The Future of Public Transit and Shared Mobility: Policy Actions and Research Options for COVID-19 Recovery

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Abstract The global tragedy of the COVID-19 pandemic devastated communities and societies. The pandemic also upended public transit and shared mobility, causing declines in ridership, losses in revenue sources, and challenges in ensuring social equity. Despite ongoing uncertainty, guidance can instruct recovery and build a more resilient, socially equitable, and environmentally friendly transportation future. This chapter summarizes a recent scenario planning exercise conducted by the University of California Institute of Transportation Studies in collaboration with the Transportation Research Board (TRB) Executive Committee in Spring to Fall 2020. The exercise convened 36 transportation experts in the United States who developed policy actions and research options crafted to guide near- and long-term public transit and shared mobility. Clear themes emerged from the study regarding key actions for public transit operators in the areas of: (1) innovation and technology, (2) planning and operations, (3) customer focus, and (4) workforce development. A second grouping of broader policy strategies for both public transit and shared mobility included: (1) immediate policy and actions across actors, (2) alignment of societal objectives, (3) federal transportation spending authorization, and (4) finance and subsidies. While the exercise reiterated the need for rapid actions, thoughtful planning and decision-making can prepare both sectors for a more cooperative, multimodal ecosystem.

[1] In this chapter, we define shared mobility as the shared use of a vehicle, motorcycle, scooter, bicycle, or other travel mode that provides users with short-term access to a transportation mode on an as-needed basis. While public transit is a form of shared mobility, we define public transit as a more traditional public transport system that is owned and/or operated by public agencies, transporting individuals predominately via bus, rail, and ferry.

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1 Introduction

The COVID-19 global pandemic upended travel and triggered a crisis for public transit and shared mobility services.[1] Plunging ridership and unstable funding across public transit and many shared mobility modes led to many uncertainties. Starting mid-March 2020 for much of 2020, public transit ridership for many agencies in the U.S. fell by over 60 percent compared to 2019 [1]. In New York City, the Metropolitan Transportation Authority reported that ridership dropped in mid-March 2020 by about 50 percent on buses, 60 percent on subways, and up to 90 percent on commuter rail, compared to the same time period in 2019 [15]. Meanwhile, the Bay Area Rapid Transit (BART) District in the San Francisco Bay Area experienced ridership drops over 90 percent compared to similar time periods in 2019 [5]. These impacts were not isolated to urban areas. Many small public transit agencies in rural areas also experienced major declines in ridership in 2020 [2]. Even into 2021, public transit only experienced moderate ridership recovery, hovering between an average of 40 to 60 percent of baseline ridership from 2019 depending on the operator size [4]. It is important to note that public transit ridership was already experiencing small declines prior to the pandemic (for example, in California, see [18]. However, the shock of the pandemic led to substantial ridership drops far below the estimated declines.

Transportation network companies (TNCs), such as Lyft and Uber, also reported ridership drops in Summer 2020, ranging from 54 to 75 percent compared to the prior year [22]. Other forms of shared mobility, such as carsharing, bikesharing, and scooter sharing, saw mixed ridership changes, depending on the geography and trip purpose [6, 26]. Unlike other transportation sectors, delivery services driven by e-commerce growth [14] became profitable for the first time [12]. Moving into 2021, TNCs experienced substantial recovery, reflecting post-pandemic levels [17, 23]. In contrast, the longer term effects of the pandemic on other mobility forms, for example, bike sharing and scooter sharing, were largely negative into 2021 [8].

The COVID-19 crisis tragically struck many communities, leading to terrible loss of life, long-term health challenges, and substantial emotional toll and grief. This pain was exacerbated by the collapse of basic life necessities such as transportation, exposing underlying issues in how mobility was provided to society. Short-term fixes, while critical, will not solve pervasive transportation issues related to access, high-quality service, and social equity. Policy- and decision-makers at all levels of government, especially at public transit agencies, need strategies and actions to recover from COVID-19 and build long-term sustainability and resilience into communities and transportation systems. At first glance, untangling the complex web and creating guidance would require years of dedicated research. However, what can policy- and decision-makers do now? Our strategy was to use a well-known tool to address both uncertainty and the need to make immediate decisions. This tool—scenario planning—can help organizations prepare, plan, and develop robust alternatives to manage risk and produce positive outcomes.

