A Report by the Center for Clean Air Policy
Transportation and Climate Change Program

June 2009

Cost-Effective GHG Reductions through Smart Growth & Improved Transportation Choices

An economic case for investment of cap-and-trade revenues

Center for Clean Air Policy
Dialogue. Insight. Solutions.

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About CCAP

Since 1985, CCAP has been a recognized world leader in climate and air quality policy and is the only independent, non-profit think-tank working exclusively on those issues at the local, national and international levels. Headquartered in Washington, D.C., CCAP helps policymakers around the world to develop, promote and implement innovative, market-based solutions to major climate, air quality and energy problems that balance both environmental and economic interests. For more information about CCAP, please visit www.ccap.org.

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Acknowledgements
This report was made possible by support from the Kresge Foundation, the Rockefeller Foundation, the Surdna Foundation and the Federal Highway Administration. CCAP is responsible for the methodology and conclusions.

Front page photos from left to right:
(1) Streetcar, Portland, Oregon- www.busdude.com
(2) Arlington, VA - www.epa.gov
(3) Atlantic Station, Atlanta, Georgia - www.smartgrowthamerica.org

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The Need to Connect Transportation and Climate Change Policies

Nearly one third of greenhouse gas (GHG) emissions in the U.S. come from the transportation sector, making it the nation's largest end-use source of emissions. Moreover, transportation is the fastest growing source of U.S. emissions, accounting for almost half of the net increase in total U.S. emissions between 1990 and 2007.[1] Transportation GHG emissions are a result of three drivers — vehicle fuel efficiency, fuel emissions and how much people drive, as measured in vehicle miles traveled (VMT). In 2007, Congress addressed the first two drivers by improving Corporate Average Fuel Economy (CAFE) standards and mandating reduced GHG intensity of motor fuels. However, Congress has not put the same effort into improving travel choices to address how much people drive. Historically, U.S. transportation policy and infrastructure investments tend to encourage more driving. If we do not change how we invest in transportation, driving will continue to increase, effectively offsetting the emissions savings expected from the recently improved fuel efficiency and low carbon fuels requirements.

Cap-And-Trade Models Ignore Smart Growth and Transportation GHG Reductions

The price signal from a cap-and-trade system will not be effective in reducing VMT, due to market imperfections and limited transportation choices in many parts of the country.[2] Typical GHG reduction analyses miss the emissions reductions and economic benefits of improved transportation choices and assume a high "cost per ton" for these reductions. They also overlook broader benefits of smart growth and transportation pricing including lower infrastructure costs, consumer fuel cost savings, time saved, lower insurance costs and increased local tax revenues.

Smart Growth and Transportation Choices Reduce Emissions and Save Money

In this report, the Center for Clean Air Policy (CCAP) analyzes the benefits of reducing GHG emissions through smart growth, improved transportation choices, and transportation pricing. With input from Transportation for America, Smart Growth America, Natural Resources Defense Council, Environmental Defense Fund, and HDR Inc., we estimate that comprehensive **application of best practices could reduce VMT per capita by 10 percent** and reduce annual GHG emissions 145 $MMTCO_2$ in 2030 — equivalent to the annual emissions of some 30 million cars or 35 large coal plants.[3] These GHG reductions total approximately 6 percent of the 2030 GHG reduction goal proposed in the American Clean Energy and Security Act.[4] **Our analysis indicates that these reductions can be achieved profitably,** when factoring in

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[1] Energy Information Administration, Office of Integrated Analysis and Forecasting, U.S. Department of Energy. "Emissions of Greenhouse Gases in the United States 2007," ftp://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/ggrpt/057307.pdf

[2] Winkelman, Steve, Tim Hargrave, and Christine Vanderlan. "Transportation and Domestic Greenhouse Gas Emissions Trading." Center for Clean Air Policy, April 2000. http://www.ccap.org/docs/resources/558/Transportation20&20GHG20Trading20(CCAP%202000).pdf.

[3] Our calculations assume 55 mpg CAFE standards in 2030 and a 15 percent reduction in fuel GHG intensity. GHG savings from VMT reduction would be higher if we had assumed lower mpg or fuel GHG savings. Coal plant and car estimates based on current US averages for a 600 MW coal plant and on-road light duty vehicle fleet.

[4] 145 MMTCO2 is 5.8 percent of the 2030 savings from covered sources or 4.8 percent of economy-wide GHG reductions in House Report 111-137: http://thomas.loc.gov/cgi-bin/cpquery/R?cp111:FLD010:@1(hr137).

avoided infrastructure costs, consumer savings and projected tax revenue growth. When viewed holistically, many transportation-related emissions reductions are not only cheaper than reductions in the utility and petroleum sectors, but also would help ease the cost of compliance on those sectors.

According to our review of the economic impacts of smart growth, integrated planning can:

- **Reduce infrastructure costs** by approximately 25 percent or more;
- **Attract private investment**, increasing municipal revenues through real estate taxes;
- **Reduce household costs**, freeing up disposable income, especially for working families;
- **Improve energy security** by reducing dependency on oil; and
- **Increase walking and bicycling**, **improve public health** and reduce medical costs.

The report contains case studies at the local, regional, state and national level, which include:

- The **Sacramento** region's smart growth plan is projected to reduce emissions by 7.2 $MMTCO_2$ through 2050. CCAP calculates a net economic *benefit* of $198 per ton CO_2 saved through $9 billion dollars savings on infrastructure and consumer fuel savings.
- In **Atlanta**, CCAP calculates that the Atlantic Station project will reduce CO_2 by a total of 0.63 $MMTCO_2$ over 50 years at a net cost savings, because municipal tax revenues from the project will be greater than what is required to pay back the initial project loan.
- A McKinsey analysis for **Georgia** concludes that strategic investments in transit, demand management, and freight could yield net economic benefits of over $400 billion over 30 years. CCAP calculates associated transportation GHG savings of 18 $MMTCO_2$.
- Rails-to-Trails calculates that **Portland, Oregon's** investment in bicycle infrastructure will cut 0.7 $MMTCO_2$ with net economic *benefits* of more than $1,000 per ton CO_2. The Center for Transit Oriented Development reports that $73 million invested in the Portland Streetcar helped attract $2.3 billion in private investment within two blocks of the line.
- A Brookings Institution study shows that shifting to per-mile car insurance **pricing** could cut VMT and related GHGs by 8 percent yielding insurance cost savings for two thirds of households, averaging $270/vehicle/year and annual societal savings of $50-60 billion.

Conclusion

Smart growth is not only cost-effective compared to other mitigation measures, it can be profitable. If we ignore the full economic benefits of smart growth and improved transportation choices, we miss inexpensive GHG reductions that also provide additional community benefits and reduce the burden on other sectors to reduce their emissions. Dedicating a meaningful portion of allowance value to smart growth planning would be a cost-effective investment that can lower economy-wide GHG mitigation costs. For a more in-depth look of these issues, look for our forthcoming report, "Growing Wealthier: The Economic Benefits of Smart Growth."

Cost-Effective GHG Reductions through Smart Growth & Improved Transportation Choices

An economic case for investment of cap-and-trade revenues

Steve Winkelman, Allison Bishins, Chuck Kooshian

SUMMARY

The Center for Clean Air Policy (CCAP) has analyzed the benefits of reducing greenhouse gas (GHG) emissions through smart growth, improved transportation choices, and smart transportation pricing. CCAP estimates that comprehensive application of these policy tools according to best practices could reduce vehicle miles traveled (VMT) per capita by 10 percent and reduce annual GHG emissions 145 $MMTCO_2$ in 2030 — equivalent to the annual emissions of some 30 million cars or 35 large coal plants.[1] **These GHG reductions would be approximately 6 percent of the 2030 GHG reduction goal proposed in the American Clean Energy and Security Act.[2] Our analysis indicates that these reductions can be achieved with significant net positive economic benefits, yielding net savings per ton,** when factoring in avoided infrastructure costs, consumer fuel and insurance cost savings and projected tax revenue growth from high value economic development. These positive economic findings hold at local, regional, state and national levels. In this light, many of the GHG reductions from smart transportation choices are not only cheaper than reductions in the utility and petroleum sectors, but also would help ease the cost of compliance on those sectors.

