



Autonomous and connected vehicles: Building the future of mobility

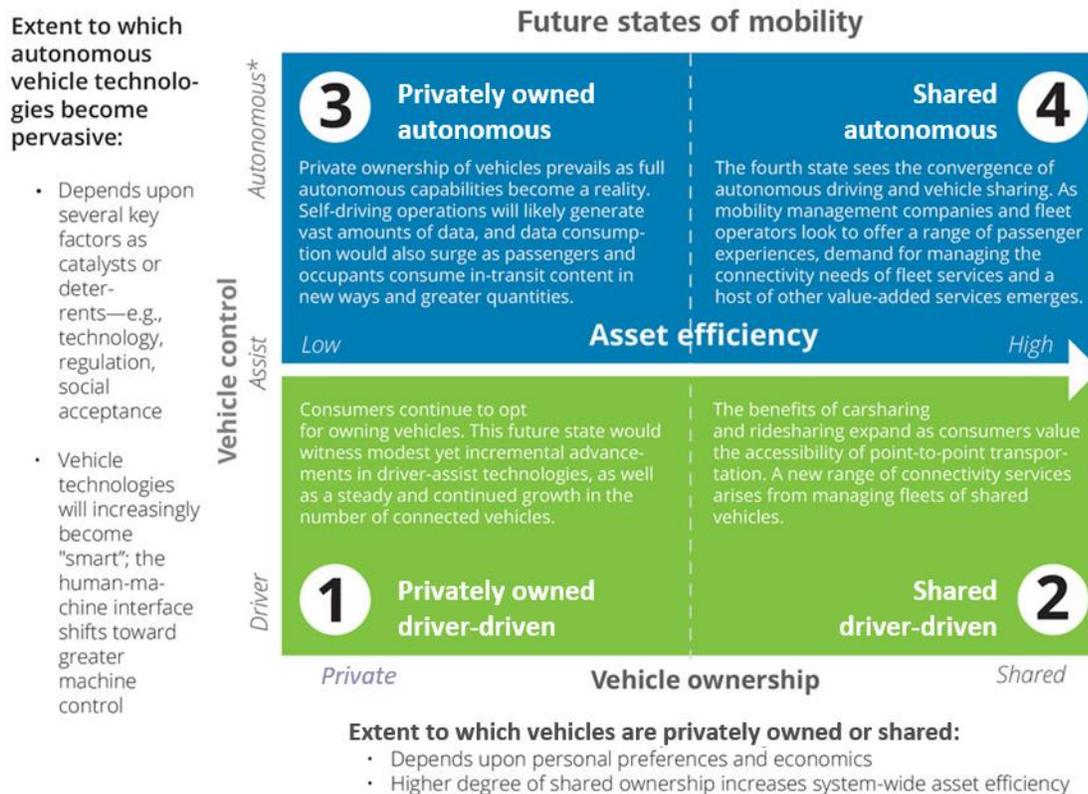
A series of technological and social forces are profoundly changing the way people and goods move about: the emergence of connected, electric, and autonomous vehicles; the rise of the sharing economy; and the shift in attitudes toward mobility.

Deloitte’s perspective: Four future states of mobility

Uncertainty about the pace and scope of transition to fully autonomous vehicles means that the nature of this mobility ecosystem may evolve in a number of different ways over the short and long terms and in uneven ways around the world, with different populations requiring or demanding different models of transportation.

Deloitte envisions four future states of mobility, which are emerging from the intersection of two critical trends: the extent to which autonomous vehicle technologies become widely adopted and the extent to which vehicles are shared or privately owned (see Figure 1).¹ These states are privately owned and driver-driven, shared driver-driven, privately owned autonomous, and shared autonomous.

Figure 1: Four potential future states



*Fully autonomous drive means that the vehicle’s central processing unit has full responsibility for controlling its operation and is inherently different from the most advanced form of driver assist. It is demarcated in the figure above with a clear dividing line (an “equator”).

Source: Deloitte analysis.

Future state 1: Privately owned driver-driven

This conservative vision of the future sees private ownership remaining the norm, with consumers opting for the particular forms of privacy, flexibility, security, and convenience that come with owning vehicles. Importantly, while incorporating driver-assist technologies, this vision assumes that fully autonomous drive will not become widely available any time soon.