This chapter summarizes a multi-phase scenario planning exercise conducted by the University of California Institute of Transportation Studies (UC ITS) in partnerships with the Transportation Research Board's (TRB) Executive Committee from June to September 2020. Convening 36 transportation experts in the United States (U.S.), the exercise developed a focal question, possible driving and external forces, future scenario (or worlds) based on these forces, and future policy options/actions. The exercise explored different pathways and potential outcomes for public transit and shared mobility across three timeframes: within 12 months, 1 to 3 years, and 4 to 6 years. The developed scenarios helped to inform the creation of policies and strategies to aid in recovery.

This chapter is organized into six sections. First, we present the methodology employed for the scenario planning workshops. Next, the scenario worlds are described, followed by actions to take within each timeframe. In Section 5, we present integrated policy options and actions across all three timeframes, which are categorized as key actions for public transit operators and broader policy strategies across a larger ecosystem of transportation stakeholders. Next, we present future research needs and offer concluding remarks in the final section.

2 Methodology

This research employed a Delphi to develop a series of sustainable policies for public transit and shared mobility services. The Delphi approach is a group process that develops collective judgments over several rounds of investigation [11]. This process also allows group participants across a wide range of disciplines to explore all possible alternatives and assumptions and build consensus [16]. In this study, we followed a similar procedure employed in Shaheen et al. [24] to conduct online workshops (due to COVID-19 in-person restrictions) with 36 transportation experts from a diversity of sectors, organizations, and geographic areas. The workshops were divided into four phases involving three different sets of committees: steering, scenario planning, and policy (see Table 1 for summary).

2.1 Scenario Planning Workshops

The multi-day workshops were designed to develop recommendations to assist in the short-term recovery of public transit and shared mobility services, while promoting future sustainable and equitable mobility. The 36 experts represented multiple geographies in the U.S. and various transportation and related sectors including: (1) public transit agencies and operators of various sizes and modal mixes; (2) non-governmental organizations (NGOs); (3) academia and research institutes; (4) transportation consulting and futurists; (5) local, state, and federal governmental

Table 1 Summary of workshop phases

	Phase One	Phase Two	Phase Three	Phase Four
Timeframe	June/July 2020	July/August 2020	September 2020	September 2020
Committee	Steering	Scenario Planning	Policy	Steering
Number of Experts	Seven	18	10	Eight*
# of Sessions	Four	Four	Two	One
# of Hours Total	Seven	Eight	Six	Two
Goals	• Develop a focal question • Define scenario timeframes • Identify driving forces • Identify the two most critical driving forces per timeframe	• Refine focal question and timeframes • Identify and build two scenario worlds for each timeframe • Develop preliminary policies, research needs, and signposts	• Refine scenario world descriptions • Refine policies, research needs, and signposts	• Review all material and finalize the exercise

* One member joined only for the second steering committee phase

agencies; and (6) private transportation, sustainable design, and shared mobility companies.

In the first phase, the eight-person steering committee developed the framework for the scenario planning exercise. The participants first defined the study's focal question as follows:

> What are sustainable and equitable, short- and longer term public transit and shared mobility policies for different types of communities (e.g., urban, suburban, and rural) under different scenarios in the context of the global pandemic and recovery?

This focal question was reviewed by each committee and remained largely unchanged. The steering committee then developed a list of 30 driving forces that could impact the scenarios. Driving forces were generated by employing the **S**ocial, **P**olitical, **E**conomic, **L**egal/Policy, **T**echnology (SPELT) framework. Each steering committee member selected the six most important driving forces for each timeframe. Results were aggregated and used to select the top two driving forces per timeframe.

In the second phase, the 18-person scenario planning committee was divided into three groups to each focus on a specific timeframe. In each breakout discussion, experts explored and altered the two key driving forces accordingly. Two scenario worlds (out of four possible worlds) were selected for in-depth evaluation. Scenario planning committee members crafted characteristics of each scenario world along

with initial policy options and research directions. It is important to note that the drivers were selected independent of each other for each timeframe, as key drivers were likely to change over time.

In the third phase, the ten-person policy committee reviewed and refined the work of the second phase and began identifying policies/actions across the three timeframes. Two plenary sessions offered holistic thinking across the three timeframes. Finally, the steering committee was reconvened to further refine the results through a holistic plenary session. The key data from the workshops—policies and strategies for public transit and shared mobility recovery—are presented at the end of this chapter.