OVERVIEW

This paper explains the economic and GHG emission reduction benefits of reducing travel demand by improving transportation choices. Section 1 explains the important connections between transportation and climate change policies. Section 2 examines the diverse economic benefits of smart growth and improved transportation choices. Section 3 shows how these broad economic benefits make it profitable to reduce transportation GHGs and presents results of cost-per-ton calculations. Section 4 presents an estimate of the total national GHG reductions possible from comprehensive application of smart growth, improved transportation choices and pricing strategies. The paper concludes in Section 5 with policy conclusions and recommendations.

This summer, CCAP will publish a report titled "Growing Wealthier: The Economic Benefits of Smart Growth" which examines these issues in greater depth.[3]

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[1] Our calculations assume 55 mpg CAFE standards in 2030 and a 15 percent reduction in fuel GHG intensity. GHG savings from VMT reduction would be higher if we had assumed lower mpg or fuel GHG savings. Coal plant and car estimates based on current U.S. averages for a 600 MW coal plant and on-road light duty vehicle fleet.

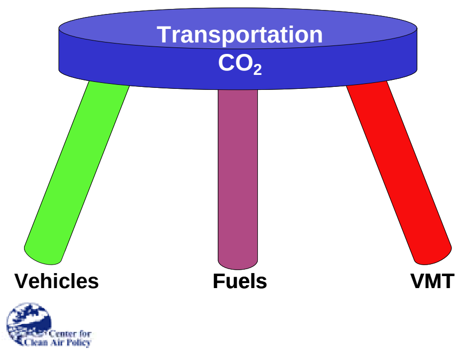
[2] 145 MMTCO2 is 5.8 percent of the 2030 savings from covered sources or 4.8 percent of economy-wide GHG reductions in House Report 111-137: http://thomas.loc.gov/cgi-bin/cpquery/R?cp111:FLD010:@1(hr137).

[3] For more information, please visit http://www.ccap.org/index.php?component=issues&id=9

1. THE NEED TO CONNECT TRANSPORTATION & CLIMATE CHANGE POLICIES

There is a growing consensus that industrialized nations need to reduce their GHG emissions 80 percent below 1990 levels by 2050 to stave off the most severe impacts of climate change. Recent analysis suggests even deeper cuts may be necessary. [4] Meeting the 80 percent goal will require emissions reductions from all sectors of the economy, including the transportation sector. Nearly one third of GHG emissions in the U.S. come from the transportation sector, making it the nation's largest end-use source of emissions. Moreover, transportation is the fastest growing source of U.S. emissions, accounting for almost half of the net increase in total U.S. emissions between 1990 and 2007.[5]

Transportation GHG emissions are a result of three factors that CCAP refers to as a 'three legged stool' — vehicle fuel efficiency, the lifecycle GHG emissions of fuels and how much people drive, as measured in VMT.



Congress recognized the important role of transportation in the Energy Independence and Security Act of 2007 (EISA 2007), in which it mandated 35 mile per gallon Corporate Average Fuel Economy (CAFE) standards by 2035 and a roughly 10 percent reduction in the GHG intensity of motor fuels by 2020. However, it did not address the third important factor for transportation emissions — how much people drive. Existing U.S. transportation laws and the transportation infrastructure investments they support tend to encourage more driving, increased overall transportation sector GHG emissions and are undercutting our ability to reduce GHG emissions reductions in the transportation sector. Between 1977 and 2007, driving, measured in vehicle miles traveled (VMT), grew by 110 percent, even though U.S. population increased only 37 percent.[6] If we do not change how we invest in transportation, driving will continue to increase, effectively offsetting the emissions savings expected from the recently improved fuel

[4] Hansen, J. et al. "Target Atmospheric CO2: Where Should Humanity Aim?" *Open Atmos. Sci. J.*, 2008: 217-231
[5] Energy Information Administration, Office of Integrated Analysis and Forecasting, U.S. Department of Energy. "Emissions of Greenhouse Gases in the United States 2007," ftp://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/ggrpt/057307.pdf
[6] Derived from US Census. "Historical National Population Estimates: July 1, 1900 to July 1, 1999," http://www.census.gov/popest/archives/1990s/popclockest.txt, and Federal Highway Administration. "Annual Estimates of the Population for the United States, Regions, States, and Puerto Rico: April 1, 2000 to July 1, 2007" Annual Vehicle - Miles of Travel, 1980 – 2007," http://www.census.gov/popest/states/NST-ann-est2007.html; Federal Highway Administration, "http://www.fhwa.dot.gov/policyinformation/statistics/vm02_summary.cfm, and "Annual Vehicle Distance Traveled in Miles, 1936-1995" http://www.fhwa.dot.gov/ohim/summary95/vm201.pdf.

efficiency and low carbon fuels requirements in EISA 2007,[7] and even the new vehicle standards proposed by the Administration (35.5 mpg by 2016).

However, in the last few years, Americans have started to drive less. For the first time since the oil shocks of the 1970s, the number of miles we drive, measured on an aggregate basis and per-capita basis, began to flatten in 2004, and actually decreased in 2008.[8] From January 2002 to January 2008 the real price of gasoline more than doubled — the sharpest rise in almost 50 years – which likely played a major role in flattening VMT growth. Nevertheless, VMT has continued to decline — even after fuel prices plummeted in late 2008 — most likely due to the deep economic recession. Still, the latest national forecast projects continued growth in driving, with a 15 percent increase in per-capita VMT through 2030, assuming business-as-usual transportation and land use policies.[9] It is unclear whether we have reached saturation or crossed a tipping point for driving, and while people are currently driving less, the future is unknown.

Unchecked VMT growth is a policy choice, not a foregone conclusion. Recent studies make it clear that where and how we invest in our transportation infrastructure matters make a difference — people drive less in areas with greater walkability and transportation choices. Wise transportation investments that reduce the growth of travel demand are smart not only environmentally, but also economically. Developers are seeing significant market and demographic trends indicating growing demand for walkable communities and public transportation. Studies indicate that the decline in housing values nationally have been most pronounced in areas with little walkability and few transportation choices. And, communities cannot afford to keep building infrastructure to keep up with development ever expanding into greenfields and hinterlands.

Will a Higher Price on Fuel from a Cap-and-Trade Program Reduce VMT?

An economy-wide cap-and-trade system effectively sets a price on emissions and, theory says, will stimulate the most cost-effective GHG reductions, as sectors with cheaper emissions reduction potential will achieve greater reductions relative to other sectors. The theory works well when applied to large point sources of emissions. However, it breaks down when it comes to driver behavior for few reasons: (1) modest changes in fuel prices have not historically changed driving behavior, (2) citizens in many parts of the country are stuck in their cars because they do not have practical transportation choices, and (3) transportation infrastructure and land use decisions are made by a multitude of government and private entities such that no single party is in a position to make comprehensive changes in response to a price signal.[10]

Most official economic impact analyses of proposed climate legislation rely upon models that estimate transportation fuel consumption as a function of fuel price. However variations in fuel prices have not historically been a strong determinant of VMT. Also, even at relatively high

[7] Ewing, Reid, K. Bartholomew, Steve Winkelman, Jerry Walters and Don Chen, *Growing Cooler: The Evidence on Urban Development and Climate Change*, Urban Land Institute, 2008.
[8] Puentes, Robert and Adie Tomer, “The Road…Less Traveled: An Analysis of Vehicle Miles Traveled Trends in the U.S.,” Brookings Institution, December 16, 2008.
[9] Energy Information Administration, Office of Integrated Analysis and Forecasting, U.S. Department of Energy. “Annual Energy Outlook 2009,” 2009. http://www.eia.doe.gov/oiaf/aeo/
[10] Winkelman et. al (2000), *op cit.*

prices, fuel costs remain only a fraction of total vehicle ownership and operating costs. The relationship between fuel prices and travel behavior, quantified as the long-term elasticity of VMT with respect to fuel price, is estimated by some economists as -0.22.[11] A $50 per ton CO_2 permit price would raise the price of gasoline by $0.44, an 18 percent increase from a base consumer price of $2.50 per gallon and would result in a mere 4 percent reduction in VMT (-0.22 x 18 percent).

