Regional Initiatives to Reduce Greenhouse Gasses: The Crucial Importance of Auctioning Permits for Jobs, Competitiveness, and Equity

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A number of states in the Northeastern U.S. have now committed to reducing their greenhouse gas emissions. Two separate initiatives are underway in the region. The first is a comprehensive greenhouse gas emissions agreement under the auspices of the Conference of New England Governors and Eastern Canadian Premiers.[2] Its purpose is to return greenhouse gas emissions to 1990 levels by 2010, with further reductions in subsequent years.[3] The second is an electricity-sector only initiative consisting of state commitments in response to a call from Governor Pataki of New York for a regional cap-and-trade system for electric utilities, known as the Regional Greenhouse Gas Initiative (RGGI).[4] Most states in the region have individual state initiatives as well.

There are many open questions concerning the implementation of these agreements. This report discusses a key issues in the design of regional greenhouse gas emissions reduction policies: whether the permits are auctioned or grandfathered (i.e. given away to power producers or utilities). We show that, relative to a grandfathered system, auctioning improves economically efficiency, help to solve the current state budget crises in the region, is more distributionally fair, creates in-state jobs and preserves the competitiveness of the region. Though some have argued that a grandfathered system is politically easier to put in place, we believe that the much greater social costs of grandfathering will make grandfathered systems politically unviable in the long run. Conversely, the greater efficiency and improved equity of an auctioned system will help to stabilize it politically as it becomes a point of pride for the region and a national model.

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[2] Participating states are Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. Participating provinces are Newfoundland, New Brunswick, Nova Scotia, Prince Edward Island, and Quebec.

[3] By a resolution adopted July 16-18, 2000, the Conference of New England Governors and Eastern Canadian Premiers agreed to create a joint Climate Change Action Plan and a process to review and update that plan. See http://www.scics.gc.ca/cinfo00/85007913_e.html for the text of the resolution. The 2001 Climate Change Action Plan sets a short-term goal of reducing greenhouse gas emissions to 1990 levels by 2010, to ten percent below 1990 levels by 2020. The plan's long-term goal is to reduce greenhouse gas emissions to the level required to avoid any harmful impact on the climate, currently estimated to be 75 to 85 percent below current levels. See http://www.massclimateaction.org/pdf/NECanadaClimatePlan.pdf for the Climate Change Action Plan.

[4]The Pataki initiative proposes to create a regional cap-and-trade program for CO2 emissions from power plants. Participating states as of August 27, 2004 are Connecticut, Vermont, New Hampshire, Delaware, Maine, New Jersey, Pennsylvania, Massachusetts, and Rhode Island. See http://www.rggi.org/.

Economic Efficiency

A. Flexibility

It is now generally acknowledged that, where they are feasible, market-based approaches are among the most cost-effective ways to reduce pollution reduction,[5] because they allow emissions reductions to be made by the polluter who can achieve those reductions at the lowest cost. Thus, the broader the coverage of, e.g. an emissions trading system, the more that high-cost reductions can be exchanged for low-cost ones, and the greater the savings that can be achieved.

For example, an electric sector trading program such as that proposed under the RGGI would allow reductions to be accomplished by the firms and plants where they can be achieved the most cheaply. By including the residential and transportation sectors, reductions can be made in the sectors that can accomplish them at the lowest cost, further reducing the total cost of the program. Such universal coverage would make sense under the Governors' and Primers' agreement, and future expansions of the RGGI to cover more sectors have been contemplated as well.[6]

Such comprehensive permitting systems recognize that we do not have perfect information about the cost of reductions, either now or in the future. It harnesses the creative power of the market to identify least-cost reductions wherever they may be found.

B. Revenue recycling effects

In addition to the efficiencies that come with flexibility, emissions permitting systems can raise revenue that can be used to reduce distorting taxes and thereby improve the economic efficiency of the entire economy, or can be invested in new clean technologies to help ease the transition to new, lower-emission ways of living and doing business. Emission permits that raise revenue and are then used to cut taxes are estimated to have only a quarter of the total economic cost of grandfathered permits.[7] Studies have also shown that further economic benefits can be gained if a portion of the revenue is returned in the form of assistance in adopting new clean technologies to ease (and accelerate) the transition.[8]

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[5] See, e.g., Robert N. Stavins, *Lessons from the American Experiment with Market-Based Environmental Policies* Kennedy School of Government Working Paper No. RWP01-032 (April 2002) and papers cited therein.

