Smart Growth Policy As an Offset in GHG Cap-and-Trade

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ABSTRACT

Smart growth measures can provide substantial reductions in greenhouse gas (GHG) emissions, but costs and benefits of such measures may be difficult to define and quantify. Even assuming adequate quantification, it is not at all clear that putting a price tag on GHG emissions would provide a substantial incentive to get smart growth programs off the ground. Furthermore, the primary means discussed at present of attaching such a price tag is setting up cap-and-trade programs for GHG emissions, and these programs so far have been designed only for power generators and, in some cases, large industrial emitters.

Despite these potential obstacles, we attempt to identify a smart growth measure that could receive credits under a cap-and-trade scheme, in order to consider the obstacles cited in a concrete context. A strong candidate measure will need to be quantifiable, verifiable, and cost-competitive, among other things. Even today, with no GHG cap-and-trade programs in place that cover the transportation sector, devising a smart growth measure that meets these criteria would in fact have practical implications, because the measure could be proposed as an offset for the Regional Greenhouse Gas Initiative (RGGI), another domestic agreement, or an international one.

The analytical underpinning for this effort is the substantial literature documenting the relationship between vehicle miles traveled (VMT) (and therefore GHG emissions) and various community design features such as density, proximity to transit, and walkability. These relationships could allow an existing smart growth zoning program to go far in establishing eligibility for credits in a cap-and-trade program, though some issues remain. These credits would not be sufficient to cover the costs of the program today, but under plausible future scenarios the credits could finance a substantial percentage of program costs.

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Introduction

As part of a project to investigate opportunities to reduce greenhouse gas emissions from the transportation sector in the Northeast, ACEEE is working with Northeast States for Coordinated Air Use Management (NESCAUM) to explore ways of bringing the transportation sector into a cap-and-trade scheme and to define candidate transportation measures that could gain carbon reduction credits in such a framework. The project is to analyze a wide range of transportation GHG reduction measures from this perspective.

The Regional Greenhouse Gas Initiative (RGGI) undertaken by the Northeast and Mid-Atlantic states provides a concrete context for this investigation. In 2005, RGGI established state-by-state CO_2 caps for power generation and a timetable for achieving 10% reductions from these levels. Covered entities can purchase credits toward the required reductions from other covered entities and through offsets, i.e., the purchase of reductions from sources of CO_2 (or other GHGs) not covered by the program. While RGGI is a power sector program only at present, its scope may extend to other sectors in the future. In the meantime transportation measures could in principle be used as offsets under the existing Memorandum of Understanding. Candidate offsets must be, at a minimum, “real, surplus, verifiable, permanent and enforceable” (RGGI 2005).

It should be noted that, in the broader context of devising multi-sector GHG cap-and-trade programs, how transportation should be included in such a program, and indeed whether this is a good idea at all, are open questions. Covered entities in a trading program that includes transportation might be fuel providers, vehicle manufacturers, motorists, or some combination of the three, but none of these options has been deemed entirely satisfactory (Winkelman, Hargrave, and Vanderlan 2000; German 2005). Prior to the resolution of these issues, however, opportunities will arise for transportation measures to gain GHG reduction credits, for example, through the Clean Development Mechanism of the Kyoto Protocol (Browne et al. 2005) or as offsets in a power-sector program such as RGGI.

Discussion of transportation in GHG cap-and-trade programs to date has focused on reductions through vehicle efficiency and fuel substitutions. Yet various authors have made the case that measures to manage vehicle miles traveled, and in particular smart growth[1] measures, could greatly reduce GHG emissions as well (see, e.g., Bürer, Goldstein, and Holtzclaw 2004). While direct verification of these reductions for purposes of assigning credits would generally be difficult, quantification of emissions reductions attainable through smart growth has improved substantially in recent years (CCAP 2003).

Massachusetts’ 40R Program

As in happens, the Massachusetts Department of Housing and Community Development has put in place a smart growth incentive program that meets key eligibility requirements for participation in a cap-and-trade program quite well. In July, 2004, Massachusetts adopted the Smart Growth Zoning and Housing Production Act (“40R”), which allows municipalities to receive funds from the commonwealth for adopting and implementing “smart growth zoning” in a given district. Such zoning must adhere to certain minimum requirements set out by law (Section 6), which include:

- Allow densities of at least 8, 12, or 20 units per acre, in districts zoned for single-family, 2- or 3-family, or multi-family units, respectively;
- Allow provision of additional housing units in existing buildings; and
- Not exceed, in the aggregate, 25% of the total land area of the city or town that is establishing the districts.

