



# Governing the future of mobility

Opportunities for the US government to shape  
the new mobility ecosystem

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Inaction is not an option

# Introduction

What roles should the government play?

Through the last century, American automakers drove much of the nation's economic strength with innovations and global sales. The US government played a tangible role, from formalizing driver education to building the Interstate Highway System to bolstering consumer confidence through safety regulations.

**T**HE public sector remains key as demographic trends and advances in technology and social attitudes seem to be propelling the world toward a new transportation revolution built on driverless ridesharing, seamless multimodal travel, and other new types of mobility. Not only might government guidance help integrate and coordinate a sprawling array of users and providers—a nation that leads the race in mobility innovation could gain a source of competitive advantage in the global economy.

As companies, cities, states, and academic institutions explore new mobility models, what roles should the federal government play? This article explores the challenges and opportunities associated with three key functions:

- As *policymakers and regulators*, federal agencies can ensure public safety and security as

companies and state and local governments navigate this new territory. The policies and regulations the federal government creates and implements can have make-or-break impacts on the maturation of mobility innovations.

- As *researchers and developers*, they can help foster technological innovation. Where federal research dollars are allocated, and how quickly policy decisions and grantmaking are made, can influence the market. They can serve as important arbiters balancing technological development with public safety and security as citizens adopt these new technologies.
- As *end users*, federal agencies can improve government-operated fleets, invest in new related infrastructure, and spur state and local adoption of autonomous vehicles, shared mobil-

ity, and other new types of travel through their procurement decisions.

The future of mobility is uncharted territory with enormous scope and complexity. Yet the United States has seen change on this scale before—and the federal government has played a role in making it work. For example, the US government helped enable the innovative, competitive environment<sup>1</sup> that allowed the Internet to evolve into the mature, interconnected, sustainable, and accessible platform it is today.<sup>2</sup> In their roles as policymakers and regulators, researchers and developers, and end users, federal agencies have multiple opportunities to influence tomorrow's mobility ecosystem. For every federal office that plays a part in the new mobility ecosystem, there is a narrow—and closing—window

to determine its role and define how it will help to shape our nation's transportation future.

Granted, a comprehensive examination of the myriad ways the federal government could influence the future of mobility is beyond this article's scope. We simply aim to help government decision makers understand how they might fit into this fast-moving environment; identify some of the most pressing issues facing regulators, researchers, and end users; and offer guidance on the path forward. Although the future of mobility is being driven by a series of converging trends—including advances in vehicle materials and powertrains, connectivity, and ridesharing—we concentrate on the implications of autonomous vehicles as the area likely to have the most wide-ranging impacts by and on the federal government.



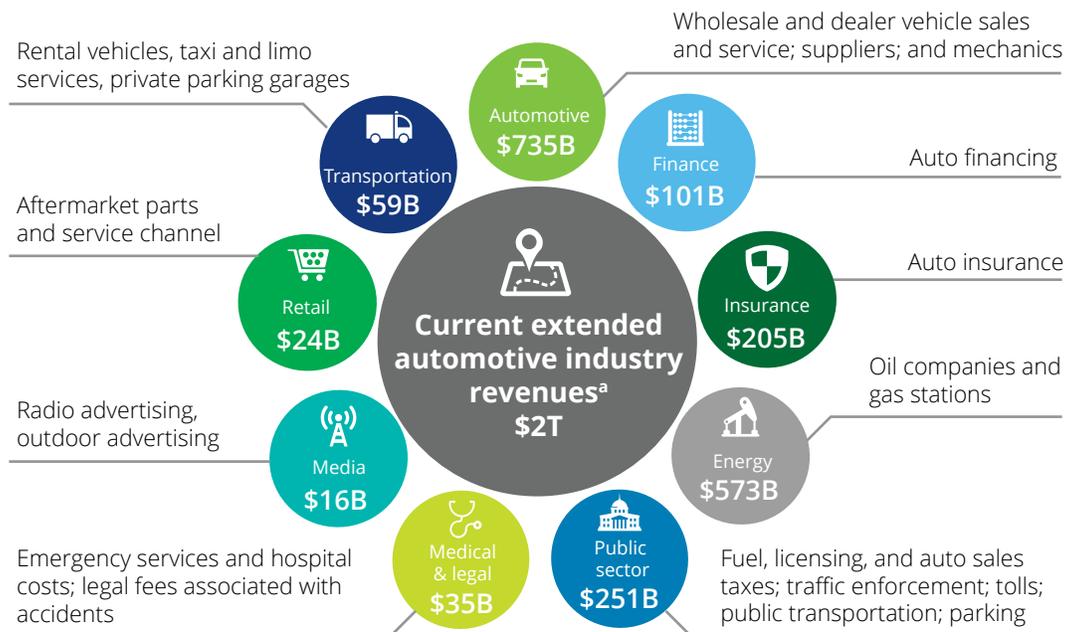
# A century-defining opportunity is unfolding