For example, the Energy Information Administration (EIA)'s analysis of last year's Lieberman-Warner Climate Security Act estimated an allowance price in 2030 of $100 per ton CO_2-equivalent ($61 in constant 2006 dollars), yielding a 3 percent decline in VMT relative to the reference case in that year.[12]

Judging from these models, a carbon price alone will not be sufficient to address transportation GHGs. Just as complementary policies are needed to address vehicle efficiency (e.g., CAFE) and fuel GHG intensity, will we also need coordinated transportation policy and land use planning to increase travel choices and reduce GHG emissions. If such policies could lower VMT and achieve greater reductions from the transportation sector, then the overall cost of the program can be lowered, allowance prices can be lowered, and the quantity of reductions needed from other sectors can be made more manageable.

Moreover, **typical GHG reduction analyses often miss the emissions reductions and economic benefits of improved transportation choices and assume a high cost per ton for these reductions.** For example, EIA's analysis, which assumes substantial growth in VMT from today's levels, projected that only 3 percent of national emissions reductions would come from transportation, with 92 percent of reductions from the electricity sector.

Such analysis typically overlooks, for example, the evidence that transit-oriented development fosters more walk trips and shorter vehicle trips, yielding up to four times the CO_2 benefit resulting just from transit ridership, which is what the models typically include.[13] They also miss broader benefits of smart growth, which we document in this paper, including lower infrastructure costs, consumer fuel cost savings and increased local tax revenues. While not all of these benefits can be quantified on a dollar-per-ton basis, many can. Similarly, many GHG studies have not considered how pricing strategies, like pay-as-you-drive insurance and congestion pricing, can cut GHGs while producing significant consumer cost and time savings.

The price signal from a cap-and-trade system, alone, will be insufficient to yield significant GHG reductions in the transportation sector, regardless of their cost-effectiveness. A narrow focus on consumer price response leaves cost-effective tons 'on the table' by ignoring broader economic benefits that can be achieved with changes in transportation and land use policies and practices.

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[11] Small, Kenneth A. and Kurt Van Dender, "Fuel Efficiency and Motor Vehicle Travel: The Declining Rebound Effect." UC Irvine Economics Working Paper #05-06-03, July 2006. Observed short-run elasticity have been even smaller (more inelastic), consistent with the expectation that neither peoples' driving patterns nor the efficiency of the vehicle fleet respond immediately to heightened fuel prices.
[12] Energy Information Administration, Office of Integrated Analysis and Forecasting, U.S. Department of Energy, "Energy Market and Economic Impacts of S. 2191, the Lieberman-Warner Climate Security Act of 2007." April 2008.
[13] APTA. "Public Transportation Reduces Greenhouse Gases and Conserves Energy." February 2008.

Real-estate developers and municipal economic development agencies departments fully appreciate these benefits. Federal climate and transportation policy should also account for such economic benefits and actively promote efficient land use patterns, improved travel choices and increased system efficiency that can reduce GHGs and bolster the U.S. economy.

Growing Support for Transportation Policy Reform

A growing number of stakeholder groups recognize that reducing emissions from the transportation sector requires the three pronged approach. CAFE standards and incentives or requirements for low-carbon fuel production represent two such complementary policies, but more are needed. CCAP established the Climate Policy Initiative (CPI) to support development of an effective and efficient national climate policy in the United States that can win the necessary support for implementation.[14] Participants include industry representatives, environmental organizations and government officials. During this process, clear support has evolved for the need to address all three 'legs of the stool,' recognizing that vehicle and fuel technology will not be enough to reach our climate goals without initiatives that address VMT as well. Similarly, the U.S. Climate Action Partnership (USCAP), representing dozens of large companies and environmental groups, has called for the transportation sector to take steps including reductions in VMT, greater use of less-carbon-intensive forms of transportation, improvements in the efficiency of the transportation system and planning and infrastructure to support these changes.[15]

CCAP also convenes a VMT and Climate Policy Dialogue with top thinkers and decision makers with expertise in transportation policy, climate policy, smart growth planning and air quality regulation to explore, debate and develop effective and tenable national policy packages for reducing GHG emissions associated with travel demand or VMT.[16] Participants have worked to understand what can be done to slow VMT growth and increase transportation system efficiency and to make recommendations for specific policy actions. Participants agree that a portion of revenues from a federal GHG cap-and-trade system should be used to fund planning, projects and policies to help states and MPOs reduce GHG emissions by slowing VMT growth and improving system efficiency. They also agree that such a program is predicated on improvements in collecting and modeling transportation data so that the GHG effects of transportation investment decisions can be measured and evaluated.

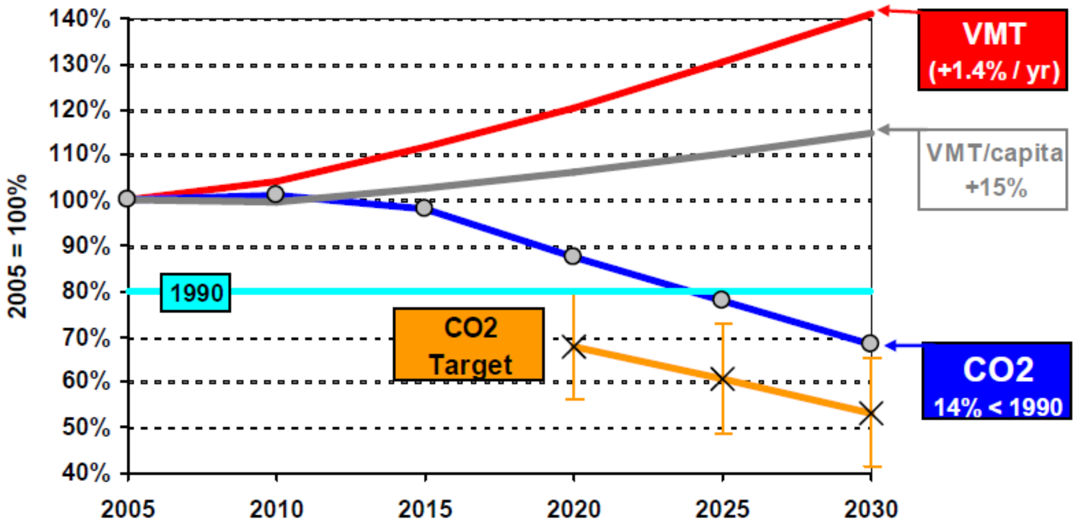
What Will Happen if Transportation Does Not Achieve Significant GHG Reductions?

CCAP calculates that by 2030 if per-capita VMT grows 15 percent from current levels, while assuming major progress on vehicle technology (55 mpg CAFE standard in 2030)[17] and fuel GHG intensity (-15 percent by 2030), GHG emissions from passenger vehicles would be **14 percent** below 1990 levels. But, to be on track to economy-wide GHG emissions levels of 60-80

[14] CCAP, Climate Policy Initiative, http://www.ccap.org/index.php?component=programs&id=2.
[15] U.S. Climate Action Partnership. "A Blueprint for Legislative Action: Consensus Recommendations for U.S. Climate Protection Legislation." (2009): 22-23. http://www.us-cap.org/pdf/USCAP_Blueprint.pdf.
[16] CCAP, Transportation and Smart Growth Program, http://www.ccap.org/index.php?component=issues&id=9.
[17] We assume 35.5 mpg CAFE standards in 2016, consistent with the recent Administration proposal.

percent below 1990 levels by 2050 requires that 2030 GHG emissions be **20-47 percent** below 1990 levels (Figure 1).[18]

Figure 1. Passenger Vehicle GHG Emissions Forecast: Business-as-Usual VMT



Source: CCAP calculations based on assumptions of +1.4 percent VMT/year, 55 mpg CAFE standard in 2030, 15 percent reduction in fuel lifecycle GHG intensity

If we fail to pursue cost-effective GHG reductions from the transportation sector, other sectors of the economy will need to implement more expensive solutions, ultimately costing the public more money. There is compelling evidence that we can achieve significant, and inexpensive, transportation GHG reductions. The landmark 2008 study, *Growing Cooler: The Evidence on Urban Development & Climate Change*, surveyed decades worth of empirical studies and analyses and demonstrated that coordinated transportation and land-use policies can have a significant impact on transportation-sector GHG emissions.[19] With improved transportation options, supportive land use and travel demand management policies, Americans will choose to drive less, and therefore emit less — and can save money in the process. Federal climate change policy should help provide the necessary tools and incentives, while also leveraging significant additional federal, state, local, and private resources, to harness the cost-effective GHG reductions possible from the transportation sector. Moreover, these benefits will continue to accrue well into the future, helping to meet the nation's long-term GHG reduction goals.

