



CRITICAL ISSUES IN TRANSPORTATION 2019

POLICY SNAPSHOT

The National Academies of
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TRANSPORTATION RESEARCH BOARD

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Introduction

Driverless cars maneuvering through city streets.
Commercial drones airlifting packages. Computer-captained ships navigating the high seas. Revolutionary changes in technology are taking us to the threshold of a bold and unprecedented era in transportation.

These technologies promise improvements in mobility, safety, efficiency, and convenience, but do not guarantee them. Will the technological revolution reduce congestion, fuel use, and pollution or make them worse by encouraging more personal trips and more frequent freight shipments?

The transportation sector also faces other unprecedented challenges. It needs to (1) sharply curb greenhouse gas emissions to slow the rate of climate change and (2) respond to more climate-related extreme weather. It must serve a growing population and cope with worsening highway congestion. It needs to maintain and upgrade a massive system of roads, bridges, ports, waterways, airports, and public transit and determine how to pay for those improvements. The transportation sector also needs to

adapt to shifts in trade, energy, and funding sources that affect all modes of transportation. How will these challenges affect the transportation systems on which consumers and the economy depend?

The answers to these and other questions are critically important. Transportation plays a central role in society and the economy but is frequently taken for granted. Reflect, though, on how much you depend on reliable and affordable transportation to access work, friends and family, recreation, shopping, and worship. Then visualize the transportation networks needed for the daily movement of hundreds of millions of vehicles, ships, planes, and trains to satisfy both personal needs and commercial demands. These networks are enormous and complex. The transportation systems the economy and lifestyles rely on may be challenged dramatically in the coming decades in ways that cannot always be anticipated.

A national conversation among policy makers and citizens about how the country should respond to these challenges

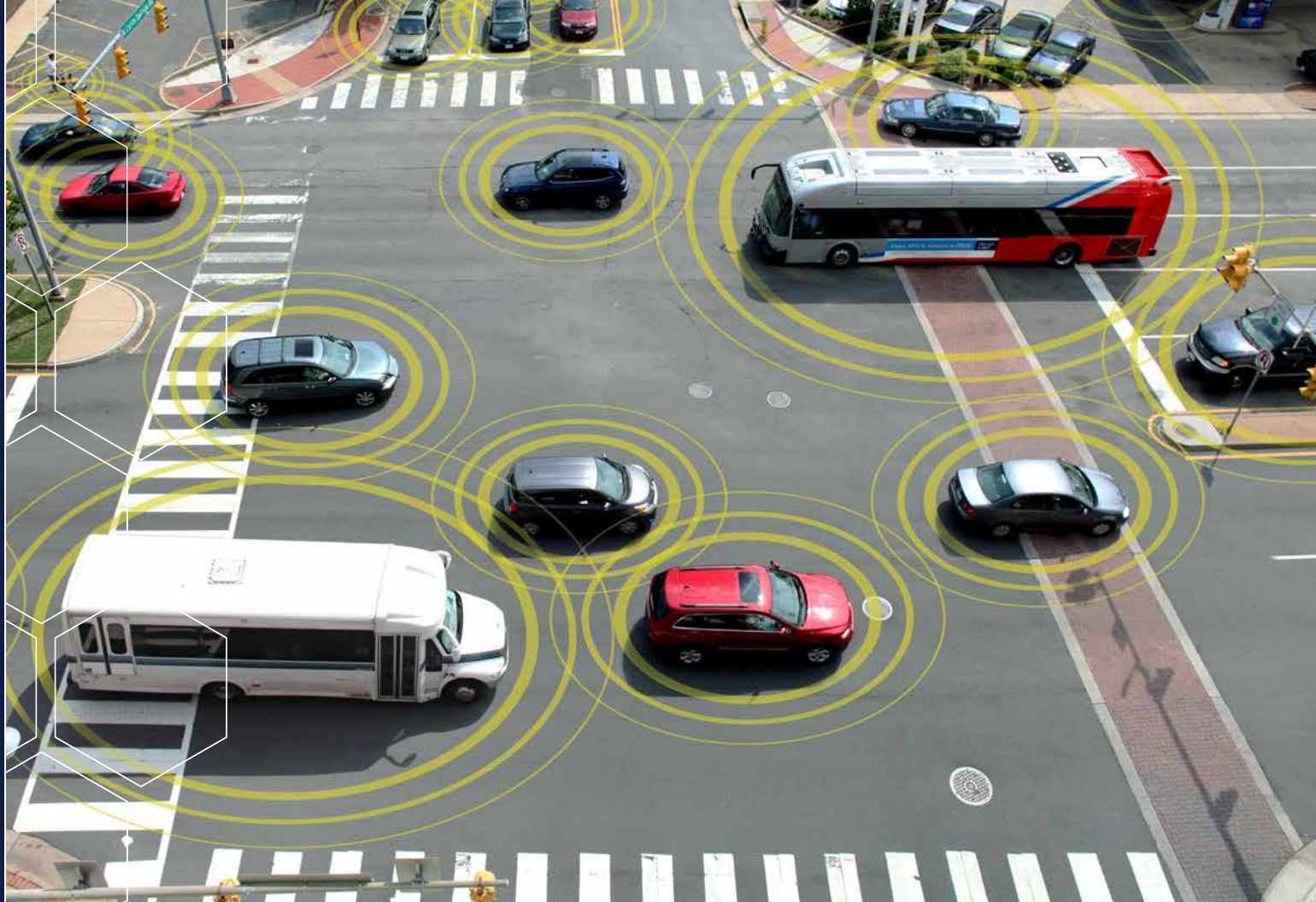
is urgently needed. Stakeholders need to debate, discuss, and analyze how transportation can evolve to meet growing and evolving needs and adapt to changes in society, technology, the environment, and public policy.