This research has several limitations. First, the Delphi approach does not capture all viewpoints and can also encourage groupthink. Second, due to time constraints, we developed only six worlds, two for each timeframe (rather than the 12 possible worlds) that represented the most probable and highly consequential scenarios. Third, the timespan of the scenario workshops (June to September 2020) may have altered opinions due to changes related to the pandemic. Fourth, policy actions and research needs were not inherently new or innovative. However, many actions and needs are framed within the context of the pandemic, which offers a more targeted approach in policy development. Finally, this research focuses on key drivers selected by the committees for public transit and shared mobility not necessarily all driving forces. Entrenched land-use patterns, private automobile use, and systemic inequalities are a few drivers that will impact public transit and shared mobility recovery in the short and longer terms. Additional research is needed to better integrate these challenges into policies and actions.

3 Scenario Worlds

For each timeframe, experts created and explored two selected scenario worlds in depth. The two chosen worlds per timeframe were considered the most probable from the four quadrant worlds created by the two intersecting driving forces. Table 2 presents the six final worlds.

3.1 Within 12 Months

For the first scenario timeframe (within 12 months), the policy experts explored two driving forces: (1) new funding sources versus no additional funding sources and (2) public transit demand remains depressed versus return to pre-pandemic levels. Policy options for this timeframe focused on stabilizing public transit and shared mobility service immediately, while building a foundation for future timeframes as a secondary goal. Figure 1 shows the final vectors and worlds, highlighting selected worlds in yellow.

Table 2 Final driving forces and scenario worlds

Timeframe	Level of optimism	Final scenario worlds	Framing assumptions
With 12 months	Less optimistic	Shrink to essential services	• Public transit demand remains depressed • New funding sources are secured
	More optimistic	Restore services	• Return to pre-COVID-19 public transit demand • New funding sources are secured
1 to 3 years	Less optimistic	Downward spiral	• Lack of political will to fund and support change • Slow economic recovery
	More optimistic	Change the conversation	• Political will to fund and support change • Slow economic recovery
4 to 6 years	Less optimistic	Unguided incremental change	• Limited focus on sustainability • Gradual evolution in business models*
	More optimistic	Business and policy evolution	• Greater focus on sustainability • Innovative new business models**

* Gradual evolution in business models refers to incremental developments, such as public–private partnerships among public transit, local/regional governments, and shared mobility operators (e.g., the US Department of Transportation's Mobility on Demand (MOD) Sandbox initiative)
**New business models reflect innovative (previously untested) approaches to public transport provision through partnerships between the public and private sectors. These new models: (1) embody a synergistic relationship among public transit, local/regional governments, and shared mobility operators; (2) reflect federal funding flexibility; and (3) prioritize social equity and accessibility for underserved communities

The more optimistic world, named *Restore Services*, assumes that public transit demand will be recovering to pre-COVID-19 ridership levels. Through this recovery, public transit and shared mobility operators will need to explore new funding sources to overcome deep budget deficits. This world also focuses on a pathway to multiyear federal transportation spending reauthorization legislation and distributes resources to retain public transit riders and recapture some core riders. In contrast, the more negative world, *Shrink to Essential Services*, assumes that public transit demand remains depressed over the next 12 months, leading to drastic service cuts. While exploration of new funding sources also occurs, all available resources are directed to only essential services.

