

**Climate Change and Adaptive Strategies in Sub-national Transportation Planning  
Agencies in the United States**

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## **Introduction**

Despite the potential for billions of dollars of damage, the possibility of climate change's impact on transportation infrastructure has received little attention. Most of the focus on the climate/transportation nexus has been on impacts to the environment caused by transportation sources, such as automobile emissions. However, considerations of adaptation to the potential impacts from sea level rise, changes in precipitation and temperature and an increase in magnitude and frequency of severe storms is equally important and there has been little attention to how transportation infrastructure, and its associated governance systems, will respond. This is particularly important in areas vulnerable to sea level rise, storm surge, and flooding.

Adaptive strategies to large scale climate changes in the United States will primarily be addressed at the sub-national level. For transportation infrastructure, this adaptation will need to occur in 1) the departments of transportation (DOT) in each of the 50 states, and 2) the Metropolitan Planning Organizations (MPOs), regional transportation planning and support agencies. Much of the impact of climate variability will be felt at these levels, and there will be significant negative implications for not developing adaptation strategies.

This paper presents preliminary findings and recommendations from a research project focusing on adaptive measures at these sub-national levels of government. Specifically we are interested in the question of whether state and regional governments are currently including climate change impacts or vulnerability issues in their decision and planning processes. As an initial product from this research project, the focus in this paper is on the basic question: are state DOT and MPOs in the United States addressing the issue of climate change in general, and more specifically, the issue of adaptation to potential climate change and variability impacts? Following an introduction focusing on current research on climate change and adaptation from the transportation planning perspective we outline the methods and findings from this research. We then outline the next steps for this research project. In conclusion we respond to issues raised in Biermann's recent article (2007) on earth system governance and discuss its implications to the context described in this paper.

## **Climate Change, Adaptation, and Transportation**

According to the U.S. Department of Transportation's (USDOT) Center for Climate Change workshop, projected climate-related changes in sea level, weather patterns, temperatures and precipitation, and an increase in extreme weather events (including tropical storms and hurricanes) will adversely affect transportation infrastructure and decision making (2002). Transportation infrastructure across all modes is considered to be vulnerable to these impacts, even in the near future. Much of the debate over climate change and transportation has previously been focused on mitigating the impact of automobile greenhouse gas emissions. However, the need to link climate change/variability science, (including modeling, risk analysis and assessments, regional impacts assessment, projections and probabilities) with adaptive strategies, regardless of the cause, has risen on the decision agenda within the USDOT and the Transportation Research Board. Key findings from the USDOT workshop identified research needs in the area of climate change assessment integration with existing transportation decision processes and for an assessment of response strategies. Much of the impact of climate

change and variability will be felt at the state and regional levels, and there will be significant negative implications for not developing adaptation strategies at these decision and policy levels.

The impact of climate change/variability on transportation is an area which has seen little attention, considering the significant potential damage to billions of dollars of critical infrastructure in this country. Much of the focus on the climate/transportation nexus has been on the impact to climate from transportation, such as automobile emissions, and policies designed to mitigate this impact. The other side of the equation, and equally as important, is adaptation and recovery, and there has been little attention paid to how transportation infrastructure can adapt to potential changes or variation in climate and how this infrastructure will recover from specific negative events. Adaptation to change and recovery from specific events presents important policy process issues for transportation planners and decision makers, yet there is a surprising lack of research being conducted on these issues.

In an early report on the linkages between climate change and transportation the U. S. Department of Transportation (1998) released a report analyzing the potential impacts of global climate change on transportation. While most of the report focused on the contribution of transportation to the GHG problem, adaptation was raised as a potential response to such potential impacts as sea level rise. For example, technical solutions such as seawalls, were suggested for protecting roads and causeways in coastal areas. Airports would also require sea walls and port facilities would need improvements to handle higher tides. It also noted that freight transportation systems would need to adapt to increases in severity and frequency of severe weather patterns. Land use planning was also suggested as an adaptability mechanism. This would be particularly significant in coastal areas that could potentially see massive disturbances of the population.

Several years later, the 2002 workshop conducted by the U.S. Department of Transportation Center for Climate Change & Environmental Forecasting brought together experts from diverse backgrounds working on climate change impacts. Participants agreed that more research was needed to better understand shifts in weather patterns and potential impacts on infrastructure as nearly all infrastructure could be considered vulnerable: sea level change requiring the relocation of roads and airport runways, and the flooding of underground tunnels and damaged pipelines from increased freeze-thaw cycles. Ultimately, the workshop summary report stresses the need for more comprehensive research on climate change and its impacts and disseminating the information to key transportation decision makers. More recently, the Transportation Research Board's (TRB) established its Committee on Climate Change and U.S. Transportation, to examine "the potential consequences of climate change of U.S. transportation and possible adaptation strategies." The Committee expects to release a report in 2007, outlining their findings.

