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Future of Public Transit and Shared Mobility: Scenario Planning for COVID-19 Recovery

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16. Abstract In 2020, the novel coronavirus (COVID-19) pandemic enveloped the world, leading to a public health crisis that profoundly changed all aspects of society, especially multiple sectors in transportation such as public transit and shared mobility. With so much uncertainty about the future of travel, the transportation sector needs to move rapidly to shape the nature of public transit and shared mobility services during the COVID-19 recovery period. Consequently, the University of California Institute of Transportation Studies (UC ITS) and the Transportation Research Board's (TRB) Executive Committee launched a scenario planning exercise from June to September 2020 involving 36 transportation experts. The exercise resulted in a series of policy options and research directions across three timeframes (i.e., within 12 months, one to three years, four to six years) that could guide the recovery of the public transit and shared mobility industries. This report offers several key takeaways. First, external forces beyond COVID-19 (e.g., economy, political will, etc.) will significantly drive the future of public transit and shared mobility and determine the effectiveness and feasibility of any policy strategies. Second, 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 also laying the groundwork for more sustainable transportation in the future beyond COVID-19. Actions taken to <i>only</i> address the current crisis will not prepare public transit and shared mobility 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 for crafting policies, identifying all positive and negative outcomes, and shaping actions toward a future transportation system that is more resilient, socially equitable, and environmentally friendly.					
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About the UC Institute of Transportation Studies

The University of California Institute of Transportation Studies (UC ITS) is a network of faculty, research and administrative staff, and students dedicated to advancing the state of the art in transportation engineering, planning, and policy for the people of California. Established by the Legislature in 1947, UC ITS has branches at UC Berkeley, UC Davis, UC Irvine, and UCLA.

An initiative of UC ITS, the California Resilient and Innovative Mobility Initiative (CA RIMI) is supported by all four UC ITS branches — UC Berkeley, UC Davis, UC Irvine, and UCLA. The CA RIMI serves as a living laboratory bringing together university experts, policymakers, public agencies, industry stakeholders, and community leaders to inform the transportation system's immediate COVID-19 response and recovery needs, while establishing a long-term vision and pathway for innovative mobility with the goal to develop sustainable and resilient transportation in California and the United States.

About the Transportation Research Board

The Transportation Research Board (TRB) is one of seven program units of the National Academies of Sciences, Engineering, and Medicine, which provides independent, objective analysis and advice to the nation and conducts other activities to solve complex problems and inform public policy decisions. The Academies also encourage education and research, recognize outstanding contributions to knowledge, and increase public understanding in matters of science, engineering, and medicine. TRB's varied activities annually engage more than 7,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest by participating on TRB committees, panels, and task forces. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation.

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Future of Public Transit and Shared Mobility: Scenario Planning for COVID-19 Recovery

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January 2021

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Key Acronyms

American Public Transportation Association	APTA
Automated Vehicle	AV
Battery Electric Vehicle	BEV
Community-Based Organization	CBO
Federal Transit Administration	FTA
General Transit Feed Specification	GTFS
Greenhouse Gas Emissions	GHGs
Key Performance Indicator	KPI
Metropolitan Planning Organization	MPO
Mobility as a Service	MaaS
Mobility on Demand	MOD
Non-Governmental Organization	NGO
Public-Private Partnership	PPP
Transit Oriented Development	TOD
Transportation Demand Management	TDM
Transportation Network Company	TNC
Transportation Research Board	TRB
U.S. Department of Transportation	U.S. DOT
University of California Institute of Transportation Studies	UC ITS
Urban Air Mobility	UAM
Vehicle Miles Traveled	VMT

Glossary

Bikesharing	A system that provides users with on-demand access to bicycles at a variety of pick-up and drop-off locations for one-way (point-to-point) or roundtrip travel
California Integrated Traveler Project	An initiative by the California Department of Transportation to facilitate easy and accessible travel planning and payment across California
Community-based organizations	Non-profit organizations that serve local and community needs
Concept of Operations	An analysis and formal document that describes the use of a system, asset, or capability
Curb management	Strategies taken to determine uses and times of use of curb space along roadways

Dashboards	A graphical user interface of data or indicators that provides information and visualizes data to serve a specified purpose
Micromobility (personal and shared devices)	A collective form of transportation focusing on individual modes of transportation including but not limited to bicycles, bikesharing, electric bicycles/e-bikes, scooter sharing, and an array of light electric-powered modes
Farebox recovery	The percentage of operating expenses that are covered by revenues from public transit fares
General Transit Feed Specification (GTFS)	An open-source data format through which public transportation agencies share information about routes and vehicle arrival and departure times, such as static public transit schedules (GTFS-s) or real-time information (GTFS-r)
Goods delivery	The transportation of items, packages, and/or food to a predefined destination
Key Performance Indicators (KPIs)	Quantifiable measurements used to gauge performance of a system, operation, or service
Microtransit	A privately or publicly operated, technology-enabled transport service that typically uses multi-passenger/pooled shuttles or vans to provide on-demand or fixed-schedule services with either dynamic or fixed routing
Mobility	The ability to move freely and easily, regardless of mode or purpose
Mobility ecosystem	A holistic, interconnected system that integrates travel across modes, encouraging multimodality and complementary (rather than competitive) services
Mobility as a Service (MaaS)	A mobility marketplace in which a traveler can access multiple transportation services over a single digital interface
Mobility for all	The ability for all people, no matter their identity, environment, circumstance, ability, or income, to move freely and easily, regardless of mode or purpose
Mobile hot spots	An unfixed vehicle or asset where people can access the Internet, typically through Wi-Fi
Mobility on Demand (MOD)	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
Mobility wallets	A unified payment platform for various public transit systems and potentially other public and private mobility services to facilitate seamless access regardless of geography, enabling subsidies from government and employers to fund individual accounts based on need, income, geography, etc.
Non-governmental organizations (NGOs)	Non-profit organizations that are organized on a local, national, or international level to support the public good

Parking cash out	A commuter benefit where employers, who provide subsidized parking for employees, offer a cash allowance instead of a parking space
Platforms (technology)	A group of technologies or an environment for building and running applications, systems, and processes
Public-Private Partnerships (PPPs)	Cooperative agreements between/among the public sector (e.g., governmental agencies) and the private sector (e.g., companies)
Reauthorization	Multiyear omnibus federal transportation spending legislation The last bill was the Fixing America's Surface Transportation (FAST) Act of 2015, which is set to expire on September 30, 2021
Resilience	The capacity of social, economic, and environmental systems to cope with a hazardous event, trend, or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation
Right sizing	A process of obtaining vehicles that are a more appropriate physical size to better meet demand and service needs
Road pricing	Mechanisms where fees are collected for use of the road, such as tolling
Shared mobility	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
Sustainability	A concept and framework that balances three key outcomes/goals related to: 1) environment; 2) equity; and 3) economy
Transportation Demand Management (TDM)	A set of defined strategies aimed at providing travelers with effective choices to improve travel reliability, particularly in relation to work trips
Transportation network companies (TNCs)	Prearranged and on-demand transportation services for compensation in which drivers and passengers connect via digital applications, which are typically used for booking, electronic payment, and ratings
Transit oriented development (TOD)	A type of higher-density, often mixed-use, urban development that is located adjacent to or near public transit
Turn-key contracts	Contracts with technology and/or transportation providers that employ pre-built and ready to use settings and platforms, typically for on-demand mobility services
Universal basic mobility program	A program that would dedicate a fixed total of funds to households for transportation and/or make public transit free
Urban air mobility	An urban transportation system that moves people and/or goods by air at lower elevations, often using electrified, vertical take-off and landing (VTOL), and/or automated aircrafts
Value capture	A series of strategies for governments to recover and reinvest some/all of the value of public infrastructure (e.g., public transit station, rail line) that is typically generated for private landowners

Executive

Summary

Executive Summary

The COVID-19 global pandemic has upended travel and triggered a crisis for public transit and shared mobility services. Since mid-March 2020, public transit ridership for many agencies has fallen by over 60 percent compared to 2019 (APTA, 2020a). In New York City, the Metropolitan Transportation Authority reported that ridership had dropped in mid-March of 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 (Goldbaum, 2020). Meanwhile, Bay Area Rapid Transit (BART) in the San Francisco Bay Area experienced ridership drops of over 90 percent compared to similar time periods in 2019 (Bay Area Rapid Transit, 2020). These impacts are not isolated to urban areas. Many small public transit agencies in rural areas also experienced major declines in ridership (APTA, 2020b). 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 (Rana, 2020). Other forms of shared mobility, such as carsharing, bikesharing, and scooter sharing, have seen mixed changes in ridership, depending on the geography and trip purpose (Bliss, 2020; Wilson, 2020). Unlike other transportation sectors, delivery services driven by growth in e-commerce (Federal Reserve Bank of St. Louis, 2020) are becoming profitable for the first time (Efrati, 2020). Overall, the COVID-19 crisis not only devastated many public transit and shared mobility services, but it exposed underlying issues in how mobility is provided to society. Short-term fixes, while critical, will not solve pervasive transportation issues related to access, high-quality service, and social equity. For public transit and shared mobility services to recover in the short- and long-term, they will require a significant focus on policy and planning to ensure future sustainability that meets critical societal goals.¹

To guide the short- and longer-term sustainability of public transit and shared mobility, researchers at the University of California Institute of Transportation Studies (UC ITS) conducted a multi-phase scenario planning exercise to construct possible future worlds over three timeframes — within 12 months, one to three years, four to six years. This scenario planning exercise was designed to help answer the following framing questions:

- How has COVID-19 affected public transit and shared mobility services, operations, business structures, and finances?
- What key driving forces (e.g., social, political, economic, legal/policy, technological) in addition to COVID-19 will shape the future for public transit and shared mobility?
- What barriers and opportunities (e.g., institutional, financial, mindset) exist for public transit and shared mobility?
- What policy and planning options (along with key research needs) are needed to mitigate the negative impacts of COVID-19 and advance social, environmental, and resilience goals?

To tackle these critical questions, from June to September 2020, the authors collaborated with 36 transportation experts serving on one of three committees — steering, scenario planning, and policy — to develop possible future scenarios, policy options, and research needs for each timeframe. The experts came from many different areas across the United States and represented multiple transportation and related sectors including:

- Public transit agencies and operators of various sizes and modal mixes;
- Non-governmental organizations (NGOs);

¹ For purposes of this study, achieving sustainability rests on three pillars — environment, social equity, economy — and encompasses all aspects of public transit and shared mobility, ranging from operations to business structures to finances.

- Academia and research institutes;
- Transportation consulting and futurists;
- Local, state, and federal governmental agencies; and
- Private transportation, sustainable design, and shared mobility companies.

We employed the Delphi approach across the exercise’s four phases to facilitate a conversation from multiple perspectives and build consensus on possible scenario worlds and policy directions. In the first phase, the eight-person steering committee developed the framework for the scenario planning exercise and a list of key external driving forces that would impact public transit and shared mobility for each timeframe. The participants defined the study’s focal question as:

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 throughout the exercise. In the second phase, the 18-person scenario planning committee was divided into three groups to each focus on a specific timeframe, choose two key driving factors that would characterize the future scenario worlds, and craft initial policy options and research directions. Next, the ten-person policy committee reviewed and refined the scenario worlds, policy options, and research directions and began identifying policies and needed actions across the three timeframes. Finally, the steering committee was reconvened to further refine the results and analysis. Throughout the exercise, the key driving factors and even the names given individual scenario worlds were often changed to reflect the participants’ evolving thinking. Table ES1 presents the entire group’s consensus for the six finalized worlds -- two scenario worlds for each timeframe.

Table ES1: Final Scenario Worlds and Driving Vectors for Each Timeframe

Timeframe	Level of Optimism	Final Scenario Worlds	Framing Assumptions
With 12 Months	Less Optimistic	Shrink to Essential Services	<ul style="list-style-type: none"> • Public Transit Demand Remains Depressed • New Funding Sources are Secured
	More Optimistic	Restore Services	<ul style="list-style-type: none"> • Return to Pre-COVID-19 Public Transit Demand • New Funding Sources are Secured
One to Three Years	Less Optimistic	Downward Spiral	<ul style="list-style-type: none"> • Lack of Political Will to Fund and Support Change • Slow Economic Recovery
	More Optimistic	Change the Conversation	<ul style="list-style-type: none"> • Political Will to Fund and Support Change • Slow Economic Recovery
Four to Six Years	Less Optimistic	Unguided Incremental Change	<ul style="list-style-type: none"> • Limited Focus on Sustainability • Gradual Evolution in Business Models*
	More Optimistic	Business and Policy Evolution	<ul style="list-style-type: none"> • 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 marginalized communities.

Policy Development by Timeframe

Using the narratives created for each scenario world, all three committees developed possible policies and actions that could be implemented to bolster the sustainability of public transit and shared mobility services. The experts were guided by the focal question and two additional questions:

How should public transit and shared mobility policies be designed to achieve environmental, financial sustainability, social equity, and resilience goals?

