INTERACTIONS OF STATE AND FEDERAL CLIMATE CHANGE POLICIES

Lawrence H. Goulder
Department of Economics, Stanford University
National Bureau of Economic Research
Resources for the Future

Robert N. Stavins
John F. Kennedy School of Government, Harvard University
National Bureau of Economic Research
Resources for the Future

Prepared for
The Design and Implementation of U.S. Climate Policy
Edited by Don Fullerton and Catherine Wolfram
National Bureau of Economic Research

May 6, 2010

Interactions of State and Federal Climate Change Policies

ABSTRACT

In the near future, federal action addressing climate change is likely to emerge either through new legislation or via the U.S. EPA's recently granted authority under the Clean Air Act. The prospect of federal action raises important questions regarding the interconnections between federal efforts and ongoing state-level climate policy developments. To what extent will federal efforts overlap with state policies? In the presence of federal policies, to what extent will state efforts be cost-effective? How does the co-existence of state- and federal-level policies affect the ability of state efforts to achieve emissions reductions?

This paper addresses these questions. We find that in scenarios corresponding to current and planned climate policies, the co-existence of state and federal policies leads to significant difficulties (although in other cases, co-existing state and federal climate policies can be mutually effective or reinforcing). The problematic interactions arise when the federal policy involves restrictions on aggregate emissions quantities (as with a federal cap-and-trade program with no safety valve) or constraints relating to performance (as with fuel-economy standards or renewable fuel standards). In these circumstances, the emission reductions accomplished by a subset of U.S. states reduces pressure on the constraints posed by the federal policy, thereby freeing facilities or manufacturers to increase emissions in other states. Serious "emissions leakage" thereby occurs. In contrast, when the federal policy fixes prices for emissions (as under carbon taxes or under a cap-and-trade program with a binding "safety valve"), more aggressive climate policy in subset of states does not produce the state-federal interactions that lead to offsetting emissions increases elsewhere.

The potential for problematic interactions does not necessarily vitiate the case for some state-level policies. We articulate and evaluate a number of arguments that have been made to support state-level climate policy in the presence of federal policies, despite the potential for leakage.

INTERACTIONS OF STATE AND FEDERAL CLIMATE CHANGE POLICIES

Lawrence H. Goulder and Robert N. Stavins[*]

1. Introduction

Over the past five years, a series of climate bills with national cap-and-trade systems at their heart have been introduced in the U.S. Congress.[1] But as of May 2010, only one bill – H.R. 2454, the American Clean Energy and Security Act of 2009 – had been passed by a house of Congress, and no bill had been sent to the President for his signature. In this environment of relatively slow federal action, a number climate policy initiatives have begun to emerge at the regional, state, and even local levels. Most prominent among these are the Regional Greenhouse Gas Initiative (RGGI) in ten northeastern states,[2] and A.B. 32, California's Global Warming Solutions Act of 2006.[3]

Federal-level action may soon take place, however. Although the prospects for passage of a new federal climate bill in the current Congress seem to have waned substantially, in the absence of new climate-change legislation greenhouse gas regulation by the U.S. Environmental Protection Agency under the Clean Air Act would likely occur as a result of the 2006 U.S. Supreme Court decision in *Massachusetts v. EPA*,[4] the Obama administration's subsequent "endangerment finding" that carbon dioxide (and other greenhouse gases) endanger public health and welfare, and the consequent designation in 2010 of carbon dioxide as a pollutant for regulatory purposes under the Clean Air Act both for stationary and mobile sources.

---

[*]Goulder is the Shuzo Nishihara Professor in Environmental and Resource Economics and Chair of the Economics Department at Stanford University, a Research Associate of the National Bureau of Economic Research, and a University Fellow of Resources for the Future; Stavins is the Albert Pratt Professor of Business and Government at the John F. Kennedy School of Government, Harvard University, Research Associate of the National Bureau of Economic Research, and a University Fellow of Resources for the Future.

[1] A few of the most recent climate bills with national cap-and-trade systems are Kerry-Graham-Lieberman (2010), Cantwell-Collins (2010), Kerry-Boxer (2009), Waxman-Markey (2009), Lieberman-Warner (2008), Lieberman-McCain (2007), Bingaman-Specter (2007), Kerry-Snowe (2007), Sanders-Boxer (2007), Waxman (2006), Feinstein (2006), and Udall-Petri (2006).

[2] See Regional Greenhouse Gas Initiative (2005, 2007). Other regional climate initiatives include the Midwest Regional Greenhouse Gas Reduction Accord (2007) and the Western Climate Initiative (2007).

[3] See California Air Resources Board (2006). State-level climate policies are being contemplated, developed, or implemented in more than half of the fifty states. On this, see: Center for Climate Strategies (2010).

[4] See: http://www.supremecourt.gov/opinions/06pdf/05-1120.pdf

No matter whether federal action comes through new legislation or via the EPA's authority under the Clean Air Act,[5] important questions arise regarding the relationship of federal actions to ongoing state-level climate policy developments. To what extent will federal efforts overlap with state policies? In the presence of federal policies, to what extent will state efforts be cost-effective? How does the co-existence of state- and federal-level policies affect the ability of state efforts to achieve emissions reductions?