To spur that conversation, the Transportation Research Board (TRB) identified and organized an array of important issues under 12 key topics. In each of these areas, TRB posed a series of crucial questions to help guide thinking, debate, and discovery during the next 5 to 10 years.

These 12 topics are neither comprehensive nor mutually exclusive, and no one can know how the future will unfold. But TRB thinks that asking the right questions, even if they cannot be fully answered, helps to motivate the analysis, discussion, and debate required to prepare for the potentially unprecedented changes ahead.

This document is an abbreviated version of a more thorough discussion of the critical issues in transportation. It can be accessed at www.TRB.org/criticalissues.







1. Transformational Technologies and Services: Steering the Technology Revolution

All around the globe, companies are testing automated cars, trucks, ships, and aircraft. Pilot vehicles are already in operation. Some products are almost certain to enter the marketplace in the next few years. Driverless vehicles equipped with artificial intelligence may revolutionize transportation. Perhaps even sooner, vehicles connected to one another with advanced high-speed communication technologies may greatly reduce crashes.

How will vehicle automation—along with connected vehicles and shared ride, car, bike, and scooter services—transform society? These revolutionary technologies and services can potentially speed deliveries, prevent crashes, and ease traffic congestion and pollution. But they could also cause more congestion and more pollution and exacerbate sprawl and inequity. How do we determine and guide, as necessary, the direction of these changes?

How the future unfolds depends on which technologies and services consumers and businesses embrace and how policy makers respond. While we do not know what the future will bring, the changes could be momentous. For example, if we

encourage people to pool rides in driverless electric cars, we could see the service, cost, and environment improve. What policies would best reduce traffic congestion and emissions and improve accessibility for the disabled, elderly, and economically disadvantaged? How do we benefit most from the advent of connected and automated vehicles and potentially transformative transportation services?







2. Serving a Growing and Shifting Population

The U.S. population is expected to grow about 1 percent annually, with highway use increasing similarly. But this growth will not be spread evenly across the country. Urban areas are growing more quickly, particularly clusters of metro areas known as “megaregions,” while many rural areas decline.