What transportation-related GHG reductions can we expect from smart growth, improved travel choices and smart transportation pricing? And how much will it cost? These questions will be addressed in the following sections:

2. Smart Transportation Investments Reduce GHGs and Save Money
3. Smart Growth Investments Profitably Reduce CO_2 Emissions
4. Potential VMT Reductions Achievable From Best Practices

[18] This target level assumes equal reductions from all sectors. From a cost-effectiveness standpoint, it is likely that those sectors with cheaper reductions would achieve greater relative reductions. It is also likely, given the deep reductions required, that major efforts will be required from all sectors of the economy – including transportation.
[19] Ewing et al. (2008), *op cit.*

2. SMART TRANSPORTATION INVESTMENTS REDUCE GHGs AND SAVE MONEY

Past estimates of the cost of achieving GHG reductions from the transportation sector have not considered the full range of economic benefits that can accrue through changes in transportation policies. Numerous studies have documented that transportation related land-use patterns have distinct cost impacts on a wide range of private and government expenditures. By assessing the net economic costs and benefits of development and transportation investment, we can ensure that our decisions account for the full range of potential costs and benefits. CCAP will publish a report in Summer 2009 titled "Growing Wealthier: The Economic Benefits of Smart Growth" which examines these issues in greater depth. The report concludes that there is compelling evidence that smart growth provides significant net economic benefits via avoided infrastructure costs, increased economic activity, reduction in household travel costs, job creation, public health improvements, energy and water use efficiency.[20] In addition, smart growth can reduce GHG emissions beyond transportation. Some of these conclusions are highlighted below.

There is an Expanding Market for Smart Growth

Economic price studies, real estate trends, and demographic shifts indicate robust demand for compact, walkable development.[21] A recent study found 83 percent of Americans want to live in communities that allow them to use their car less often.[22] The current real estate market is saturated with large-lot homes, even as compared to projected demand, while demand for small-lot single family and attached housing types could exceed 18 million and 17 million additional units, respectively, over the next 20 years.[23] In *The Option of Urbanism*, developer Chris Leinberger explains that there is pent-up demand for walkable neighborhoods, and that compact development is poised to dominate the real estate development market in the coming years, as the regulatory and financial environment allows.[24] Encouraging integrated land use and transportation planning, as well as smart transportation investments, will help remove barriers to smart growth development, in turn creating additional benefits for consumers and governments.

Smart Growth Reduces Infrastructure Costs

A wide variety of literature finds that smart growth produces net savings on the sum total costs of buildings, land, infrastructure and transportation. While some categories of that cost may be higher, the preponderance of literature suggests net savings overall.[25] A National Academy of Sciences and Transportation Research Board review found substantial regional and state-level infrastructure cost savings from compact development.

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[20] For more information, please visit http://www.ccap.org/index.php?component=issues&id=9

[21] Thomas, John V. "Residential Construction Trends in America's Metropolitan Regions." U.S. Environmental Protection Agency. January 2009.

[22] National Association of REALTORS®, "2007 Growth and Transportation Survey," 2007. http://www.realtor.org/smart_growth.nsf/Pages/pollingresults?OpenDocument

[23] Nelson, Arthur C. "Leadership in a New Era." *Journal of the American Planning Association* 72, no. 4 (2006): 393-407

[24] Leinberger, Christopher. *The Option of Urbanism: Investing in a New American Dream*. Island Press. 2007.

[25] Literature reviews include US EPA. "Our Built and Natural Environments: A Technical Review of the Interactions Between Land Use, Transportation, and Environmental Quality."2001; U.S. Climate Action Partnership. "A Blueprint for Legislative Action: Consensus Recommendations for U.S. Climate Protection Legislation." 2009: 22-23. http://www.us-cap.org/pdf/USCAP_Blueprint.pdf; and Muro and Puentes "Investing In A Better Future: A Review Of The Fiscal And Competitive Advantages Of Smarter Growth Development Patterns," Brookings Institute. 2004.

Figure 2. Savings of Smart Growth Compared to Trend Development[26]

Public–private capital and operating costs	Lexington, KY, and Delaware Estuary	Michigan	South Carolina	New Jersey
Infrastructure roads (local)	15%–20%	12%	12%	26%
Utilities (water/sewer)	7%–8%	14%	13%	8%
Housing costs	3%–8%	7%	7%	6%
Cost-revenue impacts	7%	4%	5%	2%

Burchell and Mukherji updated this analysis and applied it nationally to estimate costs under smart growth scenarios compared to trend development over the period 2000–2025. They found that sprawl produces a 21 percent increase in amount of undeveloped land converted to developed land. This increases water and sewer costs by 6.6 percent and increases local road costs by 9.2 percent. Altogether, the costs of sprawl increase the cost of housing by 8 percent, or $13,000 per dwelling unit.[27] Burchell and Mukherji did not estimate a VMT savings or concomitant CO2 reductions for the managed growth scenario. Many other studies of managed growth scenarios, including those cited elsewhere in this paper, find substantial VMT savings. The combination of reduced VMT and reduced public and private costs will create cost savings for each ton of CO_2 reduced.

Combining Smart Growth and Transportation Planning Can Yield Strong Economic Benefits

Blueprint planning, or “visioning,” a process for evaluating transportation and land-use growth scenarios, has been successfully used in across the U.S. The **Sacramento** region’s “Blueprint Transportation and Land Use Study,” used cutting-edge planning software in an extensive public outreach process to explore alternative growth scenarios through 2050.[28] The adopted Preferred Blueprint Scenario features infill development and transportation investments that will reduce GHG emissions and lower infrastructure costs for transportation capital, local streets, water, sewer, flood control, sidewalks, gas, electric and communication facilities. SACOG calculated the price tag of the Base Case Scenario to be $47.4 billion through 2050 versus $38 billion for the Preferred Blueprint Scenario — a savings of $9.4 billion dollars. One third of the savings are from transportation infrastructure, another third from water infrastructure, and the last third from flood control and dry utilities. SACOG calculates that transit operating costs would increase by about $120 million per year under the Preferred Blueprint Scenario. However, CCAP calculates that annual consumer fuel expenditures would be $380 million lower under the Blueprint Scenario, and the net present value of the increased transit costs, fuel cost savings and avoided infrastructure costs will be $1.4 billion — not bad for a $4 million investment in visioning! Indeed, a 1997 paper by Johnston and Rodier concluded that transportation demand management (TDM) strategies in the Sacramento region could defer roadway projects for 7-24 years, saving federal and state agencies $100-223 million (in 1992 dollars).

[26] Burchell, R., et al. *The Costs of Sprawl – Revisited (TCRP Report 39)*. Washington, D.C.: Transportation Research Board/National Research Council/National Academy Press, 1998.
[27] Burchell, R. and S. Mukherji. “Conventional Development Versus Managed Growth: The Costs of Sprawl.” *American Journal of Public Health*.93 (2003): 1534–1540.
[28] Sacramento Region Blueprint Transportation/Land Use Study “Special Report: Preferred Blueprint Alternative,” 2007. http://www.sacregionblueprint.org/sacregionblueprint/home.cfm

At the state level, McKinsey and Company conducted a study for Georgia and concluded that investments in transit, HOV/HOT, demand management, and the freight system could yield net economic benefits of $400 billion over 30 years and 320,000 jobs over 20 years.[29] CCAP calculates associated cumulative transportation GHG savings of 18 $MMTCO_2$.

Smart Growth can Increase Walking and Biking

Bicycle advocates calculate that, nationwide, non-motorized transportation, such as bicycling and walking, already reduce GHG emissions as much as 12 $MMTCO_2$ per year, with potential GHG reductions from future increases in non-motorized transportation between 33 and 91 $MMTCO_2$ per year.[30] Non-motorized transportation infrastructure is relatively inexpensive compared to other types of transportation investments, though a lack of comprehensive data has until now hampered cost-effectiveness calculations of such investments on a national level.