Smart growth zoning must also occur in an eligible location, which is defined as one that is near a transit station, in an “area of concentrated development,” or in an area that is “highly suitable …for residential or mixed use smart growth zoning districts.” Eligibility is determined by the Department of Housing and Community Development. Department regulations state that proximity to transit means location within ½ mile of a station (for a bus or ferry line, “station” means a terminal), or within ¾ mile in the presence of continuous pedestrian access. “Area of

[1] Smart growth in this paper refers to regional or neighborhood development that uses space in such a way as to minimize resource use while enhancing the livability of the built environment.

concentrated development" and "highly suitable location" are also defined in the regulations (DHCD 2005).

Once a smart growth zoning district has been approved, the commonwealth pays to the city or town a "zoning incentive payment" in an amount determined by the projected number of housing units *in excess of* the number of units that could have been built as-of-right on the property under the prior zoning as follows:

Up to 20	$10,000
Up to 100	$75,000
Up to 200	$200,000
Up to 500	$350,000
Over 500	$600,000

Upon issuance of a building permit for that construction, the commonwealth pays in addition a one-time density bonus in the amount of $3,000 per unit of new construction in the smart growth zoning district beyond what would have been allowed under the old zoning.

Chapter 40R also requires that at least 20% of units constructed be "affordable," defined as "affordable to and occupied by individuals and families whose annual income is less than 80 per cent of the area-wide median income." Indeed, production of affordable housing was perhaps the primary impetus for the law. This aspect of the program is a benefit for smart growth as well, given critics' claims that it is incompatible with adequate provision of affordable housing.

Greenhouse Gas Reductions from 40R

The structure of the Massachusetts 40R program is conducive to quantification of its transportation-related greenhouse gas reductions, due to its specification of eligibility in terms of density and transit access. Relationships between development characteristics and average VMT have been established over the past decade, while the correspondence between VMT and GHG is straightforward. The work of Holtzclaw and his collaborators (Holtzclaw et al. 2002), among others, estimated VMT per household in a given area based on density, demographics, pedestrian and bicycle friendliness, and so forth. While several factors correlate with VMT, the closest correlation found by these authors is with density. This simplified relationship is given by:

$$VMT/household = 32237\ Density^{-0.3135}$$

using national averages.

In its definition of smart growth zoning, the 40R program adds to the density requirement a transit accessibility requirement, described above. While this requirement increases the likelihood that housing built under the incentive program will achieve relatively low levels of VMT, there is no attempt here to quantify this additional benefit for purposes of estimating GHG reduction potential.

In a carbon trading scheme, greenhouse gas reduction credits for this program could be assigned to the commonwealth of Massachusetts as follows. Each development permitted in a given year in a designated smart growth district would be credited with a reduction in VMT (as implied by the relationship above):

$$VMT_{\text{smart growth units}} = VMT_{\text{average unit in municipality}} * (Density_{\text{smart growth district}} / Density_{\text{municipality}})^{-0.3135}$$

where the density of the smart growth district (and of the municipality) would take into account the units newly permitted that year. Total VMT reduction due to the program in that year would be the sum of these reductions for each unit receiving the $3,000 incentive (i.e., each newly permitted "bonus" unit).

Rezoning under Chapter 40R requires densities of at least eight units per acre, which is more than double typical metropolitan density.[2] We therefore assume that housing developments claiming credit under Chapter 40R typically are constructed to have density double the town average. According to the formula above, increasing density by a factor of two reduces VMT by 20% (since $2^{-0.3135} = 0.80$). For a household traveling 20,000 miles per year (the national average), this is a reduction of 4,000 miles per year.[3] Since automobiles emit CO_2 at the rate of about one pound per mile, this gives 2 tons savings annually per new unit.

As an aside, we compare this rate of savings to savings estimated from carbon sequestration through afforestation on a per-acre basis. The lowest density that will qualify for incentives under the 40R program is 8 units per acre; if 4 of these units are built in response to the incentive, this would eliminate 8 tons of CO_2 emissions per year. Carbon uptake by an acre of forested land depends on several factors, including tree species and maturity, but lifetime averages are in the range of 5.5 to 7.3 tons CO_2-equivalent per acre per year (Stavins and Richards 2005). So the CO_2 reduction potential per acre is somewhat greater for the 40R program. Total acreage potentially available as a forested carbon sink far exceeds the high-density acreage to which smart growth zoning might apply, however.

