Quantifying the Third Leg: The Potential for Smart Growth to Reduce Greenhouse Gas Emissions

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ABSTRACT

This report reviews the existing literature on the potential for smart growth and related policies to make a significant contribution to reducing greenhouse gas emissions, and attempts to draw conclusions about the likely magnitude of such a contribution. Analyzing assumptions of key studies, this report estimates that smart growth policies may reduce vehicle miles traveled (VMT) by 10-30% in 20-30 years, reducing overall greenhouse gas emissions by 2-5% in the same time period.

Introduction

Climate change is now widely acknowledged as a societal problem that must be addressed to avoid major environmental consequences in the future. Recent large scale weather events have contributed to swaying public opinion on the issue – including melting glaciers, hotter-than-average temperatures, rising sea levels and more and severe storm and drought events. In crafting climate change solutions, policy makers must address the transportation sector, which currently accounts for 33 percent of U.S. greenhouse gas (GHG) emissions (Ewing, et al., 2007).

Three "legs" of the transportation stool present options for addressing rising greenhouse gas emissions: improving vehicle fuel economy, substituting renewable fuel sources for oil, and reducing Vehicle Miles Traveled (VMT). While the climate change benefits of vehicle and fuel technologies—the first two legs—are relatively well understood, the literature also contains analyses of a broad range of the potential GHG savings from "smart growth" and other VMT reduction policies.

Existing studies (i.e Burer 2004, Litman 2007, Ewing 2007,) attempt to quantify the savings from various combinations of land use policies, provisions for walking and cycling, road pricing, transit improvements, carsharing and carpooling, workplace/commuter choice programs, regulatory measures—such as urban non-motorized zones and parking restrictions, Intelligent Transportation Systems (ITS) and freight management programs. The primary studies present a dizzying array of potentials estimates, attributable to different assumptions and policies analyzed. This paper also looks at a few meta-analyses whose goal is to derive an overall potential savings for the U.S. from increasing location efficiency and related strategies. It discusses the assumptions and contributions of the existing primary and secondary literature and attempts to draw conclusions about the likely potential for the third leg of the transportation stool to make a significant contribution to reducing greenhouse gas emissions.

Attempts to quantify the greenhouse gas benefits of smart growth policies are increasingly relevant as several factors attest to a strong and growing market demand for housing in compact, mixed-use, walkable communities connected by transit.

For the first time in U.S. history, in 2003, the sales price per square foot for condominiums and townhouses was higher than for detached single family homes (Ewing et al. 2007). A Brookings Institution report finds a 40 to 100 percent premium for homes in mixed-use, walkable neighborhoods compared with houses in nearby single-use subdivisions. Finally, one of the most comprehensive analyses of the projected housing demand in the coming decades suggests that, by 2025, the demand for attached homes and small-lot single family housing will exceed the 2003 supply by 71%, while the demand for large lot housing will actually fall short of 2003 supply (Ewing et al. 2007). These projections are supported by a shifting population structure. In the coming decades, households without children will constitute nearly 90 percent of new housing demand (Ewing et al. 2007). Aging baby boomers are expressing preferences for smaller units and more amenities within walking distance. And these changes are occurring in the absence of policies to reverse those that for generations have encouraged or even required low densities.

Survey of Existing Literature

The most recent report on the potential for smart growth policies to achieve carbon reductions is "*Growing Cooler: The Evidence on Urban Development and Climate Change*", published in September 2007. Drawing on examples from dozens of U.S. cities, Growing Cooler finds that on average, people living in compact, walkable neighborhoods tend to drive one-third fewer miles than those in typical auto-oriented suburbs. The paper focuses on increasing compact development, carefully defined as achieving higher average "blended" densities (as opposed to high rise or even uniformly high density), "a mix of land uses, development of strong population and employment centers, interconnection of streets, and the design of structures and spaces at a human scale." Walking through a series of assumptions including an estimation of the market share of compact development, ratio of GHG reductions to VMT reductions, and the proportion of transport CO2 due to motor vehicle travel, Ewing et. al estimate that compact development can reduce U.S. transportation sector emissions by seven to ten percent by 2050, assuming that compact development can reduce VMT by 18% in the same period. Since the transportation sector accounts for 33% of U.S. greenhouse gas emissions, the high end of Ewing's estimate is a 3.3% reduction in overall U.S. emissions, which is quite modest. However, considering that Ewing et. al. project that compact development will save consumers $250 billion in fuel costs by 2030, in addition to billions in infrastructure cost savings projected to accrue to local governments, compact development presents a highly cost-effective strategy in terms of public and private dollars spent per ton of carbon reduction, particularly when considered in the context of other costly proposals to address global warming pollution.