Portland, Oregon invested substantially in both bicycling and data collection, and has documented GHG reduction benefits from these investments. Between 1992 and 2008, bicycling increased at an annual rate of 10 percent while the city constructed 300 miles of bikeways through a $57 million investment. The Rails-to-Trails Conservancy calculates that bicycling in Portland could reduce GHGs by 0.73 $MMTCO_2$ by 2040, with a net economic *benefit* of $1.2 billion from fuel and health care cost savings from an investment of about $7 per resident per year.[31] These calculations do not include benefits from trips longer than three miles or co-benefits such as road infrastructure savings, congestion relief, avoided traffic injuries, health benefits from reduced air pollution, and increases in real estate values, which have all been associated with investments in bicycle and pedestrian infrastructure.

Smart Growth can Reduce Overall Household Costs

The Center for Neighborhood Technology (CNT) has shown that transportation is an integral part of the household budget and transportation costs often decline when housing costs increase. For households, this means that the additional housing cost they incur to live in a walkable area are often much less than what they save by using the alternative transportation options.

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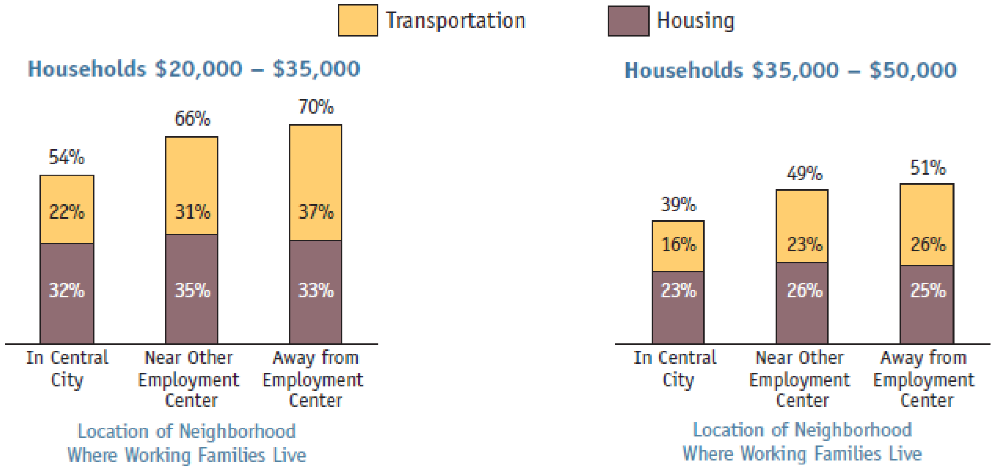
[29] Kimley Horn, "Modeling of GDOT's Investing in Tomorrow's Transportation Today (IT3) Project" presented at the Atlanta Regional Commission, February 2009. http://www.atlantaregional.com/documents/tp_mug_IT3_022709.ppt

[30] Active Transportation for America: A Case for Increased Federal Investment in Bicycling and Walking, RTC 2008 www.railstotrails.org/atfa

[31] Gotschi, T. "Cost-effectiveness of Nonmotorized Transportation Investments as a Greenhouse Gas Reduction Strategy." Rails-to-Trails Conservancy, April 2009.

Figure 3. Share of Income Spent on Housing and Transportation



Source: Center for Neighborhood Technology

Living in a central city means living closer to work, shopping, recreation, schools, and other amenities, and working families living closer to their daily needs can reduce their transportation cost from as much as 37 percent to as little as 22 percent of their income, without a corresponding increase in housing costs.[32] The chart above illustrates how the location of "working family" homes affects their annual housing and transportation expenditures. Studies have shown that households with one car and access to public transportation annually save an average of $6,251, when compared to an equivalent household with two cars and no access to public transportation.[33] The savings from living in an accessible area therefore represents additional disposable income. As land-use density increases, household VMT decreases, insulating households in denser communities from rising fuel prices and other transportation costs.[34] Indeed, there is growing consensus that more compact, walkable neighborhoods have had substantially less price change since the housing bubble burst in 2007 and 2008 than those located in more sprawling neighborhoods.[35,36]

In addition to lowering overall household costs, smart growth can positively impact vulnerable communities by improving access to jobs for workers without a car.[37] Research has shown that low income workers without cars have very limited job opportunities and have reduced access to the regional economy. Investments in smart growth, particularly transit improvements, can

[32] Lipman, Barbara J. "A Heavy Load: The Combined Housing and Transportation Burdens of Working Families." Center for Neighborhood Technology (CNT). 2006. http://www.cnt.org/repository/heavy_load_10_06.pdf
[33] Bailey et al. "The Broader Connection between Public Transportation, Energy Conservation and Greenhouse Gas Reduction." Requested by: American Public Transportation Association. ICF 2008. http://www.icfi.com/Markets/Transportation/doc_files/public-transportation.pdf
[34] Cortright, Joe. "Driven to the Brink: How the Gas Price Spike Popped the Housing Bubble and Devalued the Suburbs." CEOs for Cities 2008 www.ceosforcities.org/newsroom/pr/files/Driven%20to%20the%20Brink%20FINAL.pdf
[35] Stiff, David. "Housing Bubbles Collapse Inward." Fiserv Lending Solution. 2008.
[36] Realtytrac foreclosure summaries by counties, data converted to foreclosures per 10,000 residential units, as of February 10, 2009 http://www.realtytrac.com/
[37] Gao, Shengyi and Robert A. Johnston. "Public vs. Private Mobility for Low Income Households: Transit Improvements vs. Increased Car Ownership in the Sacramento Region." Proceedings of the 88th Transportation Research Board Annual Meeting. Washington, DC, January 11-15, 2009.

provide high levels of benefits per taxpayer dollar, based on studies of the efficacy of different kinds of programs (e.g., reverse commute programs vs. traditional welfare programs).

Smart Growth can Leverage Private Investments

Transit investments coupled with compact land-use strategies can help attract significant levels of private investment, leveraging scarce public resources toward even higher returns. The Center for Transit Oriented Development estimates $1 in public transit investment can leverage up to $31 in private investment.[38] Little Rock, Arkansas spent $20 million of public money on the Little Rock Streetcar, which helped leverage $200 million in private investment; Tampa, Florida spent $60 million in public money in the TECO Streetcar, which helped leverage $1 billion in private investment; and Portland, Oregon spent $73 million on the Portland Streetcar, which helped attract $2.3 billion in private investments within two blocks of the line, a more than 30-fold return on investment.[39] Thanks to orders from Portland Streetcar, Oregon Iron Works began manufacturing the first U.S.-built modern streetcar in 2008, creating more that 20 new local jobs.

In Atlanta, the expected tax revenues of over $500 million from the Atlantic Station development far outweigh the $195 million in upfront costs. Smart growth policies to increase the density of development along public transit lines in Arlington, VA, expanded travel options, improved travel information for users, and strengthened transportation demand management (TDM) programs, resulting in a successful transit-oriented community. Due to the high value dense development, 8 percent of County land generates 33 percent of real estate taxes.[40] The economic benefits include millions of square feet of new offices and tens of thousands of new residential units, yet because 89 percent of all Arlington office space and 40 percent of all housing units are in Metro station areas, many roads in the county now carry less traffic than they did in 1996.[41] Moreover, development takes up only two square miles around Metro stations in Arlington that would have covered 14 square miles at typical regional suburban densities, thereby reducing infrastructure costs.

Smart Growth can Reduce Energy and Water Consumption

Residential units in more compact counties use 20 percent less energy for heating and cooling than those in more sprawling counties.[42] In addition, smart growth design strategies can help mitigate urban heat islands, reducing heating and cooling requirements for urban buildings. Smart growth strategies can help manage future consumer demand for electricity, which can help electric utilities meet their emissions caps. Residential units in smart growth areas also use less potable water than those in typical suburban areas. Studies demonstrate that homes in compact, walkable areas use 20-50 percent less potable water per capita.[43] Reducing water demand can

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[38] Center for Transit Oriented Development. "Jumpstarting the Transit Space Race: How the New Administration Could Make America Energy-Independent, Create Jobs and Keep the Economy Strong." http://www.reconnectingamerica.org/public/reports/375

[39] Streetcar investments don't directly cause private developers to make invest in development, rather, streetcars can make the market much more attractive for developers, especially when in tandem with policy changes (e.g., zoning, permitting) that support transit-oriented development.

[40] Dennis Leach, personal communication

[41] Leach, D. "Meeting Community Sustainability Goals Through Coordinated Investments in Transportation and Development," presented at ICMA, 2008.

[42] Ewing et al. (2008), *op cit*., Chapter 7.