[6] "After the cap-and-trade program for power plants is implemented, the states may consider expanding the program to other kinds of sources."See http://www.rggi.org/about.htm.

[7] Lawrence H. Goulder , Ian W.H. Parry and Dallas R. Burtraw "Revenue-Raising vs. Other Approaches to Environmental Protection: The Critical Significance of Pre-Existing Tax Distortions" *RAND Journal of Economics* 28,4 (Winter 1997): 708-731; Goulder, Lawrence H., Ian W. H. Parry, Roberton C. Williams III, and Dallas Burtraw, 1998. "The Cost-Effectiveness of Alternative Instruments for Environmental Protection in a Second-best Setting*." Journal of Public Economics* 72(3): 329-360.

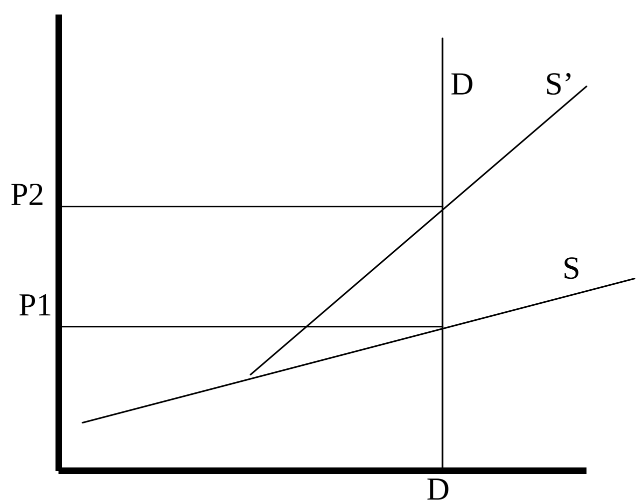
[8] See Edmonds, J., Roop, J. M., and Scott, M. J. (2000). *Technology and the Economics of Climate Change Policy* (Washington DC: Pew Center of Global Climate Change); J. Andrew Hoerner and Benoît Bosquet *Environmental Tax Reform: The European Experience,* Center For A Sustainable Economy: Washington, DC (February 2001), section 6.4.4 and the citations contained therein.

In assessing the efficiency gains of revenue recycling, whether through cutting other taxes, providing public services, or financing technology improvements, it is important to understand that consumer prices (including industrial consumers) are the same whether the permits are auctioned or grandfathered (given away based on emissions in a base period). This is because in today's competitive power markets, prices are determined, not by average costs, but by the cost of the last unit of production (marginal cost). When a utility produces an additional kWh of power, it has to buy an additional emissions permit, either from the state under an auction or from another utility under grandfathering.[9] The result is that the consumer price goes up by the cost of the permit either way – the only difference is whether the money goes to power companies or to the state.

C. Grandfathered permits as a transfer from consumers to industry

In competitive electric generation markets, when the marginal cost of generation increases by the abatement cost, the price increases by the same amount. This price increase applies to all units of electricity sold, not just the final units. Thus there is a transfer of wealth from consumers to producers. Figure 1 shows how this transfer works. We assume a fixed demand for electricity equal to D to simplify the presentation.

Figure 1.



The initial, pre-policy price, P1, is set where the supply curve, S, intersects the demand curve, D. When a permit system is put in place, it increases the cost of fossil-generated electricity. This results in a new supply curve, S', which is higher than S for values of demand that exceed the amount of non-fossil baseload generation.[10] The new price, P2, is set at the intersection of the new supply curve S' and D. Total abatement cost paid by generators is the area between S and S'. In the graph above, this is the triangle formed by S, S', and D. Increased revenue is the rectangle formed by the vertical axis, D, and the

[9] Alternatively, the utility can reduce its own emissions on other generation by enough to allow an additional kWh of generation under the allowances that it already holds. Thus the equilibrium price of permits, under either an auction or a grandfathering system, is the marginal abatement cost.