This paper addresses these questions. The nature and impact of federal and state interactions depend on a number of factors, including the policy instruments employed – taxes, subsidies, cap-and-trade regimes, performance standards, or technology standards – as well as their design. We find that in several cases corresponding to current or planned climate policies, the co-existence of state and federal policies leads to significant problems. The problematic interactions arise when the federal policy involves restrictions on aggregate emissions quantities (as with a federal cap-and-trade program) or constraints relating to performance (as with fuel-economy standards or renewable fuel standards). In these circumstances, the emissions reductions accomplished by a subset of U.S. states can reduce pressure on the constraints posed by federal policy, thereby freeing facilities or manufacturers to increase emissions in other states. Serious "emissions leakage" occurs. In contrast, when the federal policy fixes (marginal) prices for emissions (as under carbon taxes or under a cap-and-trade program with a binding "safety valve"), more aggressive climate policy in subset of states does not produce offsetting effects elsewhere.[6]

We also articulate and evaluate a number of arguments that have been raised to support state-level climate policy in the presence of federal policies, despite the potential for leakage. These arguments deserve attention, since many existing federal programs impose restrictions on quantities or performance, implying that efforts by individual states might in fact suffer the difficulties just mentioned. Therefore, it is important to consider potential offsetting attractions of state-level efforts, or identify ways that state efforts can be focused so as to lessen or avoid these problems.

The paper is organized as follows. Section 2 below offers some historical background, reviewing major arguments that have been made to justify environmental policy making at the state level rather than the federal level. We will suggest that while many of these arguments remain valid for a range of environmental issues, they have much less merit when applied to the climate change problem. Section 3 examines interactions between federal and state cap-and-trade programs, while Section 4 examines interactions between federal and state greenhouse gas per mile standards. Section 5 outlines interactions that can occur from other federal and state policies. In each of these sections, we highlight difficulties that stem from these interactions, and explore the extent to which avoiding these problems is consistent with the continuing presence of state programs. Section 6 evaluates several arguments that have been offered to justify state-level action in the presence of federal climate policy. Section 7 concludes.

---

[5] Two bills pending in the U.S. Senate – from Senator Lisa Murkowski (R-Alaska) and Senator Jay Rockefeller (D-West Virginia) – would, respectively, stop or delay such EPA regulation.

[6] Of course, even with a federal policy that fixes marginal emissions prices (including a marginal price of zero, that is, no federal policy), "ordinary" emissions leakage is still likely to occur through relocation of economic activities, but this is not due in a fundamental way to the interaction of state and federal policy, which is our focus.

2. Historical Arguments for Environmental Federalism

2.1 Federal and State Roles in Environmental Protection

Throughout most of U.S. history, state and local governments have had the primary responsibility for environmental protection (Revesz 2001). The first major federal initiative arrived in 1969 with the passage of the National Environmental Policy Act. Quickly following that were the Clean Air Act of 1970, the Clean Water Act of 1972, the Endangered Species Act of 1973, the Safe Drinking Water Act of 1972, the Resource Conservation and Recovery Act of 1976, and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980. Most of these statutes have been amended numerous times since their adoption.

The federal environmental laws generally leave room for state-level efforts to protect the environment. Typically – but with some exceptions – federal legislation establishes minimum performance thresholds, leaving states free to adopt more stringent standards. In addition, states have remained free to regulate in areas where the federal government has not taken action. Thus, even with the expanded role of environmental policy making at the federal level, independent state-level efforts have in some cases continued.

Over the years, several arguments have been put forth to support a continuing state-level role.[7] One is that in a large and diverse country, different regions will likely have different environmental preferences. Another is that the benefits of environmental protection presumably vary throughout the country. For example, a stringent (local) air quality standard may benefit many people in densely populated areas but only a few elsewhere. A third is that the costs of meeting a given standard may differ across geographic regions.

These arguments have less force when applied to the climate-change problem, however. The specific location of emissions of carbon dioxide (CO_2) and other greenhouse gases has no effect either on the overall magnitude of damages or the nature or location of climate damages, because these gases uniformly mix in the upper atmosphere. This global commons aspect of the climate problem implies that efforts should generally be undertaken at relatively broad jurisdictional level – in particular, at the level of nations. In the past, federal regulation of some pollutants, such as acid-rain-generating SO_2, has been justified in Congressional debates and administrative proceedings by reference to the existence of interstate externalities (Krier 1995). Such reference to transboundary effects forms an especially powerful argument in the context of regulating emissions of greenhouse gases. Because these gases mix uniformly around the globe, they have transboundary effects in the extreme.

2.*2 The Challenges of Climate Policy Federalism*

Given the economic logic and legal precedent for addressing climate change at the federal level, as well as the potential difficulties that can arise from interactions with state-level efforts,

[7] For a normative and positive assessment of the allocation of responsibility in the environmental realm across levels of government, see Revesz and Stavins (2007).

there may seem to be little reason for state-level climate policies. Nevertheless, state-level climate policy proposals continue to evolve in the United States, and such action has proponents across the country, particularly in those states and regions that have initiated policy action.[8]

Some proponents claim that state-level efforts make sense when the alternative of federal-level policy has not yet been implemented. Here it is argued that state-level efforts serve a useful purpose by filling a vacuum created by the lack of policy progress at the Federal level (Marshall 2010).[9] A related argument is that state-level efforts can function as testing grounds for various policy alternatives, providing valuable information for subsequent policy design decisions should a federal policy be implemented later. A third and closely related argument is that, to the degree that state-level efforts prove to be successful – and avoiding a serious cost to the economy may be one definition of success – they can increase pressure for a federal policy and thereby hasten the arrival of federal legislation.

Other proponents go further, insisting that state-level climate policy has merit even after climate policies have been implemented at the federal level. They support co-existing state and federal climate policies. Since our focus is on interactions among federal and state climate policies, the arguments raised by these proponents are especially relevant to this paper. We address these arguments in Section 5 below.

3. National and Sub-National Cap-and-Trade Systems

How would a federal cap-and-trade system interact with one or more state (or other sub-national) cap-and-trade systems? Two factors drive the nature of such interactions: the relative stringency of the two systems, and the degree of overlap in coverage (scope of sources) between the federal and state systems. We consider two important cases: programs with perfectly overlapping coverage, and programs with imperfectly overlapping coverage.