With so little change envisioned, this future state reinforces automakers' reliance on a business model that emphasizes unit sales. They continue to invest in the development and introduction of new vehicle lines with advanced technologies, and dealers retain responsibility for the customer experience. Other industry players are similarly incented to rely on the practices and structures that have been well-established for decades.

Future state 2: Shared driver-driven

The second future state anticipates continued growth of shared access to vehicles.² In this state, economic scale and increased competition drive the expansion of shared vehicle services into new geographic territories and more specialized customer segments. Here, passengers more heavily value the convenience of point-to-point transportation created through ridesharing and car-sharing, saving them the hassle of navigating traffic and finding parking spaces. Plus, the system offers options for non-drivers such as seniors, and minors without licences.

As shared mobility serves a greater proportion of local transportation needs, multi-vehicle households can begin reducing the number of cars they own while others may abandon ownership altogether, reducing future demand. The shift to the first and second future states is already happening as young adults, along with urbanites, gravitate toward a model of personal mobility consumption based on pay per use (e.g., ride-sourcing and car-sharing through Uber, Lyft, and car2go) rather than purchasing their own vehicles.³

Future state 3: Privately owned autonomous

The third state is one in which autonomous-drive technology proves to be viable, safe, convenient, and economical, yet private ownership continues to prevail. Collaboration between leading academics, regulatory agencies, and businesses accelerates progress toward this future.⁴ Both technology and automotive firms continue investing heavily to increase vehicle-to-vehicle and vehicle-to-infrastructure capabilities, while driverless technology matures in parallel, with the success of early pilots fostering quick adoption.

Given that this future state assumes most drivers still prefer to own their own vehicles, consumers seek the driverless functionality for its safety and other potential benefits but continue to own cars for many of the same reasons they did before the advent of autonomous drive. Research from the Future of Mobility practice of Deloitte United States suggests they might even invest more in their vehicles as a new era of customization dawns and it becomes appealing to use vehicles tailored for specific occasions and circumstances.⁵

That said, the features in which owners are willing to invest and the design of the vehicles themselves may change. This new segment of the market may offer lighter, more technically advanced vehicles that embrace design principles counter to today's four-door, driver-in-front-on-left, gripping-the-steering-wheel reality.

Future state 4: Shared autonomous

The fourth future state anticipates a convergence of both the autonomous and vehicle-sharing trends. In this future, mobility management companies offer a range of passenger experiences to meet widely varied needs at different price points.⁶ The earliest, most avid adopters seem likely to be urban commuters, as routes can be selected by real-time awareness of traffic and road conditions. Over time, as smart infrastructure expands and driver usage nears a tipping point, fleets of autonomous shared vehicles could spread from urban centres to densely populated suburbs and beyond.

Advanced communications technologies coordinate the customer's point-to-point mobility experience. Intuitive interfaces enable users to order a vehicle pickup within minutes and travel from point A to point B efficiently, safely, and cost-effectively. Vehicle and traffic network systems operators, in-vehicle content/experience providers (e.g., software and infotainment firms), and data owners (e.g., telecoms) could have further opportunities to monetize the value of passengers' attention in transit as well as additional metadata pertaining to system use.

Co-existing future states

Over the next 10 to 20 years, future states 1, 2, and potentially 3 and 4 will co-exist to some degree. Experts expect to see full connectivity and full automation for some vehicles (e.g., agricultural or mining equipment, cargo trucks on the highway, platoons of autonomous vehicles in particular zones) in risk-controlled environments well within that time.⁷ The end state is understood as the period 25 or more years in the future when Level 4 and 5 autonomous vehicles will be commonplace as part of a personalized and integrated set of mobility options (including trains, bicycles, etc.) available to travellers on Canadian roads.⁸

Recommendations

With this ecosystem in mind, we see two key roles governments can play in the new mobility ecosystem: as policy-makers and regulators, and as active co-investors alongside private sector organizations.