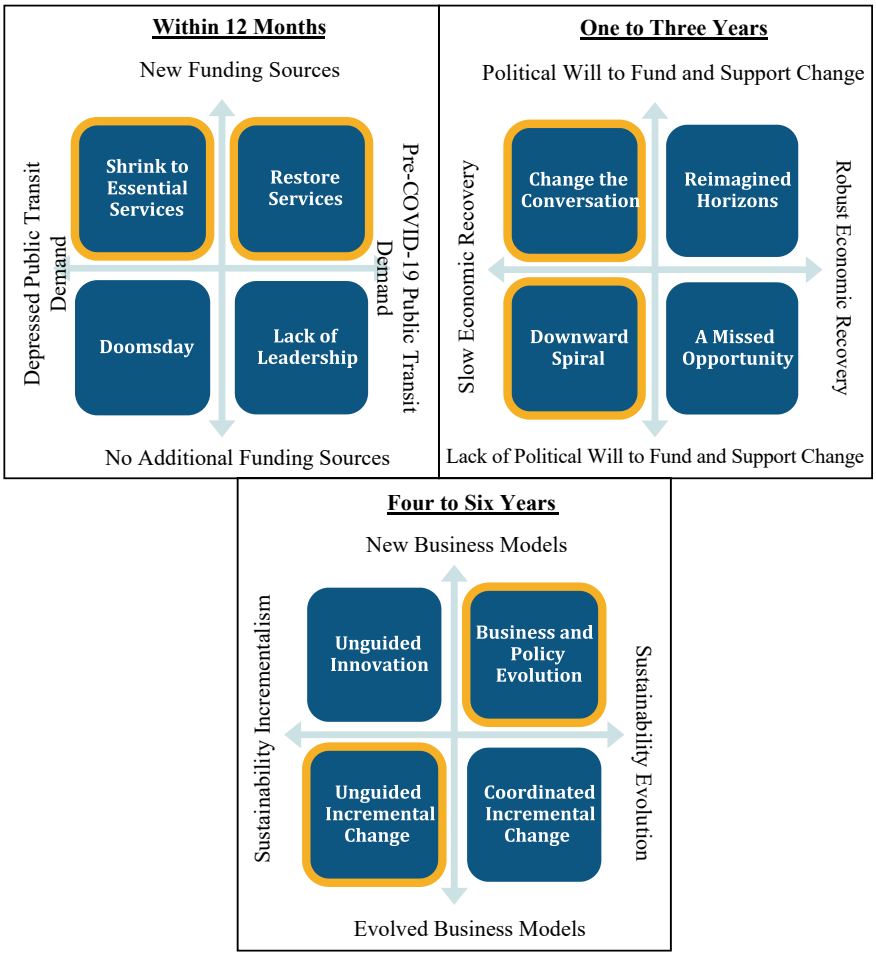

Fig. 1 Final scenario worlds and driving forces

3.2 One to Three Years

Over the next 1 to 3 years, more focus should be dedicated to laying the foundation for *systemic change* through state and local policies and the federal transportation spending reauthorization process. The two scenario worlds for this time period were based on the presence or absence of political will to fund and support change; both scenarios assume slow economic recovery (see Fig. 1). The more optimistic world, *Change the Conversation*, reflects high political will and funding to support change. This scenario world assumes that public transit ridership will begin to return due to successful COVID-19 vaccines. Congressional reauthorization is focused on a multimodal approach with a clear pathway to systemic change that embraces transportation

as a fundamental right and increased funding. The less optimistic *Downward Spiral* world is characterized by a lack of political will and funding. This world reflects a federal "Bare Bones Bill" and more incremental infrastructure funding that merely attempts to keep public transit stable with basic funding for operating subsidies and services.

3.3 Four to Six Years

Four to six years from now, in an optimal scenario, policy action and research would set the stage for innovation in public transportation with corresponding national sustainability action (particularly related to climate). Similar to the prior timeframes, two worlds were assessed, based on two driving factors: (1) business models (new versus evolved) and (2) sustainability (evolution versus incrementalism) (see Fig. 1). The more optimistic world is *Business and Policy Evolution*, which is characterized by further refinement of new technologies and operations. In this world, the experts assume that a complementary ecosystem (i.e., an integrated system across modes and trip purposes with public transit as its backbone) would start to emerge, embracing new and sustainable business models. For the less optimistic case, the *Unguided Incremental Change* world assumes more slowly evolving business models, inaction on climate change, growing socio-economic inequality, incrementalism, political gridlock, and a lack of innovation.

4 Actions to Take Within Each Timeframe

Policy options and needs were first developed by all three expert committees within each timeframe. These options and needs reflect the unique characteristics of the scenario worlds, and they guide actions for a specific temporal point for both public transit and shared mobility.

4.1 Within 12 Months (Timeframe One)

While some additional short-term funding is assumed for this timeframe, public transit demand may or may not return to pre-pandemic levels within 12 months. In light of this, public transit operators should take immediate and rapid actions to ensure essential travel and longer term public transit sustainability. Policy- and decision-makers (e.g., public transit officials, shared mobility leaders, regulators, legislators) should consider declaring a "state of emergency" (similar to actions taken in New York City following the September 11 terrorist attacks) to: (1) integrate public health goals into transportation; (2) refocus attention on customer experience; (3)

restore trust in the public transit system; (4) build public–private partnerships (PPPs)[2] (e.g., between private shared mobility operators and public transit agencies) and new funding structures; (5) address barriers to flexible use of public transit assets and offer innovative services (see Box 1); (6) start initiating systemic social change in transportation; and (7) construct coalitions and convene key organizations to combat the crisis.