[10] The quantity of electricity equal to the non-fossil baseload is the point where S' diverges from S.

two price lines, P1 and P2.[11] The revenue represented by this rectangle goes to generating company stockholders if the permits are grandfathered model and to the public if the permits are auctioned model.

Note that the total abatement cost paid by utilities is much smaller than the total additional revenue collected by utilities. It is possible to set an upper bound on this ratio by making the standard assumption that abatement costs increase as an increasing rate. This is equivalent to assuming that the (marginal) abatement cost curve is bowed down (convex). Under this assumption, which is certainly reasonable for moderate reduction levels such as those now being considered, the total abatement cost is no larger than the triangle in the graph above, though it could be considerably smaller (because a straight line is the least "bowed-down" curve possible).[12]

One way of examining the subsidy to utilities provided by a grandfathered system is to look at the ratio of increased revenue to abatement costs. To know this ratio precisely, we would need detailed information on the shape of the cost curves. However, under the simplifying assumption above, we can easily calculate the ratio of the upper bound of the cost to total revenues as the ration of the rectangle (the revenue) to the triangle (the total abatement cost). This measure has the added benefit of being invariant to the particular level of price increase that is caused by the permitting system, i.e. it is the same regardless of the difference between P1 and P2. We present the case of NY as a typical example, based on 2000 data.

In 2000, NY utilities generated a total of approximately 149 million kWh of power. 45 percent of this, or about 68 million kWh, was non-fossil.[13] Thus, total revenues would constitute not less than 2.7 times total abatement costs.[14] Again, this is a lower bound. For more realistic abatement cost functions, the ratio of new revenues to abatement costs could be quite a bit greater. Estimates in the literature for national trading systems show revenues exceeding abatement costs by a factor of roughly five to twenty.[15]

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[11]We show this result with an inelastic (vertical) demand curve in order to simplify the presentation. For realistic values of demand elasticity and moderate emissions reductions in, say, the zero to 20% range, the results are similar to the simplified inelastic results above, with very slightly higher social costs and a slightly lower transfer to producers.

[12]If marginal abatement costs increase as the level of abatement per kWh increases, the S' curve is "bowed down," shrinking the area between it and the initial supply curve, S. This is what one would expect if there are abatement opportunities at different prices, and firms use the cheapest ones first. That is why the triangle is an upper bound for this area.

[13] New York is a substantial net importer of electricity. The non-fossil share presented here is calculated based on our best estimate of the non-fossil share of imports in 2000: 34 percent of interstate imports and 80 percent of international imports.

[14] The area of the rectangle is Base * Height, or 149 kWh*(P2-P1). The area of the triangle is ½ Base * Height, or [81 kWh*(P2-P1)]/2.

[15]Goulder, L.H. & Bovenberg, A.L. "Neutralizing the Adverse Industry Impacts of CO2 Abatement Policies: What Does It Cost?"), in C. Carraro and G. Metcalf, eds., *Behavioral and Distributional Effects of Environmental Policies*, University of Chicago Press, 2001; Smith, A. E. and Ross, M. T. *Allowance Allocation: Who Wins and Loses under a Carbon Dioxide Control Program?* Report prepared by Charles River Associates for Center for Clean Air Policy, Washington, D.C., (February 2002); Burtraw, D., Palmer, K., Bharvirkar, R., and Paul, A. 2002. "The Effect on Asset Values of the Allocation of Carbon Dioxide Emission Allowances." *The Electricity Journal*, June, pp. 51-62.

The table below shows the ratio of increased revenues to the utility to abatement costs paid by the utility under the linear upper-bound discussed above and under a quadratic approximation that is probably closer to the real value. This is shown for each of the RGGI states. Because the increase in electric costs applies to all units of electricity, while abatement costs apply only to fossil-generated electricity, the subsidy is greater in states that have more non-fossil electricity in their generating mix.

Estimate of the Ratio of Power-Industry Subsidy to Cost of Remediation for RGGI States

	Linear upper bound	Quadratic approximation
Connecticut	4.6	6.9
Delaware	2.4	3.6
Maine	4.8	7.1
Massachusetts	2.6	3.9
New Hampshire	6.5	9.8
New Jersey	3.8	5.7
New York	3.5	5.2
Pennsylvania	3.2	4.8
Rhode Island	2.2	3.3
Vermont	3.2	4.9

Calculated by the author from 2000 data drawn from the Energy Information Administration's State Energy Data System.