At the same time, low-density residential development on the edges of urban areas continues to grow the fastest, which increases traffic and escalates emissions. Although many Millennials are settling in urban centers, more are locating on the edges of cities where Baby Boomers also prefer to live. How do we adjust to and guide travel demand so we are not overwhelmed with more roads, traffic, and emissions as a result of these geographic preferences?

Megaregions in the Northeast, Midwest, South, and West have emerged as economic engines for the economy, but they also have the worst traffic congestion. And their traffic volumes continue to grow faster than new transportation

facilities can be built. What are the best policies and modes for improving travel within each megaregion? How do we ensure that megaregions are well connected to the rest of the nation and the world? How can rural populations be ensured adequate access to jobs and services? How is that access changing? Which policies are needed to provide adequate rural access?







3. Energy and Sustainability: Protecting the Planet

The Earth's changing climate poses one of the most important threats humanity has ever faced. To avoid catastrophic changes, all sectors of the economy need to make drastic cuts in greenhouse gas emissions.

Vehicles, planes, ships, and other forms of transport emit more greenhouse gases than any other sector of the economy in the United States. And that share is growing because other sectors of the economy are reducing their emissions faster than transportation.

Personal vehicles could rely on electrification using batteries or hydrogen as one way to significantly reduce greenhouse gas emissions. Planes, ships, and trucks pose major obstacles to this objective because of their dependence on fossil fuels that pack more power than alternatives. What are the most effective and cost-effective ways of achieving the drastic reductions needed in fossil fuel consumption? What are the appropriate roles for the public and private sectors in hastening this transition? How can the shift to electric vehicles be accomplished without overwhelming the power grid?

Sustainability requires that there be long-term consideration of the implications of decisions and policies on social, economic, and environmental systems. Examples include making decisions based on life-cycle cost considerations and the long-term vitality of communities and key natural environmental systems. How can consideration of long-term sustainability goals be better incorporated into public policy debates and decisions about transportation?







4. Resilience and Security: Preparing for Threats

Recent floods, storms, fires, and hurricanes have disrupted the lives of millions and caused hundreds of billions of dollars in damage. Extreme weather events are exacerbated by climate change, and scientists predict things will get worse. Extreme weather and other natural disasters pose huge and costly threats to the transportation infrastructure.

Public officials face the challenge of making vulnerable highways, bridges, railroads, transit stations, waterways, airports, and ports more resilient to climate change and other threats. What policies and strategies would help them meet this challenge? How do we set priorities, cope with disruptions, and pay for these adaptations?

Terrorists often choose transportation facilities as their targets. Airports and airlines have increased security to guard against terrorism, but other modes of transport—buses, trains, and ships—are more vulnerable. How do we protect these forms of transport without unduly slowing the movement of people and goods?

We also need to address the risks of new technologies. Drones, for example, can be used by terrorists or drug smugglers. Automated vehicles and aircraft are vulnerable to hackers. And all types of transport depend on Global Positioning Systems (GPSs), for which there is no back-up system. How do we make technological advances more secure and resilient?







5. Safety and Public Health: Safeguarding the Public

We depend on motorized transportation, but we pay a price with our health with deaths, injuries, and diseases. Routine highway travel is the source of the vast majority of transport-related deaths and a significant portion of transport-related pollution in the United States. Even though there have been improvements in vehicles and facilities, most crashes are preventable. How do we muster the political will to adopt the most effective measures to reduce casualties and diseases caused by transportation?

How do we encourage the use of the safest vehicle and road designs, reduce alcohol- and drug-impaired driving, and manage operator fatigue? Also, how do we curb driver distractions, especially in semi-automated vehicles that do not require full attention except in emergencies when multi-tasking drivers may be unprepared to respond?

Marijuana legalization and opioid addiction may lead to more people driving while impaired. In addition, pedestrian and cyclist deaths are increasing. What can we do to address these problems? What successes from other countries can be applied?

Air pollution comes from many sources, but some transport emissions, such as the particulates from burning diesel fuel, are especially harmful to people. People living near roads, ports, distribution centers, railyards, and airports—often the marginalized and the poor—are exposed to more of these types of vehicle emissions. How do we best address these problems?







