



Testimony of Steve Winkelman, Center for Clean Air Policy

Subcommittee on Technology and Innovation, House Committee on Science and Technology

“The Role of Research in Addressing Climate Change in Transportation Infrastructure”

March 31, 2009

Chairman Wu, Ranking Member Smith and Members of the Subcommittee: good morning. I appreciate the opportunity to testify before you today. My name is Steve Winkelman. I am the Director of the Transportation and Adaptation Programs at the Center for Clean Air Policy (CCAP), a Washington, DC and Brussels-based environmental think tank.

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. 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.

Our behind-the-scenes dialogues educate policymakers and help them find economically and politically workable solutions. Our Future Actions Dialogue provides in-depth analyses and a “shadow process” for climate negotiators from 30 nations from around the world to help them develop the post-2012 international response to climate change. We also facilitate policy dialogues with leading businesses, environmental groups and governments in the European Union and the U.S. on designing the details of future national and transatlantic climate change mitigation, adaptation and transportation policies.

CCAP played a major role in the design and passage of the SO₂ trading system enacted in the 1990 Clean Air Act Amendments and was the lead consultant in the original design of the European Union’s Emissions Trading System (EU ETS). It has also helped develop national, regional, state and local climate policies in the U.S. and many other nations, including emission mitigation policies, smart growth initiatives, forestry policies and innovative approaches to climate adaptation.

CCAP’s *VMT and Climate Policy Dialogue* brings together high-level decision makers and experts on transportation, smart growth and climate policy from all levels of government, car and oil companies, the non profit community and academia. Participants include the secretaries of transportation from Kansas, Maryland, Pennsylvania, executives from, the American Association of State Highway and Transportation Officials (AASHTO), the California Air Resources Board and the Sacramento Area Council of Governments (SACOG), and senior representatives from American Public Transit Association (APTA), U.S. Department of Transportation (DOT), U.S. Environmental Protection Agency (EPA), New York City, Brookings, Bi-partisan Policy

Commission, BP, Exxon, Ford, Honda, Environmental Defense Fund, Natural Resources Defense Council, and Transportation for America.

Through the *Urban Leaders Adaptation Initiative*, CCAP is assisting ten partner cities and counties in developing effective policy and investment decisions to increase their resiliency to the impacts of climate change. Urban Leaders partners include representatives from Chicago, King County, Los Angeles, Miami-Dade County, Milwaukee, Nassau County, New York City, Phoenix, San Francisco and Toronto.

Ask the Climate Question

In all of our transportation and adaptation work, CCAP encourages our partners in government and industry to “Ask the Climate Question” -- How will planning, policy, funding, infrastructure and land development decisions affect greenhouse gas (GHG) emissions and our vulnerability or resilience to the impacts of climate change?

There is little doubt that answering the “Climate Question” requires both basic and applied research. More importantly, CCAP has seen first hand in our work the hunger state and local governments and other stakeholders have for the information, tools and policy options needed to answer the climate question.

The transportation community has awoken to the dangers of climate change, but has much ground to make up if we are to act swiftly enough and spend our money wisely enough in the future. My testimony today will explain in more detail why we need this research and the benefits of doing it. It also provides a detailed roadmap of research priorities and implementation needs.

We are poised to spend as much as \$500 billion in Federal funds on transportation infrastructure, which will leverage billions more in state, local and private investments. Asking the Climate Question about that \$500 billion investment poses new challenges that we are not currently well prepared to address. How can we most effectively reduce transportation GHG emissions? How much will that cost? What other costs and benefits will arise from GHG reduction policies? What tools, data and technical capacity do we need to implement GHG reduction policies? How can we reliably measure policy progress? What performance measures are most effective and practical?

Basic and applied research is necessary to build the tool box to answer those questions. Research findings will help Federal agencies such as DOT and EPA provide technical assistance to states, MPOs and local governments as they act to reduce their transportation GHG emissions.

While there are differences of opinion about which policies we should adopt to address climate change, today there is an unusually wide consensus on the need for basic and applied research to support policy choices to address climate change. This is a welcome change from even a few years ago, when the transportation community began to appreciate its role in reducing GHG emissions.

Is research needed to help address climate change issues in transportation infrastructure?

Yes, research is needed to inform how transportation infrastructure will impact GHG emissions and how transportation infrastructure will be impacted by climate change. Such research is critical to aid federal, state and local decision makers as they develop transportation plans, design policy and decide upon infrastructure investments that have both immediate and long-term economic and environmental implications.

What purpose would the research serve?

Basic and applied research is needed to help federal agencies, state and local governments to:

1. Assess the **costs, benefits and co-benefits** of transportation GHG reduction measures;
2. **Measure performance** of transportation investments and **evaluate** when, where and why changes occur;
3. **Improve data and models** to enable performance measurement and forecasting;
4. Plan for **adapting transportation infrastructure to climate change impacts**.

