of-state sources by at least the amount of the reservation price. There will also be some effect on the federal allowance price and federal auction revenue. When the coverage of the state program is more comprehensive than the federal program, a reservation price will also always ensure some additional emission reduction on the national level since in-state sources not covered by the federal program would still face a price for carbon.

Offset Provisions, Banking and Borrowing

These common provisions of cap-and-trade programs provide flexibility in meeting compliance requirements. Offset provisions allow affected sources to comply by submitting approved credits for emission reductions accomplished outside of the cap-and-trade system. Banking and borrowing provide flexibility over time within the trading system. With banking, sources can comply by submitting unused allowances from earlier compliance periods and borrowing would allow sources to use allowances issued for future periods for compliance in the current period.

These provisions will typically influence federal-state interaction only as they affect the stringency of one or the other program. For instance, the presence of relatively

[56] A recent report from the Energy Information Administration (EIA) evaluating the Bingaman-Specter bill, which contains a safety valve, finds that the safety valve would be triggered for at least some years in all the scenarios examined. *Energy Market and Economic Impacts of S. 1766, the Low Carbon Economy Act of 2007*, EIA Report SR/OIAF/2007-06 (January 2008).

[57] In response to concerns of over-allocation, RGGI will be incorporating a reservation price of $1.86 per ton in the September 2008 auction, adjusted in response to the CPI or market prices thereafter. See: Point Carbon. 2008. RGGI sets auction reserve price of $1.86. March 17.

liberal offset provisions in either the federal or state program might make that program less stringent than the other with the consequences that have been explained above. Banking provisions could have a powerful effect in determining the stringency of a given program when initial caps are relatively lax and later caps more demanding. For instance, if both state and federal programs have relatively equivalent and undemanding initial caps, but the federal program has significantly lower later caps and allows banking, the demand for early abatement to generate bankable allowances will cause the federal program to be the more stringent in the near term, potentially rendering state allowances worthless. A further effect of banking and borrowing provisions will be to stabilize the relationship between the two programs since these features tend to establish a floor and a ceiling, respectively, on variations in the allowance prices that signal the relative stringency of the two programs.

IV-4. State Retirement of Federal Allowances

The redistributive effects of more demanding state programs co-existing with a federal program could be reduced—and even avoided—if state programs also contain provisions to retire federal allowances. For instance, if state auction revenues were used to purchase and retire federal allowances, out-of-state sources would see less or no reduction of costs as a result of the state's program and federal auction revenues would be greater. Because of the retirement of federal allowances, however, the decline in the state allowance price would be larger than under the basic case. In effect, the state would be transferring its auction revenue to the federal government. While this transfer would not likely be appealing to state governments, the difference in marginal costs between in-state and out-of-state sources would be reduced by the state purchase and retirement of federal allowances, thereby entailing less loss of economic efficiency. While the exercise of such an option by states could reduce the distortions associated with a more stringent state program, it would also effectively reduce the federal cap thereby raising the allowance price and costs to all other states.

An only slightly more appealing alternative for state governments might be to retire federal allowances that are proposed to be allocated to the states by both of the leading federal proposals. An explicit purchase of federal allowances would be avoided, but the state would forego the revenue that could be obtained from the sale of retired federal allowances. However, as would also be the case with an outright state purchase of federal allowances, the value of federal allowances would be higher to the benefit of the federal auction and any other recipients of federal allowances. Moreover, the higher federal price will imply an even lower state allowance price and lower state auction revenues. The only economic gain from such a course of action would be reducing the disparity in marginal cost between in-state and out-of-state sources.

Retirement of federal allowances might also be implemented with free allocation but it is not likely to be any more politically appealing. A state regulator could require in-state sources to purchase and to submit to the state a certain percentage of federal allowances in addition to their federal and state surrender requirements. The burden of exercising the retirement option would be shifted from the state government to the

owners of the in-state sources, which would be likely to mount both political and legal challenges to the requirement. The effects on the prices of federal and state allowances and on federal and state auction revenues would be the same as if the state government were purchasing and retiring the same number of federal allowances.

V. The Impacts of Coexistence of Federal Cap-and-Trade Program and Other State Climate Programs

Beyond the ongoing development of state cap-and-trade programs, many states have implemented, or intend to implement, other more prescriptive forms of regulation that either directly or indirectly, impact GHG emissions. As is the case with state cap-and-trade programs, the impacts of the coexistence of these programs and a federal cap-and-trade program will depend on relative program stringency and overlap in coverage. We analyze the impacts of coexistence by focusing on the each of the major types of state climate action in turn.

V-1. Power Sector Emission Standards

As discussed in Section II, a number of individual states have implemented emission standards for greenhouse gases from power plants. The simplest interaction between such programs and a federal cap and trade program occurs with state emission standards where all sources covered by the emission standard are covered by the federal cap-and-trade program. If the state's emission standard requires abatement in excess of what the state's power sector emissions would be under the federal cap alone, the demand for federal allowances and their price will be reduced, as would be the case with a more demanding state cap-and-trade program. Because the federal cap will control overall nationwide emissions, the addition of an in-state standard will not provide additional reductions, but will have implications for the distribution of GHG emissions and costs as discussed in the previous section. The marginal abatement cost of sources subject to the state's emission standard will exceed that of out-of-state sources subject to the federal cap-and-trade program, and the economic inefficiencies associated with differing marginal abatement costs among states will be created. Conversely, if the state's emission standard does not require sources in the state to reduce emissions beyond the level they would achieve under the federal cap alone, the emission standard will have no impact on emissions or costs.