[43] U.S. EPA. "Growing towards More Efficient Water Use: Linking Development, Infrastructure,

reduce demand for electricity use as well, due to the electricity required for water conveyance (e.g., 20 percent of all electricity use in California).

Smart Growth can Improve Public Health and Reduce Health Care Costs

Smart growth can improve public health in two ways. First, reduced driving and congestion can improve air quality and reduce the incidence of air pollution related illnesses (e.g. asthma, cancer, respiratory distress). Second, smart growth can reduce the rate of obesity -- and attendant health risks such as type 2 diabetes, heart disease, and hypertension -- by increasing activity levels. Since annual health costs for obesity-related problems total over $76 billion, increasing activity levels and reducing obesity can potentially save the U.S. billions of dollars annually through improved productivity, reduced workers compensation claims, and reduced obesity-related health care costs.[44] From 1975 to 1995, the number of trips U.S. adults made by walking plummeted 42 percent, while the annual amount of miles driven in the U.S. has risen 4 times faster than the population.[45] Improving walking conditions and destinations influences whether or not people choose to walk, bike or take transit, for work, play and for running errands, making this a key area of health improvement and a way to reduce public and private health costs.

Smart Growth can Improve U.S. Energy Security

U.S. dependence on foreign oil exacerbates economic volatility and costs the U.S. billions of dollars annually to remain ready to intervene militarily to protect oil resources. In fact, the annual cost of oil dependence in the U.S. in 2005 was estimated to be $150-250 billion (at $35-45 per barrel).[46] Smart growth, by reducing VMT, can reduce our dependence on foreign oil, and directly and indirectly free up billions of dollars annually for other uses.

3. SMART GROWTH INVESTMENTS PROFITABLY REDUCE CO_2 EMISSIONS

Reducing VMT is necessary to reduce CO_2 emissions and meet our climate goals, even with significant reductions from vehicles and fuels. The good news from this analysis is that in many cases we can profitably reduce emissions and improve transportation access to destinations and services at the same time. In this section we provide examples of how much it costs to reduce CO_2 emissions through a variety of smart growth strategies at local, regional and national scales.

Estimating Cost-per-Ton CO_2 for Local-Level Infill Development

An EPA evaluation of Atlantic Station, a 138 acre brownfield redevelopment project in downtown Atlanta, projected that the compact, transit-oriented design would generate 30 percent less VMT than comparable developments elsewhere in the city.[47] In practice, Atlantic Station

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and Drinking Water Policies," 2006.

[44] Center for Disease Control. "Overweight and Obesity Trends Among Adults." (accessed May 7, 2009). http://www.cdc.gov/nccdphp/dnpa/obesity/trend/index.htm

[45] McCann, Barbara. and B. Delille, "Mean Streets 2000," Surface Transportation Policy Project http://www.transact.org/PDFs/ms2000/ms2000.pdf

[46] Greene, David L. and Sanjana Ahmad, "Costs of U.S. Oil Dependence: 2005 Update," http://www-cta.ornl.gov/cta/Publications/Reports/CostsofUSOilDependence.pdf

[47] Schroeer, William, "Transportation And Environmental Analysis Of The Atlantic Steel Development Proposal," Prepared for the United States Environmental Protection Agency by Hagler Bailly, Inc, May 1999.

does appear to be fulfilling its promise of reduced VMT. Initial surveys of residents and employees suggest Atlantic Station residents have an average daily VMT 59 percent lower than the typical Atlanta resident, and that employees at Atlantic Station have a daily VMT 36 percent lower than the average employee in the Atlanta region.[48] Thus a 30 percent VMT savings appears to be a reasonable assumption. CCAP calculates cumulative savings of 0.63 $MMTCO_2$ over 50 years for an initial investment by the government of $195 million. Initial calculations estimated that Atlantic Station would generate over $30 million annually in revenue from property and sales tax, and this funding stream will continue to benefit the city long after the initial investment debt is retired.[49] In addition, residents and employees are projected to save money by not needing to purchase 73 million gallons gasoline. Overall, the Atlantic Station redevelopment can be considered as zero cost per ton CO_2 if the "profit" is not rolled back into the project area, or yielding net savings per ton if increased tax revenues are invested in site amenities or transportation services.

Estimating Cost-per-Ton CO_2 for Regional Smart Growth

The Sacramento region's *Blueprint Transportation and Land Use Study* used cutting-edge planning software in an extensive public outreach process to explore alternative growth scenarios through 2050.[50] The Sacramento Area Council of Governments (SACOG) plan compared two scenarios for the year 2050. The first scenario projected past trends of growth and development, an outward growth pattern with an imbalance of jobs and housing among subareas. The alternative assumed regional growth following the Preferred Blueprint Scenario, with more housing choice, infill and better internal jobs-housing balance, while population growth was similar to the Base Scenario. The adopted scenario features infill development and transportation investments that will produce 14 percent less CO_2 than the business-as-usual forecast, a cumulative savings of 7.2 $MMTCO_2$. As discussed in section 2, SACOG calculated a $9.4 billion savings in infrastructure costs under Preferred Blueprint scenario. This process cost roughly $4 million in expenditures in Blueprint planning process — a hefty return on investment. The regional planning process can be viewed as the applied research and development (R&D) needed to achieve GHG savings from improved travel choices and accessibility, analogous to and as worthy of funding as R&D on efficient vehicles and green technologies.[51]

As also discussed in section 2, under the Blueprint scenario, transit operating costs would increase by about $120 million per year and annual consumer fuel expenditures would be $380 million lower. CCAP calculates the net present value of the increased transit costs, fuel cost savings and avoided infrastructure costs to be $1.4 billion. Dividing by the cumulative 7.2 $MMTCO_2$ savings yields a net *benefit* of $198 per ton CO_2 saved. SACOG also assessed the costs associated with mitigation land purchases,[52] and calculated additional savings of $8.3 billion through 2050. Including land purchases yields a net benefit of $341 per ton CO_2 saved.

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[48] http://www.atlanticstation.com/concept_green_projectXL08.php
[49] Atlanta Development Authority, "Atlantic Steel Brownfield Redevelopment Plan." 2000
[50] http://www.sacregionblueprint.org/sacregionblueprint/home.cfm
[51] Steve Winkelman Testimony to the Subcommittee on Technology and Innovation, House Committee on Science and Technology, March 31, 2009
http://www.ccap.org/docs/resources/612/Winkelman%20written%20testimony%20_UPDATE%203%2029%2009_.pdf
[52] Mitigation lands are land that must be purchased by a developer to satisfy mitigation requirements due to impacts from development.

It is important to note that infill development can result in higher upfront costs. Some of these costs include adding capacity (for utilities, roads, and other infrastructure), acquiring additional permits (which can be time consuming and complex), updating zoning ordinances, and conducting associated public participation efforts. Thus, given the net long-term savings, there is a well-identified policy need to make it easier and quicker to plan and build infill and mixed-use projects, a key element of smart growth. At the same time, infill development can result in increased economic activities and tax revenues that can be reinvested in site amenities and transportation alternatives. For Atlantic Station, expected tax revenues of more than $500 million swamp the $195 million in upfront costs. For Sacramento, even if upfront costs amounted to $1 billion, the net benefits would still be $70 per ton saved or $211 per ton counting mitigation land purchases. In Arlington, increased high value development has brought additional tax revenues, which have been used to support transit and other municipal services.