I provide details on each of these issues and offer suggestions as to how the research agenda could be implemented. In the appendices I provide additional details on data improvement and research needs. I also request to submit, for the record, the “CCAP Travel Data and Modeling Recommendations to Support Climate Policy and Performance-Based Transportation Policy.”

Implementing the research agenda – priority opportunities

To help navigate the long list of research needs, I have highlighted priority research opportunities that could be initiated or executed rapidly:

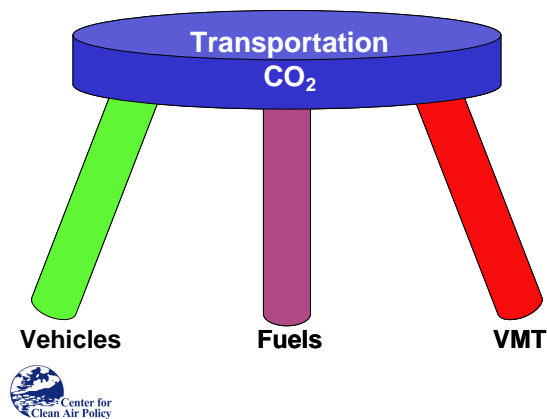
- TRB, DOT, EPA and DOE should systematically and collaboratively **assess the costs, benefits and co-benefits of transportation GHG reduction measures**, including vehicles, fuels, improved accessibility and travel choices, travel demand management, and improvements in system efficiency and construction practices.
- Congress should **require GHG measurement for major projects and metropolitan transportation programs** to assess the climate impacts of Federal infrastructure investments. Federal, state and local agencies will need new resources to conduct measurement and evaluation, say up to 1% of project costs, so that they face a ‘funded obligation’ and not an unfunded mandate.
- TRB should conduct a **study and develop recommendations on the highest priority data and modeling improvements** needed to support performance-based transportation decisions that reduce GHG emissions.
 - Congress should **provide funding** to implement the study’s recommendations
- The Federal government should **establish national climate services extension networks** to provide customized information and technical assistance to better adapt transportation planning, infrastructure and operations to climate change impacts.

1. Assess costs, benefits and co-benefits of transportation GHG reduction measures

While there is significant literature on the costs, benefits and co-benefits of vehicle fuel efficiency and low-GHG fuels,¹ there is limited information on the costs, benefits and co-benefits of GHG reduction measures of the transportation system and its infrastructure.

Transportation GHG emissions are a result of what CCAP refers to as the “three-legged stool” – vehicles, fuels and travel demand as measured in vehicle miles traveled (VMT). Some government transportation officials have offered a fourth leg of the stool that addresses system efficiency, such as traffic flow smoothing and logistics enhancements.

More research is needed to systematically assess the costs, benefits and co-benefits of transportation GHG reduction measures, including vehicles, fuels, improved accessibility and travel choices, travel demand management, system efficiency and construction practices.



This research should:

- Explore the **level, timing, and cost of GHG reductions** from a comprehensive set of transportation GHG reduction options, including:
 - Vehicle efficiency
 - Low-GHG fuels
 - Improved accessibility
 - Improved travel choices, including transit, walking and cycling
 - Travel demand management, including pricing policies
 - System Efficiency
 - Low-GHG construction practices
- Assess the **co-benefits** and impacts of transportation GHG mitigation measures on economic vitality, energy security, safety and social equity.
- Analyze the **interactions** among GHG reduction measures, including synergies and conflicts, such as: the rebound effects from higher fuel economy, induced demand and development from faster travel speeds, pricing, land use and travel alternatives.
 - This will require fundamental research into how the rapid changes in fuel prices and economic performance over the last few years have affected travel behavior. Are drivers recent response to fuel price changes (the price elasticity of demand)) consistent with past studies?

¹ For example, see, Lutsey, Nicholas P. (2008) Prioritizing Climate Change Mitigation Alternatives: Comparing Transportation Technologies to Options in Other Sectors. Institute of Transportation Studies, University of California, Davis, Research Report UCD-ITS-RR-08-15. http://pubs.its.ucdavis.edu/publication_detail.php?id=1175