The above scenario becomes more complicated when coverage differs between the state emission standard and the cap-and-trade program. The emission standard, for example, might cover some sources that are exempt from the federal cap-and-trade program. If the standard results in emission reductions at these sources, these reductions will be additional to those generated by the cap.[58]

V-2. Renewable Portfolio Standards

[58] If the allowance price under the federal cap results in increased utilization of sources exempt from the cap but subject to the emissions rate, some of these additional reductions could be offset by emissions leakage.

For a given national cap level, the presence of a binding renewable portfolio standard in a given state will reduce the incremental cost of the federal program for all states to the extent that fossil-fuel fired generation is displaced by renewable energy, thus reducing the demand for federal allowances, in the same manner as if the state had enacted a more demanding state cap-and-trade program.[59] Although the cost of the federal program would be lower for in-state sources as a result of the state RPS, the combined cost of the federal program and the RPS would be greater for in-state sources and customers. The incidence would depend on the form of regulation and how the costs of the RPS are recovered.[60]

V-3. Vehicle Emission Standards

The nature of the interaction between vehicle emissions standards and the cap-and-trade program depends upon whether motor vehicle fuel is included under the federal cap. Currently, both the Lieberman-Warner and Bingaman-Specter bills include motor vehicle fuel through upstream regulation of petroleum refineries. In these cases, vehicle emission standards will have no impact on aggregate GHG emissions, because they are determined by the national cap. Rather, the implementation of a binding state-level vehicle emission standards will result in a reduction in transportation sector demand for federal allowances as new vehicles enter the fleet, thus lowering the federal allowance price relative to the absence of the vehicle standards. Thus emissions will be shifted away from the transportation sector toward other sectors, and compliance costs will be shifted away from other sectors toward the transportation sector. The transportation sector will face a higher marginal cost of abatement than other sectors and the total cost of compliance with the federal cap will increase.[61] Finally, if the national cap and trade program does not include the transportation sector,[62] any emissions reductions generated by state vehicle emission standards would be additional.

V-4. End-use efficiency measures

Section II discussed a number of policy measures being implemented in the states to improve end-use energy efficiency, thus reducing demand growth and the need to invest in new generating capacity. These include updating building energy codes, energy efficiency portfolio standards, and system benefits charges for energy efficiency, and

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[59] We assume that any fossil generation displaced or avoided as a result of the RPS would have been subject to the federal cap.

[60] Beyond this effect, the existence of a cap-and-trade program may eliminate the value of 'green' attributes of RECs because under a cap they can no longer be associated with a reduction in emissions. In order to preserve the value of emission reductions held by RECs, some states within RGGI (CT, NH, NY, RI), have included provisions to retire allowances equal to estimated emissions reductions associated with voluntary REC purchases through state programs.

[61] Despite this potential inefficiency, the Lieberman-Warner bill requires that the Administrator of EPA conduct a review of the sector prior to the start of the program in order to determine if additional policies are need to reduce GHG emissions from the sector. See Lieberman-Warner, section 7002.

[62] It is difficult to see, for example, how a cap-and-trade program under the existing Clean Air Act could be structured to include the transportation sector. See Nordhaus, *supra* note 15.

appliance efficiency standards. Under a comprehensive federal cap-and-trade program, these measures will reduce the demand for emission allowances from electricity generation and, in the case of building code upgrades, heating fuels, to the extent that the actions called for by these measures would not occur in response to the federal cap-and-trade program. As a result, allowance prices will be lower than they would be absent these programs, resulting in a redistribution of emissions.[63] In addition, these programs will impact the distribution of abatement costs, transferring the cost of abatement from electricity generators and fuel providers to other sectors. In the case of building codes, building developers may face additional materials and construction costs associated with meeting the codes, which they may be able to pass on to building purchasers. Under system benefits charges and energy efficiency resource standards, costs will be shifted toward electricity consumers and utilities. In the case of appliance efficiency standards, costs will be shifted toward appliance manufacturers, and would likely be passed on to consumers.

In considering the implications of measures that improve energy efficiency, it is important to consider whether these measures take advantage of low-cost abatement opportunities that would not be achieved because market imperfections and market barriers lead consumers not to respond efficiently to the cap-and-trade program's price incentive.[64] If these low-cost abatement opportunities would otherwise go untapped under the federal cap-and-trade program, such that reductions under the cap come from higher-cost abatement opportunities, end-use efficiency measures could actually lower the total cost of achieving the national cap.

VI. Preemption or Carve Out of State Cap-and-Trade Programs

Beyond coexistence, two other potential relationships between state and federal cap-and-trade programs can be envisioned: preemption of state cap-and-trade programs, or the 'carve out' of state programs from the federal program. These two variations are noteworthy because they avoid the circumstance of individual sources paying both a state and federal allowance price for each ton of emissions as occurs when state and federal cap-and-trade programs overlap. In addition, the 'carve out' scenario has further implications for economic efficiency and the distribution of costs.

VI-1. Federal Preemption

This paper does not address how pre-emption might be implemented legally. While it is easy to imagine that federal legislation might include preemption with respect to state or regional cap-and-trade programs, it is less clear how federal preemption would operate for non-cap-and-trade climate policies, such as demand-side management and

[63] This effect may be tempered somewhat by a rebound effect, which will occur to some degree as electricity or heat use becomes less expensive.