6. Equity: Serving the Disadvantaged

The United States is prosperous, but not uniformly. More than 40 million Americans live in poverty. Outside central cities, an automobile is essential for access to jobs and a piece of the American dream, but about 20 percent of households with incomes below \$25,000 lack a car.

In addition, nearly 40 million Americans have some form of disability, of whom more than 16 million are working age. And the population is aging: the number of people older than 65 will increase by 50 percent from 49 million now to 73 million by 2030.

Access to jobs, health care, and other services can be expanded through transportation policies and programs and technology, but these approaches need to be affordable and effective. This is a particular challenge in sparsely populated areas.

How do we help disadvantaged Americans get affordable access to work, health care, and other services and to family and friends? What policies would ensure that new technologies and services do not create new barriers to the disadvantaged or to rural residents? Also, as we expand transportation networks, how do we ensure that we are not harming low-income and minority neighborhoods?







7. Governance: Managing Our Systems

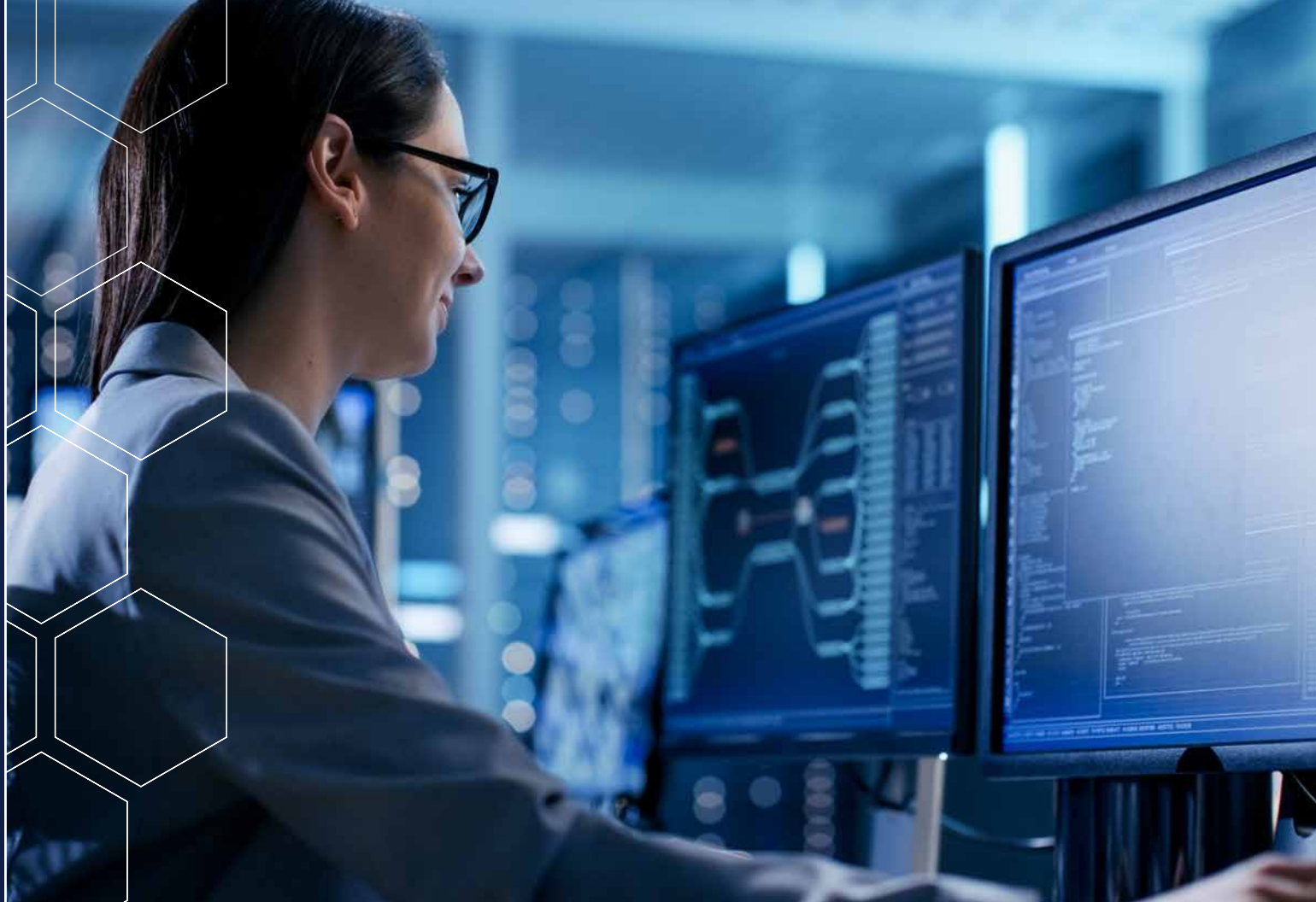
A complex web of institutions manages America's transportation services. Many levels of government, from local to national, play important roles. Some functions, such as public transit, airports, and ports, are managed by thousands of special authorities across the country.