3.1 Systems with Perfectly Overlapping Coverage

The simplest case is systems with perfectly overlapping coverage. One example is the case involving upstream federal and state cap-and-trade systems, both of which are economy-wide. Another is the case in which the federal and state systems both focus exclusively on the electricity generation sector.

[8] For a review of recent state actions to address climate change, see Litz (2008).

[9] A major argument offered in the northeast and in California during the early development of their independent climate policies was the lack of a Federal response to the problem. However, now that Federal policies are receiving serious consideration in Washington, there is very strong opposition from some members of the California and New England Congressional delegations (Boxer, *et al.* 2010) and from the heads of key environmental agencies in most of the respective states (Nichols *et al.* 2010) to Congress pre-empting or otherwise over-riding AB 32, RGGI, and other sub-national initiatives in Federal climate legislation. A striking exception is provided by both the Governor and the Secretary of Energy and Environmental Affairs in Massachusetts, who worked on the design and implementation of RGGI and yet also publicly support its preemption by a meaningful national program.

Consider first the situation where the sub-national program is *more stringent* than the national program, meaning that the state program requires reductions from sources within the state that are greater than would be achieved under the national program alone. In this case, emissions sources must surrender both state and federal allowances to comply with the two jurisdictions. If a source only needed to surrender to one jurisdiction, it would choose abatement levels such that marginal abatement costs equaled the allowance price. If the source must offer allowances to two jurisdictions, it will equate marginal abatement costs with the *sum* of the two allowance prices.

Figure 1 below depicts the impact of facing two allowance prices. Suppose one set of states (the "greener states") prefers more stringent cap-and-trade policy than the other states do. And suppose that a federal-level policy is implemented that initially pre-empts state-level efforts, so that the only cap-and-trade program is at the federal level. With allowance trading across all states, marginal abatement costs are equated across states, and a single allowance price of p_{FED} applies nationwide. Total emissions at the national level are e_{GS} plus e_{OS}, a total given by the federal policy's overall emissions cap.

Now suppose the greener states wish to impose a tighter cap-and-trade program within their own jurisdictions. They establish their own allowance cap of e_{GS}', allowing fewer emissions than their prior equilibrium emissions level e_{GS}. The tighter cap compels producers in the greener states to reduce their emissions further. This reduces demands for the federal level allowances, causing the price of these allowances to fall, which leads to increased emissions in the other states. The new equilibrium price of federal allowances is p_{FED}'. The price of the green states' allowances is p_{GS}, determined such that the sum of the federal allowance price and the state allowance price equals the green states' marginal costs of abatement at e_{GS}'.

Importantly, the greener states' efforts do not lead to any reductions in national emissions beyond that mandated by the federal cap. These states face marginal abatement costs of is p_{FED}' plus p_{GS}, higher than those (p_{FED}') in the other states. With marginal costs not equalized nationally, the country's overall abatement costs are greater than under the federal program alone. Thus, the system is *not* cost-effective. This is the likely outcome from the interaction of a stringent California cap-and-trade system implemented under AB 32 and a less stringent federal system. California's tighter cap would accomplish nothing additional for the environment, but would add to the state's costs while *subsidizing* emissions reductions in other parts of the country.[10]

Still focusing on programs with perfectly overlapping coverage, we can ask what would happen if the state program were *less stringent* than the federal program, meaning that the state program would require smaller reductions from sources within the state than would be achieved under the Federal program alone. In terms of the figure, this would be a case where the cap introduced by the greener states is to the right of e_{GS}. In this case, the federal allowance price would be sufficiently high to cause sources in the state to reduce emissions below the state cap, with the result being that the state's cap is not binding and the equilibrium price of state

[10] An earlier analysis McGuinness and Ellerman (2008) offered similar results.

allowances is zero. Here the state program has no impact and the national program remains cost-effective.[11]

3.2 Systems with Imperfectly Overlapping Coverage

The other important case is national and sub-national programs with imperfectly overlapping coverage. In this case, the nature of the interaction depends again on which program is more stringent for sources covered by both programs. It also depends upon which program is more comprehensive (greater scope of coverage) of state sources.

If the Federal program is more comprehensive (that is, includes all the sources in the state program plus others), then for those sectors which are covered both by the national and the state program, the results are the same as with perfectly overlapping coverage. This would likely apply to the Regional Greenhouse Gas Initiative (RGGI) system, which covers only electricity generation and which is much less stringent than the systems that have received the most consideration at the Federal level.[12] In terms of the previous figure, the RGGI cap would likely to be to the right of e_{GS}. So, the federal allowance price would be sufficiently high to cause sources within the RGGI states to reduce their emissions below the RGGI cap. Hence, the RGGI cap would not be binding, and the equilibrium price of state allowances would be zero. In other words, RGGI would be irrelevant once a more stringent Federal system came into force.[13]

3.3 Other Design Features and Their Interactions

How do other design features affect the nature of interaction of national and sub-national cap-and-trade systems?

Allowance Allocation Methods. The nature of the allowance allocation in general has no affect on system interaction (although there are exceptions in the case of regulated industries). The interactions just described will be the same no matter how much one or both programs relies on auctioning or free allocation. Although the particular allowance allocation method has important distributional implications and can affect cost-effectiveness as well, it does not alter the general pattern of state-federal interactions just described.[14] This is in keeping with the fact that the allowance allocation method generally does not alter incentives at the margin (or allowance prices); and it is the marginal incentives that determine emissions levels and cost-effectiveness.

---

[11] However, if the state program places constraints on trading, then costs can increase in the state, and the national program may not be cost-effective.