**E**LECTRIC and autonomous vehicles, lighter-weight materials, and growing connectivity among vehicles, infrastructure, and other devices all aim to make transportation safer, less expensive, and more attuned to people’s daily lives.<sup>3</sup> At the same time, technology-enabled services for ridesharing and carsharing are fashioning new models for moving groups of people from point A to point B, and influencing the communities in between.<sup>4</sup> These converging forces are driving a new mobility ecosystem in which various modes of transportation are often not mutually exclusive but complementary.<sup>5</sup>

As figure 1 illustrates, the implications of these shifts look to be wide-ranging. The extended auto

industry alone touches nearly every facet of the American economy. It represents nearly \$2 trillion in revenues—more than 10 percent of US GDP.<sup>6</sup> The commercial trucking industry adds another \$700 billion to that figure.<sup>7</sup> Almost 7 million people worked in the US auto industry in 2015, with another 3.8 million employed as motor vehicle operators.<sup>8</sup> Those figures, significant in themselves, don’t include the many additional jobs that rely on the provisioning of transportation, such as warehouse workers, public works employees, and those in delivery services. For that matter, the future of mobility could affect nearly everyone who commutes to and from a job, and nearly every company’s supply chain.

**Figure 1. Extended US auto industry revenues, as of 2014**



Source: Deloitte analysis based on IBISWorld Industry Reports, IHS, DOT, US Census, EIA, Auto News, TechCrunch. Current revenue represents 2014 figures (or earlier if 2014 data not available) in the United States.

<sup>a</sup>Total revenue is \$1.99T.

In the United States, cities' experiments in advanced mobility have begun to drive federal guidance. And abroad, in the near term, many countries that welcome innovation and experimentation in mobility see the opportunity to attract investment and talent. Discussing the formation of a government-backed autonomous driving development center in China, one official made the intent clear: "We want to send a clear signal to global talent in the sector . . . to come here to start a career in China where we will offer an office, home, funds and help them approach

the mainland market."<sup>9</sup> Over the longer term, countries leading experimentation and deployment will likely experience even greater economic benefits. As new transportation systems cut the cost of moving critical assets—people or goods—businesses may choose to invest in locations with flexible and informed regulations that offer mobility innovations. Other nations (Germany, Japan, India, China, and others)<sup>10</sup> are already approaching this issue with clear and holistic government policies.

### CITIES AND STATES ON THE MOVE

The technology and infrastructure may be still developing, but several states and municipalities in the United States and around the world are already aggressively pursuing new transportation models. Success on the ground, while limited, shows incredible promise. The US government can build upon these use cases and accelerate efforts to engage with and shape the emerging mobility ecosystem.

Consider just a few examples that are already shifting the economic, transportation, and R&D landscapes in cities across the United States:

- Columbus, Ohio, won the US Department of Transportation's \$40 million Smart City Challenge in 2016. Spurred by city officials' desire to make Columbus the "most attractive, livable, equitable and sustainable city in America," the city's winning Smart City application identified key issues, like inadequate transportation to community health clinics, to channel new investments in autonomous and connected vehicles, electric vehicles, and sensors.<sup>11</sup> The city has leveraged its initial grant into roughly \$500 million in total funding from a variety of public and private sources.<sup>12</sup>
- In December 2016, Michigan implemented a set of laws outlining how developers may test, use, and sell driverless vehicles.<sup>13</sup> Michigan is also home to two advanced mobility testbeds, one operated by the American Center for Mobility—designated a DOT Autonomous Vehicle Proving Ground in January 2017<sup>14</sup>—and one by the University of Michigan's Mcity.<sup>15</sup>

- While Pennsylvania's legislature crafts rules for testing autonomous vehicles in the state, Uber, Carnegie Mellon University, Delphi, and Argo AI—a start-up backed by Ford—are already conducting R&D on advanced transportation technologies in Pittsburgh.<sup>16</sup>

While a few US cities and states have moved swiftly, the lion's share seem to be modernizing incrementally or playing catch-up. A number of major global cities seem further ahead in their level of maturity. Consider that:

- Norway's national transport policy for 2018–29 prioritizes smart connected systems, "zero growth" in the number of vehicles on the road, and clean vehicle technology.<sup>17</sup> The country's largest online grocery store has launched a food delivery pilot with driverless buses in a suburb of Oslo.<sup>18</sup> Helsinki operates driverless electric transit buses along a quarter-mile route.<sup>19</sup> The ultimate goal: to make it so convenient for users to get around that they opt to give up their personal vehicles for city commuting, not because they're forced to but because the alternatives are more appealing.<sup>20</sup>
- In Shanghai, researchers have been testing more than two dozen autonomous vehicles on a 100 square kilometer, government-backed closed course.<sup>21</sup>
- Singapore hosted the first consumer-facing self-driving vehicle pilot nearly a year ago,<sup>22</sup> part of the country's broader "Smart Nation" initiative that aims to, in part, remake transportation on the island.