At what level of government (e.g., federal, state, regional/local) should these policies be developed?

The results from the policy discussions across the different scenario worlds were combined and synthesized into key themes for each timeframe, presented below.

Within 12 Months: Declare a State of Emergency

While some additional short-term funding is assumed for this timeframe, public transit demand may or may not return to pre-COVID-19 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 11th terrorist attacks) to: 1) integrate public health goals into transportation (e.g., minimizing virus exposure); 2) refocus attention on customer experience; 3) restore trust in the public transit system; 4) build public-private partnerships (PPPs) (e.g., between private shared mobility operators and public transit agencies) and new funding structures; 5) address barriers to flexibility of using public transit assets and offering innovative services; 6) start initiating systemic social change in transportation (e.g., mobility as a right); and 7) construct coalitions and convene key organizations to combat the crisis.

One to Three Years: Emphasize Systemic Change

Over the next one to three years, the most important factor is whether or not a political consensus can be developed to significantly increase public transit funding during an expected slow economic recovery. Once public transit and shared mobility services are stabilized, policy- and decision-makers should: 1) enact new funding and pricing mechanisms (e.g., road pricing, value capture); 2) employ a customer-centric approach to transportation; 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 (e.g., climate, housing, public health, etc.) legislation.

Four to Six Years: Build a Mobility Ecosystem Around Public Transit

In the longer term, the future of public transit and shared mobility will depend on whether they can develop new business models that reflect a significant commitment to sustainable practices. If the groundwork is in place from the previous timeframes, an innovative mobility ecosystem, meshing public transit and shared mobility services, can begin to provide transportation for all, especially marginalized 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 (e.g., via microtransit, micromobility, and TNCs) that complements public transit; 2) deploy fare payment technology and mobility on demand (MOD) and mobility as a service (MaaS) platforms; 3) emphasize electric vehicle (EV) technology and social equity-based programs to reduce greenhouse gas emissions (GHGs) and localized pollution (e.g., EV subsidies and charging infrastructure in marginalized communities); 4) address labor concerns with automated transit and shared mobility vehicles; and 5) augment resources to retain, retrain, and restructure the public transit and shared mobility workforce to become more multimodal and mobility focused.

In addition to these timeframe-specific policy options, the experts crafted a series of cross-cutting policy options and research needs, spanning multiple timeframes. We categorized them into two areas: 1) actions that public transit operators could take and 2) broader policy strategies that could guide public transit and shared mobility services. Each area is discussed below.

Key Actions for Public Transit Operators

Public transit operator actions are categorized into four key areas: 1) planning and operations, 2) customer focus, 3) innovation and technology, and 4) workforce development. These actions are presented below in a brief summary and in Table ES2 based on timeframe.

Table ES2: Public Transit Operator Actions for COVID-19 Recovery Across Timeframes

Public Transit Operator Actions	Action	<12 months	1 to 3 years	4 to 6 years
Innovation and Technology	Deploy more sensing, fare media integration, and contactless options			
	Employ technology to address public transit crowding (e.g., automated passenger counting systems)			
	Focus more on microtransit by metropolitan planning organizations (MPOs), reflecting a spectrum of service needs and right-sized vehicles and services			
	Explore new ideas (e.g., Concept of Operations), employ a ground-up strategy for Federal Transit Administration (FTA) funding, and carefully educate/familiarize the FTA about new ideas/approaches			
	Deploy technology-driven road pricing along with flexible allocation of curb space for different uses including deliveries, TNCs, and active transportation			
	Integrate EVs into public transit and shared mobility companies			
	Employ automated vehicles (AVs) in public transit and shared mobility companies and work on addressing AV barriers (e.g., labor, retraining)			
	Leverage data, fares, scheduling, and service integration technologies to create multi-agency coordination for travel across a region			
	Relax federal, state, and local regulations that inhibit the testing of new technology and innovative approaches			
	Deploy more MOD/MaaS options, including integrated payment			
	Employ partnerships to fill service gaps (e.g., microtransit partnerships with Via; TNCs partnerships for paratransit, late-night service, and low-ridership routes) or create more agency-operated MOD services (e.g., turnkey contracts)			
	Employ pilot projects to test new ideas (openness to entrepreneurialism)			
	Build dashboards and real-time sensing and tracking of assets, services, and operations to increase reliability			
Planning and Operations	Prioritize services for people who are public transit dependent			
	Use reduced travel demand as an opportunity to bring infrastructure and vehicles up to a state of good repair			
	Focus on cash flow management and funding stabilization when demand is down			
	Carefully manage capacity restrictions, weighing both virus transmission and ridership/revenue			
	Rely on turn-key contractors and lessons learned from other MOD PPPs to speed up partnerships, meeting shifting travel demand more quickly			

	Begin exploring alternative and/or flexible funding mechanisms for transportation (e.g., property tax, carbon market mechanisms, road user charge, revenue bonds, etc.)			
	Expand services to core and choice riders			
	Leverage zoning and development mechanisms to increase affordable and dense housing near public transit			
	Expand infrastructure changes (e.g., slow streets, bike lane construction) to provide multimodal access and a high-level of service to micromobility and walking			
	Do more with fewer resources, which could be accomplished via more efficient operations and maintenance practices (while still ensuring safety)			
	Build socially and racially equitable services and fare collection policies			
	Increase job and service access for low-income, essential worker, transit-dependent, and marginalized populations via public transit and shared mobility services			
	Require social equity in service and operations to overcome structural racism (e.g., walking while Black, predictive policing, racially motivated fare enforcement)			
Customer Focus	Identify public transit-dependent communities and workers and provide quality service to these riders			
	Promote an attitude of “public transit is here for you” through campaigns			
	Deploy public campaigns around safety of public transit, public health, etc.			
	Increase availability and wide distribution of micromobility options for connection to and from public transit			
	Increase customer engagement to provide rapid and useful feedback to improve the system			
	Provide a rating system for every trip on public transit as a low-cost, crowdsourced improvement mechanism			
	Convey importance of fare collection through campaigns and education to reduce fare avoidance			
	Augment quality service for dependent riders by renewing service quality for core riders and choice riders			
	Change the narrative that public transit is an important service to public transit is an essential right and essential to society (campaign)			
	Build longer-term and sustainable transportation demand management (also known as TDM) strategies for employers and their employees			
	Provide quality service to connect and move people, not just vehicles			
	Plan for the entire end-to-end trip, not just in-transit portion of trips			
	Tailor services for essential workers (e.g., more frequent headways, longer service hours)			
	Support more comprehensive transportation service by redistributing current funding to public transit-dependent and marginalized communities			
	Alter fare structures to allow for free or means-based fares for riders, particularly for marginalized populations (e.g., Black, Indigenous, and people of color communities; low-income households)			
Workforce Development	Develop COVID-19 training programs and address notable impacts on the workforce from COVID-19, especially related to public health and safety			
	Determine how to combat the depletion of the public transit workforce as a result of COVID-19 and retirements			

	Provide an infusion of funding and start restructuring public transit agencies to grow the profession			
	Create a recruitment campaign to encourage people to think about mobility as a career			
	Implement internal agency change by shifting internal funds to address climate change and restructuring agencies to focus on multimodality			
	Consider how to implement automation into public transit and address workforce needs and development based on federal labor regulations and retraining			
	Work closely with unions to address a range of concerns, including reduced workforce, training, and automation			
	Identify the transportation needs of essential workers, including public transit operators			

Innovation and Technology: Public transit operators should employ innovative technology to offer complementary services among public and private operators. This could be accomplished through: 1) pilot projects; 2) partnerships with shared mobility operators; and 3) MOD/MaaS platforms to fill service gaps, increase mobility options, integrate fare payment across modes and agencies, conduct real-time sensing (e.g., for real-time information via signs/applications), and build social equity in the availability and frequency of service for public transit-dependent and marginalized populations. Regulatory flexibility in enabling pilot projects, partnerships, new business models, and technology is needed to guide and spur innovation.

Planning and Operations: Public transit agencies should focus on planning and operational reforms to better serve marginalized populations and build social equity into transportation services. Key actions include: 1) developing more frequent service and stabilizing funding sources; 2) managing passenger capacity on public transit vehicles to comply with social distancing restrictions (e.g., see Matherly et al., 2020 for examples); 3) identifying new mechanisms for generating revenue; and 4) bringing vehicles and infrastructure up to good repair. Agencies should also consider adopting a multimodal approach toward transportation infrastructure and services (e.g., agencies facilitating access across multiple modes), along with land-use policies to increase affordable and dense housing.

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 marginalized communities. Such an approach also will engage communities and continue to build support for public transit as an essential right.

Workforce Development: Early actions should identify and meet critical needs for public transit workers to ensure their safety throughout the COVID-19 recovery (e.g., supplying personal protective equipment, moving riders away from drivers). Longer-term policy options and strategies could include building training programs to retain and add new drivers and workers, while considering the future effects of automation. The industry should consider restructuring public transit agencies to be more flexible, adaptive, and multimodal.

Broader Policy Strategies for Public Transit and Shared Mobility

In addition to these public transit actions, the experts developed a series of policy strategies for public transit and shared mobility services spanning: 1) immediate policy actions across actors; 2) alignment of societal objectives, 3) federal transportation spending reauthorization; and 4) finance and subsidies. Table ES3 presents a shortened list of these strategies that cut across timeframes.

Table ES3: Broader Policy Strategies Across Timeframes

Broader Policy Strategies	Action	<12 months	1 to 3 years	4 to 6 years
Immediate Policy Actions Across Actors	Declare a state of emergency, setting the stage for structural change and federal transportation spending reauthorization	■	■	■
	Allow waivers to procurement rules (e.g., Buy American Rules)	■	■	■
	Repurpose existing vehicles — even partial fleets — for new services (e.g., goods delivery, medical transportation)	■	■	■
	Make space grabs (e.g., dedicate more traffic lanes for public transit during the COVID-19 recovery)	■	■	■
	Develop partnership requirements to ensure that all partners and partnerships* are supporting sustainable transportation goals	■	■	■
	Integrate social equity (e.g., assistance for essential workers, programs for marginalized communities) immediately across modes	■	■	■
Alignment of Societal Objectives	Create more targeted, scaled services (e.g., on-demand mobility, high-frequency service) by clearly defining service needs and goals**	■	■	■
	Take advantage and expand upon environmental streamlining policies (e.g., SB 743 in California) to increase the speed of environmental reviews without compromising environmental needs, mitigation, and goals	■	■	■
	Adopt new metrics and measures for public transit performance that place more focus on social equity, safety, and environmental outcomes at the local, regional, state, and federal levels	■	■	■
	Implement policies to ensure coordinated rather than competing services, including ensuring more flexibility at the local level	■	■	■
	Focus on reducing reliance on autos as a single mode, for example through road pricing in large, more urbanized areas	■	■	■
	Build a complementary system of shared mobility and public transit that improves access to jobs and services	■	■	■
Federal Transportation Spending Reauthorization	Begin leveling the playing field across modes through more funding for public transit and shared mobility and increased flexibility to spend federal funds based on local needs	■	■	■
	Fundamentally restructure future federal transportation spending around providing mobility (as opposed to infrastructure), emphasizing public transit as a backbone	■	■	■
	Develop a Traveler’s Bill of Rights,*** growing the discussion of transportation toward people and flexible approaches (e.g., leveraging assets in new ways to fulfill basic transportation needs)	■	■	■
	Increase flexibility in funding formulas and allocation to allow local, regional, and state governments to institute innovative and creative projects and services	■	■	■
	Embed transportation funding and policies in non-transportation bills (e.g., climate, housing, public health, etc.)	■	■	■
	Explore US DOT becoming a Federal Mobility Administration with a holistic view toward mobility and funding	■	■	■
Finances and Subsidies	Reallocate resources to support sustainable transit modes and better serve historically marginalized communities	■	■	■

	Provide enough funding and human resources for public transit to serve as a social service			
	Stabilize funding streams for essential transportation (e.g., rides to wellness checks, rides to education and work)			
	Address social equity by providing fare subsidies for people that cannot afford them with linkages to MOD/MaaS and mobility wallets for managing customer incentives/subsidies and transportation payments			
	Promote road and congestion pricing (e.g., tolling, vehicle miles traveled fees) to fund transportation and invest in mobility			
	Explore and implement alternative funding structures that price transportation externalities (e.g., carbon tax, road user charge, congestion pricing, etc.)			

*Partnerships could be among public transit operators, local/regional governments, and shared mobility companies.

**Goals, such as accessibility, environment, social equity, resilience, should be developed through a conversation among agencies, companies, other key stakeholders, and the public.

***This may include a provision related to a universal basic travel program, which would either dedicate a fixed total of funds to households for transportation and/or make public transit free.