[64] See, for example, Jaffe, AJ and RN Stavins. 1994. "The Energy Efficiency Gap: What Does it Mean?" *Energy Policy* 22: 804-810. They differentiate between market failures and non-market failures in their discussion of the 'energy efficiency gap,' and suggest that, generally, socially desirable policy intervention will target the former.

renewable energy requirements, which would interact with a federal cap-and-trade program as described in section V.[65] The authority to implement such programs has been traditionally granted to the states and it is widely exercised by them. Because most discussion of preemption in the context of federal climate policy has focused on state cap-and-trade programs, we consider preemption only in that context.

When preemption is exercised with respect to state programs that preceded implementation of a federal cap-and-trade program, a transition problem is created. If the federal program does not provide credit for or recognize state program allowances, the value of existing state program allowances will fall toward zero to the extent that a bank of state allowances has been accumulated. This price decline could begin to occur well before the federal program is finalized as expectations about preemption become stronger. Sources within the state that have banked allowances will be expected to draw down their banks as the program as phased out, and statewide emissions will increase. If sources have been unable to bank allowances, allowances through the vintage of the final compliance year before preemption will retain value, though allowances from future vintages will be valueless.

When a bank of state allowances exists, a federal program could retain the value of existing state allowances and avoid increasing statewide emissions in the short term by permitting state allowances to be transferred into the federal program. If the federal program allows for the exchange of state allowances for federal allowances at full value within the federal cap, there will be no impact on the federal allowance price from incorporating state allowances; however, federal allowances in like number would have to be subtracted from the auction or free allocations to other sources. If federal program allowances are provided for banked state allowances *on top of* the cap as early reduction credits, the cap is effectively expanded, and the federal allowance price will be lower than it would have been absent the exchange of state allowances.

An example of the former approach exists in New Hampshire's current bill for implementing RGGI, which contains provisions that provide for the conversion of banked Public Service of New Hampshire (PSNH) CO_2 allowances into RGGI allowances.[66] This provision provides sources with one RGGI allowance for each banked PSNH allowance held, and then subtracts the total allowances awarded from the pool of allowances to be auctioned.[67] In this case, the value of PSNH allowances going forward will be the allowance price under RGGI.

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[65] In addition, it is unclear that preemption of state programs would be possible if EPA attempts to implement a cap on stationary sources under the existing Clean Air Act.

[66] This type of provision occurred in the European Union's CO_2 Emissions Trading Scheme. In the trial period extending from 2005 through 2007, member states were given the option of allowing banked trial period allowances to be carried over into the subsequent 2008-12 trading period. France and Poland opted to allow such banking; however, the European Commission's guidance for allocation in the second trading period required that any banked allowances be taken from the cap. As a result, neither France nor Poland chose to honor the banked allowances since it would have required an equal number of allowances to be taken from what would otherwise have been allocated to sources.

[67] See New Hampshire House Bill 1434, section 125-O:23. Online: http://www.gencourt.state.nh.us/legislation/2008/HB1434.html.

Once the preempted state program expires, the allowance price under the federal program will drive emission reductions in the state. Sources will be subject to only a federal allowance price, such that the efficiency and redistributive impacts that occur under overlapping state and federal programs are avoided. Finally, the state cap-and-trade program may continue to affect the pattern of emissions reductions under the federal program if the state program led to irreversible investments in abatement that would not have occurred under the federal program absent the prior state program. If the state allowance price had been higher than the new federal allowance price, for example, investment in energy efficiency or renewable energy may have been greater than it would be under the federal program. Because these investments are typically sunk costs and tend to be irreversible with near-zero marginal costs, they would remain economical to operate under the federal cap.

VI-2. 'Carve-Out' of State Cap-and-Trade Programs

It is possible, particularly if a federal GHG cap is implemented through a regulatory approach under the existing Clean Air Act, that a federal program may allow a state to implement its own cap-and-trade program instead of the federal program, provided that it is at least as stringent as the federal program. A federal cap-and-trade program under this scenario would resemble the NOx Budget Trading Program or the trading program that would have been established under the recently vacated Clean Air Mercury Rule. In this situation, sources in a state choosing to implement its own cap-and-trade program will be subject only to that state cap, while sources in states choosing not to implement or retain their own state programs will be subject only to the federal cap. Individual state programs will have their own independent allowance prices, which could vary widely, and the federal program will have a separate and independent allowance price.

Under this scenario and to the extent that the carved-out state programs can hermetically seal themselves off from the federal program, the inability of sources in different states to equate marginal abatement costs will result in a loss of economic efficiency. Total emissions will be lower than the original national cap to the extent that states require reductions additional to what would occur under the federal program. In any case, total national costs would be higher than if there were only a federal program.

The economic rationale for states independently implementing a cap-and-trade program when a federal program is available is unclear. States with relatively high abatement costs should have a strong incentive to join the federal program in order to lower compliance costs for its sources. States with relatively low abatement costs may be able to benefit by being net sellers of allowances or improving their competitive positions. In addition, a federal program, with thousands of sources under the cap and a wide distribution of abatement costs should provide a larger, more liquid allowance market and less price volatility than could be achieved in an individual state program.