[12] But trading constraints in RGGI could hamper the Federal program and drive up national compliance costs.

[13] However, if the state program places constraints on trading, then costs can increase in the state, and the national program may not be cost-effective.

14 Regulated firms generally face lower costs if they receive allowances free rather than need to purchase them in an auction. (See, for example, Bovenberg and Goulder, 2001.) In addition, to the extent that allowances are auctioned and the proceeds are used to finance reductions in distortionary taxes, policy costs will be lower than in cases involving other uses of auction revenue or inthe case of free allocation. (See, for example, Goulder, Parry, Williams, and Burtraw, 1999.)

Safety Valves. Some proposals for cap and trade include provisions for a "safety valve" or ceiling price on allowances. When a safety valve provision is included, the regulating authority prevents allowance prices from exceeding a given ceiling level by issuing additional emissions allowances as necessary. The effect of a safety valve depends on whether and how often it is triggered. Consider, for example, a scenario involving perfectly overlapping state and federal systems, and suppose that initially a safety valve in the federal system is active, so that allowance prices are at the ceiling price. Suppose that the level of emissions in a given state is e_1 in equilibrium in this situation. Now consider what happens if this state attempts to cap its own emissions below e_1. The given state's tighter cap will force additional abatement in that state, raising its marginal and total abatement costs.

The impact of the state's actions on nationwide emissions depends on whether the actions produce a large enough change in demand for federal allowances to disengage the safety valve. If the state's reduction is too small to disengage the safety valve, then the price of federal allowances will be unchanged: it will remain at the ceiling price. In this case, the state's actions will imply a reduction in the nation's overall emissions, since the state's own emissions reduction will not be accompanied by any increase in emissions in other states (the price of allowances to other states has not changed). On the other hand, if the given state's reduction yields a large enough reduction in demand for federal allowances to disengage the safety valve, then the price of federal allowances will fall, thereby inducing an offsetting increase in emissions from other states.

3.4 Potential Resolutions

Pre-emption. One way to avoid perverse impacts between a national and sub-national system addressing a global-commons problem is pre-emption of the sub-national policies. Although federal preemption has the attraction of avoiding the above-mentioned problems, it can create challenging transition issues. If the new federal program does not recognize the state allowances, the value of existing (banked) state program allowances will decrease to zero. This can occur even before the federal program is in place, due to expectations. The result is that emissions will increase. This can be addressed by permitting state allowances to be exchanged for federal allowances. Once the pre-empted state programs expire, the single federal allowance price will drive emissions reductions nationally, achieving cost-effectiveness. The distributional implications of overlapping national and sub-national programs are thereby eliminated, as well.

State "Carve Outs." Another route forward is so-called "carve out." A new Federal cap-and-trade program could allow states to opt out if they implement (or maintain) a state program at least as stringent. There is abundant precedent in Federal law for this generic approach, as we noted above. The result is that there will be different allowance prices in some states and in the Federal system, marginal abatement costs will not be equated, and so cost-effectiveness will not be achieved.

It is not clear why states would want to opt out, since in principle all states would benefit from joining the national system. For high-cost states, joining the national program would open up opportunities to purchase allowances at relatively low cost. For low-cost states, participating in the national program would yield opportunities to sell allowances at prices above previous marginal abatement costs. Also, the federal-level alternative would have the attraction of providing a larger, more liquid allowance market, with less price volatility.

Linkage. The lack of cost-effectiveness that would come with state carve outs can be addressed – to some degree – through "linkage," that is, mutual recognition of allowances between federal and state/regional systems. In this case, the effective cap on emissions is the sum of the quantity of allowances provided by federal and state programs. This can lead to a single allowance price, equal marginal abatement costs, and cost-effectiveness. Under such a linked system, the greener states *can* influence total emissions at the national level by reducing the number of their state allowances issued. Also, under a linked system, when a given state reduces the quantity of allowances it issues, it does not impose costs only on itself. By lowering the effective national cap, the state's reduction in allowances issued leads to greater abatement (and higher abatement costs) throughout the nation.

Although a linked system may have some appeal to the greener states, it also might be viewed as having drawbacks. A linked system will only be attractive to these states if the number of federal allowances issued is "small," so that the sum of federal and state allowances – the effective national cap – is small as well. Linkage can also raise some challenging issues, such as the automatic and unintentional propagation of cost-containment mechanisms from one program to another (Jaffe and Stavins 2008).

4. Fuel-Economy and Greenhouse-Gas-per-Mile Standards

Problematic state-federal interactions can also occur under policies involving automobile fuel-efficiency standards or limits on automobiles' greenhouse gas emissions per mile.

In response to the prospect of climate change, many U.S. states have adopted or proposed policies to reduce greenhouse gas emissions from the transportation sector. One especially noteworthy initiative has been the recent effort, undertaken by fourteen states, to establish limits on greenhouse gases (GHGs) per mile from light-duty automobiles. These so-called "Pavley" standards[15] require manufacturers to reduce per-mile GHG emissions starting in 2009. Manufacturers would need to reduce emissions by about 30 percent by 2016 and 45 percent by 2020 (California Air Resources Board, 2008).

Since CO_2 emissions and gasoline use are nearly proportional,[16] the Pavley limits effectively raise the fuel economy requirements for manufacturers in the states adopting such limits. The fourteen states claimed that the Pavley limits would significantly reduce gasoline consumption and GHG emissions. For example, the California Air Resources Board estimated that the limits would account for over 18 percent of the reductions needed to meet the state's GHG emissions target for 2020 under AB 32.

[15] The Pavley standards are named after California Assemblywoman Fran Pavley, who sponsored the California bill that launched this multi-state effort.