## Saving lives, money, and time

Because transportation affects so much of the economy and touches nearly every person's life, even incremental improvements in the movement of people and goods could create impressive gains. The first among those gains could be a significant drop in traffic fatalities and injuries.

Auto accidents killed more than 35,000 people in the United States in 2015 and left another 2.44 million with injuries.<sup>23</sup> Human error caused 94 percent of those accidents,<sup>24</sup> and for proponents of driverless cars, the safety potential is a matter of simple math: Take humans out of the picture, and we're likely to see many fewer crashes.

Along with lives, traffic accidents cost a lot of money. The National Highway Traffic Safety Administration (NHTSA) estimates that the price tag for motor vehicle crashes—including medical, legal, emergency services, and insurance costs, plus lost productivity—totaled \$277 billion in 2010.<sup>25</sup>

New technology could also make travel more efficient by reducing congestion—important given that the US population is projected to increase by 70 million by 2045.<sup>26</sup> In 2016, the *average* American

commuter lost more than 42 hours—slightly more than a full week of work—sitting in traffic.<sup>27</sup> Workers in cities such as Los Angeles, San Francisco, and New York average approximately twice the national average. The average car spends 95 percent of its time parked<sup>28</sup> while representing the second-largest expense for most US households.<sup>29</sup> Ridesharing and autonomous vehicles could significantly reshape those economics.

The potential gains extend to the movement of freight, too. For example, today it costs about \$4,500 to ship a full truckload of goods from Los Angeles to New York. With a driverless truck, labor costs could dramatically decline, and the same load could stay in motion for nearly 24 hours a day, crossing the continent twice as fast, for just 25 percent of the cost.<sup>30</sup>

With sound policy and smart investments, the federal government can foster innovation while potentially reaping the benefits of a system that moves people, goods, and services more efficiently and safely and that is more accessible, affordable, and reliable than our current transportation system. To know how and when to take action, agencies should begin with an understanding of the unique roles that government can play in this mobility revolution.