Revenue from a Carbon Permitting System

Many of the states in the Northeast are facing severe structural revenue shortages. In this fiscal environment, turning a natural, non-tax source of new public revenue into a corporate subsidy seems particularly irresponsible.

The table below shows the revenue from a carbon permitting system with a $20/ton permit price. These numbers are calculated using a modified version of the State Carbon Tax Model, developed by the author and others at the University of Maryland's Center for Global Change. Of course, the actual revenues could be higher or lower, depending on the magnitude of the carbon reduction, the extent of demand-side reductions that are achieved through energy efficiency and other policies, the

An "X" in columns 2 or 3 indicates membership in the Conference of New England Governors and Eastern Canadian Premiers accord and the Pataki agreement, respectively. Column 5 shows the revenue from a comprehensive tradable carbon permit program, while column 7 shows the revenue from an electricity-only permit system. Because we believe that carbon-only systems create economically and politically unacceptable regional disparities and other perverse incentives,[16] columns 4 and 6 show revenues from what we consider to be a more realistic permitting system. This system includes an equalizing charge on electricity from nuclear power and large hydro-power equal to the average permitting fee on fossil fuel-generated electricity.

Table 1. Revenues from Carbon Permitting Systems with a $20 Safety-Valve by State and Coverage ($mill.)							
1. State	**2. New England Compact**	**3. RGGI**	**4. Comprehensive Pollution & Energy Permit**	**5. Comprehensive Carbon Permit**	**6. Electricity: Pollution & Energy Permit**	**7. Electricity : Carbon Permit**	**8. Motor Fuels: Carbon Permit**
Connecticut	X	X	247	213	96	61	90
Delaware		X	123	114	63	54	25
Maine	X	X	142	119	50	33	47
Maryland		?	590	515	301	226	159
Massachusetts	X	X	536	501	213	178	170
New Hampshire	X	X	113	94	38	20	41
New Jersey		X	862	785	242	164	264
New York		X	1,421	1,277	475	331	354
Pennsylvania		X	1,823	1,511	865	553	350
Rhode Island	X	X	74	72	22	20	25
Vermont	X	X	51	42	11	5	22
Total, New England Compact states	**X**		**1,162**	**1,042**	**429**	**318**	**394**
Total, RGGI states		**X**	**5392**	**4728**	**2075**	**1419**	**1388**

In the table above, the regional revenues from these more comprehensive pollution and energy permitting systems are highlighted for the relevant initiative. The total emissions permitting system revenue is highlighted for the New England Compact, and revenues from the electricity-only permitting system is highlighted for states that have pledged to join the RGGI. These revenues would increase for the immediately foreseeable future as the safety valve rate rises.

It is worthwhile to note that in many cases these revenues would be sufficient to close a substantial portion of the budget shortfalls plaguing these states.

Distributional Concerns

Lower-income households spend a proportionally larger share of their income on necessities such as food and energy. As a result, the burden of any initiative that raises the cost of energy, whether through regulation or market mechanisms, is born disproportionately by low- and moderate-income families. Conversely, measures that reduce energy bills tend to provide proportionally larger benefits to these income groups.

[16] For instance, a carbon-only permitting system creates an incentive to switch to nuclear power, an alternative favored by relatively few environmentalists because nuclear plants pose their own environmental risks and costs. These risks and costs are difficult to compare to those posed by fossil plants.

Therefore, any measure to reduce total greenhouse gas emissions should include policies to offset negative distributional impacts. Offsetting these impacts can be done with a modest share of the total revenues generated by a carbon permitting system. [17]

Measures to offset the regressivity of energy charges generally fall into four types: (1) tax measures such as increases to the earned income tax credit or other refundable credits; (2) transfer measures such as the Low-Income Home Energy Assistance Program (LIHEAP); (3) targeted and general energy-efficiency measures, such as low-income weatherization programs, buyback of older fuel-inefficient automobiles, efficiency standards for appliances, etc.; and (4) pricing measures, such as inverted, lifeline, or basic-block rates for residential customers of electric and gas utilities.