Box 1
Effective public transit and shared mobility recovery should address barriers to providing innovative public transit service, including inflexible funding formulas, procurement issues, and limits on what public transit can do (e.g., goods movement use case restrictions). For example, current automated vehicle (AV) pilots have been expanded during the pandemic to offer contactless delivery [7], including a unique partnership with Jacksonville Transportation Authority (JTA), the Mayo Clinic, and Beep (a private AV company) to shuttle COVID-19 tests to laboratories. JTA also offered innovative and equitable COVID-19 vaccine access by using modified buses as mobile vaccine clinics [8].

4.2 Actions to Take in 1 to 3 Years (Timeframe Two)

Over the next 1 to 3 years, the most important factor is whether a political consensus can be developed to significantly increase public transit funding during an expected slow economic recovery. The experts assumed that COVID-19 would be increasingly controlled over this timeframe. Once public transit and shared mobility services are stabilized, policy- and decision-makers should: (1) enact new funding and pricing mechanisms; (2) employ a customer-centric approach to transportation (see Box 2); (3) create new public transit business structures; (4) engage with employers during recovery; (5) incorporate environmental and social equity in all future plans, actions, and policies; and (6) integrate transportation policies into non-transportation legislation.

[2] Experts indicated that PPPs could enable public transit to better meet shifting mobility demand following the pandemic and reduce operational costs. However, experts also indicated that more research is needed to develop fair agreements and outcome-based evaluations. Guardrails, such as: (1) mechanisms to prevent the pass through of fees and taxes to consumers or (2) permitting processes, which also require development.

Box 2
A customer-centric approach for transportation modes across all levels of governance should be a primary focus of this timeframe, including providing real-time information about traveler services, increased service reliability, customer-friendly operators, and seamless and contactless payment systems. For example, the California Integrated Traveler Program will help improve the interoperability of payment platforms and mobility data standards among public transit agencies [9], making public transit more convenient and easier to navigate.

4.3 Actions to Take in 4 to 6 Years (Timeframe Three)

In the longer term, the future of public transit and shared mobility will depend on whether the sectors can develop new business models that reflect a significant commitment to sustainable practices. COVID-19 is largely assumed to be controlled worldwide, but recovery efforts remain. If the groundwork is in place from the previous timeframes, an innovative mobility ecosystem that meshes public transit and shared mobility services can begin to provide transportation for all, especially underserved communities. Combining public transit and mobility services, either through PPPs or a public agency mobility program, will offer expanded and flexible services for more people in more geographies and times of day. Public- and private-sector operators will have the opportunity to: (1) create a connected shared mobility ecosystem that complements public transit (see Box 3); (2) deploy fare payment technology and mobility on demand (MOD)[3] and mobility as a service (MaaS)[4] platforms; (3) emphasize electric vehicle (EV) technology and social equity-based programs to reduce greenhouse gas emissions (GHGs) and localized pollution; (4) address labor concerns with automated transit and shared mobility vehicles; and (5) augment resources to retain and restructure the public transit and shared mobility workforce to become more multimodal and mobility focused. In addition, communities must undertake the challenging task of changing land-use patterns to better facilitate public transit and shared mobility and considering mechanisms to reduce auto ownership and vehicle miles traveled (VMT) [7, 13].

[3] A system that enables consumers to access mobility, goods, and services on-demand by dispatching or using shared mobility, delivery services, and public transportation strategies through an integrated and connected multimodal network.

[4] A mobility marketplace in which a traveler can access multiple transportation services over a single digital interface.

Box 3
A customer-centric approach for transportation modes across all levels of governance should be a primary focus of this timeframe, including providing real-time information about traveler services, increased service reliability, customer-friendly operators, and seamless and contactless payment systems. For example, the California Integrated Traveler Program will help improve the interoperability of payment platforms and mobility data standards among public transit agencies [9], making public transit more convenient and easier to navigate.