This spider web of governance frequently limits efficiency. For example, urban transport networks often span jurisdictional boundaries, creating disagreement about which agency is responsible for which aspects of planning, funding, and management. Separate funding streams for specific transportation modes impede efforts to provide travelers with multi-modal options. How do we address these challenges, particularly as urban areas grow into megaregions?

The federal government is responsible for interstate waterways and airspaces and for interstate commerce. However, federal leadership and funding for transportation supporting interstate commerce are waning, forcing state and local governments to take on a larger role. How do we ensure that there are efficient networks for interstate travel and international trade as the federal role declines?

New private transportation services efficiently generate enormous data sets about trips. Such data can be helpful to agencies trying to manage system performance. Connected and automated vehicles will add even more information. How can public agencies gain access to these data streams to improve traffic flow while protecting privacy and proprietary information?







8. System Performance and Asset Management: Improving the Performance of Transportation Networks

Highway congestion costs the nation as much as \$300 billion annually in wasted time. Flight delays add at least another \$30 billion. Clearly, demand for travel is outpacing growth in supply and the increasing congestion is costing us dearly.

As the population grows, demand will only increase. However, expanding or building new roads, airports, and other facilities in urban areas is costly, time consuming, and often controversial. How can we serve growing demand in a financially, socially, and environmentally responsible manner?

Transportation officials also need to squeeze more performance out of the existing networks. One way to do this is by managing demand: Charging drivers for peak-period travel in congested areas, for example, has the potential to increase ride sharing and generate revenues for transit, bike paths, and sidewalks. While pricing is more effective than other approaches, it is also unpopular. How do we build public and political acceptance for demand management strategies that work?

In the face of tight budgets, transportation officials must also figure out how to maintain the condition of roads, bridges, airports, and other assets for as long as possible. What research would help increase the durability of construction materials and designs? How do we speed adoption of new information to improve the life-cycle performance of transportation assets?







9. Funding and Finance: Paying the Tab

Fuel taxes and other user fees have traditionally paid for highways, bridges, airports, ports, and public transit. These user fees are generally fair and efficient ways to pay for the transportation infrastructure, which is valued in trillions of dollars. However, improving fuel efficiency undermines the revenue potential from the motor fuel taxes that have been the chief funding source for highways and transit.

Since 1993, federal officials have not raised the fees that fund the federal share of surface transportation and have instead turned to general revenues. In addition, Congress has declined to raise aviation-related user fees, limiting funds for air traffic control and airports.

Although most states have raised motor fuel taxes, state and local government officials are also turning to other sources as the revenues from these taxes decline. One is sales taxes, which can unfairly burden the poor. Also, officials are partnering with businesses to build and maintain roads and other assets. This approach has promising features, but relies on tolls or other charges that are controversial.

With advances in technology, officials can charge highway users by the mile traveled. They could also charge more during peak periods to manage demand and more to gas-guzzling vehicles to reduce emissions. But the public is not widely aware of these options and is not enthusiastic about them when it is.