- Assess the **effects of fuel price increases** upon fuel sales, VMT, mode split, local economic activity, passenger and pedestrian safety, **in regions and cities with varying levels of accessibility**
- Draw from **real-world pilot projects** conducted in partnership with expert researcher teams aiding with design, monitoring and evaluation. This would enable researchers to learn from real-world experiments on cutting-edge policies and add the credibility of external review.
- Enable DOT and EPA to **provide technical assistance** and guidance to help states, metropolitan planning organizations (MPOs) and local governments reduce GHGs from transportation. There are a few recent and forthcoming studies that contribute on this front:
 - The *CCAP Transportation Emissions Guidebook* helps state and local officials calculate the GHG emissions savings from 40 transportation policies and measures, including smart growth, transit, bicycle infrastructure, pricing strategies and intermodal freight.² The Guidebook includes policy overviews, success stories and links to key models and resources. It was last updated in 2005. National Cooperative Highway Research Program (NCHRP) study 20-64(64) is reviewing the CCAP Guidebook to assess its effectiveness at estimating mobile-source GHG emissions.
 - In Spring 2009, CCAP will release a working paper, “Growing Wealthier: The Economic Benefits of Smart Growth,” which summarizes savings in infrastructure costs, fuel use, building energy use, water use, household costs, social equity, and benefits such as local economic development and public health.³
 - In Summer 2009, the Urban Land Institute will publish its *Moving Cooler* study, which evaluates the cost and effectiveness of a variety of strategies to reduce VMT and increase operational efficiency, including pricing, land use, transit, carpooling, freight, intelligent transportation systems, and regulatory measures.⁴

Applied research is one of the best ways to improve accessibility, travel choices, travel demand management and system efficiency.

People marvel at the scientists and technologists toiling away in laboratories and garages inventing the next generation of windmills, batteries, hybrids, and LED light bulbs. And we must ensure that their research is adequately funded, because we desperately need them to succeed.

We should also venerate and support the heroic planners, architects and engineers working to design livable communities and more walkable neighborhoods, where basic services can be obtained without the need to drive. The empirical evidence shows that a typical resident of a traditional, walkable neighborhood emits significantly less transportation GHG emissions than typical auto-oriented development -- 30% lower on average. For example, there is 40 percent lower VMT in Chapel Hill, North Carolina’s Southern Village and 75 percent lower in Atlanta,

² http://www.ccap.org/safe/guidebook/guide_complete.html

³ S. Winkelman, “Growing Wealthier: The Economic Benefits of Smart Growth (sneak preview),” TRB Annual Meeting, January 2008: [http://www.ccap.org/docs/resources/567/Winkelman%20-%20Growing%20Wealthier%20\(TRB%20Jan%202009\).pdf](http://www.ccap.org/docs/resources/567/Winkelman%20-%20Growing%20Wealthier%20(TRB%20Jan%202009).pdf)

⁴ <http://commerce.uli.org/AM/Ecommerce/ProductDisplay.cfm?Productid=1754>

Georgia's Atlantic Station than the regional average.⁵ That's more effective than driving a Toyota Prius, and can bolster the local economy and physical health to boot. Or, as I like to say, "Sidewalks are as Sexy as Hybrids!"

And don't forget the honorable economists and engineers developing management and pricing solutions to maximize efficient use of existing infrastructure and generate valuable streams of revenue that can be reinvested in sustainable infrastructure.

CCAP applauds the new Housing and Urban Development (HUD) and DOT Interagency Partnership to Promote Sustainable Communities,⁶ which calls for joint research, data collection and outreach efforts to develop information, analytic tools to track housing and transportation options and expenditures, establish standardized and efficient performance measures, and identify best practices. An interagency working group, led by DOT, is currently developing performance metrics, research and data needs to support an integrated regional planning framework. This research effort is the analog to technology R&D for vehicles and fuels and will provide the building blocks for more livable communities.

2. Measure performance of transportation investments, and evaluate when, where and why changes occur;

In an era of shrinking budgets and transportation systems falling short of meeting community needs, there is a growing need for a performance-based approach to transportation policy.

Why Measure?

From a GHG perspective, there are several reasons for measuring performance, such as: maintaining a GHG inventory, informing policy design, assessing implementation status, and evaluating policy performance.

Research is needed to determine how performance-based policy can be operationalized in a practical and efficient way. Transportation policy aims to address many objectives such as: accessibility and mobility, economy, safety, energy, environment, equity and health. But if we're considering a dozen metrics, then many of them are likely to carry little weight and be ignored. A key research objective is to develop a workable number of highly practical and useful measures – four or five? – that address multiple policy objectives. For example, improving accessibility and travel choices can reduce GHGs, energy uses and, in some cases contribute to safety, public health and economic efficiency.

What Metrics?

Research is needed to assess which metrics are most effective for specific purposes. For example, as part of the *CCAP VMT and Climate Policy Dialogue*, CCAP maintains a Travel Data and Performance Measurement Workgroup. The workgroup strongly believes we have to be able to measure transportation GHG emissions per capita if we are to assess state and regional

⁵ R. Ewing, K. Bartholomew, S. Winkelman, J. Walters and D. Chen, *Growing Cooler: The Evidence on Urban Development and Climate Change*, Urban Land Institute, 2008.