Carbon Permits and Jobs

When money is spent in a state, it creates jobs in two ways: directly, and indirectly. Direct job creation comes from the instate jobs used to create and sell the purchased good or service. Indirect job creation comes about because the inputs used to produce the good or service may also be created in-state. For instance, when a consumer buys a book, they are creating jobs directly in retail and publishing, and indirectly in the paper industry and many other industries.

A specified sum of money spent in a state will create different numbers of jobs depending on the way it is spent. Again, there are two reasons for this. First, some industries are more labor-intensive than others, both in terms of direct and indirect production (the intensity effect). For instance, money spent on education creates almost five times the number of jobs (and almost four times the wages) that spending a similar amount of money on gasoline would create. (See Table 2 below). Second, some industries have most of their supply chain in-state, while others do most of their production out of state (the locality effect).

The table below shows the job-intensity of expenditures in various sectors of the economy per million dollars of final demand. Column 2 shows the direct and indirect jobs created, while column 3 shows the direct and indirect wages created, in millions of dollars.[18] Sectors are ordered from those that create the fewest jobs per dollar of expenditure to those that create the most. As you can see, expenditures in the energy sector create far fewer jobs than similar expenditures in most other sectors of the economy.

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[17] We are currently doing quantitative estimates of a range of alternative policy packages to offset the distributional impacts. However, preliminary calculations suggest that the regressive impact on lower-income households can be fully offset by allocating no more than 10 to 20 percent of the revenues from the permitting system.

[18] These are standard type-I multipliers for the U.S. Leontief input-output table. Source: Laitner, S., Bernow, S., & DeCicco, J. "Employment and Other Macroeconomic Benefits of an Innovation-Led Climate Strategy for the U.S." *Energy Policy* v.26 no. 5 425:429 (1998).

Table 2. Job and Wage Multipliers for the U.S. National Economy		
1. Sector	**2. Employment/$mill.**	**3. Compensation/$mill**
1. Oil refining	13.0	0.41
2. Gas utilities	16.3	0.54
3. Insurance/Real estate	17.6	0.43
4. Oil & Gas extraction	18.1	0.51
5. Electric utilities	19.9	0.64
6. Other mining	24.7	0.75
7. Coal mining	25.5	0.89
8. Motor vehicles	26.0	0.85
9. Pulp & paper	28.1	0.88
10. Primary metals	28.8	0.91
11. Other manufacturing	30.0	0.86
12. Food products	30.2	0.72
13. Metal durables	30.9	0.97
14. Other utilities	31.2	0.91
15. Stone, clay & glass	32.1	0.95
16 Construction	34.2	0.90
17. Financial services	35.6	1.09
18. Wholesale trade	36.6	1.11
19. Agriculture	38.2	0.52
20 Other services	44.2	1.12
21. Retail trade	53.7	1.03
22. Government	54.3	1.57
23. Education	61.9	1.61

Because most of the states in the New England Governors' accord and the Pataki initiative have little in-state fossil fuel production (with the notable exception of Pennsylvania) we believe that the differences in jobs created due to intensity effects are likely to be matched or exceeded by differences caused by locality effects. In essence, dollars spent on fossil fuels immediately leave the state, while dollars spent on most other goods will circulate within the state, creating additional jobs.

As a result, the reduction in fuel consumption induced by a carbon permitting system will cost relatively few in-state jobs. On the other hand, spending from the revenues generated by a carbon permitting system will probably create many more jobs, whether used to cut other taxes or to provide essential state services. Conversely, carbon permit systems that are grandfathered (given away to existing polluters for free) tend to reduce in-state employment. Grandfathered permits, like auctioned permits, drive up the price of fossil fuels and fossil-based electricity by constricting the supply. However, if the permits are sold, the revenues from this price increase will be spent in-state, whether through tax cuts or direct government expenditures. On the other hand, revenues from grandfathered permit systems go to the stockholders of energy companies that receive the permits. In some cases these are out-of-state companies, but even in cases such as an electric utility with entirely in-state operations, most of the stockholders will typically be out of state. Hence those moneys will leave the state and not generate in-state jobs.