Total GHG reductions of the Chapter 40R program can be estimated using the findings of a study by the Center for Urban and Regional Policy at Northeastern University. The study projects that a very similar program would result in 33,000 additional residential units being built in high density areas in Massachusetts over the next ten years (Northeastern 2003). Of these, 14,000 would be units that would have been built outside a smart growth zoning district in the absence of the program, and 19,000 are units that would not otherwise have been built. The latter group may be occupied by households that would not have moved to Massachusetts in the absence of the program, but their location in a high-density area can nonetheless be assumed to reduce U.S. emissions accordingly.[4] If the 33,000 additional units each reduce CO_2 emissions by 2 tons per year, total annual reductions are 66,000 tons after ten years.

Under the RGGI program, signatories must reduce annual CO_2 emissions by 10% over the period 2015–2020, which for Massachusetts would be 2.5 million tons (RGGI 2005).[5] The 40R program could contribute about 2%. This is over half of the total reductions that a state is allowed to achieve initially through offsets in the RGGI program. At the same time, the RGGI targets are not ambitious at this stage, and the magnitude of the 40R reductions is very small in

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[2] Average U.S. metropolitan densities had been declining and had reached 4.22 persons per acre in 1997 (Fulton et al. 2001), or about 1.7 households per acre. This is gross density, however, while the relevant density for the above discussion is density net of roads, undeveloped areas, etc., which is typically twice gross density in suburban areas (Charlier 2002)

[3] In the long run, this doubling of density will also reduce VMT for existing units in the same area, but we do not count those reductions here.

[4] If the reductions are outside the RGGI region, however, they will receive only half credit as long as allowance prices are low (RGGI 2005).

[5] Massachusetts recently decided not to become a RGGI signatory at this time.

the broader context of climate change. The principle objective of the present analysis, however, is to explore the mechanics of fitting a smart growth program into a cap-and-trade framework. That a menu of smart growth policies could substantially reduce GHG emissions has been argued elsewhere (Bürer, Goldstein, and Holtzclaw; CCAP 2003).

GHG Credits As an Incentive to Adopt Smart Growth Zoning

The viability of a measure within a cap-and-trade program relies in part upon its cost relative to other measures. The cost to states of the 40R program is approximately $4,000 per unit, because in addition to the $3,000 payment for each unit constructed the state pays a zoning incentive payment to the town upon approval of a smart growth zoning district that amounts to about $1,000 per unit. If each unit reduces CO_2 emissions by 2 tons per year, and we assume the life of the units is sixty years, then cost per ton reduced is $34 without discounting. The state would pay municipalities upfront, however, so discounting of the credits is probably appropriate. With 5% discounting, the cost of credits rises to $108 per ton CO_2.

This is a high cost for carbon reductions relative to prices viewed as reasonable in the U.S. today. In fact, as a consequence of the lenience of the CO_2 of the cap, the cost per ton for RGGI at the outset is expected to be under $3 per ton. By contrast, the price of CO_2 in the EU's emissions trading program in recent months has been in the range of 25€ to 30€ ($30 to $36).[6] If carbon prices in the U.S. were to reach this level in the medium term, the above discussion indicates that, using a 5% discount rate for carbon savings, carbon credits might eventually be expected to pay for about one-third of states' costs of the 40R program.

Potential Difficulties Associated with Assigning GHG Reduction Credits to Smart Growth Zoning

While the 40R program meets several criteria essential to cap-and-trade eligibility, certain points will need to be resolved before it could be accepted.

1. *Quantification*. The relationship between VMT and density utilized above is a simplified one; VMT can be shown to depend on numerous variables. Holtzclaw and others have developed more sophisticated formulae for VMT as a function of multiple neighborhood characteristics; in fact, Ewing and his collaborators found other characteristics (e.g., "regional accessibility") to be more even important than density in determining VMT (Ewing, Pendall, and Chen 2002). Consequently, the assignment of VMT reduction to smart growth policies in practice will require further refinement of the approach described here. The challenge will be to attain a level of rigor sufficient to meet the need for quantification of CO_2 reductions without making the requirements too onerous for the states offering VMT reduction programs as offsets.

2. *Additionality.* The Chapter 40R program is used as an example here precisely because it has a plausible claim to additionality; that is, the associated reductions would not have occurred in the absence of the program. The CO_2 reductions claimed for 40R would be

[6] In late April, 2006, EU carbon prices plummeted to half of these levels when several EU nations reported carbon emissions lower than expected (EurActiv 2006).

associated with the construction of units beyond those that would be permitted under existing zoning; these units would not have materialized (nor would the VMT reductions have been realized) if the program were not in place.