[16] For a given mix of gasoline and other fuels (for example, ethanol) in retail motor fuel, the CO_2 released per gallon is largely determined, since fuel combustion by automobiles is nearly complete. The fuel mix might change over time, but such changes can be regarded as independent of the Pavley initiative.

4.1 Prospects for Leakage

These state-level actions can interact significantly with the existing federal Corporate Average Fuel Economy (CAFE) standards. Consider an auto manufacturer that prior to the imposition of the Pavley limits was just meeting the federal CAFE standard. Now it must meet the (tougher) Pavley requirement through its sales of cars registered in the adopting states. In meeting the tougher Pavley requirements, its overall U.S. average fuel economy now exceeds the national requirement: the national constraint no longer binds. This means that the manufacturer is now able to change the composition of its sales outside of the Pavley states; specifically, it can shift its sales toward larger cars with lower fuel-economy.

Indeed, if all manufacturers were initially constrained by the national CAFE standard, the introduction of the Pavley requirements would lead to "emissions leakage" of 100 percent at the margin, because the reductions within the Pavley states would be completely offset by emissions increases outside of those states. Using a numerical simulation model of the U.S. automobile market, Goulder, Jacobsen, and van Benthem (2009) found that from 2009 through 2020 about 65 percent of the emissions reductions achieved in the new car market in the Pavley states would be offset by increased emissions in new car markets elsewhere.[17]

In May 2009, the Obama administration reached an agreement with the fourteen "Pavley states," according to which the U.S. would tighten the federal fuel economy requirements in such a way as to achieve effective reductions in GHGs per mile consistent with the first-phase goals of the Pavley initiative. In return, the fourteen states agreed to abandon the first phase of the Pavley effort, which was no longer necessary, given the tightening of the federal standards.[18] However, these states still intend to introduce further tightening of the greenhouse-gas-per-mile standards after 2016.[19] This would imply fuel economy standards more stringent than those applying at the federal level.

4.2 Can Technological Spillovers Undo the Leakage?

Given the real potential for emissions leakage, is it possible that there is a "positive spillover" of state-level fuel-economy regulation in the sense that such policies will stimulate technological change that ultimately will have nationwide benefits? The notion is that tougher greenhouse-gas-per-mile requirements (or, equivalently, higher fuel economy standards) imposed by greener states will accelerate the development of new technologies that auto manufacturers will eventually adopt throughout the nation, thereby leading to lower emissions and reduced fuel consumption.

---

[17] Another five percent of the emissions reduction is offset by increased emissions from used cars, as the Pavley effort leads to lower scrap rates of older, less fuel-efficient automobiles.

[18] Discontinuing the first-phase effort included dropping some related lawsuits. California had been taking legal action to obtain a waiver from the federal government enabling it to exceed federal fuel economy limits. In the state-federal agreement, the Obama administration pledged to grant the waiver, thus rendering moot the legal effort.

[19] These are referred to as the Phase II Pavley standards.

Technological spillovers can lead to increased fuel-economy of individual vehicles. Thus, holding fleet composition constant, they may lead to reduced emissions in non-adopting states. However, as long as the federal CAFE standard binds the shadow value of selling a large, fuel-inefficient automobile remains high, auto manufacturers will continue to have incentives to sell additional and relatively fuel-inefficient cars in the states that are not imposing their own, tougher greenhouse-gas-per-mile standards. Indeed, as shown by Goulder, Jacobsen, and van Benthem (2009), faster technological progress leads to greater sales of larger and relatively fuel-inefficient cars in the states that do not impose the tougher regulations than would be the case if there were no policy-induced technological progress.

Thus, the technological progress induced by state-level fuel economy requirements produces two opposing effects. On the one hand, holding fixed the composition of the automobile fleet, the induced technological progress yields methods for achieving improvements in fuel-economy at lower cost. Holding fixed the composition of the automobile fleet, this would imply reduced emissions and policy costs nationwide. On the other hand, the policy-induced technological progress also magnifies the changes in the composition of the automobile fleet, promoting increased sales of cars with relatively low fuel economy in the non-adopting states. This latter effect contributes to leakage and tends to raise the costs of achieving the nation's fuel-economy standards

5. Other Cases of Nested Regulation

5.1 Emissions Leakage in Cases Involving Other Instruments

We have seen that efforts by states to achieve greater emissions reductions than those required at the federal level can be ineffective and reduce overall cost-effectiveness. Our two examples involved cap-and-trade programs and automobile fuel economy standards. Both are cases of nested regulation, where state rules are enveloped by a broader federal rule. In both cases, more stringent action by a given state has the effect of reducing pressure on the federal constraint, which leads to offsetting adjustments in other states. In the case of cap-and-trade, the offsetting adjustments are in the form of increases in emissions levels. In the case of fuel economy standards, the adjustments arise through firms' changes in the location of automobile sales.

Similar problems can arise when other instruments are employed for climate-change policy. In recent years, several states have considered adopting renewable fuels standards, according to which the ratio of renewable to conventional fuels produced by refiners must not fall short of a given value. A federal renewable fuels standard went into effect in January 2010.[20]

Here again the effort of individual states to exceed the federal standard could fail to bring about reduced emissions (or increased use of renewable fuels). This will be the case if, to meet the

[20] Apart from the leakage issue discussed here, some analyses indicate that a renewable fuel standard may have significant disadvantages relative to emissions pricing policies such as carbon taxes or cap and trade. Holland, Hughes and Knittel (2009) show that the renewable fuel standard effectively subsidizes renewable fuels and that, as a result, it leads to more overall (renewable plus conventional) fuel use than is economically most efficient. See also Wolak (2007).

federal requirement, firms can apply a ratio based on overall (nationwide) use of renewable and conventional fuels. In this case the situation is perfectly analogous to that described above for fuel-economy standards. If a firm's ratio of renewable to refined fuels was just high enough to meet the federal requirement, then when a given state imposes a higher ratio, the firm will more than meet the federal requirement. It is now able to utilize more conventional fuels in other states in which it operates. On other hand, if the federal rules require that each refinery operation – as opposed to each refinery company -- meet the given ratio, the situation is different. In this case tighter requirements imposed by a given state will not free up firms to make opposite adjustments in other states.