Research Recommendations

Finally, the experts offered a series of research needs to inform and guide the public transit actions and key policy strategies. Research recommendations stemming from COVID-19 recovery efforts include:

- Evaluating travel behavior impacts resulting from work-from-home and telework;
- Understanding the effect of changes to TDM, parking policies, and employer-provided transportation options (e.g., shuttles) on public transit and shared mobility services;
- Modeling a wide range of scenarios for public transit and shared mobility;
- Identifying and evaluating regulatory inconsistencies across local, state, and federal levels;
- Identifying and assessing opportunities to remove regulatory restrictions on using spending and assets;
- Considering a sliding scale for federal requirements on public transit funding (e.g., federal procurement, safety, and asset management requirements), which reflects the actual proportion of federal funding received for these initiatives;
- Analyzing a range of different funding mechanisms for public transit (e.g., value capture, new business models for Wi-Fi access through buses, goods delivery via transit vehicles, etc.);
- Evaluating means to provide alternative transportation services to low-income and marginalized areas that cannot be well served by traditional public transit (e.g., microtransit, TNCs, and the application of public transit services to secure food for youth and older adults);
- Examining racial and social equity issues with regard to current fare payment and enforcement policies;
- Developing new fare structures based on financial sustainability goals;
- Encouraging innovation and technology through pilot programs/evaluation;
- Evaluating mechanisms to develop successful PPPs;
- Understanding institutional barriers to developing a multimodal transportation ecosystem;
- Investigating opportunities and policy options to build affordable housing in public transit rich places;
- Studying and testing new data standards and metrics to better measure outcomes in achieving key equity, environmental, resilience, and accessibility goals;
- Evaluating how changes in land use and density, resulting from COVID-19, will impact trip patterns and public transit ridership levels; and

- Evaluating behavioral changes in e-commerce and the impact on goods movement and curb management (e.g., how to manage space at curbs for deliveries and other uses).

Exercise Conclusions

This scenario planning exercise provides a roadmap for the longer-term recovery of public transit and shared mobility services. 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 (e.g., economy, political will, etc.) 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 COVID-19 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. Future scenario planning exercises and working groups also will be needed to follow this report to connect stakeholders, build coalitions, and address key issues in more detail.

Executive

Summary

Introduction

In March 2020, the United States was enveloped by the COVID-19 global pandemic. During the last six months, public transit ridership and patronage of transportation network companies (TNCs, also known as ridehailing and ridesourcing), ridesharing, and many shared micromobility services plummeted due to stay-at-home orders, virus concerns, and business closures. Travelers also have had strong concerns about sharing rides with persons who might potentially be infected or riding in vehicles that may have recently been used by infected persons. This crisis represents a pivotal point in our nation's transportation history. There is tremendous uncertainty about how the pandemic will affect how much people travel and by what means they will travel in the future. Short- and longer-term policy responses could dramatically affect mobility, environmental quality, and the economy, including access to jobs, use of mass transit and ferries, ridesharing (carpooling/vanpooling), and much more. The transportation sector needs to move quickly to address these and other concerns.

There are many questions and uncertainties. How will people's sensitivity to social distancing and hygiene impact public transit and shared vehicle ridership, alongside auto ownership and use? Are there simple technical fixes such as new methods to disinfect public transit and shared vehicles (e.g., ultraviolet light, disinfecting handlebars)? Will people continue their current reliance on telecommunications, which may change motorized travel for work, conferences, shopping, and health care? Will the result be more or less automotive travel? Will people continue to prefer to travel by private automobile due to public health considerations? What role will private-sector innovative mobility services play in the U.S. recovery (e.g., getting health care workers to jobs, designing new forms of public transportation services)?

Should the public sector consider subsidizing private mobility services and for whom? What role can federal transportation spending reauthorization legislation play in supporting innovative transit service delivery and subsidizing public transit operations and fares for transit dependent populations? How will reliance on local sales tax and gas tax revenues for public transit and general transportation funding affect agency budgets, service levels, and construction plans? What role can public transit, ferries, shared mobility, active transport, and advanced technologies (e.g., telecommunications, robotics, etc.) play in strengthening the public transport network, particularly for the most vulnerable populations? How can the fiscal capacity and policy flexibility of public transit agencies be enhanced to meet essential mobility needs? How should policy and decision-makers respond?

These questions and many others convey the complex web of decisions and uncertainty that face the public transit and shared mobility sectors. Scenario planning can help organizations prepare, plan, and develop robust alternatives to manage risk and guide disruptions toward positive outcomes. In this study, the University of California Institute of Transportation Studies (UC ITS) and the Transportation Research Board's (TRB) Executive Committee partnered to conduct a multi-phase scenario planning exercise, from June to September 2020, to explore different pathways and potential outcomes focused on the future of public transit and innovative mobility options.

This report is divided into four key sections: 1) a brief description of the scenario planning process, 2) a summary of recommendations for the immediate term (within 12 months), short-term (one to three years), and medium-term (four to six years), 3) cross-cutting and integrated policy options across timeframes for public transit operators and the broader public transit and shared mobility sectors, and 4) conclusions, summary of policy options, and next steps. An appendix at the end of the report provides more details about the scenario planning process and the final scenario worlds.

Scenario Planning Process

This research employed a Delphi approach 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, rather than relying on individual expertise (Delbecq et al., 1975). This process also allows group participants across a wide range of disciplines to explore all possible alternatives and assumptions and build consensus around key ideas (Hsu and Sandford, 2007). In this study, we followed a similar procedure employed in Shaheen et al. (2013) to conduct a series of 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 drawn from the entire panel: steering, scenario planning, and policy (see Table 1 for summary).

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 hours	Eight hours	Six hours	Two hours
Goals	<ul style="list-style-type: none"> • Develop a focal question • Define scenario timeframes • Identify driving forces • Identify the two most critical driving forces per timeframe 	<ul style="list-style-type: none"> • Refine focal question and timeframes • Identify and build two scenario worlds for each timeframe • Develop preliminary policies, research needs, and signposts 	<ul style="list-style-type: none"> • Refine scenario world descriptions • Refine policies, research needs, and signposts 	<ul style="list-style-type: none"> • Review all material and finalize the exercise

* One member joined only for the second steering committee phase

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 sustainable and equitable mobility for all under varying assumptions about future conditions, which reflect the high level of uncertainty over the coming months and years. Participants took account of possible future waves of the infection, vaccine timelines, and rates of economic recovery. The scenario planning exercise explored:

- Role of policy, technology, and human behaviors;
- Barriers and opportunities (e.g., institutional, financial, mindset) in future worlds;
- Policy/planning options for each scenario — to mitigate negative impacts and advance social, environmental, and resiliency goals; and
- Research recommendations.

Phase One: Steering Committee Activities

The study began by identifying members for the steering committee to construct a framework for the scenario planning workshop. We selected eight experts from different sectors (e.g., government, academia, trade groups, non-profits, consulting) based on their knowledge in the transportation field (see Table 2). Over four sessions from June to July 2020, the steering committee developed the focal question (i.e., a key question that guides the outcomes of the workshop); constructed timeframes (i.e., future times spans for developing alternatives scenario, known as “world building,” and analysis); and identified key driving forces (i.e., the most influential external forces that could impact public transit and shared mobility in a particular timeframe). The selection of the driving forces was guided using the Social, Political, Economic, Legal/Policy, Technology (SPELT) framework (Shaheen et al., 2013) and each force was plotted on an axis consisting of two extremes (e.g., slow economic growth vs. strong economic growth).

Through a voting and discussion process, the committee chose two key driving forces for each timeframe to guide the construction of four possible future world scenarios (one for each pair of assumptions represented by the four quadrants formed by the two perpendicular axes). The members also drew up a list of experts to be asked to join the scenario planning and policy committees. Through a consensus process, the steering committee agreed on the following framework:

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

Timeframes: Within 12 months (Immediate); one to three years (Short Term); and four to six years (Medium Term); and

Driving Forces: Thirty driving forces (see Appendix) related to social, political, economic, legal/policy, technology, and public health factors (e.g., COVID-19 status and restrictions).

Table 2: List of Experts and Organizations

Name	Organization	Organization Type
Steering Committee		
Amy Ford	ITS America	NGO
Brian Taylor	University of California, Los Angeles	Academia
Dan Sperling	University of California, Davis	Academia
Nathaniel Ford	Jacksonville Transportation Authority	Public Transit
Neil Pedersen	Transportation Research Board	NGO
Sharon Feigon	Shared-Use Mobility Center	NGO
Tim Papandreou	Emerging Transport Advisors	Consulting
Ysela Llord	Renaissance Planning	Consulting
Scenario Committee		
Andrea d'Amato	Massachusetts Department of Transportation	State Government
Andrew Bata	International Association of Public Transport	NGO

Arjan van Andel	PTV	Consulting
Carol Cooper	King County Metro	Public Transit
Chris Pangilinan	Uber	Private Company
Devin Liddell	Teague	Consulting
Fran Inman	California Transportation Commission	State Government
Gerry Tierney	Perkins + Will	Consulting
Jameson Auten	Kansas City Area Transportation Authority	Public Transit
Jill Hough	North Dakota State University	Academia
Karina Ricks	City of Pittsburgh	City Government
Lina Fedirko	ClimateWorks	NGO
Lori Pepper	California State Transportation Agency	State Government
Michael Berube	U.S. Department of Energy	Federal Government
Michael Pimentel	California Transit Association	NGO
Rachel Zack	Remix	Private Company
Randy Iwasaki	Contra Costa Transportation Authority	Local Government
Tilly Chang	San Francisco County Transportation Authority	Local Government
Policy Committee		
Andrei Greenwalt	Via	Private Company
Dorval Carter	Chicago Transit Authority	Public Transit
Emily Warren	Nelson\Nygaard	Consulting
Hani Mahmassani	Northwestern University	Academia
Kari Watkins	Georgia Institute of Technology	Academia
Shin-pei Tsay	Uber	Private Company
Stephanie Wiggins	Metrolink	Public Transit
Steve Cliff	California Air Resources Board	State Government
Tamika Butler	Self-Consultant	Consulting
Vincent Valdes	Southwestern Pennsylvania Commission	Regional Government

Phase Two: Scenario Planning Committee Activities

From late-July to late-August 2020, we convened four sessions with the scenario planning committee made up of 18 individuals across the country (see Table 2), from different fields and transportation sectors including public

transit agencies and operators (of various sizes and modal mixes); non-governmental organizations (NGOs); academia and research institutes; transportation consulting and futurists; local, state, and federal governmental agencies; and private transportation, sustainable design, and shared mobility companies. The scenario planning committee was divided into three groups, one for each timeframe (i.e., within 12 months, one to three years, and four to six years). Each subgroup was tasked with: 1) reviewing the focal question; 2) choosing the two key driving forces to define a matrix of four possible scenario worlds (one for each quadrant); 3) choosing for analysis the two most probable and highly consequential scenarios of the four possible scenario worlds; 4) building each scenario world (i.e., providing descriptions and characteristics of the world); and 5) developing preliminary policies, research needs, and signposts (i.e., metrics or events to signal transition into a scenario world). This resulted in a total of six scenario worlds (two for each timeframe).

The majority of the sessions focused on future world building, where the scenario planning experts described the characteristics of public transit, shared mobility, and other transportation modes for each scenario. For example, in a slow economic growth and persisting COVID-19 world, public transit would likely experience depressed ridership. We prompted the scenario planning experts with questions reflecting the driving forces that were considered important for each timeframe by the steering committee but were not selected. This was conducted to build off discussions by the steering committee. The scenario planning experts were asked to develop preliminary policies and associated research needs that could be implemented within each selected world to achieve goals related to the environment, social equity, financial sustainability, and resilience. Finally, we asked the committees to suggest signposts that would identify the different scenario worlds in practice. For instance, changes in metrics related to gross domestic product (GDP) or unemployment might signal a transition between a slow economic and a strong economic growth world.

Phase Three: Policy Committee Activities

In early September 2020, the policy committee began to meet, bringing together 10 experts with experience in crafting local, regional, state, and federal transportation policies (see Table 2). The sectors represented by the experts included public transit, NGOs, academia and research institutes, transportation consulting, local and state governmental agencies, and shared mobility companies. We tasked the policy committee with refining the scenario world descriptions, preliminary policies, research needs, and signposts developed by the scenario planning committees. The policy committee was convened in two, three-hour plenary sessions through a semi-structured discussion to review the materials created by the scenario planning experts. The plenary discussions enabled the policy committee members to develop connections among the timeframes, scenario worlds, overarching themes, and policy options. The committee renamed worlds, developed cross-cutting policy strategies, and suggested additional research recommendations. Through this process, the committee identified some inconsistencies among the initial scenario worlds.