⁶ <http://www.hud.gov/news/release.cfm?content=pr09-023.cfm>

GHG performance. Although the GHG per capita metric is sufficient for GHG inventory purposes, it is not sufficient for understanding *why* GHG emissions have changed, or *where* the changes occur – critical questions for policy design. An effective research effort will need to measure performance on all four legs of the stool (fuel economy, fuel GHGs, VMT, system efficiency), but do so at an appropriate geographic resolution (e.g., region, corridor, neighborhood) to inform policy design and evaluation.

Measuring Accessibility

Research on alternative measures of accessibility will be important for assessing how to most efficiently connect people and goods while minimizing GHG emissions.

There is a growing agreement on the importance of measuring mobility and accessibility, in order to focus on transportation outcomes for people and goods in additions to vehicles and segments of roadways. Traditional transportation performance measurement focuses on measures of *mobility* such as vehicle throughput, facility level of service and traffic congestion. Mobility measures such as, flow improvements, are important as they can tell us enable vehicles to move more efficiently, and in some cases with lower net GHG emissions. However, *accessibility* is the ability to reach desired goods, services, activities and destinations. Accessibility improvements (e.g., higher density mixed-use development) can enable people to reach the goods and services they need more efficiently, and with less vehicle travel and lower GHG emissions. Accessibility can be measured in terms of number and types of destinations reachable within a set period of time, or in terms of ease of access such as the proportion of the population within a 10 minute walk of transit service with a minimum 15 minute frequency. Both mobility and accessibility improvements can allow for more efficient use of existing infrastructure.

According to the Oregon Department of Transportation, “Cities and other major activity centers tend to have a relatively poor vehicle mobility (due to congestion), but are economically successful due to excellent accessibility (activities that are clustered together and many travel options).”⁷

How to Measure and Evaluate?

With climate change, we are in the midst of what some scientists refer to as an experiment of global proportions. Research must respond accordingly. There is much real-time learning to do to assess what works and how measures interact, and many opportunities to measure and evaluate reactions, interactions, costs and benefits.

Research is needed to determine the tools and agency capacities required to conduct timely analysis and interpretation of travel data, and provide actionable information that is relevant to planners and decision makers.

As we measure transportation system performance, based on continually improving data, we need to analyze the data to characterize and attempt to understand changes in key variables. For example, how much did VMT change, which VMT changed (freight or passenger, for which trip purposes), when and where did the changes occur and what are the likely reasons for those changes?

⁷ ODOT, “Accessibility and Mobility Differences,” www.oregon.gov/ODOT/SUS/accessibility_mobility.shtml.

Out of labs and into the streets!

There is a crucial need for research that occurs in the laboratory and in front of the computer monitor, such as vehicle R&D and data analysis. However, addressing climate change will require that we take a broader perspective on research, and integrate measurement and evaluation more thoroughly into project planning and execution. ***Research is needed to assess options for incorporating measurement and evaluation into standard transportation operating procedures, and to determine the resources required for implementation.***

Requiring GHG measurement for major projects and metropolitan transportation programs would be invaluable for assessing the climate impacts of Federal infrastructure investments. Federal agencies, state MPOs and local governments will need new resources to conduct measurement and evaluation, say up to 1% of project costs so that they face a ‘funded obligation’ and not an unfunded mandate.

3. Improve data and models to enable performance measurement and forecasting

In February, the U.S. House of Representatives and U.S. Senate approved the conference report for the American Recovery and Reinvestment Act (AARA) of 2009. The bill emphasizes **accountability and transparency**, calling for clear, accurate and timely reporting of public benefits, and that programs “meet specific goals and targets, and contribute to improved performance on broad economic indicators.”⁸ The accountability and transparency experience with AARA should offer important insights as Congress and the Administration moves to create a similar framework for upcoming surface transportation bill authorization.

- ***Research is needed on how to increase the transparency of how Federal transportation funds are actually spent*** at the state, regional and local level, including investment type (preservation, road capacity expansion, transit capacity, bicycle and pedestrian facilities , demand management) and specific geographic location.

Research is needed to assess travel data and modeling tools required to support climate policy and performance-based transportation policy.

Accurate, timely and geographically-specific travel data are critically needed to effectively plan, manage and evaluate transportation system performance across a range of issues including economic efficiency, metropolitan accessibility, GHG emissions, energy security, safety and system preservation. Transportation practitioners and researchers have identified deficiencies in the reliability, consistency, completeness, resolution and timeliness of travel data. State and local governments recognize the need, but are concerned about their ability to pay for travel data improvements. Key travel data collection efforts have lost funding or been terminated in recent years. To use the expression of transportation policy expert, Tom Downs, we’re “flying blind” when it comes to transportation data.

In CCAP’s Travel Data and Performance Measurement Workgroup, discussions on performance metrics quickly lead to the critical need for better and different travel data and models, with sufficient funding for data collection and evaluation. Attached to my testimony are the

⁸ <http://www.recovery.gov/?q=content/accountability-and-transparency>

Workgroup's recommendations finalized in January, titled "CCAP Travel Data and Modeling Recommendations to Support Climate Policy and Performance-Based Transportation Policy."