The same interactions and pattern of outcomes would hold in the case of federal and state-level renewable portfolio standards, which require the electrical generators utilize renewable sources of energy (in particular, wind and solar) for a specific share of their annual generation. The federal systems contemplated in Washington would allow for national trading.

5.2 Absence of Interactions When the Federal Policy Involves Price-Based Regulation

Problems stem from nested regulations when the federal regulations involve constraints on quantities (as under cap and trade) or on ratios (as under fuel standards). Many of these problems do not arise if the federal-level program sets prices. Suppose, for example, a carbon tax were imposed at the federal level. If a state decided to impose new regulations requiring in-state reductions beyond what the federal tax would yield, the additional state-level reductions would not lead offsetting increases elsewhere (apart from the usual "economic leakage"): the reductions in other states would remain governed by the federal carbon tax.[21] Thus, price-based regulation at the federal level can lessen these problematic state-federal interactions.

5.3 Interactions When the Federal and State Programs Involve Different Instruments

Up to now we have examined interactions in cases involving the same instruments at the state and federal levels. However, significant interactions can occur across differing instruments. As mentioned in the introduction, there is a significant likelihood that federal climate policy will be undertaken by the U.S. EPA under the auspices of the Clean Air Act. In this event, the EPA would probably make use of "conventional" regulatory approaches such as performance standards and technology mandates. Yet cap and trade is likely to continue in the northeast under the Regional Greenhouse Gas Initiative, and many western states plan to implement cap and trade within the next few years. How would conventional regulation at the federal level interact with the state-level cap-and-trade programs?

Much depends on the particular instruments employed at the federal level and on the specific rules governing the use of these instruments. Consider the following plausible scenario. Suppose that the EPA imposes performance standards such as limits on emissions of certain greenhouse gases per unit of output. State- or regional-level cap-and-trade programs will induce changes in producer behavior, and in some cases these adjustment will cause particular facilities to exceed the federal performance standard. If the federal rules allow firms (or localities) to average

[21] The situation is much like the case, described above, where a given state pursues further emissions reductions in the presence of an active safety valve.

their emissions-output ratios in determining whether they meet the federal standard, then the cap-and-trade initiatives at the state or regional level will precipitate offsetting adjustments in other states or regions. The same applies if the federal rules allow firms or localities to trade performance credits with one another.[22] Thus, the specifics of the federal rules are important.

The potential for unproductive state-level efforts can arise when the federal effort involves a different instrument from that employed at the state level. Whether or not the federal and state instruments match, the problem will arise when two conditions apply: (1) the state-level efforts cause firms or facilities within the greener states to overcomply with the federal rules and, (2) the federal rules give firms or facilities the freedom to offset this overcompliance through various adjustments in other states.

6. Is There a Role for State-Level Action?

6.1 The Issues

Several arguments have been advanced to support state-level climate policies prior to the arrival of a federal policy. One is that state policies may provide information that can guide subsequent efforts at the federal level. Another is that such policies might hasten the arrival of federal policy.

A separate question – requiring additional arguments – is whether state and regional policies should remain in place after the implementation of federal policy. We focus on this question here, since it concerns issues arising when state- and federal-level climate policies co-exist.

To begin with, it is useful to reaffirm that because greenhouse gases mix uniformly in the atmosphere, addressing the climate-change problem at the federal (and ultimately global) level has merit. This implies that establishing national-level goals for emissions reductions or the pricing of greenhouse gases is most consistent with cost-effectiveness and fairness.

Still, the question remains whether state-level policies can productively contribute to the national effort. Here we examine several arguments that have been advanced to support state-level climate policy in the presence of a federal policy.

6.2 Stronger Arguments

We first present arguments that we regard as having some validity, although some require careful qualification.

- *States can contribute to cost-effectiveness by addressing market failures not addressed by federal climate policy.*

[22] Some instruments are more conducive to averaging or cross-facility trading than others. Trading or averaging is relatively straightforward with performance standards, but more difficult with technology mandates.

In addition to the environmental externality associated with climate change, there are some other market failures that merit attention. The presence of these other market failures would imply that getting relative prices right will not – on its own -- yield the most efficient outcome. To the degree that federal climate policy disregards these other climate-related market failures, the potential exists for states to promote greater efficiency by addressing the neglected market failures.

There are specific areas where state (and, for that matter, local) policy may be superior to federal policies for addressing such additional market failures. One of the most striking is the principal-agent problem associated with renter-occupied buildings, according to which apartment renters have insufficient incentives to conserve electricity. States, counties, and cities can productively promote energy efficiency by addressing this market failure through building codes and zoning (Trisolini 2010).

However, it is at least conceivable that the first-best approach might involve a broadening of the federal effort: other prominent market failures may be candidates for additional federal, rather than state or local, regulation. Among these would be the public-good nature of research and development, whereby firms have an under-incentive to engage in basic (carbon-saving) research even in the face of "appropriate" relative prices on alternative energy sources. This is due to the fact that firms incur all of the costs of their basic-research efforts, but they do not capture all of the benefits, due to the very significant knowledge spillovers that occur. This provides an argument for the federal government to subsidize (from cap-and-trade auction revenues perhaps) private-sector executed basic research and development.