Estimating Cost-per-Ton CO_2 for Bicycle Infrastructure

As discussed in section 2, Portland, Oregon invested substantially in bicycle infrastructure and has documented associated GHG reduction benefits. The Rails-to-Trails Conservancy calculates that increased bicycling infrastructure in Portland could reduce GHGs by 0.73 $MMTCO_2$ by 2040, with a net economic *benefit* of $1.4 billion from fuel and health care cost savings, equivalent to a net savings of $1,664 per ton of CO_2 reduced.[53]

Estimating Cost-per-Ton CO_2 from Pay-As-You-Drive Insurance

Smart transportation pricing can reduce transportation GHG emissions while producing significant consumer cost savings. For example, changing all car insurance policies to "pay as you drive" (PAYD) can save money for consumers and insurance companies: up to $50-60 billion annually.[54] A Brookings study found that a universal PAYD system in California would reduce VMT by 8 percent. In addition, the system would generate 7-9 percent (12-15 $MMTCO_2$) of the 169 $MMTCO_2$ reductions needed to meet California's AB32 goals for 2020, reduce annual fuel consumption by 1.2 billion gallons, and reduce air pollution.[55] In addition, nearly two-thirds of households in California would have lower premiums under PAYD, saving an average of $276 per vehicle per year, while lower income groups may save even more, and everyone would benefit from decreases in accidents, because less driving makes roads safer.[56]

Estimating Cost-per-Ton CO_2 from Short-Term Measures

A study from the Organization for Economic Cooperation and Development and the International Energy Agency finds U.S. oil consumption and associated CO_2 emissions could be reduced by almost 14.5 percent in the very-short term as a result of measures and programs implemented at less than $3 per of ton CO_2 reduced, including car-pooling, telecommuting, compressed work week, and instructional programs for eco-driving. An

[53] Gotschi, *op cit.*

[54] Bordoff, Jason E. and Pascal J. Noel. "Pay-As-You-Drive Auto Insurance: A Simple Way to Reduce Driving-Related Harms and Increase Equity." Brookings Institution. July 2008 http://www.brookings.edu/~/media/Files/rc/papers/2008/07_payd_bordoffnoel/07_payd_bordoffnoel.pdf

[55] The Brookings Institution, "The Impact of Pay as You Drive Auto Insurance in California," http://www.brookings.edu/papers/2008/07_payd_california_bordoffnoel.aspx, (accessed Oct. 6, 2008).

[56] Edlin, A. and P. Mandic. "The Accident Externality from Driving, 2006." *Journal of Political Economy*. 114.5 (2006): 931-995 http://works.bepress.com/aaron_edlin/21

additional 2.4 percent reduction can be achieved by reducing and enforcing highway speed limits to 55 mph — a measure which can be implemented at a cost of less than \$39/ton CO_2.[57]

Summary: Cost-per-Ton CO_2 from Smart Growth, Improved Travel Choices & Smart Pricing
The examples above span a range of polices and measures over different geographic scales and time frames. The highest cost strategy, though still modestly priced relative to other emissions reduction strategies such as carbon capture and storage, is speed limit enforcement, which is estimated at \$39 per ton CO_2. A host of lower cost, short-term measures, such as car-pooling, telecommuting and eco-driving come in shy of \$3 per ton CO_2. Considering costs and benefits over a longer time horizon, the Atlantic station infill development project in Atlanta costs nothing and by some estimates is profitable, the regional smart growth efforts in Sacramento are estimated to yield net *savings* of \$198 to \$341 per ton CO_2, and bicycle infrastructure in Portland is calculated to yield *savings of* \$1,664 per ton. Although these calculations are not derived using the same methodologies and take into account different cost and benefits such as infrastructure costs, consumer fuel savings, increased local tax revenues and health cost savings, together they make a compelling case for why it makes so much environmental and economic sense to invest in smart growth, improved travel choices, travel demand management and smart pricing policies.

Although we cannot simply add together or extrapolate from these examples to arrive at national figures, we believe it is possible to produce reasonable estimates of nationwide GHG reductions and their costs. We know that driving less increases disposable income of household and reduces CO_2 emissions. Estimates of the average costs of vehicle operation are \$0.55 per mile, while the GHG emissions from the average light duty vehicle on the road today are about 0.46 kg CO_2e per mile. Therefore, a cost-free policy that encourages a reduction in driving would yield net *savings* of \$1,196/ton cost-effectiveness. A more complex analysis by the Natural Resources Defense Council projects the nationwide potential benefits of smart growth over ten years — assuming all new housing starts to be relatively location-efficient and compact, with half as infill and half in suburban areas. That analysis projects about \$2.18 trillion in economic savings, accompanied by GHG savings of 595 $MMTCO_2$ over the course of ten years.[58]

4. POTENTIAL VMT REDUCTIONS ACHIEVABLE FROM BEST PRACTICES

CCAP reviewed a variety of studies on the VMT savings from comprehensive smart growth, transit-oriented development and travel demand management policies. While each of the studies is unique, we believe they provide useful input for estimating the GHG and financial benefits of smart growth and smart transportation investments. In this section we review examples based upon measured data, modeled projections and aspirational goals.

[57] OECD/IEA Saving Oil in a Hurry. 2005. www.iea.org/textbase/Papers/2008/cd_energy_efficiency_policy/5-Transport/5-SavingOil2005.pdf,
[58] Bürer, Mary Jean, David B. Goldstein, and John Holtzclaw. "Location Efficiency as the Missing Piece of the Energy Puzzle: How Smart Growth can Unlock Trillion Dollar Consumer Cost Savings." Presented at the 2004 ACEEE Summer Study on Energy Efficiency in Buildings, Asilomar, California, August 2004.

Measured VMT Reductions

Over the last few decades the Portland, Oregon metropolitan region has implemented smart growth policies, improved transportation choices, and collected data to measure its success. In the 1970s, the city had a serious air quality problem and rising car dependence. Leaders shifted funds designated for construction of a new freeway to expanding public transportation. The region adopted an urban growth boundary, a parking cap for the downtown, and urban design standards. The region has invested relatively little in road capacity expansion since the mid-70s, instead focusing on maintaining its existing roads and developing a well integrated light rail, bus, and streetcar network with pedestrian and bicycle friendly streets. Portland and adjoining suburban Multnomah County adopted a climate action plan in 1990, taking steps to reduce traffic growth, expand travel choices, and support smarter growth. Since 1990, only 8 percent of the housing growth in the Portland region has gone beyond the urban growth boundary. Since 1990, the region developed 48 miles of light rail and streetcar, boosted the number of frequent bus routes from 4 to 16 and seen a 90 percent increase in transit use. Between 1999 and 2005, the region added 40 percent more miles to the bikeway network and cycling has increased five-fold since 1990. While national VMT per capita grew by 8 percent, between 1990 and 2007 in the **Portland-Vancouver** region **VMT per capita fell by 8-10 percent.** During this same time, the region brought its GHG emissions back to 1 percent above 1990 levels by 2008, while population grew by 14 percent and the region grew as an economic center.

In **Arlington, Virginia**, extensive transit-oriented development policies intended to increase density along transit lines expanded travel and housing options. County data indicate that population has grown more than 1 percent per year with **no growth in VMT**.[59] This would be equivalent to a 20-30 percent reduction in VMT per capita from 1980 to 2005. The County is pursuing household VMT data to enhance their measurement of VMT per capita. Residents take 47 percent of commute trips via transit, walking, or biking compared to 29 percent for the region, and only 12 percent households are car-free, compared to 4 percent in the region. And, as discussed in section 2, by attracting businesses, Arlington has reaped extensive economic benefits and increased tax revenues.

The **Atlantic Station** development was projected to reduce per capita VMT by 30 percent, and initial site review indicates a **59 percent** reduction in resident VMT and a 36 percent reduction for employee VMT.

Modeled VMT Reduction Projections

Sacramento incorporated the Preferred Blueprint land use scenario into their Metropolitan Travel Plan, and found that while increasing population will cause total VMT to climb, VMT per capita will decrease **between 6 and 10 percent** through 2035 due to the closer destinations and alternative transportation choices in the Blueprint plan.[60]

Assessment of comprehensive travel demand management policies using integrated transportation and land use models identified opportunities to cut VMT by 20 percent over a 20

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[59] Personal communication, Dennis Leach, May 4, 2009.

[60] Sacramento Area Council of Governments, "Sacramento Region MTP 2035," 2007

year planning horizon by investing more in transit, less in new roads, by giving consumers cash savings instead of driving subsidies, and promoting transit-oriented development.[61]

The McKinsey and Company study for **Georgia**, which included a number of transit, system efficiency and TDM measures, projects a **7 percent** reduction in VMT per capita for the Atlanta metropolitan area, from 2010 to 2030.

In **Growing Cooler**, Ewing et al. examined a scenario with increased density, slower growth in highway construction, faster growth in transit use, and widespread pricing policies and found that VMT per capita could be reduced **17 percent** below 2007 levels by 2030.[62]

The Federal Highway Administration has summarized findings from many regional studies looking at the potential of various **pricing and transportation management strategies** to cut GHGs, identifying multiple strategies — especially in the pricing arena - that individually can yield VMT and GHG reductions of **10 percent** or more.[63]

VMT Reduction Goals

The **Washington State** legislature has set a goal to reduce statewide VMT per capita 30 percent below 2020 levels by 2035, equivalent to a **23 percent reduction in VMT per capita** below 2005 levels.[64]

New York State has adopted a goal to **reduce total VMT by 10 percent** below projected levels by 2020, which would keep per-capita VMT flat at 2010 levels.