Also, deciding the criterion for an approvable state 'carve-out' would be difficult if the federal cap has not been divided into state GHG 'budgets' as occurred in the context of the NOx Budget Trading Program. For instance, the most obvious criterion, a specified percentage reduction of emissions from some base year, will impact states differently according the distribution of abatement costs among the states and changes in industrial structure that would affect emissions. In particular, a real potential for adverse selection exists. States with relatively abundant low cost abatement potential or emissions that are declining for other reasons would have a perverse incentive to set up their own programs thereby leaving states with relatively fewer abatement opportunities or rising emissions in a higher cost federal program. Although other criteria could be imagined, the distribution of abatement costs is only imperfectly known, as are other trends that affect emissions, such as migration or changes in industrial structure.

A scenario can be imagined where linkage is established by mutual recognition between 'carved out' state cap-and-trade programs and the federal program, permitting the trade of federal and state allowances. With such linkage, sources in states with higher state allowance prices would purchase federal allowances for compliance with the state program thereby increasing costs in other states but also equalizing marginal costs across all states. In this case, allowing state program carve-outs with linkage achieves both lower national emissions and economic efficiency through the common national allowance price.

This result presents an interesting contrast to what occurs with overlap or co-existence between a more stringent state cap and the federal program. In the overlap case, the individual state bears the cost of its more aggressive emissions reductions, lowering the cost of the national program for sources in other states, while sources within the state experience a marginal cost per ton comprised of the state and federal allowance price. In the separate-but-linked case, however, the state can distribute the cost of its more aggressive reductions among all states in the federal program, raising the federal allowance price for all sources, and eliminating the loss in economic efficiency attendant on differing marginal costs. In effect, in-state sources would be paying cheaper out-of-state sources to effect part of the state's extra emissions reduction on their behalf. The beneficiaries would be the initial holders of the federal allowances, either the federal auction or grandfathered recipients. State allowances would be equal in value to federal allowances and that state value would be intermediate between what it would be if the state program existed alone and what it would be with co-existing or overlapping state and federal programs.

VII. Conclusion

While the vast range of state and regional policies to reduce GHG emissions suggests a potential multitude of interactions between any federal climate policy and state and regional programs, these interactions are largely determined by two factors: the extent to which the state and federal programs cover the same sources and the relative stringency of the federal and state programs in question. An understanding of these

potential interactions is essential to state and federal policymakers as both move forward with climate policy design.

The basic rule is that to the extent that a state or regional program is duplicative of the federal program, the effect is either solely redistributive of emissions and costs or nugatory, depending on whether the state program is more or less demanding of in-state sources than the federal program. It may be argued that a state program could have the additional effect of lowering the cost of the federal program if it addresses a market failure that impedes low or negative cost reductions, but this is a hard test for policy to meet. Also, to the extent that the state program affects sources not covered by the federal program, the effect on cost and emissions will usually be additional.

While affected sources in other states might welcome the cost reductions that result from more demanding action in some given state, such differentiation does impose a loss of economic efficiency and therefore an additional cost nationwide. While additional costs may be justified for pollutants where the sources and damages are local, this is not the case for greenhouse gases. Therefore, to the extent that economic efficiency is a goal—and it can be argued that for a problem as complex and difficult as climate change achieving goals at least cost is very important—federal preemption of duplicative state cap-and-trade programs is warranted. It can also be argued that the inefficiencies are not large, that other non-economic considerations are as important, and that the existing precedents of retained state authority in most areas of emissions control are more compelling.

Beyond federal preemption, the only way to avoid the redistribution and inefficiency associated with a more demanding state program would be a carve-out of the state program with linkage to the default federal system. Such an arrangement would ensure additional emission reductions and a nationwide distribution of the additional cost that would achieve least cost attainment of the tighter cap. The catch for the state choosing to implement a more stringent cap, and thereby to auction or to freely allocate fewer allowances, is that auction revenue or allowance value will be less for the state or its in-state sources. While incurring somewhat higher costs, other states would also be beneficiaries as sources within the state purchase allowances from out-of-state auctions or allowance holders to avoid what would otherwise be the even higher costs of the more demanding state program that justified the carve-out. Such a provision also transfers control of the national cap level from the federal government to the states, and could create significant uncertainty as to the final cap, depending on the extent to which states exercise this option.

Appendix A

The effect of overlapping state and federal climate programs

Definitions and notation

The marginal abatement cost (MAC) function for the set of installations included in a cap-and-trade program can be written as:

A.1) $$p_i = \alpha_i - \beta_i e_i = mc_i$$

Where subscript *i* denotes the program, in this case, either *s* or *f* for state or federal, respectively. The symbol *p* represents the price of allowances; *mc,* the marginal abatement cost incurred by installations subject to the program; and *e*, the aggregate emission level. The coefficients in the marginal abatement cost function, α and β, indicate, respectively, marginal abatement cost when all emissions have been abated (e_i = 0) and the rate at which marginal abatement cost rises as emissions are abated.

For ease of presentation in what follows, let $\alpha_i = \alpha$, that is, the cost of the last possible and most expensive increment of abatement is the same for both the federal and state programs. Then, if the federal program includes all installations in a given state program, it follows that:

A.2) $$e_s < e_f \quad and \quad \beta_f < \beta_s$$

Two emission levels are particularly important in any cap-and-trade program, the capped level of aggregate emissions, denoted by a bar, $\bar{e}_i$, and counterfactual or business-as-usual level of emissions, denoted by superscript *0*, e_i^0. Since marginal abatement cost and the allowance price would be zero at the BAU emission level, and by the definition of a binding cap, it follows from equation 1) that

A.3) $$e_i^0 = \frac{\alpha}{\beta_i} \quad , \quad \bar{e}_i < e_i^0 \quad and \quad \bar{p}_i > 0$$

where $\bar{p}_i$ denotes the allowance price when $e_i = \bar{e}_e$. Finally, the level of state emissions that would obtain under the federal program, when it is considered independently of any state program, is denoted by a tilde.