For each pair of scenario worlds, the policy experts framed their comments and suggestions in the context of “more optimistic” vs. “less optimistic” strategies. Across the worlds, the experts focused primarily on taking actions based on more optimistic conditions, despite the presence of less ideal scenarios, as these would represent the minimum response needed to address the short-term crisis and achieve long-term sustainability goals. It is assumed, however, that proposed actions should be adapted based on unfolding conditions, good or bad, while acknowledging that each timeframe builds upon the prior one.

Phase Four: Final Steering Committee Meeting

In late-September 2020, we convened a final steering committee meeting to review the scenario planning workshop outcomes developed across the scenario planning and policy committee sessions. The steering committee provided additional feedback, offered more policy options, and refined the framework.

Through a semi-structured discussion, the committee provided additional overarching themes to tie the exercise together and finalized the future world descriptions, policy strategies, research agendas, and signposts. During this time, we also contacted the scenario committee and policy committee with summary reports for their final comment and input. This iterative process allowed for the inclusion of more opinions, ideas, and challenges to scenario assumptions. In some cases, the participants renamed the scenario worlds and/or chose other driving forces. The final scenario worlds and associated driving forces, representing the consensus of the participants, are shown below (Table 3) and discussed in detail in the following sections. A full description of the scenario worlds is presented in Appendix A.

Table 3: Final Driving Forces and Scenario Worlds

Timeframe	Driving Forces	Final Scenario Worlds
With 12 Months	Depressed/Restored Public Transit Ridership No Additional/New Funding for Transit	Shrink to Essential Services
		Restore Services
One to Three Years	Slow/Robust Economic Recovery Political Will/Lack of Political Will to Fund and Support Change	Downward Spiral
		Change the Conversation
Four to Six Years	New/Evolved Business Models Sustainability Incrementalism/Evolution	Unguided Incremental Change
		Business and Policy Evolution

Study Limitations

This research has several limitations. First, we recognize that the Delphi approach with selected experts does not capture all viewpoints and opinions on the future of public transit and shared mobility. In particular, the process of consensus-building can encourage groupthink, where a group tends toward harmony and cohesion, resulting in the elimination of dissenting opinions. We attempted to minimize groupthink by selecting experts from a variety of fields who could speak confidently about their opinions. The scenario committee was also divided into three subgroups to allow for more speaking time, and all experts were given the opportunity to review summary reports.

Second, given time constraints associated with the exercise, we developed world descriptions, policy options, research recommendations, and signposts for only six worlds, two for each timeframe (rather than the 12 possible worlds) that represented the most probable and highly consequential scenarios for public transit and shared mobility.

Third, three facilitators led the scenario committee subgroups. While a common protocol was developed to produce a similar experience, each subgroup made different levels of progress during the exercise. We attempted to minimize these differences by engaging the policy committee in a plenary session to review the scenario world descriptions across the three timeframes.

Fourth, we recognize the timespan of the scenario workshops (June to September 2020) may have altered opinions, particularly for experts convening later in the process. During this time span, transportation experienced rapid changes due to COVID-19, along with frequent alterations in COVID-19 restrictions and recovery. We attempted to minimize the effects of earlier views by reconvening the steering committee in September and enabling all the experts to review the summary reports from the exercise.

Finally, we recognize that scenario planning cannot predict the future. Elements of each scenario world are imperfect and are subject to the biases of the individuals participating in each discussion. Moreover, policies and research needs developed through the exercise are not inherently new or innovative. However, many policies and needs are framed within the context of COVID-19, which allows for a more tailored and targeted approach to guiding the future of public transit and shared mobility. Some of the key benefits of scenario planning are its identification of unconsidered factors that could occur and formulation of key steps and actions to guide future

responses. It also gathers a range of experts from various perspectives in a neutral environment, and a Delphi approach to scenario planning builds upon prior experts' work.

Despite these drawbacks, this exercise provides a pandemic recovery roadmap for public transit and shared mobility that can also guide their long-term sustainability. Elements of this report, such as the key public transit operator actions (i.e., innovation and technology, planning and operations, customer focus, and workforce development) and broader policy strategies (i.e., immediate policy actions across actors, alignment of societal objectives, federal transportation spending reauthorization, and finance and subsidies) require further exploration. Additional exercises, working groups, and knowledge exchange can tackle issues and opportunities raised by the group participants and refine the policy options presented in this report.

In the sections that follow, we provide policy options/actions and research recommendations across the three timeframes. Next, we present broad policy strategies that cut across the timeframes for supporting the recovery of the public transit and shared mobility industries and promoting an equitable and sustainable future mobility ecosystem. Conclusions and next steps follow. Appendix A at the end of this document provides an evolution of the scenario worlds, detailed descriptions of final scenario worlds for each of the three defined timeframes, and signposts for each world.

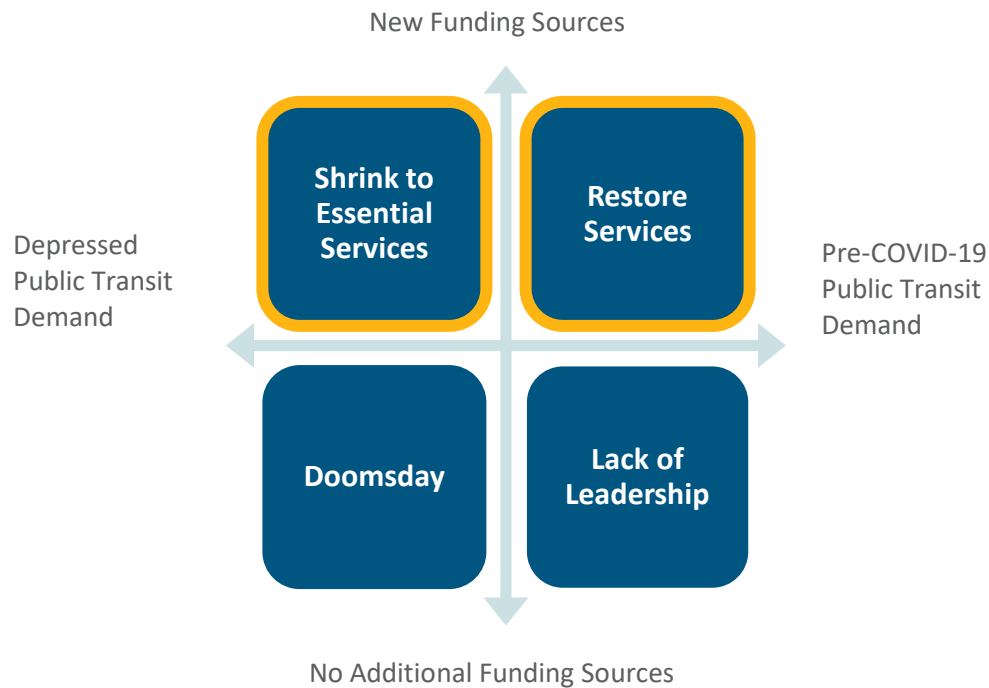
Actions to Take Within 12 Months (Timeframe One)

For the first scenario timeframe (within 12 months), the policy experts explored two future worlds formed from two driving forces: 1) new funding sources vs. no additional funding sources and 2) public transit demand remains depressed vs. return to pre-COVID-19 levels. Policy options for these worlds focused on stabilizing public transit and shared mobility service immediately, while building a foundation for future timeframes was a secondary goal. The final vectors and worlds, with selected worlds highlighted in yellow, are provided in Figure 1.

The more optimistic world, named *Restore Services*, assumes that public transit demand will be recovering to pre-COVID-19 ridership levels (as the virus is more under control). With demand still recovering and revenues remaining low, 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 dependent riders and recapture some "core" riders.² 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 to assist public transit dependent populations.

² Note "core" riders were differentiated from "choice" riders, with core referring to frequent riders who may not be taking public transit at present due to the pandemic.

Figure 1: Final Scenario Worlds and Driving Factors – Within 12 Months



Key Observations

For both possible worlds in this timeframe, the members of the committees made the following key observations:

- Public transport demand is heavily affected by the “state” of the virus. Employer work-from-home policies will continue to impact public transit ridership and the demand for innovative mobility options, along with housing and office location decisions.
- Over the next 12 months, it will be critical for public transit operators to focus on cash flow management to prepare for transit recovery.
- Public transit plays an important role in social equity and protecting the environment, and this should be translated into action.
- Even as public transit deficits will require severe service cuts, agencies need to ensure that social equity and access for transit dependent populations are prioritized.
- Policy strategies and research will likely differ based on region, city, land-use context, size of operations, and other differentiating characteristics.
- Immediate actions to promote systemic culture change (e.g., via public-facing campaigns) are needed to elevate the value of public transit for communities.
- Racial justice in transportation requires local and community-driven actions that produce clear, assertive goals on structural change.

- Public transit must do it “all” — social service, mobility, housing, etc. — but it does not receive the recognition nor the support from a policy/funding perspective. How can this be changed?
- There is an urgent need to integrate COVID-19 safety protocols and guidelines across services.
- There is a need for stronger integration of public health goals into the transportation sector — ranging from virus containment, sanitation, safety, access to health facilities and services, active transportation, etc.
- This is an “opportune” moment to set a foundation (e.g., priorities, bill language) for federal transportation spending reauthorization legislation, which will likely occur in the one- to three-year timeline (near term).
- A ground-up approach is needed with local transit agencies, state and local governments, the Federal Transit Administration (FTA), and Congress to build statutory and regulatory mechanisms that ensure greater flexibility and partnerships in public transit (e.g., new pilots and demonstrations).
- Rapid innovation and emerging technology need to be catalyzed, not held back. There is the potential to provide major economic, environmental, and social equity benefits but only if innovation is guided to achieve these benefits that are in the public interest. Key performance indicators (KPIs) and standard measurements (including employing the correct metrics) can help to ensure innovation in meeting key goals.
- Service/operations planning is an immediate need in this timeframe.
- There is an opportunity for all transportation stakeholders to work together and realize that cooperation far outweighs competition.
- In the absence of federal guidance, state, regional, and local governments will have to take charge and make changes on their own. They will need freedom and flexibility to stabilize public transit and choose from a suite of options.

Policy Options: Declare a State of Emergency

In this first timeframe, regardless of which scenario world may evolve, policy and decision-makers should consider declaring a “state of emergency” for public transit (similar to actions taken in New York City following the September 11th terrorist attacks) to enable much more operational flexibility as quickly as possible and set the stage for more systemic change. There needs to be an emphasis on urgency in this timeframe. Coordination (especially multi-jurisdictional) needs to occur immediately.

Immediate policy options that can be taken include:

- **Increase stimulus funding:** Federal assistance is needed to overcome the impact of reduced farebox revenues (e.g., increase money through the Heroes Act or other bill).
- **Integrate public health goals into the transportation sector:** Transportation should focus on public health actions to achieve virus containment, sanitation, safety, access to health facilities and services, active transportation, etc.
- **Focus on improving the public transportation customer experience, new funding structures, investing in technology, and restoring trust in public transit:** Mobility providers should focus on improving the public transportation customer experience, restoring trust in public transit, building partnerships with private operators, developing new funding structures, and investing in technology

(e.g., contactless payment systems, real-time information on transit arrivals, integrated mobility on demand [MOD] or mobility as a service [MaaS]). These actions should be conducted across all three timeframes, but they should begin within 12 months.

- **Build systemic social change through immediate actions to reorient transportation policies to enhancing social equity:** It is important to reorient transportation policies (e.g., through comprehensive racial equity and mobility justice plans, public-facing campaigns, etc.) to improve mobility as a means of enhancing social, racial, and environmental equity. Early service actions could include providing alternative transportation services for riders, especially low-income riders and essential workers, in areas and at times (off peak) when ridership is too low to justify traditional transit service. Other opportunities such as space grabs (e.g., more bus lanes to make travel efficient and fast) should be conducted quickly as a form of “tactical urbanism.”
- **Address key regulatory barriers to enhance flexibility in funding, management, and operations:** COVID-19 offers a unique moment that should be “leveraged” to overturn and address a number of key barriers to providing innovative transit service, including rigid funding formulas and limited total allocations, procurement issues, and limits on what public transit can do (e.g., goods movement, premium services). It is important to explore alternatives that may *not* be allowed by federal regulations and pursue possible changes to federal regulations and policies. Otherwise, barriers could be circumvented by engaging with the private sector and other agencies (e.g., metropolitan planning organizations [MPOs], local city/county agencies).
- **Build coalitions between the public transit industry, private shared mobility operators and other key stakeholders (e.g., CBOs) to share lessons learned, develop holistic mobility strategies, and build political influence:** Coalition building is a critical need and should include the public transit industry, private shared mobility operators (e.g., TNCs), unions, environmental groups, community-based organizations (CBOs), academia, and other key stakeholders.
- **Convene key organizations to develop action plans.** The Transportation Research Board (TRB) should convene key organizations currently talking about what to do in this crisis including but not limited to:
 - American Public Transportation Association (APTA),
 - National Association of City Transportation Officials (NACTO),
 - American Association of State Highway and Transportation Officials (AASHTO),
 - Conference of Minority Transportation Officials (COMTO),
 - Eno Center for Transportation,
 - Association of Metropolitan Planning Organizations (AMPO),
 - National Conference of State Legislatures (NCSL), and
 - National Association of Regional Councils (NARC).