5 Integrated Policy Options/Actions

To supplement the policy options for each timeframe, we developed an integrated set of policy options and actions that span all three timeframes. While specific policy options and details can be found in [25], this section provides a brief overview of: (1) key public transit operators and (2) broader policy strategies for the mobility ecosystem. Combined, these two groups of policy options and actions offer a policy strategy pathway for the future of public transit and shared mobility (Fig. 2). It is important to note that while shared mobility strategies are concentrated in the broader policies section, shared services operated by public transit agencies could benefit by implementing key public transit actions as well. The framing of these options/actions was developed by the research team using general themes from the

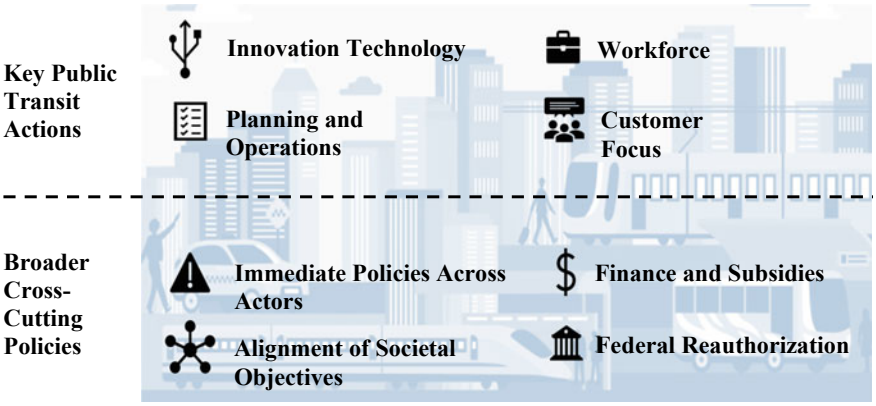

Fig. 2 Policy Strategy Pathway with Two Integrating Areas

scenario and policy committees, followed by refinement and verification from the steering committee.

5.1 Key Actions for Public Transit Operators

Public transit operator actions are categorized into four key areas: (1) innovation and technology, (2) planning and operations, (3) customer focus, and (4) workforce development.

5.1.1 Innovation and Technology

Public transit operators should employ innovative technology to offer complementary services among public and private operators. This could be accomplished through pilot projects and partnerships with shared mobility operators. For example, recent microtransit partnerships through the U.S. DOT's MOD Sandbox could be expanded or elevated to a more permanent status (see Cordahi et al. [10] for more details). Turnkey contracts with technology and/or transportation providers that employ pre-built and ready-to-use settings and platforms, typically for on-demand mobility services, could leverage technological advances more quickly.

Expanding on these projects and partnerships, MOD/MaaS platforms could fill service gaps, increase mobility options, integrate fare payment across modes and agencies, and provide real-time information via signs/applications. These platforms could also build social equity in the availability and frequency of service for public transit-dependent and underserved populations. Regulatory flexibility in enabling pilot projects, partnerships, new business models, and technology is needed to guide and spur innovation. For more long-term considerations, public transit agencies need to move forward with the implementation of EVs in fleets and consider how to employ AVs, especially in the context of workforce changes and retraining needs.

5.1.2 Planning and Operations

Public transit agencies should focus on planning and operational reforms to better serve underserved populations and build social equity into transportation services. One important early action is to stabilize funding sources. Options could include property taxes, carbon market mechanisms, road-user charges, and revenue bonds, in addition to traditional funding via gas taxes, vehicle registration fees, and sales taxes. Even though agencies are struggling to find revenue, they must first prioritize providing service to underserved and transit-dependent populations. This service must be safe and frequent, while also employing best practices to reduce the transmission spread of COVID-19 (see Matherly et al. [21], for example).

Once service is restored for transit-dependent populations, public transit operators can begin to consider how to attract core and choice riders again. Public transit agencies should also prioritize bringing vehicles and infrastructure up to good repair. In parallel, agencies can focus on expanding infrastructure changes for multimodal access and consider adopting a multimodal approach toward transportation infrastructure and services. In the long-term, agencies should advocate for/implement land-use policies to increase affordable and dense housing. Across all timeframes, actions conducted by public transit agencies must ensure social, environmental, and racial equity in services and operations.

5.1.3 Customer Focus

Public transit agencies should adopt a customer-centric business approach that ensures safe, healthy, and high-quality service focused on connecting and moving people, which increases social equity and addresses the needs of public transit-dependent and underserved communities. More immediately, agencies should identify public transit-dependent communities and workers and provide frequent service. Operators should work on expanding open-air micromobility options to and from stations. Customers also offer lived-experience and should be contacted for feedback on services, operations, public health protocols, and safety. For example, public transit operators could develop a rating system that crowdsources trip quality. Customer engagement also extends to fare collection. Discussions are needed with the community to determine reasons for fare avoidance, identify equitable fare structures, and test free public transit. Social and racial justice must guide any discussions, campaigns, and strategies.