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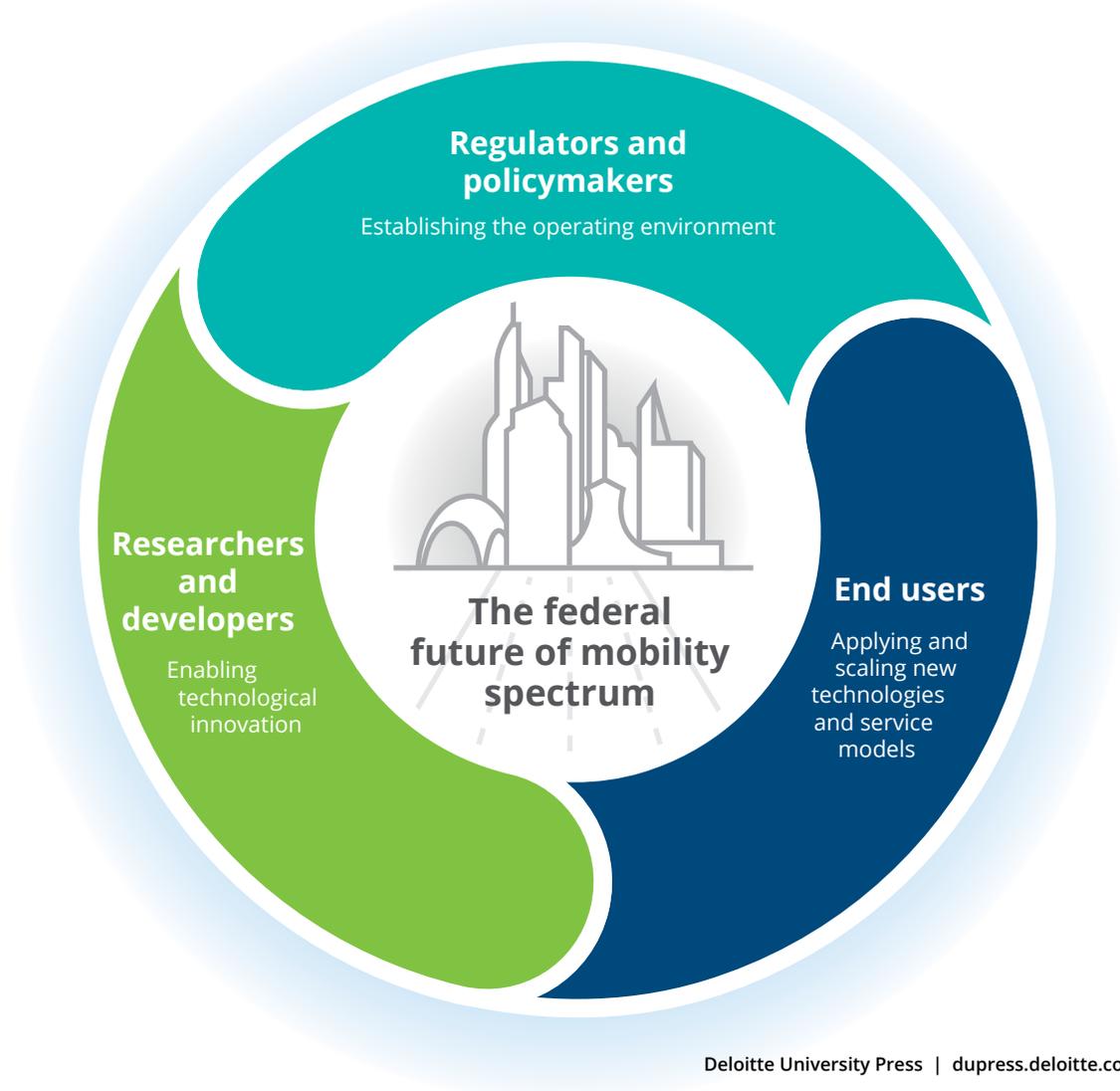
The average car spends 95 percent of its time parked while representing the second-largest expense for US households.

# Where federal agencies fit in

**G**IVEN the potential gains, and as cities and other nations make the future of mobility a reality, how should the US government engage and lead? A key first step is determining which role or roles any particular government entity plays

with respect to the mobility ecosystem: as a regulator and policymaker, as a researcher and developer, or as an end user. These three roles constitute the *federal future of mobility spectrum* (see figure 2).

**Figure 2. The federal future of mobility spectrum**



Many agencies' missions fall into two or all three areas. That makes being clear-eyed about the tensions and tradeoffs associated with each role even more essential. And all agencies, regardless of their role, could benefit from regularly communicating with stakeholders across the spectrum to integrate diverse and new ideas in this rapidly evolving arena.

Whether through action or inaction, the federal government *will* shape the future of mobility. Manufacturers, naturally, would prefer to avoid designing a different product to conform to each state's rules. So companies looking to invest in transportation

technologies, and state and local governments looking to experiment, desire clear rules and an environment with minimal uncertainty—with few regulations that might impede innovation. Setting federal research priorities—and allocating resources—could accelerate or retard the development of key technologies. And as one of the largest single end users of vehicles, the federal government can provide a spur for private sector adoption of new types of mobility. The first, critical question across the spectrum of federal agencies, then, is a simple one: How will they embrace their roles?

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Whether through action or inaction, the federal government *will* shape the future of mobility.

# Regulators and policymakers

## Establishing the operating environment

**T**HERE are few other actors besides the federal government that can play an active, arbitrating role to ensure that core mobility systems—including autonomous vehicle operating systems, citywide transportation management platforms, mobility-as-a-service applications, and more—evolve in a way that advances the interests of all stakeholders and are not skewed toward a single private sector player or technology. Leaving such important and fundamental policy issues to the marketplace or random evolution could put those gains at risk.

The scope of the rulemaking challenge posed by new transportation technologies is impressive. An exhaustive treatment of those complex challenges is beyond this article’s scope, but consider just a handful of the areas regulators will likely need to address:

- **Vehicle safety standards:** What standards must a driverless vehicle meet for performance in low light and inclement weather, crash avoidance, and crashworthiness? What features—steering wheels, rear-view mirrors, etc.—does a vehicle need to have, according to the Federal Motor Vehicle Safety Standards? How can regulators ensure that different autonomous vehicle operating system platforms are interoperable with each other and the surrounding infrastructure?
- **Liability:** Where does fault lie when a self-driving car crashes? With the vehicle manufacturer? The designer of the operating system software? The owner or occupant? Will each vehicle be required to possess a “black box,” similar to aircraft, to help determine liability? Even then, in instances where deep learning algorithms are at work, it may be nearly impossible to deduce why an autonomous vehicle system made the decision it did.<sup>31</sup>
- **Connectivity and interoperability:** How much bandwidth should be dedicated for transportation and vehicle connectivity? The Federal Communications Commission assigned 75 MHz of bandwidth at 5.9 GHz to Dedicated Short-Range Communication for connected vehicles and other mobility-related purposes, but to date little of that bandwidth has been employed, and pressure is mounting to reallocate it for other purposes.<sup>32</sup> Short-range, vehicle-to-vehicle communication is not strictly necessary to enable fully autonomous vehicles, but it would likely create impressive safety benefits—new crash avoidance technology could potentially address 81 percent of crashes involving unimpaired drivers<sup>33</sup>—were cars able to “talk” to each in near real time.<sup>34</sup>
- **Data management and privacy:** The growing ubiquity of sensors means more and more aspects of our lives are being digitally documented—a trend that new, connected mobility options will likely accelerate. With the potential to know, with specificity and fidelity, where, when, how, and with whom we travel, who “owns” this data? What responsibility do providers have to safeguard it? And to what ends can it be used?<sup>35</sup>
- **Cybersecurity:** What measures must the makers of autonomous vehicle operating systems take to make sure hackers don’t cause accidents, force vehicles off their intended routes, or steal personal information?<sup>36</sup> How can critical traffic and road infrastructure be secured?

This part of the federal mobility spectrum also includes agencies, such as the Department of Labor, whose missions could be indirectly affected by advanced mobility (see sidebar, “Preparing a shifting mobility workforce”).

## PREPARING A SHIFTING MOBILITY WORKFORCE<sup>37</sup>

The future of mobility could bring dramatic shifts in the workforce. When transportation modes are profoundly changed, what are the implications for the almost 7 million US autoworkers and nearly 4 million professional drivers?<sup>38</sup> How might the future of mobility affect the numerous ancillary jobs that largely hinge on how transportation is provisioned, such as warehouse workers and public-works employees? As mobility is expected to increasingly shift from being product-centered to being service-centered, with data playing an ever-greater role, what role should the federal government play in preparing and adapting the workforce to meet those potentially changing demands?

For the Department of Labor and other agencies, they could begin preparing the workers likely to be most susceptible, such as taxi drivers in urban areas, by targeting them for retraining and reskilling programs. They might also consider creative approaches to smooth the transition. It is estimated that the trucking industry, for example, will need 890,000 new drivers through 2025 to meet rising demand.<sup>39</sup> Working with long-haul trucking regulators to ease hours-of-service restrictions while still requiring a human occupant (or even remote monitor)<sup>40</sup> could, in the short term, help alleviate the industry's labor shortfall while preventing wholesale dislocation of the workforce.<sup>41</sup>

Although hardly the only issue facing transportation regulators, clearly the emergence of self-driving cars looms large. Accordingly, the Department of Transportation has been the first out of the gate with new policies to govern advanced transportation technology. In September 2016, the NHTSA released the “Federal Automated Vehicles Policy,” a summary of guidelines—not binding rules—for “highly automated vehicles,” plus recommendations for state governments.<sup>42</sup> The department is in the midst of updating its guidance,<sup>43</sup> and Congress has begun exploring the issue through a series of hearings and draft proposals.<sup>44</sup>

Given that many mobility technologies are still nascent, this relatively light regulatory touch is understandable but could prove untenable as others look to craft their own policies. In Michigan, for instance, vehicles need not have a steering wheel or brake pedal, while in California they do.<sup>45</sup> So far, 19 states have passed laws to regulate autonomous vehicles, several others have legislation in the works, and four governors have issued executive orders on the subject.<sup>46</sup> It will likely take federal action—such as the NHTSA's guidance—to help transform this patchwork of rules into a harmonious environment that can foster innovation while ensuring public safety and security. And where issues involve interstate commerce, like the emergence of driverless

long-haul trucks, the federal government's role—in this case, the Federal Motor Carrier Safety Administration—is mandated.<sup>47</sup>

## A way ahead for regulators and policymakers

The policymaker's central challenge is to ensure the public's safety and security and mitigate risk while, at the same time, avoiding stifling innovations that could yield impressive economic and societal benefits. To that end, federal regulators should keep in mind some key principles and challenges:

- **Invite industry and state and local regulators to discussions** to make sure that the resulting rules are relevant to states and cities, and to avoid creating a patchwork of contradictory regulations that prevent progress and ultimately hurt consumers.
- **Make regulations flexible**, allowing for timely exceptions so they do not inhibit advances in technology. For example, automakers can field up to 2,500 vehicles per year that are exempt from portions of the Federal Motor Vehicle Safety Standards in order to improve the vehicles' “overall safety level.” Given the level of testing needed to refine autonomous vehicle systems