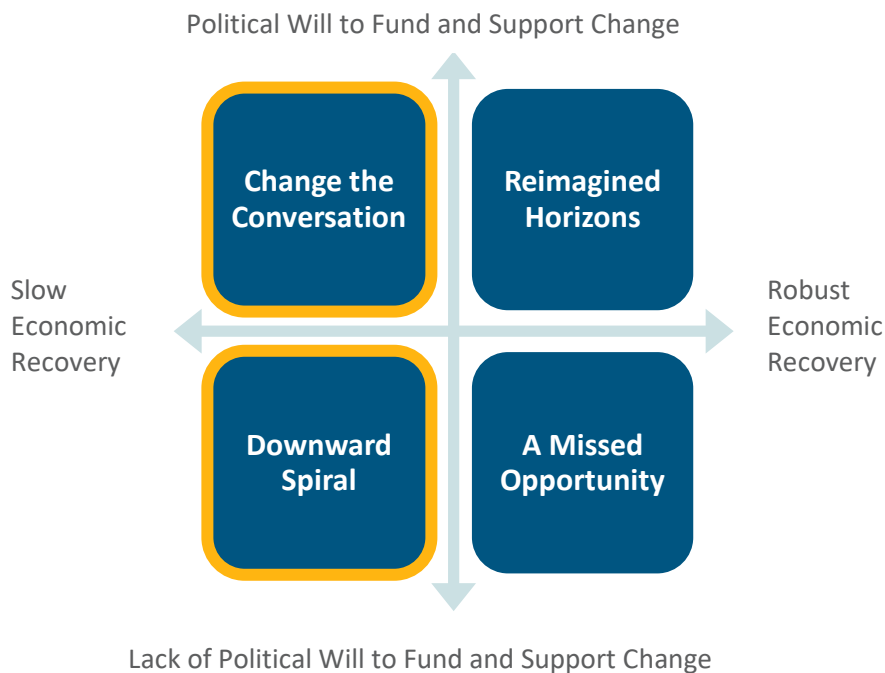
Convenings should also be neutral spaces to explore/foster a complementary ecosystem (e.g., where mobility operator systems complement each other and not compete for customers) for promoting public transportation and shared mobility with diverse stakeholders.

Actions to Take Within One to Three Years (Timeframe Two)

Over the next one to three 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, which will most likely occur in this period. Federal transportation spending (e.g., surface transportation) is governed by authorization bills over a set period. The current Fixing America’s Surface Transportation (FAST) Act was enacted in 2015 for five years and was extended one year through fiscal year 2021. These long-term spending bills set funding priorities and determine the long-term direction of transportation in the U.S. 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 assumed slow economic recovery. Both worlds focus on the pathway to reauthorization and meaningful changes to state, regional, and local policies, but they differ by the aggressiveness of the policy response. In both scenarios, funding flexibility (i.e., what funds, especially federal money, can be spent on) will be critical for driving systemic change.

The more optimistic world, *Change the Conversation*, reflects high political will and funding to support change (see Figure 2). This scenario world assumes that public transit ridership will begin to return due to successful COVID-19 vaccines. Congressional reauthorization is focused on passing a “Traveler’s Bill of Rights” and a multimodal approach with a clear pathway to systemic change that embraces transportation as a fundamental right and increased funding — this reframing drives a significant amount of progress, reducing reliance on private autos. The less optimistic *Downward Spiral* world is characterized by a lack of political will and funding (Figure 2). 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.

Figure 2: Finalized Scenario Worlds and Driving Factors – One to Three Years



For both worlds, work-from-home is more common and affects daily travel. Several prominent workforce-related issues are exacerbated by the pandemic (e.g., people leaving the public transit industry, the need for training programs, underrepresentation of women in the workforce due to the need to focus their time on homeschooling, underrepresentation of people of color, especially Black professionals) that require the transportation industry to focus more resources on retention and recruitment. Key takeaways for this timeframe are provided below.

Key Observations

- Local and regional governments will not be able to make changes work for their community without innovative tools and flexibility (e.g., devolution down to the local level).
- Transportation professionals and policymakers cannot lose sight of the need for financial sustainability and necessary finance changes to enact systemic change.
- A mobility ecosystem framework will become important moving forward. This framework establishes more holistic policies that integrate mobility across modes, encouraging multimodality and complementary (rather than competitive) services.
- Labor considerations (e.g., issues related to automated vehicles [AVs]) are key and will be a critical component of the next federal transportation spending reauthorization bill.
- New public transit innovations will play a role in this timeframe related to public transit business structures, pilot projects, finance reform, and expedited service approaches, for example:
 - Microtransit services to fill service gaps and leverage right-sized vehicles (regional/local action needed),
 - Premium services to gain more consistent funds through members (federal policy action needed),
 - Goods delivery to use idle vehicles and add new revenue streams (federal policy action needed),
 - Mobile hot spots to provide communities with Wi-Fi access (federal policy action needed), and
 - Value capture to gain monetary benefits of land development (regional/local action needed with federal policy action and political will).
- Demonstrations, pilots, and long-term research will affect the willingness of state and local policymakers to implement innovations in public transit and shared mobility.
- Public transit services and recovery will rely on actions of employers, especially regarding work-from-home policies and transportation demand management strategies.
- Most stakeholders will likely focus on environmental issues in future plans and actions (e.g., as a guiding principle and/or measurable outcome) to create opportunities to reduce greenhouse gas emissions (GHGs).
- Electric vehicle (EV) technology will play a larger role in public transit and shared mobility during this timeframe, with some states (e.g., California) leading electrification.
- Shifting travel behavior and demand (spatially and temporally) will significantly influence transportation needs — how can public transit and microtransit meet the changing needs of a post-COVID-19 workforce, split between transit-dependent riders and more sporadic choice riders?

Policy Options: Emphasize Systemic Change

- **Develop new flexible funding and pricing mechanisms to increase social equity and foster longer-term financial sustainability:** New flexible funding and pricing mechanisms are needed to promote and enable systemic change that increases social equity and fosters longer-term financial stability. Road pricing (e.g., mechanisms where fees are collected for use of the road, such as tolling) should be instituted, and the funds collected should be invested in alternative mobility services (starting in timeframe two and ramping up in timeframe three).
- **Employ a customer-centric approach across transportation modes and levels of government:** 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 and options, safe and convenient options for access to and from public transit, increased service reliability, and customer-friendly operators. Actions could include accelerating the adoption of seamless and contactless payment systems (e.g., California Integrated Traveler Project³) and integrating different transportation modes into a mobility ecosystem (promoted across all levels of government, including the federal level),
- **Create new public transit business structures to increase diversification of revenue and improve services:** To diversify revenue streams and better serve customer, public transit should advance pilot projects, focus on finance reform, and fast track innovative approaches (e.g., microtransit services, premium services, goods delivery as a business model, mobile hot spots, and value capture).
- **Engage with employers who are critical to public transit recovery:** Employers are key to public transit recovery; they should be engaged regarding public transit recovery, new work-from-home policies, employer-provided services (e.g., shuttles, parking cash-out programs) and short- and long-term changes in travel behavior.
- **Stress environmental and social equity issues in future plans, actions, and community-centered policies:** Racial, environmental, and social equity require community-oriented and actionable policies that increase awareness of transportation as both a problem and a solution for justice. This will require a greater emphasis on serving transit dependent communities rather than choice riders, who are often higher income.
- **Fund innovation through pilots, demonstrations, and funding increases:** Transportation professionals and policymakers need to speed up and scale pilot research during this timeframe. There needs to be a massive increase in innovation funding (e.g., putting \$400 million toward FTA pilot projects) and a willingness of state and local policymakers to take funding and service risks.
- **Restructure transportation agencies around multimodal mobility:** The U.S. Department of Transportation (US DOT) needs to put greater emphasis on multimodal mobility at the federal level to achieve systemic change. This may require restructuring within the agency around new core priorities. A similar restructuring and reemphasis may be necessary for state, regional, and local transportation agencies.
- **Integrate transportation policies into non-transportation legislation:** Practitioners, policymakers, and coalitions of key stakeholders should work to integrate transportation policies into non-transportation bills at all levels of governance (e.g., climate, housing, public health, etc.).

³ An initiative by the California Department of Transportation to facilitate easy and accessible travel planning and payment across California

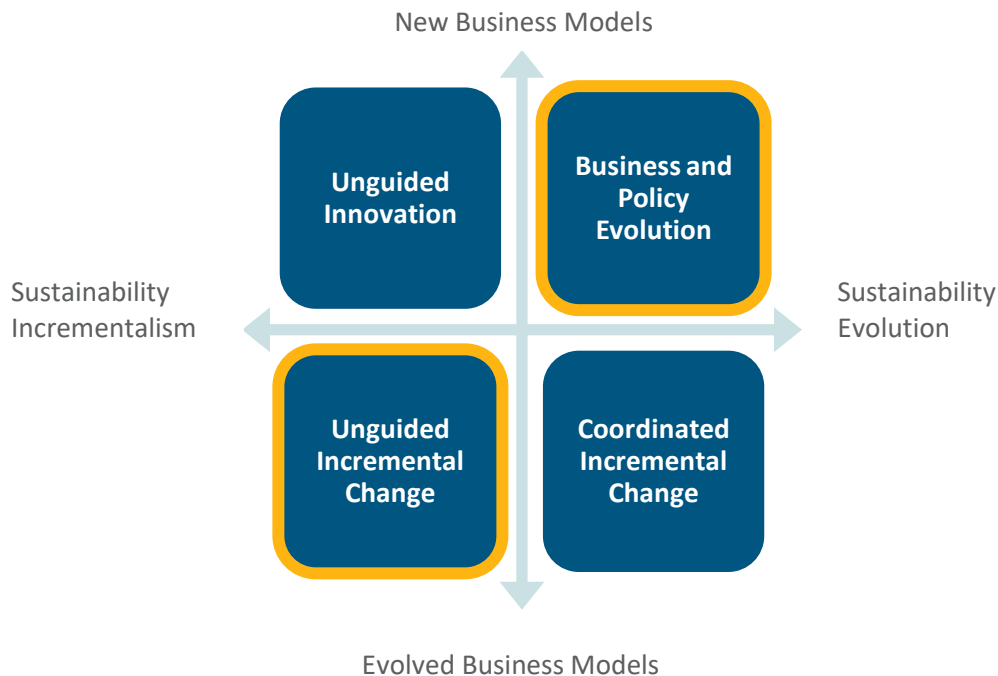
Actions to Take Within Four to Six Years (Timeframe Three)

Four to six years from now, in an optimal scenario, policy action and research have set the stage for an innovation outburst 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 vs. evolved) and 2) sustainability (evolution vs. incrementalism). The finalized worlds and driving factors are presented in Figure 3.

The more optimistic world is *Business and Policy Evolution*, which is characterized by further refinement of new technologies and operations, benefitting from the strong foundation of prior years. 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), has started to emerge, embracing new business models that are more sustainable (i.e., environmentally friendly and equitable). Backed by national climate policy, businesses are embracing GHG reduction policies and operations along with EVs and other technologies to reduce their environmental impact.

For the less optimistic case, the *Unguided Incremental Change* world assumes more slowly evolving business models, inaction on climate change, growing socioeconomic inequality, incrementalism, political gridlock, and a lack of innovation. This world corresponds to the pre-COVID-19 reality of declining public transit ridership and private-sector competition. The public and private sectors continue to operate largely independently, reminiscent of the pre-COVID-19 world, and fail to capitalize on innovation and green opportunities. Key takeaways from this discussion are provided below, followed by suggested policy options.

Figure 3: Finalized Scenario Worlds and Driving Factors – Four to Six Years



Key Observations

- This medium-term timeframe relies upon actions (or inactions) of the prior timeframes. If the stage is set for change, more can be realized now. If key actions are not accomplished in the earlier timeframes, many will need to be revisited, slowing progress.
- In this timeframe, there is an even greater emphasis on EV technology in public transit, shared mobility, and private vehicles, particularly coming from states and businesses.
- Public transit innovations will largely depend on the progress made toward service and operational flexibility in the prior timeframes (e.g., microtransit). Premium services, goods delivery via public transit, and value capture, for instance, could be realized in an optimal scenario by further advancing business models. Much of this could start as pilot projects through funding from federal transportation spending reauthorization legislation (i.e., the second timeframe) and grow into best practices/mainstream in this timeframe (optimal case).
- Deployment of AVs will be more common in this timeframe for the public and private sectors. However, labor regulations must be addressed to facilitate their inclusion in the public transit industry. This work needs to happen prior to this timeframe (and before automation starts rolling out more rapidly and directly impacts jobs).
- A greater emphasis will be needed on integrating public transit with the private sector by increasing TNCs, carsharing, micromobility options (e.g., availability of rides, vehicles, and bikes at public transit stations). This could be accomplished through mobility hubs at public transit stations that provide multimodal access to and from public transit. However, policies will need to be adopted to constrain excessive vehicle miles traveled (VMT) growth by both TNCs and AVs.