A.4) $$\tilde{e}_s = \frac{\alpha - \bar{p}_f}{\beta_s} = \frac{\beta_f}{\beta_s}\bar{e}_f < e_s^0$$

Equation A.4) effectively states that the state's emissions will be a share of the federal cap that is determined by the slope of the state's marginal abatement cost (MAC) curve relative to that of the country as a whole.

Finally, all the variables indicated above may be different when state and federal programs overlap. Such variables will be denoted by a prime so that, for instance, $\overline{p}'_s$, would indicate the state allowance price when both state and federal programs exist. Figure A.1) illustrates these relationships for the case of a more demanding state program; and it will be helpful in understanding the discussion of state and federal program interaction that follows.

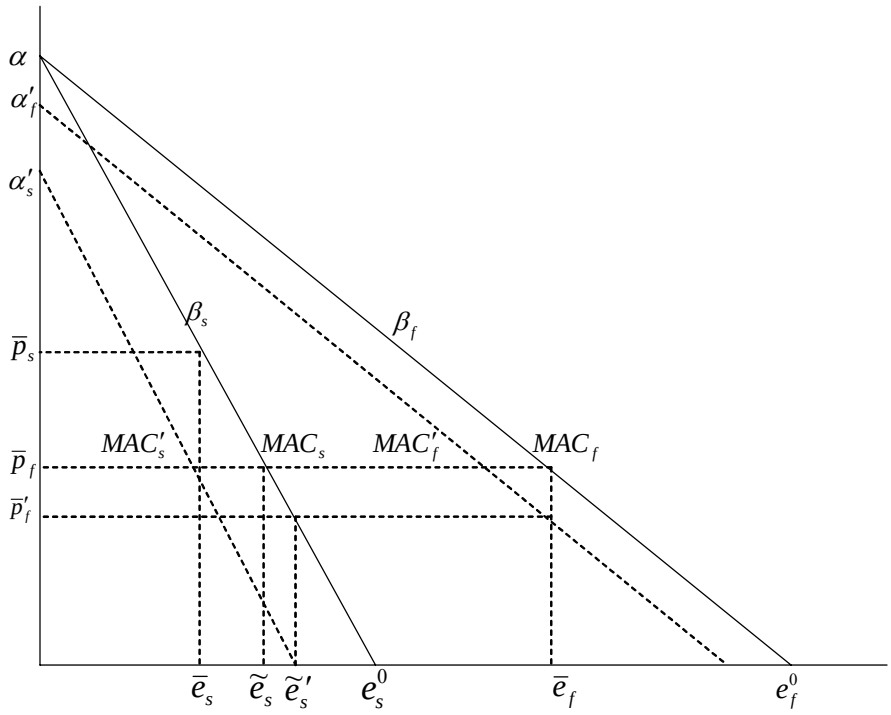

Figure A.1. Marginal abatement cost curve shifts and implications for emissions and allowance prices under overlapping federal and state cap-and-trade programs.

Overlapping effects

State and federal cap-and-trade programs can be said to be overlapping when the owners of affected facilities must comply with both programs for the same emissions. For any level of emissions at affected facilities, owners would surrender federal allowances for compliance with the federal cap-and-trade program and state allowances for the state program. In effect, they would be paying twice for the emissions. Accordingly, the marginal cost paid by in-state sources would be:

A.5) $\quad mc_s = \overline{p}'_s + \overline{p}'_f$

A first question to be addressed concerns the relationship of this marginal cost, which is the sum of two allowance prices, to the marginal cost that would be faced by in-state sources if either the state or federal programs existed alone. To address this question, it is necessary first to determine the effect of the state program. This can be expressed as the difference between the state cap and what in-state emissions would be under the federal program, when both exist alone. Using equation A.4), this difference can be expressed as:

A.6) $$\Delta e_s = \bar{e}_s - \tilde{e}_s = \bar{e}_s - \frac{\beta_f}{\beta_s}\bar{e}_f = \bar{e}_f\left(\frac{\bar{e}_s}{\bar{e}_f} - \frac{\beta_f}{\beta_s}\right)$$

The relationship within parentheses compares two shares. The first ratio within parentheses expresses the share of the state cap in the federal cap when both exist. The second share is the one just noted: the state's emissions under a stand-alone federal program. If the state program would allow more in-state emissions than would occur under the federal program alone, then the expression in parentheses and equation A.6) take a positive value and the state program can be said to be less demanding of in-state sources than the federal program. In this case, the state program imposes no additional requirement on in-state sources and the state constraint is slack. Accordingly, state allowances will have no value ($\bar{p}'_s = 0$) so that the marginal cost faced by in-state sources will be determined by the federal program alone. Using equation A.5),