In another respect, however, the argument for additionality is still lacking: the benefits of the program to the state are diverse, and a program of this kind might be adopted in some states without the incentive of CO_2 credits, as the existence of the 40R program demonstrates. Moreover, the above estimate of cost per ton indicates that some other source of funding in addition to the sale of CO_2 reductions would be needed to pay the full cost of the smart growth program. Given many states' high level of interest in smart growth, this may be quite feasible, but the fact that the CO_2 credits alone would not bring the program about complicates the case for additionality.

Double counting of emissions claimed for smart growth measures is another potential concern. Other policies to control transportation GHG emissions, such as increasing fuel economy standards or fuel taxes, could reduce the savings associated with measures to manage VMT. How to account for these interrelationships is a tricky question for purposes designing a cap-and-trade program into which the transportation sector is fully integrated (Winkelman, Hargrave, and Vanderlan 2000). For offset purposes, however, preventing double counting can be achieved through periodic updating of the approach described above. Increases in average fuel economy would alter the assignment of pounds CO_2 per mile traveled, for example, and higher fuel taxes would affect both pounds per mile and average household miles per year.

3. *Acceptability to stakeholders*. The RGGI Memorandum of Understanding specifies preferred offset types, which include afforestation projects and end-use efficiency for natural gas, propane, and heating oil, but no transportation-related measures (RGGI 2005). Other kinds of projects may face an uphill battle in gaining approval.

   Environmental stakeholders have been wary of allowing offsets in the RGGI program. Offsets could allow power generators as a whole to reduce emissions less than they are capable of reducing them and impede regional CO_2 reduction by moving reductions outside the region. At this point, however, the use of offsets has been capped (at 3.3–5%, depending on the price of allowances), and the proposed smart growth credits are largely in-region and have ancillary environmental benefits. These considerations may make their use as offsets palatable. Another concern has been that using transportation measures as an offset for power generators undermines the argument for expanding the cap-and-trade program to cover other sectors, including transportation. The program considered here does not pose a threat in this regard, however, due to its modest size. Broad-based programs such as caps on vehicle GHG emissions or vehicle purchase incentives call for a different approach.

4. *Appeal to potential adopters.* It remains to be seen whether municipalities take advantage of the Massachusetts 40R program. One question is whether the incentives are large enough to interest them. In November, 2005, Massachusetts adopted a companion statute, Chapter 40S, guaranteeing state support for added school costs associated with the 40R program (Massachusetts Legislature 2005). School funding could be a large component of the cost of the program to the state, so it will be necessary to understand the fiscal

impacts of Chapter 40S to refine the estimate of CO_2 reduction costs for the 40R program.

Discussion

Whether fully integrating the transportation sector into a GHG cap-and-trade program is a good idea or a bad one is an unresolved question. The existence of substantial oil-related externalities, together with barriers to efficiency in the vehicle market, cast doubt on the notion that a market mechanism such as a cap-and-trade program would capture much of the potential for cost-effective GHG reductions in the sector. In fact, a poorly designed multi-sector trading program could be counterproductive, especially if it were used as a substitute for existing efficiency regulation. On the other hand, transportation is responsible for such a large part of GHG emissions that, as cap-and-trade programs take hold, there will inevitably be pressures to bring transportation into the regime, in order to achieve the necessary emissions reductions overall and to ensure they are achieved at the lowest cost.

In the meantime, an offset program such as the one established in RGGI provides a framework for testing whether a market-based GHG reduction scheme could promote transportation efficiency measures. Since carbon prices will yield only dimes on a gallon of gasoline in the near future, it may seem implausible that carbon reduction credits would drive VMT reductions where fuel savings have not. The offset program allows the state to aggregate the GHG reductions, however, and use the revenue to fund a program to achieve VMT reduction. The discussion above implies that, in the case of Massachusetts' Smart Growth Zoning program, GHG credits could in the future pay for a substantial fraction, though still under half, of the cost of the program.

Conclusion

Greenhouse gas cap-and-trade programs such as the one established by the Regional Greenhouse Gas Initiative are prudently setting quite rigorous eligibility requirements for offsets. Certain VMT reduction measures, such as the smart growth zoning program discussed here, can be shown to meet those requirements to a great extent, though not entirely. The resultant credits may not be of sufficient monetary value to drive VMT reductions, however. In the case of the Massachusetts 40R program, the credits would cover only a small fraction of program costs at the expected RGGI CO_2 price of a few dollars per ton, while at EU prices, credits could pay for approximately one-third of the program cost.

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