Policy Options: Build a Mobility Ecosystem Around Public Transit

- **Create a connected mobility ecosystem that integrates public transit and shared mobility:** Cities and regions can create a connected mobility ecosystem by integrating public transit with the private sector and increasing TNCs, carsharing, microtransit, and micromobility options. These alternatives should *complement* public transit service (e.g., first- and last-mile connections to public transit stations and stops) and not compete for customers.
- **Deploy advanced fare payment technology and solve institutional and policy issues:** Fare payment technology and MOD/MaaS platforms are already feasible in 2020. Current institutional and policy issues, such as minimal funding opportunities and poor multi-jurisdictional coordination, should be identified and addressed. In a best-case scenario, institutional and policy issues would no longer hold these systems back.
- **Emphasize EV technology to reduce GHG emissions and localized pollution:** With decreasing battery costs, electric buses and vehicles for public transit and shared mobility are more financially viable. This EV technology should be harnessed through incentive programs in public transit and shared mobility to reduce GHG emissions. Social and racial equity should be a prominent goal by prioritizing clean technology in marginalized neighborhoods, which will help decrease localized pollution.
- **Provide greater operational flexibility and implement new business models:** For public transit to advance in this timeframe, agencies will need more flexibility in their business models to continue to exist and thrive (e.g., premium services, goods delivery via public transit, and value capture). This could include regulatory relief and/or incentives to encourage the private sector to participate in PPPs.

- **Augment resources to retain, retrain, and restructure the public transit and shared mobility workforce and increase professional development:** As business structures diversify and automation accelerates, employees will need to be retained and retrained. With the increasing use of AVs that could lead to driver layoffs, retraining programs should begin before automation starts penetrating the market and directly impacts jobs. To keep up with changes to mobility, public transit operators (in particular) should consider restructuring their organizations to focus on multimodality and mobility. Future professional development should focus on multimodality that achieves long-term sustainability goals.

Integrated Policy Options/Actions and Research Recommendations

To supplement the scenario world-specific policy options, we developed an integrated set of policy options, actions, and research recommendations that span all three timeframes. Based on the rich discussion of the policy committee, we developed two tables (Table 4 and 5) that summarize proposed actions in two categories: 1) *Actions that public transit operators can take* in four key areas: a) innovation and technology, b) planning and operations, c) customer focus, and d) workforce development; and 2) *Policy strategies* organized into four categories: a) immediate policy actions across actors, b) alignment of societal objectives, c) federal transportation spending reauthorization, and d) finance and subsidies. We also summarize key recommendations for future research.

Key Actions for Public Transit Operators

Table 4: Key Public Transit Actions Across Timeframes

Public Transit Operator Actions	Action	<12 months	1 to 3 years	4 to 6 years
Innovation and Technology	Deploy more sensing, fare media integration, and contactless options			
	Employ technology to address public transit crowding (e.g., automated passenger counting systems)			
	Focus more on microtransit by metropolitan planning organizations (MPOs), reflecting a spectrum of service needs and right-sized vehicles and services			
	Explore new ideas (e.g., Concept of Operations), employ a ground-up strategy for Federal Transit Administration (FTA) funding, and carefully educate/familiarize the FTA about new ideas/approaches			
	Deploy technology-driven road pricing along with flexible allocation of curb space for different uses including deliveries, TNCs, and active transportation			
	Integrate EVs into public transit and shared mobility companies			
	Employ AVs in public transit and shared mobility companies and work on addressing AV barriers (e.g., labor, retraining)			
	Leverage data, fares, scheduling, and service integration technologies to create multi-agency coordination for travel across a region			
	Relax federal, state, and local regulations that inhibit the testing of new technology and innovative approaches			
	Deploy more MOD/MaaS options, including integrated payment			
	Employ partnerships to fill service gaps (e.g., microtransit partnerships with Via; TNCs partnerships for paratransit, late-night service, and low-ridership routes) or create more agency-operated MOD services (e.g., turnkey contracts)			
	Employ pilot projects to test new ideas (openness to entrepreneurialism)			
	Build dashboards and real-time sensing and tracking of assets, services, and operations to increase reliability			
	Prioritize services for people who are public transit dependent			

Planning and Operations	Use reduced travel demand as an opportunity to bring infrastructure and vehicles up to a state of good repair			
	Focus on cash flow management and funding stabilization when demand is down			
	Carefully manage capacity restrictions, weighing both virus transmission and ridership/revenue			
	Rely on turn-key contractors and lessons learned from other MOD PPPs to speed up partnerships, meeting shifting travel demand more quickly			
	Begin exploring alternative and/or flexible funding mechanisms for transportation (e.g., property tax, carbon market mechanisms, road user charge, revenue bonds, etc.)			
	Expand services to core and choice riders			
	Leverage zoning and development mechanisms to increase affordable and dense housing near public transit			
	Expand infrastructure changes (e.g., slow streets, bike lane construction) to provide multimodal access and a high-level of service to micromobility and walking			
	Do more with fewer resources, which could be accomplished via more efficient operations and maintenance practices (while still ensuring safety)			
	Build socially and racially equitable services and fare collection policies			
	Increase job and service access for low-income, essential worker, transit-dependent, and marginalized populations via public transit and shared mobility services			
	Require social equity in service and operations to overcome structural racism (e.g., walking while Black, predictive policing, racially motivated fare enforcement)			
	Customer Focus	Identify public transit-dependent communities and workers and provide quality service to these riders		
Promote an attitude of “public transit is here for you” through campaigns				
Deploy public campaigns around safety of public transit, public health, etc.				
Increase availability and wide distribution of micromobility options for connection to and from public transit				
Increase customer engagement to provide rapid and useful feedback to improve the system				
Provide a rating system for every trip on public transit as a low-cost, crowdsourced improvement mechanism				
Convey importance of fare collection through campaigns and education to reduce fare avoidance				
Augment quality service for dependent riders by renewing service quality for core riders and choice riders				
Change the narrative that public transit is an important service to public transit is an essential right and essential to society (campaign)				
Build longer-term and sustainable transportation demand management (also known as TDM) strategies for employers and their employees				
Provide quality service to connect and move people, not just vehicles				
Plan for the entire end-to-end trip, not just in-transit portion of trips				
Tailor services for essential workers (e.g., more frequent headways, longer service hours)				
Support more comprehensive transportation service by redistributing current funding to public transit-dependent and marginalized communities				

	Alter fare structures to allow for free or means-based fares for riders, particularly for marginalized populations (e.g., Black, Indigenous, and people of color communities; low-income households)			
Workforce Development	Develop COVID-19 training programs and address notable impacts on the workforce from COVID-19, especially related to public health and safety			
	Determine how to combat the depletion of the public transit workforce as a result of COVID-19 and retirements			
	Provide an infusion of funding and start restructuring public transit agencies to grow the profession			
	Create a recruitment campaign to encourage people to think about mobility as a career			
	Implement internal agency change by shifting internal funds to address climate change and restructuring agencies to focus on multimodality			
	Consider how to implement automation into public transit and address workforce needs and development based on federal labor regulations and retraining			
	Work closely with unions to address a range of concerns, including reduced workforce, training, and automation			
	Identify the transportation needs of essential workers, including public transit operators			

Broader Policy Strategies Across Timeframes

Table 5: Key Policy Strategies Across Timeframes

		<12 months	1 to 3 years	4 to 6 years
Broader Policy Strategies	Action			
Immediate Policy Actions Across Actors	Declare a state of emergency, setting the stage for structural change and federal transportation spending reauthorization			
	Allow waivers to procurement rules (e.g., Buy American Rules)			
	Repurpose existing vehicles — even partial fleets — for new services (e.g., goods delivery, medical transportation)			
	Make space grabs (e.g., dedicate more traffic lanes for public transit during the COVID-19 recovery)			
	Develop partnership requirements to ensure that all partners and partnerships* are supporting sustainable transportation goals			
	Integrate social equity (e.g., assistance for essential workers, programs for marginalized communities) immediately across modes			
Alignment of Societal Objectives	Create more targeted, scaled services (e.g., on-demand mobility, high-frequency service) by clearly defining service needs and goals**			
	Take advantage and expand upon environmental streamlining policies (e.g., SB 743 in California) to increase the speed of environmental reviews without compromising environmental needs, mitigation, and goals			
	Adopt new metrics and measures for public transit performance that place more focus on social equity, safety, and environmental outcomes at the local, regional, state, and federal levels			
	Implement policies to ensure coordinated rather than competing services, including ensuring more flexibility at the local level			

	Focus on reducing reliance on autos as a single mode, for example through road pricing in large, more urbanized areas			
	Build a complementary system of shared mobility and public transit that improves access to jobs and services			
Federal Transportation Spending Reauthorization	Begin leveling the playing field across modes through more funding for public transit and shared mobility and increased flexibility to spend federal funds based on local needs			
	Fundamentally restructure future federal transportation spending around providing mobility (as opposed to infrastructure), emphasizing public transit as a backbone			
	Develop a Traveler's Bill of Rights,*** growing the discussion of transportation toward people and flexible approaches (e.g., leveraging assets in new ways to fulfill basic transportation needs)			
	Increase flexibility in funding formulas and allocation to allow local, regional, and state governments to institute innovative and creative projects and services			
	Embed transportation funding and policies in non-transportation bills (e.g., climate, housing, public health, etc.)			
	Explore US DOT becoming a Federal Mobility Administration with a holistic view toward mobility and funding			
	Finances and Subsidies	Reallocate resources to support sustainable transit modes and better serve historically marginalized communities		
Provide enough funding and human resources for public transit to serve as a social service				
Stabilize funding streams for essential transportation (e.g., rides to wellness checks, rides to education and work)				
Address social equity by providing fare subsidies for people that cannot afford them with linkages to MOD/MaaS and mobility wallets for managing customer incentives/subsidies and transportation payments				
Promote road and congestion pricing (e.g., tolling, vehicle miles traveled fees) to fund transportation and invest in mobility				
Explore and implement alternative funding structures that price transportation externalities (e.g., carbon tax, road user charge, congestion pricing, etc.)				

*Partnerships could be among public transit operators, local/regional governments, and shared mobility companies.

**Goals, such as accessibility, environment, social equity, resilience, should be developed through a conversation among agencies, companies, other key stakeholders, and the public.

***This may include a provision related to a universal basic travel program, which would either dedicate a fixed total of funds to households for transportation and/or make public transit free.

Research Recommendations

The scenario and policy experts identified multiple areas for research to complement possible actions and policy options. One important theme from the research discussion was a need to conduct more cross-comparison research between geographic areas (i.e., different urban form types such as urban/suburban/rural, states, and/or countries) to identify lessons learned and effective strategies. Research that develops both geographic-specific and generalized policies will be needed across all research areas. Experts also noted that research will be needed to document how COVID-19 has impacted transportation across all modes and transportation topics. The key research takeaways are discussed briefly below.

Work-from-Home: Critical research is needed to study what employers are planning to do relative to work-from-home in the short- and longer-term. Time boundaries are very important around COVID-19 planning. For example, many companies are planning around remote learning schedules for their employees with children. Even if an effective vaccine is developed, work-from-home will likely have ongoing impacts that will differ by city, region, and land-use context. We need to better understand how to best address this from a policy perspective (e.g., pricing and MOD/MaaS mobility wallets, parking cash-out, employer-provided transit services). Additional work will be needed to determine if work-from-home will “stick” and how work-from-home employees will travel.

Employers: Employers are key to public transit recovery. More research is needed on partnerships with employers, their telework plans and work-from-home arrangements, and how they provide transportation services for their commuting employees. Along with these research needs, additional work will be needed to understand workplace culture, especially as it relates to work-from-home. Incentive structures and new TDM strategies for employers will require reconsideration and new research. Employers require research (and empowerment) to reduce peak-commute demand, provide new benefit programs, and institute alternative public transit and parking programs.

Scenario Analysis and Modeling: It is important to model different scenarios for public transit and shared mobility services, which reflect changes in market conditions and new approaches. What has COVID-19 done to cities that will alter how they operate in the future? What is the future of work? What is the future of the city? What will be the impact of the possible relocation of employers and residents outside the central business district? What are the changing needs, behavior, and satisfaction of public transit riders? Research should develop an understanding of how COVID-19 is impacting public transit and innovative mobility through modeling (e.g., network and demand modeling tools).