Clearly, we need to find new ways to maintain and expand the transportation infrastructure. How do we build understanding of the need to invest in transportation assets, identify the best funding options, and reach consensus for action?







10. Goods Movement: Moving Freight

The economy and our lifestyles depend on an efficient system for moving freight. Although railroads and pipelines are privately owned, funded, and managed, the freight system also requires adequate public infrastructure—roads, airports, ports, and waterways—for private companies to carry the goods needed.

Freight movement is expected to grow dramatically in the coming decades to serve the growing population and economy. Without more spending on public infrastructure, this trend could lead to more traffic bottlenecks and capacity problems, especially as overnight and same-day delivery become more popular. How do we provide additional capacity when and where it is needed and ensure that beneficiaries bear the cost?

Government officials face the challenges of providing adequate infrastructure for the freight industry while setting a level playing field for competition among private carriers and across transportation modes. In doing so, they need to account and charge for the costs that trucks, aircraft, ships, and other vehicles impose on public infrastructure. This is a process that is both difficult and controversial. How can officials best foster competition and set fair user fees for the freight industry?

Another challenge for the freight industry is how to reduce its large and growing share of greenhouse gas emissions. One way to do this is through technology: improving batteries and fuel cells to speed the shift to electric-powered vehicles and moving to automated vehicles. Another is by improving efficiency, such as ensuring more vehicles are carrying freight on return trips. How do we make these improvements effectively and affordably?







11. Institutional and Workforce Capacity: Providing a Capable and Diverse Workforce

Government transportation agencies face huge challenges and tight budgets. Their ability to rise to these challenges depends on having capable workers with the tools they need to do their jobs.

These agencies have difficulty competing for and keeping talented workers. They simply cannot pay as much as private industry. How can officials attract and retain the best employees despite the pay disparities between the public and private sectors?

Also, the changing nature of transportation is creating different requirements for the workforce. As a result, transportation organizations struggle to keep workers up to date in the skills they need. This problem is especially acute at the local government level in dealing with complex issues such as climate change and revolutionary new transportation services. How do we address these challenges?

Automated trucks, trains, vessels, and aircraft will disrupt the transportation workforce in both the public and private sectors. What are the likely impacts of these technological changes on transportation jobs? What are the best ways to help displaced workers?

With a growing, changing, and aging population, transportation organizations will need to hire new and diverse employees. How can managers attract more members of underrepresented racial and ethnic groups into the transportation field? How can they minimize the loss of expertise and experience when Baby Boomers retire?







12. Research and Innovation: Preparing for the Future

America is known for innovation. Our discovery and embrace of the new is fueled in large part by public investments in education and research. The revolutionary breakthroughs in transportation-related technology happened because of decades of public spending on basic research.

In addition, steady improvements in the design, construction, operation, and management of transportation infrastructures have been spurred by research funded by government agencies. Public funding for research and education has never been more important, nor more uncertain.

Many experiments are taking place in transportation across the country to meet the challenges of technological innovation and climate change. How do we record, evaluate, and share the results of these experiences and adopt innovations more quickly into standards and practices?

Demands on transportation are growing as public spending on transportation research is declining. At the same time, public officials are often discouraged from taking risks. How do we encourage innovation in transportation agencies? How do we speed the pace of research to keep up with the major challenges transportation faces?



Conclusion

Modern civilization would not be possible without extensive, reliable transportation systems. Technology is poised to transform transportation and impact society and the environment in ways we cannot fully predict but must be prepared to manage. In addition to coping with a technological revolution, we also face hard questions about how to reduce transportation's greenhouse gas emissions; make it more resilient, efficient, safe, and equitable; and pay the staggering costs of doing so.

TRB framed what it thinks are the most important transportation questions to address in the next few years. It hopes this document will help spur and inform an urgently needed national debate about the future of transportation and help researchers frame and inform choices about the most promising paths forward.

Join the debate. Analyze the options. Find new solutions. Our future depends on it. For a more thorough discussion of these issues go to www.TRB.org/criticalissues.



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