These developments suggest an incremental movement in the United States toward recognition of the significance of climate change impacts on transportation, yet many other relevant stakeholders have not addressed the need for climate change adaptation to transportation. A review of planning and strategic documents from relevant interest groups including the American Association of State Highway and Transportation Officials (AASHTO) and National Association of Regional Councils (NARC), and the American Planning Association supports this assertion as even these institutions are not

addressing the climate change issue. Overall, the picture in the United States in regard to adaptation of transportation infrastructure and system to potential impacts from climate change suggests that currently this issue is not on the agenda for most of the relevant stakeholders in the transportation planning and decision processes. As McBeath states: “American governments at the federal levels and at the state and local levels have been slow to respond to the evidence of climate change impacts” (2003, 4).

The Canadian perspective more thoroughly addresses the impacts of climate change on transportation and possible adaptation mechanisms. According to Transport Canada (2004), global warming may be a net savings to the country. Yet, significant problems will arise from a shift in temperatures. In Northern Canada, roads will experience increased damage from more frequent freeze-thaw cycles. These northern roads may require expensive changes in design and maintenance. The report indicates that more populous areas in southern Canada are susceptible to change. For example, an increase in sea level may cause flooding of coastal areas. Additionally, as the Great Lakes evaporate more quickly, ships will be required to carry less payload, increasing shipping costs. Yet there are benefits to warming a cold climate. The document indicates that warmer temperatures may extend the road construction season and increase Arctic shipping.

The report suggests several mechanisms for adaptation. One possible solution is to relocate facilities in coastal areas, threatened by sea level rise. Another option requires spending more money for road maintenance and supplies. Transportation officials will want to select better asphalt, one that can withstand the increase freeze-thaw cycles of the northern regions. This recommendation is echoed by Haas, et al (2006), in their 2006 Transportation Research Board paper which suggests selecting less frost susceptible foundation materials as an adaptation strategy, and also that roads will need more frequent maintenance. A 2003 conference, “Impacts of Climate Change on Transportation in Canada,” underscores anticipated impacts of climate change noted above. Conclusions from the workshop include suggestions for government planning and preventative measures (Transport Canada 2003).

In the UK, the Department of Transport’s report, “The Changing Climate: Impact on the Department for Transport” (2005), details the impact of climate change on the transportation system. In general the report suggests that climate change will bring an increase in flash floods and harsher weather conditions in the country. Officials believe that poor travel conditions will result in a transport system that runs with less safety and performance than before. The report largely ignores adaptation measures, but does say that transportation infrastructure will no longer be built in flood-prone areas. They credit the delay in action to uncertainty about climate change, citing that stakeholders want more certainty before investing in transportation upgrades. Finally, according the European Environment Agency, many European Union countries are developing climate change adaptation plans. For example, in Denmark, transportation planners considered an anticipated rise in sea level when developing Metro stations (European Environment Agency, 2005).

## **Research methods**

In order to address the general questions raised in this research, we conducted World Wide Web searches for relevant policy documents from our target agencies (state DOTs and MPOs). For the search of the 50 state DOTs, we downloaded and reviewed general

state transportation plan documents, mission statements, or strategic plans. Multiple documents for each state were generally assessed for this task as most states provide a general policy or strategic statement or summary, plus more extensive mobility or statewide transportation planning documents. The Texas Department of Transportation, for example, publishes the following relevant documents:

- TxDOT has a Plan: Strategic Plan for 2007-2011 (2007a)
- 2007 Unified Transportation Program: Statewide Mobility Program (2007b)

The Strategic Plan outlines the general vision, mission, goals and strategies, while the Statewide Mobility program is an extensive project by project matrix of budget and spending priorities for the State. We conducted a similar approach to identifying and reviewing the MPO transportation related documents for the approximately 70 largest MPOs in the United States. The objective in this task was to identify those states that explicitly include “climate change” in the text of these documents, then to further identify if “adaptation” was included in the discussion. While this approach may seem simplistic, the objective was to develop a baseline understanding of the extent to which these agencies are including climate change and adaptation in their plans and programs. To date even such a simple understanding has not yet been systematically developed.

### **Preliminary Findings**

Overall, we find that the state and regional transportation agencies are not including climate change, much less adaptation, as factors in these documents. At the State level we find only four States (California, Connecticut, Oregon and Washington) explicitly mentioning climate change.

The California Transportation Plan 2025 (2006) includes several mentions of climate change, including a relatively strong statement in the initial Trends and Challenges section of the Plan under the “Environmental Impacts” section:

“The earth’s atmosphere is warmed resulting in climate change and potential adverse impacts to public health, agriculture, forests, storm frequency and intensity, mountain snow pack, smog, and rising sea levels” (2006, 21).

Additional mention of climate change shows up in later sections of the plan, under goals to enhance the environment, by focusing on GHG emissions. No specific goals or strategies are articulated to adapt to potential impacts from climate change, however.

The Long-range Transportation Plan for the State of Connecticut (2004) includes climate change as an issue in the section on environment, energy conservation and quality of life. While the section mainly focuses on greenhouse gas emission strategies, one action item does focus on what can be interpreted as adaptation:

“Encourage efforts that focus on risk and response assessment, including prediction tools, products and strategies for potential maintenance, system planning, safety management and emergency preparedness issues arising from global climate change.”