Estimate of Potential VMT Reductions from Comprehensive Applications of Best Practices

The measured, modeled and aspirational per-capita VMT reductions described above range from 6-50 percent, with many of the studies falling within the 10-20 percent range. Based on these studies, CCAP concludes that a 10 percent reduction in per-capita VMT by 2030 is achievable with comprehensive application of best practices.

A 10 percent reduction in VMT per capita from 2005 levels could be achieved with a VMT growth rate of 0.4 percent per year, bringing VMT in 2030 10 percent higher than 2005 levels. Assuming significant progress on vehicles and fuels as well (Figure 4), passenger vehicle CO_2 emissions would be 33 percent below 1990 levels in 2030 — on path to climate protection.

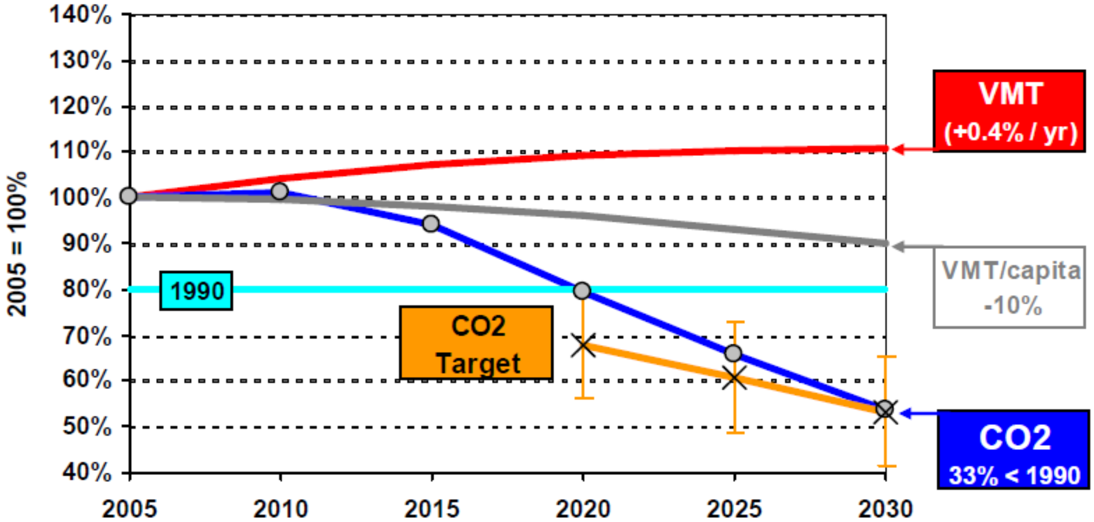
[61] Johnston, R. "Review of U.S. and European Regional Modeling Studies of Policies Intended to Reduce Motorized Travel, Fuel Use, and Emissions." Victoria Transport Policy Institute. August 2006, http://www.vtpi.org/johnston.pdf

[62] Based on Ewing et al. (2008), *op cit.*, Chapter 8.

[63] U.S. Federal Highway Administration, "Transportation and Global Climate Change: A Review and Analysis of the Literature." *Strategies to Reduce Greenhouse Gas Emissions from Transportation Source* 5: 1998. http://www.fhwa.dot.gov/environment/glob_c5.pdf.

[64] Personal communication, Karin Landsberg, WSDOT Climate Change Technical Program Lead, April 23, 2009.

Figure 4. Passenger Vehicle GHG Emissions Forecast: Smart Growth Case



Center for Clean Air Policy

Source: CCAP calculations based on assumptions of +0.4 percent VMT/year, 55 mpg CAFE standard in 2030, 15 percent reduction in fuel lifecycle GHG intensity

Leveling VMT growth would not likely arise solely from policies to increase accessibility and improve travel choices -- travel demand management and pricing policies would also need to be part of the package.[65] In addition, demographic changes, market changes and higher fuel prices are all likely to play a role, as discussed in section 2.

A **10 percent decline in per-capita VMT** would result in annual savings of **145 MMTCO_2 in 2030**.[66] These GHG reductions would be approximately 6 percent of the 2030 GHG reduction goal proposed in the American Clean Energy and Security Act and equivalent to the annual emissions of some 30 million cars or 35 large coal plants.[67]

We do not include the additional GHG benefits of reduced traffic congestion that could be produced by this cut in traffic which could be further increased by smart traffic management. Nor do we include GHG savings from reduced building energy and water consumption.

Reducing per-capita VMT by 10 percent would relieve some of the abatement burden from other sectors of the economy. The total value of emissions allowances that would be needed by other sectors to cover the same number of tons is $8.8 billion per year in the 2030 carbon market ($61 per ton in 2006 dollars x 145 million tons). This savings actually understates the improvement in the overall cost effectiveness of the legislation, however, as VMT reductions would reduce the price of remaining allowances for all regulated entities.

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[65] Johnston, *op cit.*

[66] This is the difference between Figures 3 and 4. Our calculations assume 55 mpg CAFE standards in 2030 and a 15 percent reduction in fuel GHG intensity. GHG savings attributable to VMT reduction would be higher if one were to assume lower mpg or fuel GHG savings.

[67] GHG savings from VMT reduction would be higher if we had assumed lower mpg or fuel GHG savings. Coal plant and car estimates based on current US averages for a 600 MW coal plant and on-road light duty vehicle fleet.

5. CONCLUSIONS

Using cap-and-trade revenues to fund smart growth and improved transportation choices is an investment in energy efficiency that yields energy cost savings dividends, kind of like switching to an energy-efficient light bulb. Unlike a light bulb, though, smart growth investments can also reduce net infrastructure costs, attract private investment and generate new revenue streams. If we ignore the full economic benefits of smart growth, we will miss inexpensive and money-saving GHG reductions that provide additional benefits to our communities.

Dedicating cap-and-trade allowance revenue values to smart transportation investments, supportive land use and travel demand management measures can therefore lower economy-wide GHG mitigation costs, lower household transportation costs and yield broad economic returns. We have demonstrated that the long-term economic payback from coordinated planning for GHG reduction — including smart growth policies, increased transportation choices, transportation pricing and travel demand management — far exceeds the upfront costs of those activities. The examples in this report are only a few of the many communities that "Ask the Climate Question" and have realized the economic opportunities that come from linking climate, transportation and land use policies.

Federal climate policy alone cannot resolve the nation's transportation issues and slow VMT growth — complementary transportation policies and programs are required. However, climate change policy can and should provide tools and incentives to utilize the most cost-effective GHG reductions possible, while leveraging additional federal, state, local, and private resources for these investments. Just as major market penetration of plug-in hybrid electric vehicles is dependent on investments in research and development, federal incentives to remove current barriers to smart transportation investments are necessary.

One way to immediately remove barriers to low-carbon transportation is to fund the backlog of unfunded and ready-to-go transit, bicycle, and pedestrian projects throughout the nation. These projects represent immediate investment opportunities, and applying climate revenues to these projects will reduce GHG emissions in both the short- and long-term. Bicycle and pedestrian projects alone represent $3.7 billion in unmet need;[68] while 78 regions in 37 states have proposed 400 new transit projects worth $248 billion.[69]

Giving states, MPOs and the local governments a set of tools and incentives to expand and improve low-carbon travel choices, enhance system efficiency, reduce congestion, and encourage compact growth patterns is an effective way to help achieve local, state and national GHG reduction goals. Directing 10 percent of cap-and-trade allocation values toward smart planning and low-carbon transportation investments would not only provide long-term economic benefits, but would strengthen our communities and help build the foundation for a healthy, vibrant and equitable future.

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[68] America Bikes, "Ready to Go Bike and Pedestrian Projects." 2009. www.americabikes.org/docs/America_Bikes_Ready_to_Go_Projects_lr.pdf

[69] Center for Transit Oriented Development. "Jump Starting the Transit Space Race." October 2008. http://reconnectingamerica.org/public/display_asset/jumpstartingtransit