Longer term policy options should be developed to improve customer service and public transit quality more holistically. For example, a focus on the entire end-to-end trip, not just its in-transit portion, could provide better service to connect and move people (not just vehicles). Agencies will also need to promote the essential role that public transit plays in the economy and accessibility. This new thinking could help guide the redistribution of funding to public transit-dependent and underserved communities. Consequently, this focus on customers will enable public transit to move beyond just survival mode and reprioritize resources in a sustainable way.

5.1.4 Workforce Development

The transportation workforce has been severely impacted by the pandemic. Early actions should identify and meet critical needs for public transit workers and independent contractors to ensure their safety in precarious working conditions. Strategies developed by the APTA [3], such as supplying personal protective equipment and moving riders away from drivers, should become essential and consistent across public transit agencies. An ongoing concern is the depletion of bus/rail/vehicle operators, who have become sick from COVID-19, retired early, or changed careers

due to the high risk of infection. While specific policies and recruitment campaigns will differ by agency, a concerted effort will help reduce the loss of institutional knowledge and skills.

Over the upcoming years, public transit agencies will need to work with unions, workers, and independent contractors to address a range of concerns, such as growing automation. Retraining may be needed to ensure that workers still retain employment and can interface with automation. To increase long-term resilience and sustainability, agencies should consider implementing internal reorganizations, shifting funds to transportation projects, plans, and staff that focus on climate change. Agencies should also consider restructuring to become more multimodal, which could bring a mobility-for-all pathway to fruition and increase agencies' adaptive ability to tackle future disruptions.

5.2 Broader Policy Strategies Across Timeframes

In addition to the specific policy options and actions for public transit operators, broader policy strategies across timeframes were constructed for both the public transit and the shared mobility sectors. These strategies are split across four areas: (1) immediate policy and actions across actors, (2) alignment of society objectives, (3) federal transportation spending reauthorization, and (4) finances and subsidies.

5.2.1 Immediate Policy and Actions Across Actors

Despite efforts to curb the spread of COVID-19, both public transit and shared mobility could benefit from a declaration of a state of emergency, setting the stage for structural changes with funding and PPPs. Any new partnerships must ensure that stakeholders are supporting sustainable transportation goals, which will require buy-in from all partners. Procurement waivers could also be issued to increase the flexibility of governments and public transit agencies. Over the next 3 years, both public transit and shared mobility should consider repurposing existing vehicles (or partial fleets) for new services. These services could include goods delivery, medical transportation, or mobile clinics for health care and vaccinations. Across all these actions, an integration of social equity should be immediate and sustained. The two sectors provide transportation assistance to essential workers, improve access for underserved communities, and prioritize resources for those most disadvantaged.

5.2.2 Alignment of Societal Objectives

Significant steps are needed to ensure that policy actions and strategies across the two sectors align with sustainability and resilience objectives, while still ensuring safety and efficiency. Public transit and shared mobility should first adopt new metrics

and measures for their performance that place more focus on social equity, safety, and environmental outcomes. For example, metrics related to ridership could be replaced by measures of accessibility for transit-dependent populations or travel times to jobs and essential services. Public and private operators could then create more targeted and scaled services that are on-demand and higher frequency for people who need transportation the most. These services could be developed more quickly through environmental streamlining policies that increase the speed of environmental reviews without compromising environmental needs, mitigation, and goals. Over future timeframes, operators should also implement policies to ensure the coordination of services. A complementary system of shared mobility and public transit that improves access to jobs and services can help reduce the reliance on autos as a single mode, thus moving away from an auto-centric built environment.