A.7) $$mc_s = \bar{p}'_f + \bar{p}'_s = \bar{p}_f + 0 = \bar{p}_f$$

Conversely, if $\bar{e}_s < \tilde{e}_s$ and the value of the expression in parentheses and of equation A.6) is negative, the state program is more demanding than the federal program and the marginal cost faced by in-state sources could be expected to be higher than it would be under the federal program. However, the federal price would not be as high as it would be without the state program or with a less binding state program, since the additional in-state reduction required by the more stringent state cap would reduce the demand for federal allowances from in-state sources. This change in the demand for federal allowances will shift the federal MAC inward by the amount of the difference stated in equation A.6) and reduce the price of federal allowances for both in-state and out-of-state sources. The shift in demand for federal allowances will have the effect of reducing the vertical intercept, α, by $\beta_f \Delta e_s$ so that the new federal price will be:

A.8) $$\bar{p}'_f = \left(\alpha + \beta_f \Delta e_s\right) - \beta_f \bar{e}_f = \bar{p}_f + \beta_f \Delta e_s$$

In interpreting equation A.8), it is important to remember that when $\Delta e_s \geq 0$, or the state constraint is slack, there is no effect on the demand for federal allowances or the price of federal allowances. Therefore,

A.9) $$\begin{aligned} &If\ \Delta e_s \geq 0, \quad \bar{p}'_f = \bar{p}_f \\ &If\ \Delta e_s < 0, \quad \bar{p}'_f = \bar{p}_f + \beta_f \Delta e_s < \bar{p}_f \end{aligned}$$

When state and federal programs overlap, the interaction extends also from the federal program to the price of state allowances. The demand for state allowances will also be less because in-state sources would take into account the cost of complying with the federal program that is, $\overline{p}'_f$,the federal price resulting from the overlapping programs. In the same manner as the federal MAC is shifted by the additional reductions required by the state program, so the state MAC is shifted inward by the difference, $\widetilde{e}'_s - e_s^0$, the extent to which in-state emissions are reduced in response to the federal allowance price. Accordingly, the adjusted state allowance price can be expressed as:

A.10) $$\overline{p}'_s = \alpha + \beta_s\left(\widetilde{e}'_s - e_s^0\right) - \beta_s\overline{e}_s = \alpha - \beta_s\overline{e}_s + \beta_s\left(\frac{\alpha - \overline{p}'_f}{\beta_s} - \frac{\alpha}{\beta_s}\right) = \overline{p}_s - \overline{p}'_f$$

Equation A.10) demonstrates that the adjusted state allowance price will be the difference between what the state allowance price would be with a stand-alone state program and the federal price after consideration of the effect of the more demanding state program. Thus, for the case of a more demanding state program, the marginal cost paid by in-state agents will be:

A.11) $$mc = \overline{p}'_s + \overline{p}'_f = \overline{p}_s$$

Summarizing, the marginal cost paid by in-state sources will be the higher of the stand-alone allowance price for the state or federal program depending on which demands more of sources within the state.

A.12) $$\begin{aligned} &If\ \Delta e_s \geq 0, \quad mc = \overline{p}_f \\ &If\ \Delta e_s < 0, \quad mc = \overline{p}_s \end{aligned}$$

When the programs overlap and the state program is more demanding than the federal program, the interaction of the two programs reduces the demand for and value of allowances from each program. Keeping in mind that Δe_s is negative in the case of a more demanding state program, it can be easily shown that the effect of the interaction between state and federal programs is greater on the state price than on the federal price.

A.13) $$\frac{\Delta\overline{p}_s}{\Delta\overline{p}_f} = \frac{\overline{p}'_s - \overline{p}_s}{\overline{p}'_f - \overline{p}_f} = \frac{-\overline{p}'_f}{\beta_f\Delta e_s} = \frac{-\left(\overline{p}_f + \beta_f\Delta e_s\right)}{\beta_f\Delta e_s} = 1 + \frac{-\overline{p}_f}{\beta_f\Delta e_s} > 1$$

Consequently, the effect on allowance value (and on auction revenue) will be proportionately greater for the state allowances than for the federal allowances.

Appendix B

The effect of overlapping state and federal programs when the state program is more comprehensive

When the state cap-and-trade program is more comprehensive than the federal program, there is an interesting divergence from the rule that the combined compliance cost of the federal and state programs would equal the stand-alone state allowance price. In fact, there are two important differences from what is observed in the case of perfectly overlapping state and federal systems. The first difference is that the state allowance price may not be zero even though the state program is less demanding of the in-state sources covered by both programs than the federal program. Thus, a less demanding but more comprehensive state program may trigger the allocative inefficiencies that are observed in perfectly overlapping programs only when the state program is more demanding than the federal program. The second difference is that the state allowance price, after taking the interaction with the federal program into account, can be higher than the stand-alone state price. The cause of these differences is the demand from the in-state sources that are not covered by the federal program. The mathematical explanation follows.

The Stand-alone Federal Program

In the case of a more comprehensive state program, the federal program affects sources located in one sector only, perhaps electricity generators. In subsequent notation, this sector will be denoted by subscript *s1* or *f1* for the in-state sources and all federal sources, respectively. The federal price and the resulting level of in-state emissions from covered sources are given by equations B.1) and B.2), respectively.

B.1) $$\overline{p}_{f1} = \alpha - \beta_{f1}\overline{e}_{f1}$$

B.2) $$\widetilde{e}_{s1} = \frac{\alpha - \overline{p}_{f1}}{\beta_{s1}} = \frac{\beta_{f1}}{\beta_{s1}}\overline{e}_{f1} < e_{s1}^{0} \quad so\ long\ as \quad \overline{p}_{f1} > 0$$

As in the case of perfect overlap, the level of emissions for in-state sources is a sub-set of the federal cap that is determined by the slopes of the federal and state MACs for the affected sources.