Regulatory Inconsistencies Across Modes: There are inconsistencies in how different transportation modes and their associated business models are regulated (e.g., public transit funding, partnerships, operations, etc. compared to highways, airlines). Research is needed to identify these inconsistencies, which can help set the stage for more comprehensive and clearer federal transportation spending reauthorization legislation.

Lifting Restrictions on Local Public Transit Operations: Local public transit is subject to numerous regulations that are imposed from above at the federal and regional levels. More research is needed to better understand where to lift restrictions to offer local public transit operators more flexibility. Research also will be needed on how to remove barriers to funding requirements that hinder public transit agencies from being responsive (e.g., reducing restrictions on percentage spending by mode). Lifting restrictions should be studied to advance social/racial equity and enable more investments in marginalized communities.

Federal Finance and Sliding Scales: Research should examine the potential benefits of adopting a more sliding scale approach toward federal funding requirements, based on the funding split between levels of government. The legacy of an 80/20 federal funding split for public transit should be re-examined as part of the federal transportation spending reauthorization process (e.g., no projects or agencies currently receive 80 percent of funding from the federal government). Many regions fund public transit with sales tax measures. For example, in Los Angeles and the Bay Area, public transit operators are only seeking 20 percent of federal funding. Over time, nationally, this has slipped to about a 40 percent split of federal funds (on average).

Funding Mechanisms: Research is needed on how to equitably allocate resources to communities and projects, especially those suffering from historic disinvestment. Concurrently, the effectiveness and equity of new revenue mechanisms, such as road user charges, split-rate property taxes, curb fees, and new business ventures (e.g., goods delivery) needs to be explored. Investigation is needed on new PPP structures and philanthropic initiatives, which could reduce operational costs in some circumstances. In some cases, funds could be identified by repurposing existing resources/assets or leveraging land development opportunities (e.g., value capture, upzoning to allow for denser and/or higher buildings). Funding sources need to be stable and promote social equity.

Social Equity in Mobility: Substantial research is needed to determine mechanisms, funding, and operations to better serve low-income and marginalized communities. This is especially important for public transit-dependent communities and areas that are poorly served by transit. Prioritizing construction of public transit infrastructure,

redistribution opportunities of funds to marginalized communities, improvements in public transit frequency, and more environmentally friendly service could begin to address social inequity and environmental injustice.

Fare Payment and Enforcement: With respect to fare payment/enforcement, research needs to address the root cause of fare evasion, why agencies need fares in the first place, and why people will not pay them, all within the context of lived experience and racial equity. Research is needed to compare current pricing mechanisms. Moreover, study is needed to better understand the harms of fare enforcement, especially on Black communities, and how to reallocate funding from policing toward equity-boosting transportation programs. New membership, subscription, and incentive models should also be tested across modes and between public transit and shared mobility services. These innovative models should be evaluated on social equity, customer acceptance, and environmental metrics.

Innovation Management and Evaluation: Pilot projects should be initiated to jump-start technological innovation in public transit with testing to ensure that they do not adversely affect environmental and social equity goals. Evaluations and measurements (including new metrics and performance indicators) can help determine if innovation is meeting desired goals. Microtransit services and alternative transportation services, including those provided by community- and neighborhood-based organizations, require further exploration and evaluation. Barriers to technology-based strategies and trust in innovation should be assessed for marginalized populations (e.g., unbanked, undocumented immigrants, low-income, rural residents). Research on sustainable transportation, ranging from EVs to active modes, is needed to better understand technological, financial, and cultural barriers to adoption. To carry out this research, innovation challenges (e.g., US DOT's MOD Sandbox) and start-up pipelines (e.g., incubators for companies or non-profits) should be considered. Innovation evaluations should be made by neutral parties.

Active Transportation: Walking and cycling have become viable transportation options to reduce COVID-19 exposure. More research is needed to determine the effects of infrastructure changes (e.g., slow streets) and how to make "space grabs" for active transportation. New rights-of-way designs and strategies to plan for equitable infrastructure also require research. Additional studies are needed on effective incentives for bike and e-bike purchases, public health campaigns that encourage active transportation, and integration planning for active transportation as a first- and last-mile connection to public transit.

Public-Private Partnerships (PPPs): To create a meshed and complementary transportation ecosystem, significant research is needed on how to develop successful PPPs. Key needs include identifying partnership requirements, developing outcome-based indicators, determining changes to PPPs based on land use form and geographies, and evaluating existing pilot and demonstration projects for lessons learned. Pilot projects need to be legally allowable and have access to consistent funding. Guardrails, such as 1) mechanisms to prevent the pass through of fees and taxes to consumers or 2) permitting processes, require development and evaluation.

Culture Change: More research is needed to better understand current barriers to reframing transportation as a right, developing a cohesive narrative around sustainable transportation, and gaining acceptance of an integrated and multimodal mobility ecosystem. A universal basic mobility program (similar to a universal basic income program that would provide a set amount of funds per household for transportation and/or make public transit free) requires testing. Research may also help to develop communication strategies to shift the culture and form key stakeholder coalitions.

Long-Term Residential Choice: COVID-19 may contribute to changing demographics including where people live. Significantly more research is needed to understand how changes in land use and density, resulting from COVID-19, will impact trip patterns and public transit ridership levels. Residential choice changes could lead to new opportunities for innovative mobility strategies (e.g., microtransit).

Public Transit and Housing: High quality public transit services will increasingly link dense and affordable housing near public transit to jobs and services. More research is needed on land use policies, zoning regulations, inclusionary zoning, and funding opportunities (e.g., value capture) that require modification or development to increase affordable housing in public transit-rich locations. Curb management and space allocation near new

developments require research to improve the efficiency of deliveries, reduce congestion, and increase sustainable outcomes.

Data Standards and Metrics: The General Transit Feed Specification (GTFS) is a first big step toward standardizing data collection across the public transit industry. Research is needed to develop GTFS guidance, including how to interpret data and conduct analyses. At the same time, there is a need to study and test equitable and efficient KPIs (e.g., cost to passenger, number of people to jobs, travel times, cost of operations) for public transit. Common data-driven dashboards require further development, along with protocols and mechanisms to share data among state, regional, and local agencies.

Goods Movement and the Curb: The pandemic could lead to notable long-term shifts in shopping behavior that affect transportation services. Research is needed to understand behavioral changes in e-commerce and the impact on curb management, congestion, GHGs, and VMT. Research is needed on how public transit and shared mobility operators pivot toward goods delivery as an alternative funding source, including the role of PPPs. Research is also needed on how to better manage, price, and regulate the curb, particularly when space is at a premium.

Conclusions, Summary of Policy Options, and Next Steps

This research outlines an urgent and ambitious strategic vision for the future of public transit and shared mobility for the United States. COVID-19 has dramatically changed how society travels and moves and the consequences of inaction cannot be understated. Without policy action, strategies, and research, public transit and shared mobility services will be unable to serve the needs of public transit-dependent and vulnerable populations across the country. The downward spiral of service cuts and fewer riders will cause immense and irreversible social equity, environmental, and economic harm to society. Public transit and shared mobility stand at a key junction that will require a concerted effort to reshape how mobility is perceived, viewed, and used.

In a first and critical step, from June to September 2020, 36 experts created six scenario worlds across three timeframes (i.e., within 12 months, one to three years, and four to six years). The group focused on the following focal question throughout the exercise:

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?

Within 12 Months: Declare a State of Emergency

In the first timeframe, regardless of which scenario world may evolve, policy and decision-makers should consider declaring a “state of emergency” for public transit to enable operational flexibility as quickly as possible and set the stage for more systemic change. Coordination (especially multi-jurisdictional) needs to occur immediately, facilitated through an emergency state (similar to actions taken in New York City following the September 11th terrorist attacks). Immediate policy options include:

- Increase stimulus funding;
- Integrate public health goals into the transportation sector;
- Focus on improving the public transportation customer experience, new funding structures, investing in technology, and restoring trust in public transit;
- Build systemic social change through immediate actions to reorient transportation policies to enhancing social equity;
- Address key regulatory barriers to enhance flexibility in funding, management, and operations;
- Build coalitions among the public transit industry, private shared mobility operators, and other key stakeholders (e.g., CBOs) to share lessons learned, develop holistic mobility strategies, and build political influence; and
- Convene key organizations to develop action plans.

One to Three Years: Emphasize Systemic Change

Not surprisingly, actions taken within 12 months will play a critical role in shaping the direction of the one- to three-year timeframe. If policy- and decision-makers can stabilize public transit and shared mobility, this

timeframe should begin to emphasize systemic change in the transportation sector. Suggested policy strategies include:

- Develop new flexible funding and pricing mechanisms to increase social equity and foster longer-term financial sustainability;
- Employ a customer-centric approach across transportation modes and levels of government;
- Create new public transit business structures to increase diversification of revenue and improve services;
- Engage with employers who are critical to public transit recovery;
- Stress environmental and social equity issues in future plans, actions, and community-centered policies;
- Fund innovation through pilots, demonstrations, and funding increases;
- Restructure transportation agencies around multimodal mobility transportation; and
- Integrate transportation policies into non-transportation legislation.

Four to Six Years: Build a Mobility Ecosystem Around Public Transit

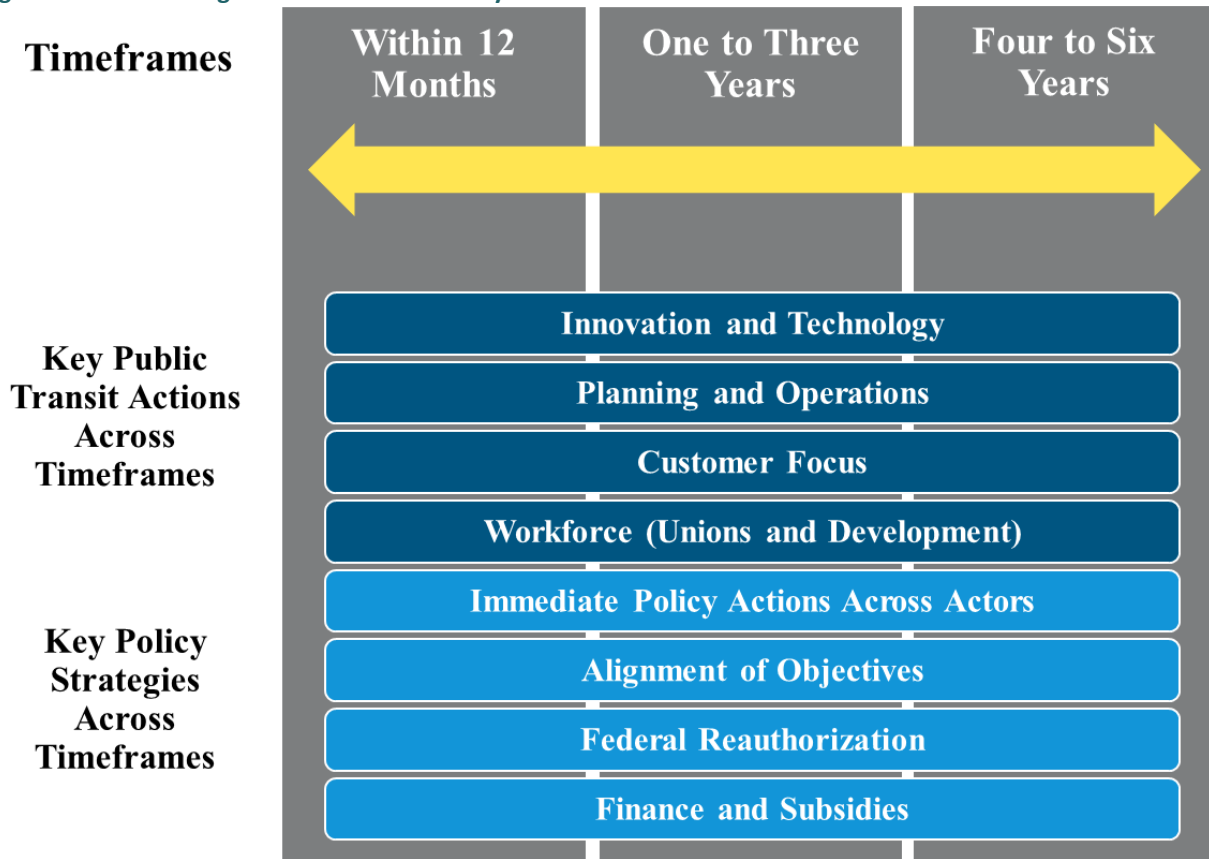
As with the previous timeframe, critical steps in the prior years will lay the groundwork for building a mobility ecosystem around public transit. This ecosystem will be integrated across modes and involve a meshing of public and private operators to provide mobility for all. Failure by stakeholders to take bold action will produce only incremental change. Key policy options and actions in this timeframe include:

- Create a connected mobility ecosystem that integrates public transit and shared mobility;
- Deploy advanced fare payment technology and solve institutional and policy issues;
- Emphasize EV technology to reduce GHG emissions and localized pollution;
- Provide greater operational flexibility and implement new business models; and
- Augment resources to retain, retrain, and restructure the public transit and shared mobility workforce and increase professional development.