5.2.3 Federal Transportation Spending Reauthorization

Federal surface transportation is funded through multiyear omnibus spending legislation. The Fixing America's Surface Transportation (FAST) Act of 2015 was the most recent bill passed and was set to expire on September 30, 2021. Each reauthorization of funding presents opportunities to shift funding priorities and societal objectives in transportation. For example, the new legislation could begin leveling the playing field across modes through more funding for public transit and shared mobility and increased spending flexibility on local needs, particularly during the COVID-19 recovery. This switch to spending funds on mobility (as opposed to infrastructure, especially automobile infrastructure) could help emphasize public transit as the backbone for transportation. To achieve a sustained and holistic focus on mobility, an exploration could be launched to reorient the US Department of Transportation (DOT) as the Federal Mobility Administration. Finally, a coalition of transportation advocates could help embed transportation funding and policies into non-transportation bills related to climate, housing, and public health. It important to note that the FAST Act was extended and replaced by the Bipartisan Infrastructure Law, which was signed by President Biden on November 15, 2021. This historic legislation was enacted over a year after the scenario planning exercise was completed. This law includes nearly $39 billion in funding for public transit systems.

5.2.4 Finances and Subsidies

With growing inequalities exacerbated by the pandemic, public transit and shared mobility have become more essential for equitable travel and access to jobs and services. A key first step is to stabilize funding streams for essential transportation, which includes rides for health services, education, and work. Alternative sources through property taxes, value capture, goods delivery, and other options could be leveraged. An opportunity also exists to better price transportation externalities through carbon taxes, road-user charges such as tolling, and congestion pricing. Both

public and private operators will then need to direct funding and human resources to support sustainable transit modes and mobility in historically underserved communities. In addition, funding and attention must be focused on how transportation currently fills (and could fill) notable social service gaps. Operators should test and implement new technology, such as mobility wallets that link shared mobility and multiple public transit services together, to enable seamless transportation.

6 Future Research Needs

Moving forward, the public transit and shared mobility sectors will require substantial research to develop equitable, environmentally friendly, and resilient policies and strategies. With a significant amount of research already conducted on the immediate impacts of the pandemic, future research should shift to the pandemic's long-term impacts. Table 3 begins to answer these long-term impacts by presenting several highlighted research needs developed by experts. Additional attention and policy development are needed to address land use, auto ownership, and VMT patterns that diminish the recovery (and long-term feasibility) of public transit and shared mobility. Strategies should be created and refined by local, regional, state, federal, and tribal governments and agencies in collaboration with public transit and shared mobility operators.

Table 3 Highlighted future research needs identified by experts

Topic area	Identified research topics
Changes in travel, goods movement, and residence	• Determine short- and long-term implications of work-from-home policies • Assess behavioral changes in e-commerce and its impact on goods movement, curb management, congestion, GHGs, and VMT • Analyze how changes in land use and density due to COVID-19 will impact trip patterns and public transit ridership
Funding	• Determine viable and equitable funding and allocation mechanisms for public transit and shared mobility • Reform federal mechanisms that finance transportation and distribute funds to local, regional, and state governments • Analyze the harms of fare enforcement, especially on Black communities, and how to allocate funding from policing to transportation

(continued)

Table 3 (continued)

Topic area	Identified research topics
Regulations and metrics	• Identify and remove barriers to funding requirements that hinder public transit agencies from being responsive • Develop and expand General Transit Feed Specification (or GTFS) guidance • Study and test equitable and efficient performance metrics (e.g., cost to the passenger, number of people to jobs, travel times)
Innovations	• Initiate pilot projects to jump-start technological innovation in public transit • Conduct empirically driven evaluations to ensure pilots are sustainable and resilient • Explore microtransit services and alternative transportation services
Social and cultural change	• Assess current barriers to reframing transportation as a right and creating an integrated and multimodal mobility ecosystem • Determine mechanisms, funding, and operations to better serve low-income and underserved communities • Identify opportunities to address social inequity and environmental injustices through transportation

7 Conclusions

This chapter provides a pathway for the longer term recovery of public transit and shared mobility services following the tragic toll of the pandemic on societies, communities, and individual lives. First, while public transit and shared mobility face a dire future in the short run, steps can be taken immediately to reduce the effects of the current crisis, while laying the groundwork for more sustainable transportation in the future. Second, as disruptive as the pandemic has been, long-term external forces beyond COVID-19 will significantly drive the future direction of public transit and shared mobility services and determine the effectiveness and feasibility of policy strategies. Consequently, operators should look beyond the COVID-19 pandemic at policies and actions that can achieve future environmental, social equity, and resilience goals. Actions taken to only address the current crisis will not prepare the public transit and shared mobility industries for the future. Finally, future policies and actions will not be effective without in-depth analysis and development. Research and lessons learned from demonstration and pilot projects will be critical to crafting policies, identifying all positive and negative outcomes, and shaping actions toward greater mobility.

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