Similarly, the Oregon Transportation Plan includes the reduction of GHG emissions as one of its “Sustainability” goals (Oregon Department of Transportation 2006, II-14). While not linked directly to climate change, one of the key stressors of climate change, flooding, was also identified in the Oregon Transportation Plan as a natural disaster that

would impact “on the efficiency and sustainability of the location and design if new or improved transportation facilities as appropriate” (Oregon Department of Transportation 2006, II-15). In Washington State, the most recent Transportation Plan (2006) also links transportation and environmental quality with climate change, focusing on emissions and related issues. No specific mention was made of adaptation.

Similar results were found from the MPO assessment. Very few of the MPOs include climate change as an issue in their transportation planning documents. For example, the Grand Valley (Michigan) Metropolitan Council (2007) includes one mention of climate change in its section on biodiesel as an alternative fuel to help reduce emissions. The Pioneer Valley (Massachusetts) Planning Commission (2007) does not include climate change as an issue, only a brief note that several of its communities participated in a local climate change and transportation project for emission reduction planning.

One exception is in the Metropolitan Transportation Commission (MTC), the San Francisco Bay area agency responsible for regional transportation planning. Although its most recent transportation plan (2005) does not mention climate change or its impacts, they did develop public workshops of a more general level on climate change and the Bay Area (2007). Adaptation was included as a strategy for one of the partner agencies, the Bay Conservation and Development Commission, but not for the MTC. Overall, however, the workshop raised the question of how regional agencies and resources should be devoted to adaptation. This suggests that the MTC may include adaptation issues in future transportation plans for the area.

Our search for climate change and adaptation concepts in state and regional transportation plans and policy statements represents the initial research tasks for a larger project currently being conducted. The next tasks will provide significantly more detail into the inclusion, or lack of inclusion, of these concepts into long range planning at the sub-national level in the United States. Specifically we will be conducting a survey of the 50 state DOTs and 70 largest MPOs and case studies of those states and MPOs that are including climate change as a factor in their planning and decision processes. Significant questions will be answered in these subsequent tasks, specifically, why are these long range focused agencies not considering climate change in their planning and programming decisions? Most of the state DOT plans are forward looking, covering multiple years (2007- 2026, 2004-2030, for example), which would correspond to a similar long range perspective on climate change stressors.

[NOTE: the survey was in the process of being administered at the time this paper was uploaded for the Conference. Please contact the author for survey results and other questions.]

### **Conclusions and Response to Biermann (2007)**

We conducted a systematic assessment of state DOT and MPO transportation planning documents on-line in order to develop a baseline understanding if these agencies are including climate change and adaptation as a factor in their planning processes. Our preliminary findings reveal that few of these agencies, in spite of their focus on long range planning issues, include climate change as an issue or potential problem, and even fewer introduce the concept of adaptation in regard to potential impacts from climate change. Future research for this project will seek to determine the rationale behind this

situation and whether these agencies are considering climate change and adaptation for future plans and policies as the issue rises on the decision agenda in this country.

In conclusion we provide a general response to the Biermann (2007) paper on earth system governance that outlines the general theme of this conference. This response is in the context of Biermann's definition of governance as "new forms of regulation that differ from traditional hierarchical state activity ... and new forms of multi level policy" (3). Transportation by its very nature is transnational or global in that transportation systems, like rivers, do not stop at international borders, for the most part, even if there are border zones or institutional interruptions. This is becoming increasingly evident as commerce and the role transportation plays in the movement of goods and services expands in the global community. While the system of transportation may appear to have global characteristics in its current state, in its governance structure in the United States it is anything but global or integrated. Our current system of transportation governance in the U.S. is to divide up responsibility between federal, state and local levels, first, and mode, second, with little attention paid to the connectivity context.

In particular, Biermann's discussion of functional interdependence (2007, 5) will be problematic its relation to transportation systems. The focus on intermodalism and multimodalism in the early 1990s in U.S. transportation planning activities, culminating with the Intermodal Surface Transportation Efficiency Act of 1991 recognized the interdependence that Biermann raises in his article. These have been difficult concept to grasp, institutionalize and implement in traditionally rigid modal/sectoral environments for decision making as the state DOTs and MPOs. However, using Hurricane Katrina as an illustration, the transportation community was reminded of this interdependence as barges full of grain and other commodities sat up stream on the Mississippi River with nowhere to go following the damage to the New Orleans area port structure.

Finally, Biermann states that the core functions of the state needs to evolve into what he terms an "adaptive state," or one able to "adapt to sudden alterations of the natural environment" (2007, 8). This will also be problematic at the sub-national levels of government in the U.S. in regard to transportation planning and decision making. In spite of the long range perspective (estimated longevity of a structure or roadway), the focus is on making it durable or stable enough for as long as possible so you don't have to revisit it, or adapt it to changing conditions. The focus is on maintenance to a steady state or condition. It will be a significant challenge to move the transportation community in the U.S. to such an adaptive system as Biermann suggests. An initial step in moving these agencies closer to the adaptive state, however, is to understand where they are now in regard to climate change and adaptation, and in understanding what the barriers and constraints are to integrating these issues into their policies and decision processes. The paper and research presented here is part of this initial step to increasing our understanding of this significant issue.

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