As **policy-makers and regulators**, the federal government will play a key role ensuring harmonization across municipal, provincial, territorial, and federal legislative and regulatory frameworks. Where appropriate, national guidelines and policies will be vital for ensuring the public's safety and security by mitigating cybersecurity and ethical risks while, at the same time, avoiding stifling innovations that could yield impressive economic and societal benefits.⁹

To that end, the federal government should keep in mind some key principles and challenges:

- **Plan for all potential future states of the new mobility ecosystem** by considering the implications of developments in autonomous and connected vehicles on future infrastructure and transportation needs. Business cases for current investments (e.g., roads, bridges, transit, marine and air ports) must be viewed through a funding filter that considers multiple possible scenarios.

Although research has tended to focus on the implications of such developments for the mass movement of people, governments should provide equal attention to the implications on the movement of goods across borders.¹⁰

- **Avoid reinventing the wheel** by engaging academic and research institutions, such as the World Economic Forum, and the governments of other countries, such as the United States, United Kingdom, or Australia, to share best practices and learn about different approaches to testing, regulation, and reporting on autonomous and connected vehicle developments.¹¹
- **Formulate smart, agile regulation** that includes the perspectives of the full scope of industries affected (e.g., insurers, software developers, logistics providers and shippers, mobility management providers, industry associations, among many others) to avoid creating a patchwork of contradictory regulations that prevent progress and inhibit the ability of governments to quickly respond to technological change.¹²

For example, it will be critical to engage telecommunications companies to ensure that leading-edge technologies, such as 5G and next-generation network, as well as emerging technologies play a key role in defining the potential future states of the ecosystem.

- **Revisit and refine often**, emphasizing results over processes, to ensure federal policies are able to evolve over time from high-level guidance to detailed—and binding—rules.
- **Remain technology-neutral** in developing regulations to avoid prematurely codifying a particular technological solution and stifling future innovation.¹³

- **Invest in skills-development programs** to help retrain workers who will be displaced by the coming automation and to ensure a sufficient pool of qualified talent is available to meet business needs.¹⁴

As **active co-investors** in research and development initiatives, departments in the federal government can play a pivotal role in driving innovation by setting strategic research priorities that focus on areas overlooked by market actors and dispersing funding to a cross-section of public and private sector organizations.

With that in mind, we recommend the federal government:

- **Partner across the ecosystem** with a wide range of companies, academic institutions, other levels of government, and not-for-profits to define research questions based on the real-world experiences of communities that are looking for innovative solutions to their mobility issues.

Research and development hubs comprised of academic institutions, non-profits, research organizations, community groups, and industry associations are emerging as catalysts for technological advancement and collaboration across sectors and governments.

One example is the Government of Ontario's recent \$80 million investment in the Autonomous Vehicle Innovation Network project in partnership with the Ontario Centre of Excellence, which will help promote technological advancement and create sites across the province to develop, test, and validate new technology.¹⁵

- **Invest in research based on strategic priorities** for autonomous and connected vehicle technological development, but there is a need to take different geographic lenses.

For example, while much of the discussion about the future of mobility has focused on cities, the impacts of these mobility developments in other parts of Canada—such as rural areas and the North—should also be examined.

- **Explore the societal implications** of autonomous vehicle technology. Today's advancements in mobility have great potential to benefit individuals and communities, but the longer-term implications of these changes to the way people get around are not always foreseen.

The issue of data ownership and consent, for example, still needs to be resolved. The risk here is that the technological capabilities to aggregate, analyze, and use personal and other sensitive information will outpace attempts to develop policy guidance, standards, or regulation to protect privacy.¹⁶

Conclusion

New mobility technologies and systems are emerging quickly. The federal government can play a pivotal role in shaping the speed, direction, and timing of the mobility ecosystem of the future by continuing to engage with a diverse group of cross-sectoral stakeholders, invest in research, and develop smart, agile regulatory frameworks to prepare for widespread technological change.

About Deloitte

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Deloitte's Future of Mobility practice brings unmatched industry knowledge, established partnerships, and developed publications, tools, and accelerators to developing a connected and autonomous vehicles strategy.

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- ¹² For more information on the projected effects of the shift to a future mobility ecosystem on industries beyond the automotive and transportation section (such as retail, finance, technology, telecommunications, media, energy, insurance), please see *Force of Change: The Future of Mobility, Navigating a Shifting Landscape: Capturing value in the evolving mobility ecosystem, The Future of Mobility: How transportation technology and social trends are creating a new business ecosystem, and The future of mobility: What's next?*
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