In summary, they recommend to:

- ***Substantially increase funding for transportation data and model improvement.***

We are poised to spend as much as \$500 billion in Federal funds on transportation infrastructure, which will leverage billions more in state, local and private investments. Higher quality and more timely data will be required to ensure that these funds are spent effectively, and, frankly, to credibly make the case for generating a sustainable revenue stream to invest in critical public infrastructure. Increased funding is needed to: collect and improve travel data; research and analyze travel data trends; improve travel models; improve fuel economy measurement; and support cross-agency coordination at the federal, state, MPO and local levels.

- ***Improve Quality and Utility of Travel Data***

Conduct a study and develop recommendations on the highest priority data and modeling improvements needed to support performance-based transportation decisions that reduce GHG. The study should develop recommendations for, with participation from, federal, state, MPO and local governments, as well as experts from the private sector, academia and NGOs. As we move into authorization of a new surface transportation bill, federal, state and local decision makers need such information. Data and model improvement efforts must be strategically focused to balance needs, time, costs and benefits. The recommendations should reflect that the level and resolution of data required will vary by policy scale, geography and scope.

Research is necessary to assess the costs and benefits for states to process, collect and analyze odometer data. This information is needed first to understand local travel behavior and determine land use influence on travel behavior and ultimately to aid policy evaluation and improve predictive capabilities of travel models. Collection and analysis of odometer data could provide quick and useful information on VMT and GHG emissions. MassGIS, the Massachusetts' Office of Geographic and Environmental Information has mapped odometer readings from vehicle inspection and maintenance programs in a way that both protects privacy and illuminates how VMT differs by land use characteristics such as density, mix of uses and regional location. Such information is invaluable in understanding where policy intervention is most needed and can be most effective. Policy makers in California are considering similar data collection and analysis.

Specific data improvement opportunities identified by participants in CCAP's workgroup are included in Appendix A. Highlights include:

- Provide stable funding for the National Household Travel Survey (NHTS) at a frequency appropriate to inform transportation, energy and climate planning, policy design and evaluation.
- Re-instate the Vehicle Inventory and Use Survey (VIUS) to provide information on truck characteristics and truck travel.
- Develop a **national rotating panel** on vehicle and fuel use.

- Expand coverage and increase the detail on the Commodity Flow Survey (CFS)
 - Determine how State departments of taxation fuel track **fuel sales data**, whether these can be mapped to specific retail service station locations.
 - Pursue **electronic data collection tools** such as transponders, GPS, and cell phones, following industry standards to protect privacy. Such data sources would be invaluable for efficient transportation system planning, management, and GHG policy design.
 - **Improve the availability of data from the Census** Transportation Planning Package (CTPP) at the level of detail and small area geography needed to support more extensive travel demand modeling and forecasting.
- **Enhance travel and emissions modeling capacity**
In an age of climate change, transportation planners and modelers are going to be tasked with answering new questions and more detailed questions. New responsibilities will require new resources, tools, practices and staff training.

New research is needed to improve travel and emission modeling capability to address GHG concerns: GHG vs. speed and traffic flow, induced demand, land use, geographic and temporal resolution, transit, non-motorized travel, freight, fuel price sensitivity, and macro system efficiency. Improved travel and land use data will be required to calibrate and apply the models.

Research is needed to develop quick response sketch planning models to complement major regional and state level models.

Specific opportunities identified by CCAP's workgroup include improving models' treatment of:

- Operational issues that affect CO₂ such as speed, acceleration, traffic flow uniformity;
 - Behavioral issues such as response to pricing strategies;
 - Induced travel demand, land use changes (regional, micro, induced development) and non-motorized travel; and
 - Multi-modal freight travel.
- **Improve accuracy and reliability of fuel economy measurements**
New research is needed to measure real-world vehicle fuel economy, continue to develop better driving cycle tests, and conduct research to develop better ways to predict the fuel economy any individual will get. Such vehicle testing could be executed by the US EPA and the California Air Resources Board and used to update their emissions models (MOVES and EMFAC, respectively) to better reflect GHG emissions. Such data are also key for validating, corroborating and analyzing fuel use and VMT data collected by DOT and DOE.
 - **Improve coordination and collaboration across government agencies and levels of government** to support data corroboration, quality assurance, policy design and

evaluation.

Federal agencies such as DOT, EPA, DOE, IRS, HUD and the Census Bureau should share, compare, and integrate complementary data sets (travel, fuel sales, fuel economy, GHGs, demographics, land use) and establish procedures for data corroboration. These agencies should conduct joint research to understand relationships among policy variables and inform policy design. There is also a need to coordinate at the interregional, inter-state and regional levels, especially regarding freight movement.