Estimates of the magnitude of these job effects are contained in Hoerner & Freeman, *The Regional Greenhouse Gas Initiative: A Job Creation Strategy* (Redefining Progress, forthcoming 2004).

Competitiveness

As discussed above, a grandfathered permit system will reduce employment and also transfer capital out of the state, relative to an auctioned system. In addition, there are even more serious competitiveness problems posed for the region if grandfathered permits become the model for a national system.

Recall that, whether auctioned or grandfathered, carbon permits restrict the supply of fossil fuels and so drive up the price. In a grandfathered system, the benefit of these higher prices goes to those who receive the grandfathered the permits, i.e. those who have produced or consumed large amounts of fossil fuels in the past. As most northeastern states are net importers of energy of all types, this would cause an enormous transfer of wealth from energy-consuming states to energy-producing states. The result would be reduced jobs, higher prices and lower growth in the northeast.

Even northeastern utilities might correctly fear such a scenario. The average carbon-intensity of electricity for the RGGI region is 136 tons of carbon per Gigawatt-hour, which is 27 percent less than for non-RGGI states. Thus, on a per GWh basis the subsidy provided by a grandfathered national carbon trading system would be 27 percent greater for non-RGGI power producers than for northeast utilities. In today's competitive electric markets, this tilt toward subsidies for out-of-region power producers will erode the competitive position of in-region power producers, and could ultimately put them out of business entirely. For the New England Compact states, the contrast is even more striking, with non-Compact states averaging 37 percent more carbon-intensive than Compact states.

On the other hand, an auctioned permit system returns the revenue from the constriction of fuel supply to the public. As a national system, though it would add to the costs of production for all utilities, it would improve the competitive position of relatively clean power producers such as those in the Northeast. If the revenues were returned to the states on a non-carbon basis, such as per capita, per dollar of gross state product, or through cuts in general federal taxes or increases in general federal services, the result would be a net transfer of resources to relatively clean regions like the Northeast.

Thus, in addition to the competitiveness effects described in the last section, if the Governors' accord or the RGGI is to become a model for a national initiative (as seems likely), the competitiveness of both the region as a whole, and local power producers in particular, will be benefited by an auctioned system and injured by a grandfathered system.

Table 3. Carbon intensity of Electric Generation, by State and Region (2000)

State or Region	Tons Carbon from Electric Generation	Utility Generation (GWh)	Non-Utility Generation (GWh)	Total Generation (GWh)	Carbon intensity (Tons/GWh)
Connecticut	3,057,293	16,993	16,485	33,478	91
Delaware	1,624,985	4,137	1,774	5,911	275
Maine	1,163,105	3	13,048	13,051	89
Massachusetts	6,609,237	1,705	37,443	39,148	169
New Hampshire	1,376,094	12,703	2,242	14,945	92
New Jersey	5,559,387	25,251	32,953	58,204	96
New York	16,006,377	73,189	64,850	138,039	116
Pennsylvania	34,588,377	97,063	108,440	205,503	168
Vermont	37,659	5,308	975	6,283	6
RGGI	70,022,514	236,352	278,210	514,562	136
Non-RGGI	611,416,479	2,779,039	506,341	3,285,380	186
Compact States	12,243,388	36,712	70,193	106,905	115
Non-Compact	669,195,606	2,978,679	714,358	3,693,037	181
National	681,438,994	3,015,391	784,551	3,799,942	179

Calculations by the author from 2000 data from the Energy Information Administration, State Energy Data System

Summary

To summarize:

- A market-based system of carbon permits or taxes is the most efficient and fair way of achieving CO2 reductions.
- A system that raises revenue costs only about a quarter of a system that is grandfathered.
- An auctioned permit system raises sufficient revenue to play a significant role in helping to resolve major structural budget problems in the region.
- The regressivity of a carbon permit system can be offset by devoting a small portion of the revenue to tax reduction, energy efficiency policies, and similar measures.
- A grandfathered permit system would reduce employment, investment, and competitiveness in northeastern states, while an auctioned permit system would increase employment.
- If taken as a model for a national system, a grandfathered permit system would transfer wealth and jobs out of the northeast, while an auctioned system would transfer resources to the Northeast.