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## The emerging mobility landscape encompasses far more than the developers of self-driving cars.

and demonstrate their soundness, that cap is already being challenged by companies investing in the technology, and proposed legislation has suggested lifting that limit to 100,000 vehicles.<sup>48</sup>

- **Revisit and refine often.** Because of the speed with which the technologies are advancing, a “one and done” approach to rulemaking is ill-suited to the future of mobility. Instead, agencies should review and refresh regulations frequently, with an emphasis on outcomes rather than process or product form. That becomes especially critical as federal policies evolve from high-level guidance to increasingly detailed—and binding—rules.
- **Remain technology-neutral** to allow for further innovation. While developers have made much progress, there are still plenty of unsettled questions when it comes to self-driving technology. What is the optimal suite of sensors to ensure safe and reliable operation? Are logic-based autonomous vehicle operating systems a viable alternative to those built on machine learning? And even more fundamentally, can humans be expected to safely retake control of a vehicle in some circumstances, or do they need to be disintermediated completely? Beyond the car, a host

of other mobility systems are still in early stages of development, including the capability to integrate different types of transportation across a city. Prematurely codifying a particular technological solution in regulation risks lock-in and path dependency.<sup>49</sup>

- **Convene the ecosystem.** The emerging mobility landscape encompasses far more than the developers of self-driving cars. Academic institutions, state and local governments, and a host of private sector players—insurers, financiers, suppliers, telecom companies, health care providers, media companies, and beyond—will likely all be impacted. Federal policymakers are among the best positioned to bring all stakeholders together, and gathering their input is likely to be critical to formulating smart, agile regulation. While soliciting public comment is a required step for all policies and regulations, when these venues are accessible and open, like the NHTSA’s regular public meetings, it increases the chances of real-time feedback and dialogue between federal agencies and stakeholders, and decreases the likelihood of a patchwork of contradictory regulations that could hinder progress and ultimately hurt consumers.

# Researchers and developers

## Enabling technological innovation

**T**HE federal government has already played a major role in galvanizing autonomous vehicle innovation. In 2004, the Department of Defense launched the Defense Advanced Research Projects Agency Grand Challenge, a series of prize-based competitions aimed at promoting autonomous vehicle development. The department's goal was to enable combat zone supply transport without endangering the lives of human drivers. The DARPA Grand Challenges "created a community of innovators, engineers, students, programmers, off-road racers, backyard mechanics, inventors and dreamers," laying the technological groundwork and assembling expertise to spur rapid advancements in self-driving technology.<sup>50</sup> Reflecting on the impact of the Grand Challenge, DARPA's liaison to the Marine Corps notes, "The fresh thinking [the Grand Challenge teams] brought was the spark that has triggered major advances in the development of autonomous robotic ground vehicle technology in the years since."<sup>51</sup>

Despite the Grand Challenges' jumpstart and the progress of recent years, there are still many technological hurdles to clear before advanced transportation systems—especially self-driving cars—can perform flawlessly under most road conditions. Perhaps foremost among those is reacting to the at-times unpredictable behavior of human drivers, though the challenges of dealing with inclement weather, poor road markings, and unexpected detours remain vexing.<sup>52</sup> Even the most innocuous issues—such as bird excrement—can require novel technological solutions, like the small wiper Waymo designed to clear droppings from vehicle sensors.<sup>53</sup>

## A way ahead for researchers and developers

While the private sector has taken the lead in developing new mobility technologies and government R&D funding could be increasingly limited, there is still a potentially important role federal agencies could play. They can begin by assessing the totality of the mobility ecosystem and identifying the areas in which market incentives may be insufficient to compel companies to participate but where a clear societal or economic benefit could be attained. Practically, that could mean:

- **Incentivizing the private sector.** Federal investments in R&D can provide a fillip for market players to engage and create spillover benefits that far exceed the initial outlay. Through its Federal Highway Administration's Intelligent Transportation Systems Joint Program Office (ITS/JPO), the Department of Transportation used its own funding to encourage pilot efforts in advanced mobility through competition and public-private partnerships when it created the Smart City Challenge (the competition that ultimately awarded its prize to the city of Columbus). All seven finalists were invited to collaborate and got help from government researchers, regulatory experts, and private companies as they moved into the final stages of the competition.<sup>54</sup> In an ideal example of return on investment for a federal government program, Columbus leveraged the \$40 million federal grant into over \$500 million of subsequent funding through a variety of public-private partnerships.<sup>55</sup> Additionally, many of the semifinalists—including

