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Critical Issues in Transportation 2019: Climate Change Resilience

Vicki Arroyo
Georgetown University Law Center, vaa@georgetown.edu

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The climate is rapidly changing, bringing more frequent and extreme floods, droughts, and heatwaves, along with stronger hurricanes and more intense wildfires. Each year brings new record-breaking weather extremes; in the first six months of 2019, for example, a record number of U.S. counties flooded. July 2019 was the hottest month ever recorded for the world as a whole (1). Climate change is also melting glaciers, reducing the amount of sea ice, and raising sea levels, bringing devastation to coastal areas. From Louisiana to Alaska, many coastal communities are forced to make difficult decisions about whether to relocate to less-vulnerable areas.

As detailed in the Fourth National Climate Assessment, these extremes pose serious threats to transportation systems, making it more difficult for these systems to provide the crucial services relied upon by individuals, communities, and other critical systems (2). There is an urgent need for decision-makers at all levels of government and in the private sector to better prepare transportation assets, systems, and workforces for a changing climate. In particular, decision-makers need better information, new tools, innovative best practices, and implementation assistance.

Last year, the Transportation Research Board (TRB) published a new edition of Critical Issues in Transportation, which identified climate change—and the need for resilience—as one of the critical issues now facing transportation (3). Critical Issues 2019 poses several key questions: how best to use climate information to improve risk-based decision-making; how to communicate adaptation successes from states and localities; how to build flexibility and adaptability into policies, designs, and standards; how to make the business case for adaptation; and how to facilitate managed retreat and discourage risky investments.

This article describes current work on building resilience to climate change impacts in which states and cities are often...
evaluated vulnerabilities of transportation infrastructure in the Gulf Coast region; the Transportation Engineering Approaches to Climate Resiliency project, which identified methods for different engineering disciplines to integrate climate considerations into project development within different engineering disciplines; and the Hurricane Sandy Follow-Up Study, which assessed impacts from Sandy and climate-related vulnerabilities to assets in the New York area and identified adaptation strategies. Informed by these pilot projects and research efforts, FHWA has developed an adaptation decision-making framework and a range of complementary tools and guidance documents.

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Other modal administrations within U.S. DOT have contributed to the collective knowledge on climate change effects in the transportation sector as well. For example, the Federal Transit Administration (FTA) report Flooded Bus Barns and Buckled Rails documents current and anticipated climate impacts to public transportation systems and transit agencies’ efforts to adapt their infrastructure to those impacts (4). In 2011, FTA funded pilot projects for transit agencies in seven regions to help decision-making. FHWA’s primary roles have been to support states and regions, to build resources and tools that are informed by lessons from the states, and to accelerate innovation by supporting research pilots.

FHWA has funded five rounds of pilot projects that have allowed state departments of transportation (DOTs) and metropolitan planning organizations (MPOs) across the country to assess and map climate and extreme weather-related vulnerabilities, to evaluate adaptation options (including nature-based options in coastal areas), and to integrate resilience into asset management processes. FHWA has also funded other projects and studies over the years, including the Gulf Coast Study, which

leading the way. It is also important to point out that, in addition to being vulnerable to climate impacts, transportation is now the largest source of greenhouse gas emissions that contribute to climate change. Therefore, immediate action is required to reduce emissions too, with states taking the lead on this work as well.

**Federal, State, and Local Action**

At the federal, state, and local levels, many transportation agencies have been working to understand climate change’s impacts to their systems and to integrate these findings into decision-making processes. As suggested in Critical Issues 2019, these experiences should be evaluated and shared to foster a common understanding of how climate change affects transportation systems and what can be done about it.

**Federal Activities**

**FEDERAL HIGHWAY ADMINISTRATION**

For more than a decade, the Federal Highway Administration (FHWA) has led efforts to improve the collective understanding of climate change impacts to surface transportation and to develop tools and methodologies that can inform decision-making. FHWA’s primary roles have been to support states and regions, to build resources and tools that are informed by lessons from the states, and to accelerate innovation by supporting research pilots.

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Transportation is vulnerable to climate change, but it also is the largest contributor to the emissions that worsen climate change.
Broward County, Florida, passed an ordinance requiring the use of “future conditions” maps, which consider sea-level rise effects on the groundwater table, when making decisions to approve drainage or water-management infrastructure projects.

New York City has adopted and updated climate resiliency design guidelines to account for climate-change projections and impacts in the design of city capital projects. San Francisco, California, developed guidance in 2014 for considering sea-level rise in the capital planning process. Communities across the country are also implementing green infrastructure programs to help manage the increasing rainfall- and stormwater-driven flooding often associated with climate change.

**TRB’s Role in Advancing Transportation Resilience**

TRB has been working for more than a decade to advance the transportation community’s understanding of how climate change and extreme weather affect this critical sector and how decision-makers can create assets, systems, and processes that are more resilient. As the leading research institution on transportation in

Other states have begun to assess climate change impacts to their transportation systems and to identify viable adaptation strategies for the future. These efforts have taken the form of preliminary studies and literature reviews (Arizona DOT); transportation vulnerability assessments (Rhode Island DOT); standalone transportation adaptation plans (Oregon DOT and District DOT in Washington, D.C.); and infrastructure chapters in multisectoral, statewide adaptation plans (Pennsylvania).