4. Plan for adapting transportation infrastructure to climate change impacts.

Research on how a changing climate might affect transportation is in its early stages. While there is sufficient information today to begin to assess risks and implement adaptation strategies, further development of data and analysis would help planners, engineers, operators, and maintenance personnel as they create an even more robust and resilient transportation system, ultimately at lower cost. Key research opportunities include integrated climate data and projections, risk analysis tools and region-based analysis.

Research is needed to develop replicable and efficient techniques to inventory transportation infrastructure vulnerabilities to climate change impacts such as sea level rise, storm surge, and flooding. Studies to date on climate change and transportation, such as, a Gulf of Mexico study⁹ have started these inventories, but are not at the level of detail that would allow for effective local decision making on transportation planning. King County, Washington has used available climate change information from University of Washington researchers as a guide to increasing the capacity of their transportation infrastructure to withstand higher river flows including building one major bridge over the Snoqualmie River higher and longer, reinforcing smaller bridges, expanding culvert size under roadways, and using permeable pavement and rain gardens in road projects. Additionally, King County has worked with the same researchers to develop a GIS tool to assess the vulnerabilities of their 31 wastewater treatment facilities around Puget Sound to sea-level rise, storm surge, and tides—a tool that can also be applied to assessing transportation infrastructure vulnerabilities.

CCAP sees the need for ***national climate services extension networks***¹⁰ to provide customized information and technical assistance to better adapt transportation planning, infrastructure and operations to climate change impacts, including:

- Best practices in evacuation planning and execution
- Hardening of buildings to create safe shelters that avoid the need to evacuate (e.g. Florida International University Campus Library)

⁹ Final Report of Synthesis and Assessment Product 4.7, Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study
<http://www.gcrio.org/library/sap-final-reports.htm>

¹⁰ For more information on CCAP's approach to national climate services and extension networks, see Appendix B and the Urban Leaders Adaptation Initiative: <http://www.ccap.org/index.php?component=programs&id=6>.

- Research on innovative materials and material standards for transportation infrastructure to withstand climate extremes (e.g., cold for permeable pavement; heat for rails);
- Research how to mitigate subway flooding.

Other opportunities include:

- Interagency Joint research conducted by NOAA, EPA, DOT, DOE, U.S. Geological Survey, DOE, National Center for Atmospheric Research, with state, regional and local transportation planners to *develop climate change scenarios*, including probabilities of occurrence, and evaluate risks to transportation infrastructure under the scenarios;
- FEMA research to *update flood maps* that reflect climate change scenarios, and use these to evaluate transportation infrastructure vulnerability;
- Research to improve *transportation and weather data collection and integration*, including from fixed and mobile, sources to improve the resilience of transportation systems to climate extremes; and
- Research on the *impact of future development patterns on the vulnerability* of infrastructure, natural resources and communities to climate change impacts (e.g., development in floodplains, coastal and desert areas, slope instability).

Summary

We are about to invest some \$500 billion on transportation infrastructure. Or at least we need to. How can we find the courage and vision to generate the revenue streams needed to maintain, improve and thoughtfully expand our transportation system? I think of the \$500 billion as an investment in a robust economy, in a sustainable environment, in energy security and public health. I believe that the ambitious research agenda I propose would provide critical support for a performance-based approach to transportation policy, grounded in verifiable facts, sound analysis and accountability for outcomes.

It used to be that when driving somewhere new, we sometimes had to stop at the gas station to ask for directions. Now we can be thankful for our GPS navigators, and for the research, technology, data and information systems that make them work. To address climate change, to help our economy thrive – we have a pretty good idea of where we need to go, but we’re not exactly sure how to get there. We’re not lost, but we need navigation guidance.

A robust and applied research effort can provide that guidance for us. High quality data and reliable information systems will be critical, so we don’t have to listen to that the electronic voice say “recalculating” or “lost satellite reception.” I look forward to the Subcommittee’s leadership in guiding us forward to hear, “now arriving at destination!”

I would be happy to respond to any questions the Subcommittee may provide. Thank you.

APPENDIX A: Further Travel Data, Model Improvement & Research Opportunities

Below I offer additional detail on travel data improvement opportunities:

Travel Data Improvements

- Provide stable funding for the National Household Travel Survey (**NHTS**) at a frequency appropriate to inform transportation, energy and climate planning, policy design and evaluation
- Improve land use, travel patterns and demographic data in the NHTS and the ACS
- Re-instate the Vehicle Inventory and Use Survey (**VIUS**) to provide information on truck characteristics and truck travel.
 - Expand the VIUS to include buses and passenger cars.
- Develop a **national rotating panel** on vehicle and fuel use (e.g., 5,000 participants at any time, done quarterly, with participants tracked for a year).
- Re-recruit people already in several travel surveys across many regions of the nation and to design a plan that stratifies regions by type and size.
- Add fuel use diaries to the EIA Residential Energy Consumption Survey
- Expand coverage and increase the detail on the Commodity Flow Survey (**CFS**)
- Determine how State departments of taxation fuel track **fuel sales data**, whether these can be mapped to specific retail service station locations, and what it would take and cost to process such data to be available at the metropolitan regional level, state level and aggregated to the national level.
- Examine how the IRS ExSTARS data base can be used to identify the State of destination for gallons of motor fuel sold to better determine how much fuel to attribute to each State. This would improve data currently used in formulas that apportion Federal funds to the States.
- Survey design and implementation refinements:
 - Conduct travel surveys in census years.
 - Include weekend data in any survey effort.
 - Improve consistency and sampling coverage and reduce margin of error
 - Synchronize vehicle classification reporting and collection methodologies.

Additional Research Opportunities

- Demographic and market trends influencing demand for different real estate products
- Induced investment and travel shifts resulting from highway infrastructure, transit and high-speed rail investment
- Impediments to local implementation of regional smart growth plans including fiscalization of land use
- Impacts of ‘black swan’ events on travel and the economy, such as unprecedented and sustained increases in energy price

APPENDIX B: Detailed Transportation Adaptation Research Opportunities

CCAP sees a need for the Federal government in collaboration with public universities, companies, states, and technical experts around the country to work to **establish national climate services and extension networks** to aid state and local governments in implementing climate change solutions.¹¹ These networks should provide information and technical assistance on:

- adaptation planning and risk management best practices;
 - models, data, decision support tools, hardware, and systems improvements; and
 - early warning on weather and climate impacts.
- These networks should help local governments and communities, particularly in urban areas, to **prepare for and cope with climate impacts** such as severe storms, flooding, sea-level rise, drought, wildfire, and heat island effects
 - These networks should **improve climate related decisions across diverse sectors** such as emergency management, building codes and zoning, ecosystem services, transportation, and water supply and wastewater infrastructure
 - In practice, **merging a classic agricultural extension model with a community organizing and education approach** will ensure that local decision makers, businesses, and citizens will have the resources and information to understand their climate risks, and the opportunity to learn about and participate in solutions to reducing greenhouse gas emissions, preparing for extreme weather, planning ahead for real and emerging climate change impacts, and increasing overall community resilience.
 - Sample transportation climate extension activities:
 - Research, monitor and test of **pavement designs** for roads and parking lots to determine optimum reflectivity and thermal properties to lower urban heat island effects and permeability characteristics to address extreme rainfall and flooding.
 - Assess **frequency and severity of flood impacts** along different road segments under historical and climate change scenarios to determine persistent vulnerabilities in order to assist with travel and evacuation planning.
 - Work with emergency managers to **educate the public, particularly vulnerable populations**, on the basics of severe weather (e.g. hurricanes, tornados, flood, heat) under different climate changes scenarios and what to do in case of emergency or evacuation including shelter in place strategies
 - Strengthen the capabilities of Federal agencies, such as, the National Hurricane Center to convey information to local decision makers and the public at the nexus of **climate change and hurricane preparedness and planning**. Information could include FAQs on the impact of climate change on hurricane frequency and intensity, evacuation planning software tools tailored for local emergency managers, enhancement of flood and storm surge maps, support for community readiness planning, and community vulnerability assessment tools.

¹¹ CCAP Urban Leaders Adaptation Initiative: <http://www.ccap.org/index.php?component=programs&id=6>.

Attachment: “CCAP Travel Data and Modeling Recommendations to Support Climate Policy and Performance-Based Transportation Policy.”

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CCAP Travel Data and Modeling Recommendations to Support Climate Policy and Performance-Based Transportation Policy

Informed by stakeholder discussions in the
CCAP VMT & Climate Policy Dialogue

In an era of shrinking budgets and transportation systems falling short of meeting community needs, there is a growing call for a performance-based approach to transportation policy. The new emphasis on addressing climate change and reducing petroleum dependence reinforces this point. However, current data, models and planning capacity are not up to the task.

Accurate, timely and geographically-specific travel data and planning capacity are critically needed to effectively plan, manage and evaluate transportation system performance across a range of issues including economic efficiency, metropolitan accessibility, greenhouse gas (GHG) emissions, safety and system preservation. Transportation researchers and policy analysts have identified deficiencies in the quality, resolution and timeliness of travel data. State and local governments recognize the need, but are concerned about their ability to pay for travel data improvements. Key travel data collection efforts have been defunded or terminated in recent years.