Austin, Denver, and Pittsburgh—have continued to aggressively advance their efforts in mobility innovation.<sup>56</sup> For the Department of Defense, efforts at “smart base” modernization could create a similar catalyzing effect.<sup>57</sup>

- **Focusing on areas overlooked by market actors.** Much of the discussion about the future of mobility has focused on cities, but rural areas face their own mobility-related difficulties, and federal researchers could explore how autonomous vehicles could impact those parts of the country. In 2013, less than a fifth of the American population lived in a rural area, but rural road accidents accounted for more than half of all traffic fatalities.<sup>58</sup> The fatality rate per 100 million miles traveled was two and a half times greater in rural than in urban settings, according to the NHTSA. Encouraged by federal R&D, self-driving cars could see those numbers plunge dramatically.
- **Exploring the societal implications.** Today’s mobility shifts have increasing potential to benefit individuals and communities, but the longer-term implications of these changes are not always foreseen. Federal research can help identify those unintended consequences. For instance, members of five labs funded by the Department of Energy are studying how to make sure that autonomous vehicles—whose 24/7 availability might increase overall road miles traveled—don’t significantly increase energy consumption.<sup>59</sup> Notably, the US departments of energy and transportation initiated new collaboration within the National Renewable Energy Laboratory to accelerate research, demonstration, and deployment of innovative transportation and alternative fuel technologies.<sup>60</sup>

Other agencies, such as the Centers for Disease Control and Prevention, often promote approaches that support longer-term thinking. For instance, states and localities looking to

integrate new mobility technologies into their own transportation systems could use a Health Impact Assessment to convene city planners, health and transportation officials, local businesses, and community developers to document the health benefits or risks of a new mobility technology, develop relevant policy recommendations, and monitor and evaluate the overall impact on end users—a critical piece to any investment.<sup>61</sup> Washington and California, as well as Denver, San Francisco, and New York City, have already applied the Health Impact Assessment approach to their policy development, and there is an opportunity to see how it can be applied to the new mobility ecosystem.<sup>62</sup>

- **Partnering across the ecosystem.** As described above, in many instances, federal researchers and developers could work collaboratively with a wide range of companies, academic institutions, and nonprofits that can provide an in-market perspective and present the needs of all stakeholders. In this role, R&D is a linchpin that enables real-world experience to raise research questions to drive growth and action in the real world. As one recent study of New York City notes, rather drily, “The economic opportunities in neighborhoods without multiple transportation options are shown to be tangibly inferior to areas with denser public transit services.”<sup>63</sup>

The Department of Health and Human Services (HHS) might look to ridesharing to provide new models of paratransit. Ride-hailing providers are already partnering with the Massachusetts Bay Transportation Authority to offer services for customers with disabilities.<sup>64</sup> This also lends an opportunity for HHS and the Department of Housing and Urban Development to work together to leverage more efficient forms of intermodal urban transportation—such as dynamic shuttles and ride-hailing services—to help bridge the “spatial divide” between homes and jobs and other community services.

# End users

## Applying and scaling new technologies and service models

**T**HE federal government is the nation's largest employer and operates some of the world's largest vehicle fleets—a total of more than 600,000 nontactical vehicles.<sup>65</sup> The US Postal Service alone owns nearly 228,000 motor vehicles,<sup>66</sup> and the General Services Administration leases more than 200,000 vehicles to federal agencies.<sup>67</sup>

Mobility innovations are already surfacing among federal end users, although most efforts remain exploratory. The Postal Service has begun the search for a next-generation delivery vehicle to replace its aging fleet; the prototypes being explored include hybrid electric and alternative fuels-powered vehicles.<sup>68</sup> The Department of Defense is already experimenting with driverless vehicles, both for day-to-day operations and for combat. At Fort Bragg, NC, for instance, the US Army Tank Automotive Research, Development and Engineering Center plans to test driverless vehicles to transport wounded soldiers to hospitals for rehabilitation treatment.<sup>69</sup> Lockheed Martin has developed a kit that allows vehicles and convoys to operate autonomously, or nearly so; it is now working with the Army to get some of this technology into the field.<sup>70</sup>

Because the US government operates such large fleets, federal agencies naturally could play an early and important role in the proliferation of new mobility technologies. Agencies certainly could benefit from this technology: The Postal Service, for example, reported nearly 27,000 motor vehicle accidents in 2015,<sup>71</sup> making it a prime candidate for automated systems—including self-driving vehicles—that reduce collisions.