While generic estimates of cost savings for compact development as a strategy for reducing greenhouse gas emissions are not available in the literature, regional examples show savings in a single metropolitan planning area in excess of $10 billion in government expenditures alone.

The regional blueprint for the Sacramento Area Council of Governments (SACOG), for example, was created through an extensive stakeholder outreach process and resulted in a preferred growth scenario that preserved open space, concentrated growth around transit corridors and limited highway expansion. In addition to a projected reduction of 26% in household VMT and associated GHG reductions, the plan is projected to *save* the six county region nearly $16 billion in unnecessary infrastructure and mitigation costs through 2050 (SACOG, 2007). The Southern California Association of Governments (SCAG) projects that they will be able to save $48 billion by concentrating new housing growth around existing transit corridors (SCAG Compass Report, 2004). The state of Arizona Climate Action Plan projects that their smart growth bundle of options will save 26.7 $MMtCO_2e$ between 2007 and 2020, at a cost-effectiveness of $0 per ton, due to the cost savings that will accrue to local governments and residents from reduced infrastructure costs, shorter commutes and more energy efficient homes (Arizona Climate Action Plan, 2006). And what is most certainly the most comprehensive national study of cost savings due to smart-growth-style development patterns found overall potential cost savings of $110 billion and 188,000 miles of road avoided between 2000 and 2025, $12.6 billion savings in water and sewer infrastructure costs, and a decrease of 49.6 million in daily travel miles for an associated savings of $24.1 million in daily travel costs (Burchell et al., 2002).

Growing Cooler's authors admit that their estimate of the potential carbon savings from smart growth is deliberately conservative, based on safe assumptions and only factoring in land use changes. The paper specifically excludes from analysis the potential for pricing policies or transportation demand measures. As a result of these key omissions, Growing Cooler fails to capture the full potential or full cost or cost savings for smart growth policies, mentioning only the $250 billion in savings likely to accrue to consumers in reduced fuel costs.

Standing in contrast to the somewhat limited scope of Growing Cooler, a paper by U.C. Davis Emeritus professor Robert Johnston, "*Review of U.S. and European Regional Modeling Studies of Policies Intended to Reduce Transportation Greenhouse Gas Emissions*", examines these policies more holistically. By analyzing the results of over 40 long-range regional scenario exercises from jurisdictions in the U.S. and Europe, Johnston concludes that 10-30% reductions in vehicle miles traveled are possible in 20 years, with roughly proportionate reductions in greenhouse gas emissions and fuel use. This report teases out the impacts of the various policy options including land use policies, transit provision, and congestion pricing. Land use policies – such as compact development –alone are found to have a limited impact. The same is true for investing in public transit while preserving the status quo of expanding highway capacity and continuing to build sprawl, which simply results in expensive public transit with low ridership. The most effective results are achieved with an increase in compact development, strong transit provision, a moratorium on highway development and expansion and pricing policies – including fuel taxes, work parking charges and all day tolls.

In "*Location Efficiency as the Missing Piece of the Energy Puzzle: How Smart Growth Can Unlock Trillion Dollar Consumer Cost Savings*", Burer, Goldstein and Holtzclaw (2004) review the literature on location efficiency—which reflects the average car ownership and distance driven for households in particular neighborhoods—and use the results to project various scenarios for reducing energy use and global warming pollution. Unlike the previous studies, which try to project likely or foreseeable changes in markets in response to policy, this study simply estimates what would happen if ALL new development corresponded to current self-described smart growth projects, and assumes that the reader can assign a percentage implementation rate. Using an estimate of total national housing starts and calculating the reduced VMT and associated energy benefits from six example smart growth communities, they project that within 10 years, cumulative nationwide reductions of 595 million metric tons—or

10% of 2001 global warming pollutants – are possible with smart growth developments. They assume 50% of new development on brownfield infill and 50% on greenfield. While this order of magnitude of reductions is matched by other categories, i.e. improved fuel economy standards or upgraded energy construction codes, smart growth outpaces these other proposals in terms of present value of consumer savings, estimated at $2.3 trillion, dwarfing the cumulative economic benefit of all other strategies proposed.

While the authors admit that achievement of 100% of the potential discussed is unlikely, they refrain from speculating what percentage is probable, citing the fact that no methodology currently exists to translate specific policy changes into expected results in terms of development. They criticize their estimate as conservatively low in that the national potential is based on six real life examples, rather than hypothetical developments that could incorporate greater levels of density, transit service or pedestrian/bike accessibility than current projects. This methodology thus ignores the potential that the same smart growth policies that might permit all new development to eventually resemble these six communities might also remove market barriers and allow the sample developments to achieve higher densities or improved location efficiencies; it also ignores the potential for adding transit or pedestrian/bike features to existing neighborhoods without new development.