The Stand-alone State Program

In-state sources that are covered by the state program but not the federal program are denoted by subscript *s2* and the emissions covered by the state program are denoted by subscript *s* so that

B.3) $e_{s1} + e_{s2} = e_s$

Alternatively,

B.4) $\frac{\alpha - p}{\beta_{s1}} + \frac{\alpha - p}{\beta_{s2}} = \frac{\alpha - p}{\beta_s}$ so that $\beta_s = \frac{1}{\frac{1}{\beta_{s1}} + \frac{1}{\beta_{s2}}} = \frac{\beta_{s1}\beta_{s2}}{\beta_{s1} + \beta_{s2}}$

The equations corresponding to B.1) and B.2) above for the federal program are given below with the emissions level in the two sectors denoted by a dot over the symbol.

B.5) $\overline{p}_s = \alpha - \beta_s \overline{e}_s$

B.6) $\dot{e}_{s1} = \frac{\alpha - \overline{p}_s}{\beta_{s1}} = \frac{\beta_s}{\beta_{s1}} \overline{e}_s < e_{s1}^0 \quad and \quad \dot{e}_{s2} = \frac{\alpha - \overline{p}_s}{\beta_{s2}} = \frac{\beta_s}{\beta_{s2}} \overline{e}_s < e_{s2}^0$

Note that using equation B.4), $\dot{e}_{s1} + \dot{e}_{s2} = \beta_s \overline{e}_s \left(\frac{1}{\beta_{s1}} + \frac{1}{\beta_{s2}} \right) = \overline{e}_s$

Determining the Conditions for a Slack State Program

As noted in the case of perfectly overlapping programs, interaction with the federal program can cause the state allowance price to fall to zero and to render the state program completely without effect. However, when the state program is more comprehensive that the federal program, it is not enough for the federal program to reduce emissions in the sector with overlapping requirements beyond what they would be without the federal program. It must reduce emissions even more to the point that eliminates any requirement for sources in the sector without federal obligations to reduce emissions at all. Thus, the state program will become slack if the federal program causes sector 1's emissions to be low enough that the state cap is met without any effort from sources in sector 2. The condition for a zero state allowance price can be stated as

B.7) $\dot{e}_{s1} - \widetilde{e}_{s1} \geq e_{s2}^0 - \dot{e}_{s2} \quad or \quad \widetilde{e}_{s1} \leq \overline{e}_s - e_{s2}^0$

Algebraic manipulation of equation 7) using the previous equations will yield the condition for a zero state price.

B.8) $\overline{p}_s \leq \frac{\beta_s}{\beta_{s1}} \overline{p}_{f1}$

Using the prime notation to designate allowance prices when programs interact, the conditions for a positive state allowance price can be stated as.

B.9) $\quad \overline{p}_s' > 0 \quad \textit{iff} \quad \overline{p}_s \geq \dfrac{\beta_s}{\beta_{s1}} \overline{p}_{f1}$

The notable difference from the case with complete overlap is that a positive state price may still obtain when the stand-alone state price is lower than the stand-alone federal price. The mathematical reason is that the fraction formed by the slopes of the MACs for the state program as a whole and for the sector with overlapping federal requirements will always take a value less than unity. Obviously, the larger is sector 1 and the more closely the value of β_{s1} approaches that of β_s, the closer the zero state price condition approaches what obtains in the case of perfectly overlapping federal and state programs.

Effect of the Federal Program on the State Program

We assume always that the federal price will be positive and for the time being we ignore any state program effects on the federal program. Thus, the marginal costs facing sources in the two state sectors are:

B.10) $\quad mc_{s1} = \overline{p}_s' + \overline{p}_{f1} \quad \textit{and} \quad mc_{s2} = \overline{p}_s'$

The introduction of the exogenous federal price will have the effect of shifting the state MAC by an amount equal to $\widetilde{e}_{s1} - e_{s1}^0$ so that the new state MAC curve will be

B.11) $\quad \overline{p}_s' = \overline{p}_s + \beta_s\left(\widetilde{e}_{s1} - e_{s1}^0\right) = \overline{p}_s - \dfrac{\beta_s}{\beta_{s1}} \overline{p}_{f1}$

With equation B.11), the redistribution of emissions between the two sectors of the state program can be identified.

B.12) $\quad \dot{e}_{s1}' = \dfrac{\alpha - \left(\overline{p}_{f1} + \overline{p}_{s1}'\right)}{\beta_{s1}} = \dfrac{1}{\beta_{s1}}\left[\alpha - \overline{p}_{f1} - \overline{p}_s + \dfrac{\beta_s}{\beta_{s1}} \overline{p}_{f1}\right] = \dot{e}_{s1} - \dfrac{\overline{p}_{f1}}{\beta_{s1}}\left(1 - \dfrac{\beta_s}{\beta_{s1}}\right)$

B.13) $\quad \dot{e}_{s2}' = \dfrac{\alpha - \overline{p}_s'}{\beta_{s2}} = \dfrac{\alpha - \left(\overline{p}_s - \dfrac{\beta_s}{\beta_{s1}} \overline{p}_{f1}\right)}{\beta_{s2}} = \dot{e}_{s2} + \dfrac{\beta_s}{\beta_{s1}\beta_{s2}} \overline{p}_{f1}$

Further manipulation of these results using equation 4) produces

B.14) $\quad \dot{e}_{s1}' = \dot{e}_{s1} - \dfrac{\overline{p}_{f1}}{\beta_{s1} + \beta_{s2}} < \dot{e}_{s1} \quad \textit{and} \quad \dot{e}_{s2}' = \dot{e}_{s2} + \dfrac{\overline{p}_{f1}}{\beta_{s1} + \beta_{s2}} > \dot{e}_{s2}$

These equations simply state that the change of emissions between sectors in the state program will be equal and offsetting as would be required by the cap on state emissions.