### A way ahead for end users

As major fleet buyers, the government has an opportunity to support industry sales while shaping the evolution of offerings and solutions by making clear their criteria for purchase. Further, by testing and deploying advanced technologies, particularly autonomous vehicles, federal agencies can send markets and consumers a powerful vote of confidence in these systems' viability and reliability.

Mobility needs are as diverse as federal agencies' missions; warfighting and delivering the mail make very different demands on vehicles. As agencies rethink their own mobility needs as users, they should bear several considerations in mind:

- **“Future-proof” mobility systems.** Technology changes quickly, but federal procurement processes tend to have long cycles, and an agency that commits to a new technology might have to live with it for years, even as better options emerge. Agencies should consider ways to modify procurement processes to accommodate the fast pace of change in mobility technology. Shorter than typical leases might be an option or, where possible, employing modular systems that make upgrades easier. In some cases, the private sector might be able to respond more quickly, and public-private partnerships or even privatization of some functions may be worth exploring.
- **Explore creative financing options.** Could mobility-as-a-service, cost sharing, or other approaches allow agencies to introduce new technologies without requiring a huge up-front

investment? In some cases, private sector players eager to create viable in-market proof points might be willing to provide technology or services at reduced cost. Are there ways to make better use of purchased assets? For example, could a

ridesharing service for federal employees be created rather than assigning cars to individuals? Or set up charging stations for federally owned electric vehicles and then let members of the public pay to use them?

## INVESTING IN TOMORROW'S INFRASTRUCTURE

Policymakers, developers, users, and others are working to make the future of mobility a reality, but getting to their meetings is increasingly a challenge: The American Society of Civil Engineers (ASCE) gave the nation's road conditions a D+ grade in 2017.<sup>72</sup>

The investment required to keep the current infrastructure operable is significant. According to the ASCE, the United States needs to spend \$420 billion to bring existing highways into good repair, and another \$123 billion on bridge repair. Expanding the surface transportation network to meet current needs would take another \$167 billion, and making necessary enhancements would require \$126 billion.<sup>73</sup>

While the federal government provides nearly half of the funding for all highway and street expenditures via the Highway Trust Fund—itsself largely sustained by a federal gas tax vulnerable to a growing market for electric vehicles—how that money is spent is ultimately up to state and local governments.<sup>74</sup> As city and state agencies wrestle with these investments, they may be asking: *How will streets and highways accommodate traffic that includes both autonomous and traditional vehicles? Where will people want to live now that their commuting time is potentially more productive? If new mobility options reduce the need for parking in urban centers, what will we do with some of the space currently devoted to parking lots and garages? What will be the tax and revenue implications of electric vehicles, self-driving cars, and the shift to access over ownership? How will our decisions benefit the larger community by making transportation more accessible or by repurposing lost parking lots as affordable housing or parks? With whom should I be working, and what data should I use to make these decisions?*

How might federal agencies help cities and states navigate this change? Offices that consider scenario planning approaches, and offer services—similar to technical assistance provided by the Federal Highway Administration's Office of Planning, Environment and Realty—may be better prepared to help states and local jurisdictions navigate future changes. Additionally, the Federal Transit Administration's Mobility-on-Demand Sandbox Program has taken seed funding to pilot new solutions.<sup>75</sup> Formalizing and sharing best practices through these types of programs can help communities bracing for the anticipated proliferation of advanced mobility transformations.

"Balance" is the watchword for government's engagement with the future of mobility. When it comes to costly and long-lived infrastructure investment, that means balancing the needs of today's legacy systems with the uncertain—but likely quite different—demands that will accompany new types of mobility.

# Conclusion

## Inaction is not an option

**N**EW mobility technologies and systems are accelerating quickly, and federal agencies should keep pace. The potential benefits of these new systems—in terms of safety, cost, efficiency, and global competition—are too significant to ignore.

To realize those gains, the federal government should move with dispatch and thoughtfulness, using the full range of tools available. The private sector is driving innovation at a rapid pace. A reactive approach is likely to be unsustainable, and inaction is a choice in and of itself—and the least likely to have a net positive impact on the country as a whole. Instead, federal agencies can play a

meaningful role in shaping the speed, direction, and timing of change.

Imagine if private industry had created the Internet and been entirely unfettered in setting the rules for its original construction: Equal access and ubiquity would likely be tenuous at best, and many of the technology’s life-changing implications would have been missed. The same is true with the future of mobility. The public sector has little choice but to play a data-informed and mission-driven role in this time of change. And the sooner it accelerates its approach to these issues in an integrated way, the closer we could be to realizing the enormous potential associated with a safer, cleaner, more efficient, and open mobility ecosystem.



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