That is why members of the Center for Clean Air Policy's VMT & Climate Policy Dialogue,¹ a diverse group of governments, advocacy groups and industry, have identified improvements in travel data as a high priority to support policy design, implementation and evaluation. The group discussed at length options for improving travel data to support climate policy and a performance-based approach to transportation policy. The recommendations below reflect the group's general consensus of policies that, if followed, would be of great value to climate and transportation policy design, implementation and evaluation.²

¹ CCAP has convened a unique dialogue of 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 policy packages for reducing GHG emissions associated with travel demand or vehicle miles traveled (VMT) in upcoming climate and transportation legislation. CCAP is carrying out the VMT and Climate Policy Dialogue using its well-tested approach of bringing diverse interests together to share lessons learned, consider diverse view points and develop a common understanding of potential policy options. The premise of the dialogue is that slowing VMT growth and increasing system efficiency are needed to complement vehicle efficiency improvements mandated in the 2007 Energy Bill, a potential CO₂ cap on petroleum refiners and any low carbon fuels standard in meeting long-term climate protection goals.

² CCAP is preparing a supplemental memo listing some specific recommendations to make the overarching recommendations more actionable (e.g., re-establish VIUS survey).

**CCAP Recommendations to Improve Travel Data and Modeling
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FINAL: January 30, 2009

General Observations

1. High quality data are essential for performance-based transportation policy with implications across a broad range of national priorities including climate change, system efficiency, metropolitan accessibility, economic development, safety, system preservation and petroleum use.
2. Developing, implementing and evaluating GHG reduction policies will require improved travel data and modeling capacity.
3. The required precision, resolution and quality of data and modeling will vary by application (planning, policy evaluation, financing, regulation).

Key Recommendations for Improving Travel Data and Modeling

1. Substantially Increase Funding for Travel Data Improvement:

- a. Travel, fuel use and land use data collection and improvement
- b. Research and analysis
- c. Travel modeling improvements
- d. Fuel economy measurement
- e. Cross-agency coordination at the federal, state, MPO and local levels

2. Improve Quality and Utility of Travel Data

- a. Conduct a study and develop recommendations on the highest priority data and modeling improvements with recommendations for, and participation from, federal, state, MPO and local governments, as well as experts from the private sector, academia and NGOs.
 - i. Assess the costs and benefits of collecting and integrating travel and fuel use data from multiple sources to fill holes, corroborate data and assess interactions among policy variables.
 - ii. Assess the appropriate level and rigor of data for different uses and users.
- b. Assess the costs and benefits for states to process, collect and analyze odometer data to track local travel behavior and determine land use influence on travel to aid policy evaluation and improve predictive capabilities of travel models.
- c. Enhance collection and analysis of freight data

3. Enhance Travel and Emissions Modeling Capacity

- a. Improve travel and emission modeling capability to address GHG concerns: CO₂ vs. speed and traffic flow, induced demand, land use, geographic and temporal resolution, transit, non-motorized travel, freight, fuel price sensitivity, and macro system efficiency. This will require improved travel data.
- b. Provide resources to help states, MPOs and local governments to enhance modeling capacity and shift towards advanced travel models while maintaining and improving current models.

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4. **Improve Accuracy and Reliability of Fuel Economy Measurements**
Provide resources to expand testing of real-world vehicle fuel economy, continue to develop better driving cycle tests, and conduct research to develop better ways to predict the fuel economy any individual will get.

5. **Coordinate and Collaborate Across Government Agencies and Levels of Government** to support data corroboration, quality assurance, policy design and evaluation.
 - a. Share, compare, and integrate complementary data sets (travel, fuel sales, fuel economy, GHGs, demographics, land use) and establish procedures for data corroboration.
 - b. Analyze data and conduct research to understand relationships among policy variables and inform policy design.
 - c. Provide guidance, technical support, tools and information on: data collection, data integration, model improvement, planning, scenario analyses, best practices, policy design, implementation and evaluation.

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Representatives from the following organizations participated in the VMT & Climate Policy Dialogue Meetings:

AASHTO	National Governors Association
ACEEE	New York City DOT
APTA	New York State Department of Environmental Conservation
Arlington County, VA	North Carolina Division of Air Quality
AMPO	North Central Texas Council of Governments
Bay Area Rapid Transit	NRDC
BBG Group	Pennsylvania DOT
Bi-Partisan Policy Institute/NTPP	Rails to Trails
BP	Sacramento Air Quality Management District
Brookings Institution	Sacramento Area Council of Governments
California Air Resources Board	Serafix
Clean Air Task Force	Smart Growth America
East-West Gateway COG	STPP
Entergy	Transportation for America
Environmental Defense Fund	UC Berkeley
Exxon Mobil	US EPA
Federal Highway Administration	Utah DOT
Ford Motor Company	Van Ness Feldman
American Honda Motor Company	Veolia Transportation North America
Kansas DOT	Virginia DOT
Maryland DOT	WRI
Metropolitan Transportation Commission	

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About the Center for Clean Air Policy

Since 1985, CCAP has been a recognized world leader in climate and air quality policy and is the only independent, nonprofit 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.