- *States can function as test-beds for alternative policy approaches not contained in the existing federal effort, thereby providing useful information for possible later adoption at the federal level.*

This argument can have some force, but it is easily overstated. Clearly, experimentation has appeal, since experiments sometimes pay off handsomely (Ostrom 2009). However, as discussed earlier, state-level efforts impede cost-effectiveness, at least in the short term before the benefits from experimentation are realized. The potential longer-term benefits from experimentation need to be weighed against the short-term costs. Note that this argument seems to call for eventual implementation of the innovative policy approach at the federal level and a phasing-out of this effort at the state level. Furthermore, the question arises whether the experimentation needs to be directed by states, rather than the federal government.

- *State policies – particularly those that are more stringent than the federal policy – can exert pressure for more aggressive action at the federal level if the state efforts appear effective.*

To the extent that a state with more aggressive climate policy can demonstrate that greater reductions can be achieved at lower cost than previously thought, this can give impetus to stronger federal policy. Here again the state is functioning as a test bed, providing new information. In the previous case, the new information comes from an experimental policy design; in this case it comes from the revealed impact of a more stringent policy.

- *When a given state imposes a tougher requirement than applies in other states, it can pressure manufacturers to adopt the tighter requirement nationwide rather than need to offer different technologies in different parts of the country.*

California's tighter auto pollution laws in the 1970s led to the tightening of the federal auto pollution standards – in part because auto manufacturers did not want to have to face two standards. Likewise, the Pavley effort initiated by California may have been instrumental in prompting the Obama administration's agreement to tighten federal fuel economy standards. Of course, in neither case does such causality imply that social welfare is maximized by the more stringent standard being adopted nationally.

6.3 Weaker Arguments

The above arguments may provide some support for state-level climate policies. We now examine two arguments that have considerably less merit.

- *States may face different costs of achieving greenhouse gas reductions, and may experience different benefits from avoided climate change (either because of different preferences or different physical outcomes)*

Differences of this sort exist and are important, but such differences do not provide a sound justification for state-level policy. Instead, they may justify compensation schemes and other elements that allow for differential net burdens across states, such as through the allocation across states of allowances or auction revenues from a federal cap-and-trade system

- *States are more familiar with details related to in-state firms and institutions. With this better information, they may be most capable of exploiting low-cost opportunities for addressing climate change.*

Clearly federal regulators – and state regulators as well -- have limited information. Individual firms tend to have much better information about technological opportunities and abatement costs than do the regulators. The information problem primarily provides a sound argument for market-based environmental policy – for policy approaches that give individual facilities or firms the flexibility to make best use of their (better) information. Market-based policies such as cap-and-trade or carbon taxes have this feature. Note that such policies can address the information problem effectively, even if the policies are introduced at the federal level. Thus, the information problem does not provide a good reason for state-level policy.

7. Conclusions

Because greenhouse gases tend to mix uniformly in the atmosphere, a strong case can be made for conducting climate policy at the federal (indeed, international) level. However, some

states may wish to introduce policies more aggressive than those at the national level. We have explored the circumstances under which such state-level efforts will be productive.

We find that in scenarios corresponding to current and planned climate policies, the co-existence of state and federal policies leads to significant difficulties, although in some other cases, co-existing state and federal climate policies can be mutually effective. Problematic interactions arise when the federal policy involves restrictions on aggregate emissions quantities (as with a federal cap-and-trade program) or constraints relating to performance (as with fuel-economy standards or renewable fuel standards). In these circumstances, the emission reductions accomplished by a subset of U.S. states reduces pressure on the constraints posed by federal policy, thereby freeing facilities or manufacturers to increase emissions in other states. Serious "emissions leakage" occurs. In contrast, when the federal policy fixes (marginal) prices for emissions (as under carbon taxes or under a cap-and-trade program with a binding "safety valve"), more aggressive climate policy in subset of states does not interact with federal policy to produce offsetting emissions increases elsewhere. Of course, even with a federal policy that fixes marginal emissions prices (including a marginal price of zero, that is, no federal policy), emissions leakage can still occur through relocation of economic activities, but this is not due in a fundamental way to the interaction of state and federal policy.

The potential for problematic interactions does not necessarily vitiate the case for state-level policy. We have examined a number of arguments that have been made to support state-level climate policies in the presence of federal policies, despite the potential for leakage. We find that state-level policies can usefully promote efficiency by concentrating on some of the other market failures not addressed at the federal level, although some of these other market failures are best addressed through federal policy. In addition, states can function as test-beds for policy designs not implemented at the federal level, but the potential long-term benefits from experimentation need to be weighed against the short-term costs. And it is at least conceivable that such policy experimentation could be executed by the federal government.

REFERENCES

Bovenberg, A. Lans, and Lawrence H. Goulder. "Neutralizing the Adverse Industry Impacts of CO2 Abatement Policies: What Does It Cost?" *Behavioral and Distributional Effects of Environmental Policy*, C. Carraro and G. Metcalf, eds., University of Chicago Press, 2001.

Boxer, Barbara, *et al.* Letter from Fourteen Members of the U.S. Senate to Senators John Kerry, Lindsey Graham, and Joe Lieberman, Opposing Pre-Emption of State and Regional Climate Policies in Federal Climate Legislation. March 26, 2010. http://www.eenews.net.ezp-prod1.hul.harvard.edu/features/documents/2010/03/31/document_cw_01.pdf

California Air Resources Board. The California Global Warming Solutions Act of 2006. Text of Assembly Bill 32, August 31, 2006. http://www.arb.ca.gov/cc/docs/ab32text.pdf

Center for Climate Strategies. "Helping States and the Nation Tackle Climate Change." http://www.climatestrategies.us/

Goulder, Lawrence H., Ian W. H. Parry, Roberton C. Williams III, and Dallas Burtraw. "The Cost-Effectiveness of Alternative Instruments for Environmental Protection in a Second-best Setting." *Journal of Public Economics* 72(3):329-60, 1999.