Effect of the State Program on the Federal Program

It is now time to relax the assumption that the federal allowance price is invariant. If the conditions stated in equation 8) are such that the adjusted state allowance price, $\overline{p}'_s$, is positive, then the emissions in sector 1 will be lower than they would be under the federal program alone. The magnitude of this difference will be $\dot{e}'_{s1} - \dot{e}_{s1} < 0$. Accordingly, using equation B.14),

B.15)

$$\overline{p}'_{f1} = \overline{p}_{f1} + \beta_{f1}\left(\dot{e}'_{s1} - \dot{e}_{s1}\right) = \overline{p}_{f1} + \beta_{f1}\left(\dot{e}_{s1} - \frac{\overline{p}'_{f1}}{\beta_{s1} + \beta_{s2}} - \dot{e}_{s1}\right) = \overline{p}_{f1} - \left(\frac{\beta_{f1}}{\beta_{s1} + \beta_{s2}}\right)\overline{p}'_{f1}$$

Note that the federal allowance price is no longer fixed but dependent on the interaction as it would be in any final equilibrium. Gathering $\overline{p}'_{f1}$ on the left-hand side of equation B.15) and rearranging, the following is obtained.

B.16) $$\overline{p}'_{f1} = \frac{\overline{p}_{f1}}{1 + \dfrac{\beta_{f1}}{\beta_{s1} + \beta_{s2}}} = \frac{\beta_{s1} + \beta_{s2}}{\beta_{s1} + \beta_{s2} + \beta_{f1}}\overline{p}_{f1} < \overline{p}_{f1}$$

As would be expected and so long as there is a positive state allowance price, the adjusted federal allowance price will always be less than the stand-alone federal price, as determined by the slopes of the three inter-acting MACs.

Restating the State Effects with the Adjusted Federal Price

When the federal price is no longer invariant, the results previously obtain for the effects of a federal program on the state program can be restated to reflect the interaction. Thus, equation B.10) becomes [using equation B.4) in substituting for β_s]

B.17) $$\overline{p}'_s = \overline{p}_s - \frac{\beta_s}{\beta_{s1}}\overline{p}'_{f1} = \overline{p}_s - \frac{\beta_s}{\beta_{s1}}\frac{\beta_{s1} + \beta_{s2}}{\beta_{s1} + \beta_{s2} + \beta_{f1}}\overline{p}_{f1} = \overline{p}_s - \frac{\beta_{s2}}{\beta_{s1} + \beta_{s2} + \beta_{f1}}\overline{p}_{f1}$$

The emissions in the two sectors of the state program become

B.18) $$\dot{e}'_{s1} = \dot{e}_{s1} - \frac{\overline{p}'_{f1}}{\beta_{s1} + \beta_{s2}} = \dot{e}_{s1} - \frac{\overline{p}_{f1}}{\beta_{s1} + \beta_{s2} + \beta_{f1}} \text{ and } \dot{e}'_{s2} = \dot{e}_{s2} + \frac{\overline{p}_f}{\beta_{s1} + \beta_{s2} + \beta_{f1}}$$

The only difference here is that the shift of emissions from sector 1 to sector 2 is a little smaller in magnitude due to the interaction with the federal MAC curve and the consequent lower federal price.

Finally, the marginal cost faced by sources in the two state sectors as stated in equation B.9) become using equations B.16) and B.17)

B.19)
$$a)\ mc_{s1} = \overline{p}'_s + \overline{p}'_{f1} = \overline{p}_s + \frac{\beta_{s1}}{\beta_{s1} + \beta_{s2} + \beta_{f1}} \overline{p}_{f1} > \overline{p}_s$$
$$b)\ mc_{s2} = \overline{p}'_s = \overline{p}_s - \frac{\beta_{s2}}{\beta_{s1} + \beta_{s2} + \beta_{f1}} \overline{p}_{f1} < \overline{p}_s$$

Thus, the second difference from the case of perfect overlap is obtained. The post-interaction price for the sources facing both state and federal obligations will be higher than the stand-alone state price if the state program is more comprehensive and the federal program does not make it slack.

It should be noted in explaining this result that the difference between the marginal costs in the two sectors is equal to the adjusted federal price.

B.20)
$$mc_{s1} - mc_{s2} = \frac{\beta_{s1} + \beta_{s2}}{\beta_{s1} + \beta_{s2} + \beta_{f1}} \overline{p}_{f1} = \overline{p}'_{f1}$$

This result is similar to what obtains in the perfectly overlapping case in that the adjusted federal price defines the difference in marginal cost between the two sectors in the state program. What is different from the case of perfect overlap is that the continuing demand from the in-state sources not subject to the federal program must be taken into account and that accommodation causes the cost faced by the in-state sources with dual obligations to be higher than that cost would be without the federal program. This also means that the disparity in marginal cost is greater between sources in sector 1 and those in sector 2 than it is between those in sector 1 and similar out-of-state sources in the federal program.