**Local Leadership**

Municipalities and regional agencies (MPOs, port authorities, and other agencies) are engaged in adaptation planning, capturing best practices, and developing policies integrating resilience considerations into decision-making. For example, MPOs in Chattanooga, Tennessee; Boston, Massachusetts; and Charlotte County, Florida, have made strides integrating climate resilience into their planning efforts.

Some local governments are incorporating risk mitigation and resilience into project design and other policies and requirements related to infrastructure investment decisions. For example, them analyze risks and, in some cases, develop adaptation strategies (5). After Hurricane Sandy, FTA used a portion of its disaster recovery funding to administer a competitive resilience grant program.

**State Leadership**

States have led the way in preparing their transportation systems for climate change, modifying their transportation planning and programming processes and integrating resilience considerations into state legislation, executive orders, and agency policies. For example, California passed legislation in 2016 requiring the development of a Climate-Safe Infrastructure Working Group to recommend methods to integrate climate science into state project engineering.

In New York, the 2014 Community Risk and Resiliency Act mainstreamed considerations of climate change into state investment decision-making. This included adoption of official statewide sea-level rise projections and development of new criteria for evaluating public infrastructure projects that consider sea-level rise, storm surge, and flood risk mitigation.

Since 2009, Washington State DOT’s environmental review process has incorporated guidance for evaluating climate change impacts to transportation projects; more recently, the agency also developed guidance for integrating climate resilience into transportation planning. Washington State DOT also has developed a Community Planning Portal that provides a variety of data for transportation planning purposes.

As part of its environmental impact plan, Washington State DOT is exploring options for modifying ferry terminals to adapt to rising sea levels.
The United States, TRB plays a vital role in the field of climate resilience and climate change research through its convening, research, and communications activities. TRB’s Executive Committee convened two separate task forces focused on resilience—with the second also focused on sustainability issues more broadly—which developed recommendations on research gaps and strategic actions that TRB could take to further its work in this field. TRB’s recently updated 5-year strategic plan was informed by the recommendations of these resilience task forces as well as the needs identified in Critical Issues 2019.

In addition, a wide range of National Cooperative Highway Research Program (NCHRP) projects and publications have led to development of information about climate change impacts to transportation, best practices for adaptation, and ways to improve decision-making to reduce risk. These include the ongoing efforts to produce a resilience primer for state DOT CEOs [NCHRP Project 20-59(55)], a research roadmap focused on resilience and implementation [NCHRP Project 20-59(54)], and support tools for state DOTs to facilitate and accelerate the use of existing resilience research and deployment of resilience practices (NCHRP Project 20-117).

Various committees within the Technical Activities Division have promoted research in this area by identifying resilience research needs and sharing research results. The TRB Special Task Force on Climate Change and Energy has helped to coordinate committee activities related to climate change, including resilience-related work. TRB also elevated the topic of transportation resilience through convening activities and by including resilience as a “hot topic” at recent Annual Meetings. TRB cosponsored the First International Conference on Surface Transportation System Resilience to Climate Change and Extreme Weather Events in 2015, as well as an international exchange in Brussels, Belgium, among experts on transportation resilience in 2016.

In 2018, TRB sponsored the Transportation–Resilience Innovations Summit and

Future Directions for Resilience Research

Although some agencies, states, and academic institutions are developing tools and expertise to evaluate future impacts and prepare systems, many informational, legal, financial, and institutional barriers remain—as do many questions.

There still are more questions than answers on how to align land use, development, and transportation policies and investments with the necessary adaptation strategies. For example: how can communities best implement managed retreat from flood-prone areas? How can solutions be designed and managed to

 Chattanooga, Tennessee, and other cities have integrated electric buses into their fleets in response to climate resilience goals.

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3 For more information, see www.mytrb.org/OnlineDirectory/Committee/Details/3465.
prevent cascading failures from extreme events? How can agencies ensure that resilience solutions advance sustainable and equitable outcomes and address other critical issues?

TRB can play a crucial role in answering these questions, and partners like the American Association of State Highway and Transportation Officials (AASHTO) and the Georgetown Climate Center (see sidebar below) can share best practices and provide forums for regular peer exchange to inform practitioners, reduce barriers, and promote solutions. TRB and AASHTO have provided important support to state DOTs by sponsoring workshops and other events, developing reports and case studies, and hosting a 2018 webinar series on current resilience issues facing state DOTs.

With changes already under way and accelerating, transportation officials at all levels of government and the partners who serve them have important roles to play in promoting a transition to a more resilient, sustainable, and equitable system—and must act quickly.

Georgetown Climate Center

The nonpartisan Georgetown Climate Center (GCC) seeks to advance effective climate and energy policies in the United States and serves as a resource to states and communities working to cut carbon pollution and prepare for climate change. GCC works with states to develop innovative policies that reduce emissions from energy and transportation sectors and that help communities adapt to the impacts of climate change.

For example, GCC facilitates the Transportation and Climate Initiative, a regional collaboration of 13 Northeast and Mid-Atlantic states and the District of Columbia that seeks to improve transportation, develop the clean energy economy, and reduce carbon emissions from the transportation sector. GCC’s Adaptation Program helps states and communities prepare for climate change impacts, works to integrate adaptation and resilience planning into all levels of government decision-making, and maintains the Adaptation Clearinghouse, a state-of-the-art database of resources for communities, policymakers, and adaptation professionals. The Clearinghouse has hundreds of entries featuring communities acting on transportation resilience, stormwater management, coastal adaptation, and more.

For more information, visit www.georgetownclimate.org.

REFERENCES