This paper does not attempt to attribute greenhouse gas savings to particular smart growth policies; rather it assumes that the VMT savings observed in existing smart growth communities could be replicated. Given current regulatory and political limitations, it is overly ambitious to assume that overnight *all* new development could or would be built using smart growth principles, thus the 10 year time frame is too aggressive. More likely, policies enabling this kind of development would be implemented over the next 3-5 years, yielding a time frame closer to 20 years to see this kind of progress. On the other hand, the paper doesn't include an analysis of supportive policies such as pricing, which Johnston claims are essential to realize the full potential of compact development and transit provision, thus the paper can be critiqued as providing a conservatively low estimate of emissions reductions potential.

Litman's 2005 contribution to the literature, "*Win – Win Strategies for Achieving Transportation Sector Emissions*," suggests that a coordinated approach of transportation demand management, planning and pricing strategies can achieve a 30-50% reduction in vehicle miles traveled, though he fails to specify a time period for such gains. He argues that these estimates are validated by the fact that developed countries that have more diverse transportation systems and higher fuel taxes demonstrate 30-40% lower per capita vehicle mileage than the United States. By his own admission, exact impacts of win-win policies are difficult to predict and vary based upon local factors including demographic and economic conditions. Potential critiques of Litman's work include the omission of a detailed discussion of the political and regulatory barriers to achieving some of the more aggressive policy proposals included, and a lack of discussion of rebound, overlap or synergies of the various policy proposals.

Building off of Litman's analysis, NRDC's yet-to-be published "Improving Transportation Choices" by William Cowart includes an analysis of synergies, overlap and rebound effects, and finds reasonably aggressive implementation of current best practices can yield a 16% reduction in VMT by 2020, 24 percent by 2030 and 32 percent by 2050. Measures included in this analysis are land use policies, provisions for walking and cycling, road pricing, transit improvements, carsharing and carpooling, workplace/commuter choice program, regulatory measures, ITS and freight management programs. All of the measures included have been implemented, mostly in the U.S., and borrowing a few from Europe.

While the estimate is strengthened by the fact that the majority of the measures have been implemented in the U.S., Cowart does not attempt to address the current political barriers to implementation of these policies. For example, congestion pricing may have great societal potential; however, most California localities will require authorization from the 2/3 of the legislature to charge for driving. The current political climate may not be likely to yield such support for an increase in driving fees, however characterized. Cowart's analysis of VMT reductions is not translated to a GHG reduction potential, but such an analysis is forthcoming. In the interim, a rough estimate borrowed from Johnston and corroborated in Ewing is that each percentage reduction in vehicle miles traveled is associated with a proportionate reduction in greenhouse gas emissions.

Conclusion

A reasonable consensus emerging from surveyed literature is that land use policies, combined with aggressive investments in transit funded by market-correcting pricing signals can achieve a 10-30% reduction in VMT in a 20-30 year time horizon, with the variation explained by assumptions made about the political feasibility and public acceptance of these concepts.

Ewing estimates that compact development alone can plausibly reduce VMT by 18% by 2050. Cowart and Johnston argue that a suite of pricing policies and transit investments can leverage these land use changes to achieve greater VMT reductions of 24% and 30% respectively in a shorter period of time, by 2030. Litman predicts 30 – 50% reductions in VMT are possible, but fails to specify a time horizon. The lower end of Litman's estimate is consistent with Ewing, Johnston, and Cowart, since he fails to discuss synergies, overlap or rebound effects, and fails to discuss political barriers to implementation of these policies. Burer is both aggressive in the time predicted to achieve reductions and conservative in scope, predicting roughly 10% VMT reduction in 10 years. The ten year estimate is too aggressive, since this study predicts the outcome if *all* new development were to follow the example of six smart growth developments, and assumes that these changes can be implemented overnight. A more realistic prediction might assume that that new policies to influence land use could be implemented in the next 3-5 years, and thus anticipate reductions in VMT from better land use in 20-30 years. Burer's 10% VMT reduction estimate is perhaps low since pricing policies are excluded from the analysis.

Since personal vehicles account for roughly 18% of total U.S. greenhouse gas emissions, a 10-30% reduction in VMT translates to a 1.7% to 5 % reduction in overall greenhouse gas emissions in 20-30 years.

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