Goulder, Lawrence H., Mark R. Jacobsen, and Arthur van Benthem. "Unintended Consequences from Nested State and Federal Regulations: The Case of the Pavley Greenhouse-Gas-per-Mile Limits." Working paper, Stanford University and University of California, San Diego. August 2009.

Holland, Stephen P., Jonathan E. Hughes, and Christopher R. Knittel. "Greenhouse Gas Reductions under Low Carbon Fuel Standards?" *American Economic Journal: Economic Policy* 1(1): 106-46, 2009.

Jaffe, Judson, and Robert N. Stavins. *Linking a U.S. Cap-and-Trade System for Greenhouse Gas Emissions: Opportunities, Implications, and Challenges.* Washington, D.C.: AEI-Brookings Joint Center for Regulatory Studies, January 2008.

Krier, James E. "On the Topology of Uniform Environmental Standards in a Federal System – And Why It Matters." *Modern Law Review* 54:1226.

Litz, Franz T. *Toward a Constructive Dialogue on Federal and State Roles in U.S. Climate Change Policy*. Arlington, Virginia: Pew Center on Global Climate Change, June 2008.

Marshall, Christa. "U.S. Senators Worry About Damage to State Climate Efforts." *ClimateWire*, March 31, 2010.

McGuinness, Meghan and A. Denny Ellerman. *The Effects of Interactions between Federal and State Climate Policies.* CEEPR 08-004. Cambridge, MA: Massachusetts Institute of Technology Center for Energy and Environmental Policy Research, May 2008.

Nichols, Mary D., *et al.* Letter from Fourteen State Environmental Directors to Senators John Kerry, Lindsey Graham, and Joe Lieberman, Opposing Pre-Emption of State and Regional Climate Policies in Federal Climate Legislation. March 30, 2010. http://www.eenews.net.ezp-prod1.hul.harvard.edu/features/documents/2010/03/31/document_cw_04.pdf

Ostrom, Elinor. "A Polycentric Approach for Coping with Climate Change." Policy Research Work Paper 5095. Washington, D.C.: The World Bank, October 2009.

Regional Greenhouse Gas Initiative. "Memorandum of Understanding." December 20, 2005. See: http://www.rggi.org/docs/mou_12_20_05.pdf

Regional Greenhouse Gas Initiative. "Model Rule –Final with Corrections." January 5,f 2007. See: http://www.rggi.org/docs/model_rule_corrected_1_5_07.pdf

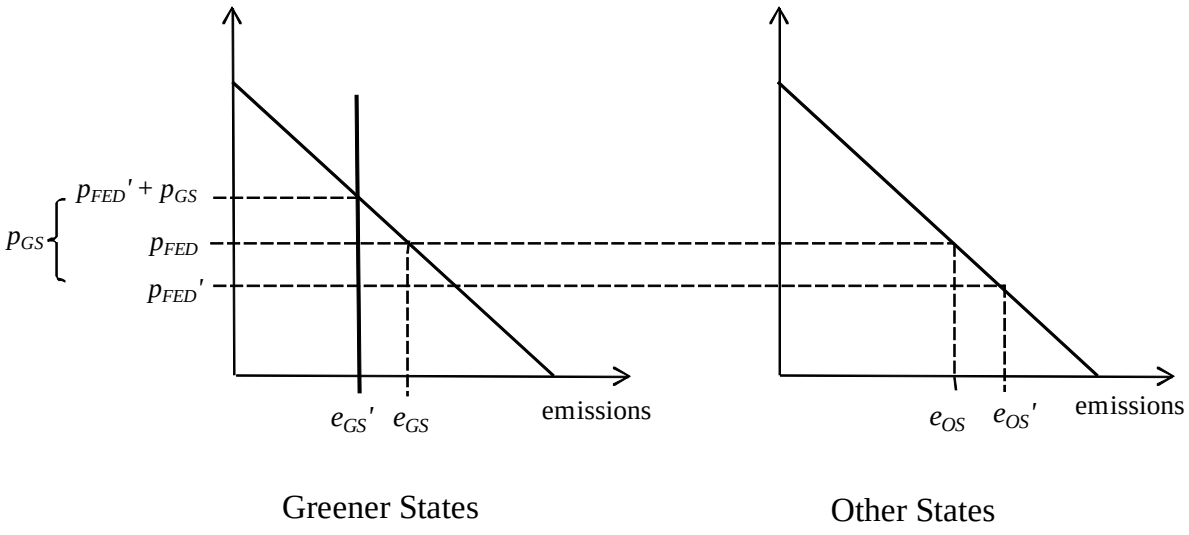
Revesz, Richard L. AFederalism and Environmental Regulation: A Public Choice Analysis.@ *Harvard Law Review* (2001), volume 111, pp. 553-641.

Revesz, Richard L. and Robert N. Stavins. AEnvironmental Law.@ *Handbook of Law and Economics, Volume I,* eds. A. Mitchell Polinsky and Steven Shavell, pp. 499-589. Amsterdam: Elsevier Science, 2007.

Trisolini, Katherine A. "All Hands on Deck: Local Governments and the Potential for Bidirectional Climate Change Regulation." *Stanford Law Review*, volume 62, issue 3, 2010, pp. 669-746.

Wolak, Frank. "Low-Carbon Fuel Standards: Do They Really Work?" Stanford Institute for Economic Policy Research *Policy Brief*, May.

Figure 1: Interaction of Federal and State Cap-and-Trade Programs



Greener States

Other States