Policy Actions: Public Transit Operators and Broader Strategies Across Stakeholders

We categorized the policy actions into two areas: 1) actions that public transit operators could take and 2) broader policy strategies that could guide public transit and shared mobility. Key areas of focus for public transit action include: 1) innovation and technology, 2) planning and operations, 3) customer focus, and 4) workforce development. Broader policy strategies across stakeholders include: 1) immediate policy actions across actors, 2) alignment of objectives, 3) federal reauthorization, and 4) finance and subsidies. These policy actions were developed to cut across the timeframes (see Figure 4).

Figure 4: Cross-Cutting Public Transit and Policy Actions Across Timeframes



Research Recommendations

Experts also offered a series of research recommendations to inform and guide the public transit actions and key policy strategies. Research topics and recommendations stemming from COVID-19 recovery efforts included: 1) travel behavior resulting from work-from-home and telework, 2) changes to TDM/employer actions, 3) scenario modeling for public transit and shared mobility, 4) regulatory inconsistencies across governance levels, 5) opportunities to remove regulatory restrictions, 6) sliding scales of federal requirements for public transit funding, 7) different funding mechanisms for public transit, 8) service needs for marginalized communities, 9) racial and society equity issues in transportation, including fare payment, 10) innovation and technology through pilot programs/evaluation, 11) active transportation, 12) mechanisms to develop successful PPPs, 13) barriers to cultural change toward a multimodal transportation ecosystem, 14) changes in residential choice, 15) opportunities to build affordable housing in public transit-rich places, 16) new data standards and metrics, and 17) behavioral changes in e-commerce and the impact on goods movement and curb management.

Next Steps

The steering committee recommended several next steps including:

- 1) Convening diverse stakeholders in UC ITS and TRB jointly-sponsored workshops to develop strategic actions in partnership with the FTA, APTA, and UC ITS focused on the short- and longer-term future of public transit and shared mobility;

- 2) Forming subcommittees to develop strategic white papers in seven key areas (i.e., innovation and technology, planning and operations, customer-centric service, workforce development, immediate policy actions across actors, alignment of societal objectives, and finance and subsidies);
- 3) Developing a research agenda to support the strategic plan;
- 4) Developing an outreach and communications plan (e.g., briefings for FTA, APTA, the California Transit Association, AASHTO, NACTO, and NCSL, and key legislative committees);
- 5) Coordinating with APTA on its role in seeking funding and regulatory reform on behalf of the public transit industry; and
- 6) Seeking funding from appropriate sponsors to support the above items.

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Appendix A: Description of Scenario Planning Process

From June to July 2020, the steering committee developed a framework for the scenario planning exercise by: 1) creating a focal question, 2) establishing three timeframes for the analysis, 3) identifying potential driving forces and conducting a ranking exercise, and 4) choosing two key driving forces per timeframe (e.g., strongest external forces that impact public transit and shared mobility during a particular timeframe). These tasks helped set the stage for the scenario planning committee to begin world construction. Following the steering committee's actions, the scenario planning and policy committees made substantial changes to both the driving forces and the descriptions of the future worlds. The evolution of this process is shown in Table A1 and the final driving factors and worlds (including chosen worlds) are provided in Figure A1. An original list of driving factors is provided below.

SOCIAL

Social Equity: Growing Social Inequality vs. Increasing Social Equity
Accessibility: Falling Accessibility vs. Rising Accessibility
Social Equity: Transportation as a Right vs. Transportation as a Utility

POLITICAL

Government: Proactive Government vs. Reactive Government
Policing/Enforcement: Highly Policed State vs. Community-Based Policing
Political Philosophy: Nationalism vs. Globalism
Government: Political Gridlock vs. Political Compromise

ECONOMIC/FINANCIAL

Economy: Slow Economic Recovery vs. Strong Economic Recovery
Funding: Traditional Funding Formula vs. Flexible and Innovative Funding
Funding: Funding Stimulus vs. Minimal Federal Assistance
Economics: User-Based Cost System vs. Subsidy System
Labor: Unionized Labor vs. Contractor Labor
Work: Centralized Work vs. Decentralized Work
Business Model: Traditional Business Models vs. New/Evolved Business Models

LEGAL/POLICY

Policy Metrics: Performance-Based Decision-Making vs. Prescriptive Decision-Making
Regulatory Environment: Strong Regulations vs. Minimal Regulations
Planning Processes: Centralized Planning vs. Devolved Planning
Government: Transparency vs. Opaqueness
Role of Government: Public Good vs. Outsourcing/Privatization
Policy: Policy Acceptance vs. New Policy Backlash

TECHNOLOGY

Technology Access: Technology Divide vs. Inclusive Technology Access
Data Philosophy: Data Skepticism vs. Data Acceptance
Electrification: Slow Electrification vs. Rapid Electrification
Automation: Slow Automation vs. Rapid Automation

OTHER

COVID-19 Status: COVID-19 Persists vs. COVID-19 Contained
COVID-19 Restrictions: Strong COVID-19 Restrictions vs. No COVID-19 Restrictions




Sustainability: Sustainability Crisis vs. Green Revolution

Public Trust: Low Trust in Transportation System vs. High Trust in Transportation System

Land Use: Urban Growth vs. Suburban/Rural Growth

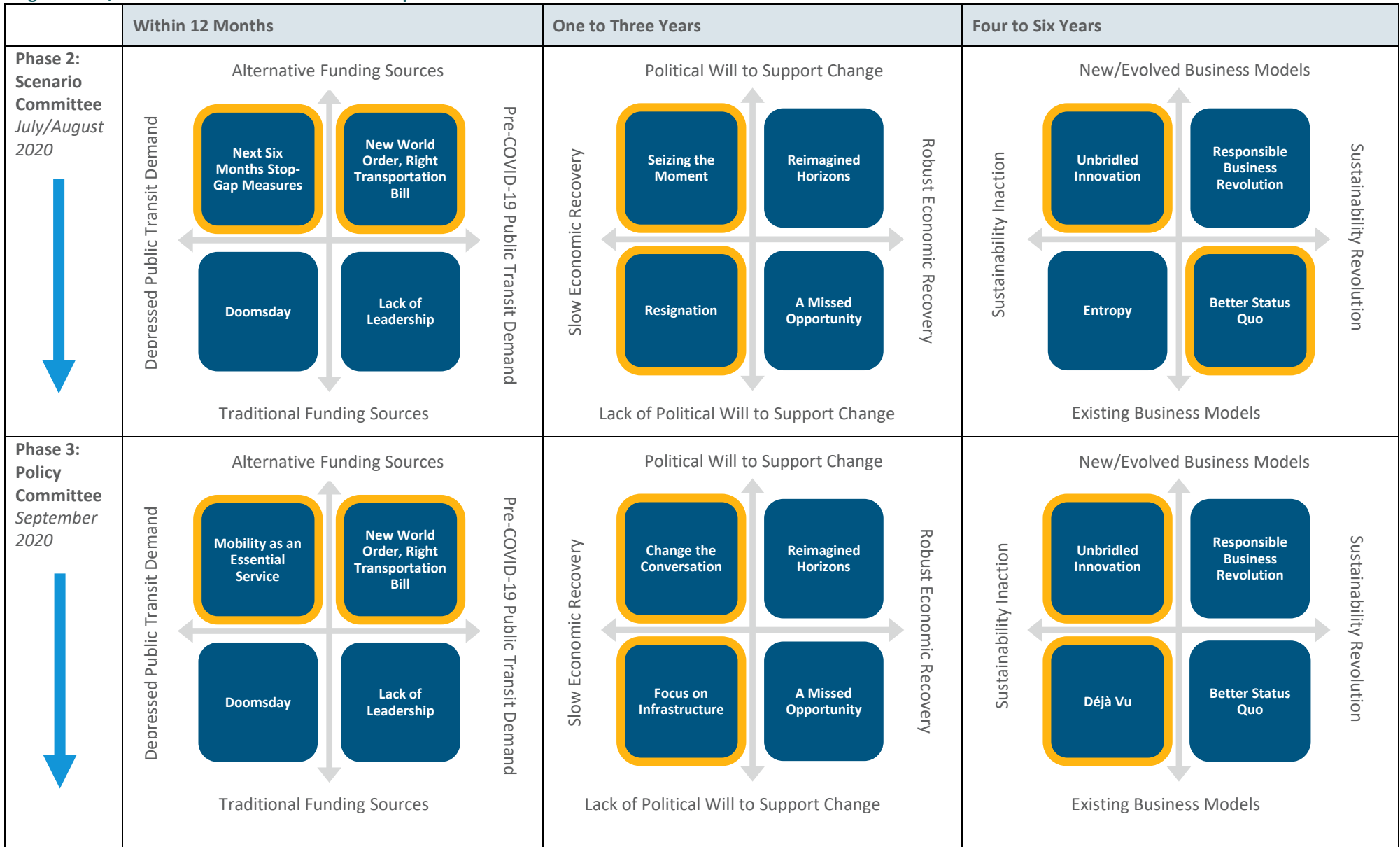
Land Use: Localized Communities vs. Megaregions

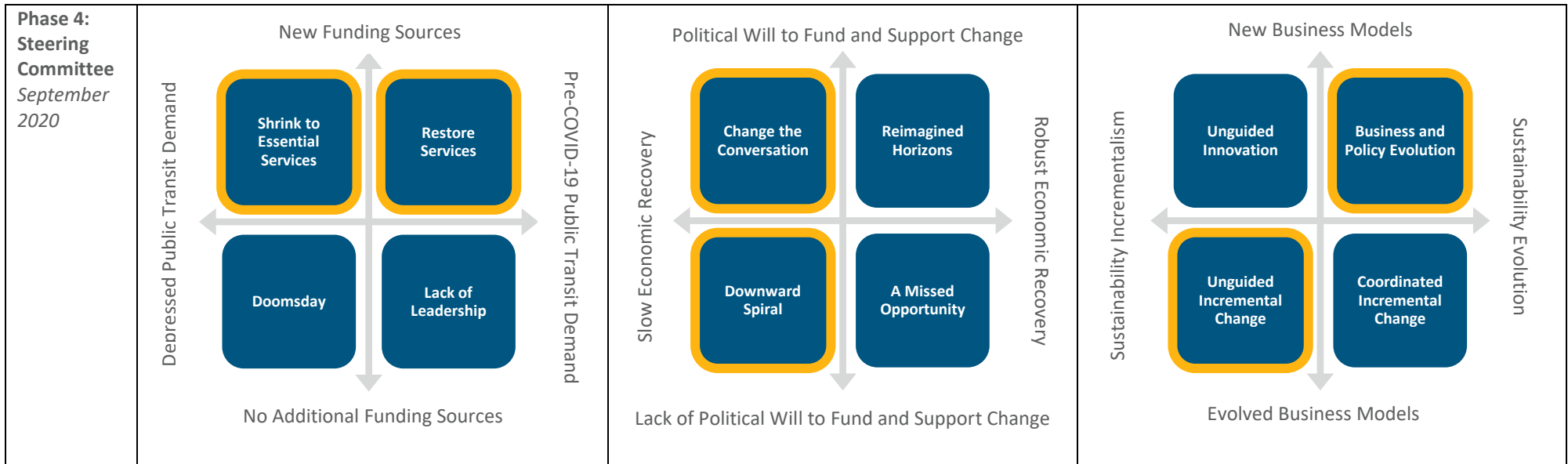
Table A1: Scenario World Development and Evolution

	Within 12 Months	One to Three Years	Four to Six Years
<p>Phase One: Steering Committee</p> <p>June/July 2020</p> 	<p>Selected external forces related to the economy and COVID-19:</p> <ul style="list-style-type: none"> • Robust Economic Recovery vs. Slow Economic Recovery and • COVID-19 Contained vs. COVID-19 Persists 	<p>Selected external forces related to the economy and business models:</p> <ul style="list-style-type: none"> • Robust Economic Recovery vs. Slow Economic Recovery and • New/Evolved Business Models vs. Existing Business Models 	<p>Selected external forces related to sustainability and business models:</p> <ul style="list-style-type: none"> • Sustainability Revolution vs. Sustainability Inaction and • New/Evolved Business Models vs. Existing Business Models
<p>Phase Two: Scenario Committee</p> <p>July/August 2020</p> 	<p>Named worlds and chose two key worlds (highlighted in yellow in Figure A1)</p> <p>Changed initial external forces to funding sources and public transit demand, assuming COVID-19 would persist in the next 12 months and public transit agencies would be most impacted by funding and ridership</p>	<p>Named worlds and chose two key worlds (highlighted in yellow in Figure A1)</p> <p>Changed the business model external force to political will (or lack of) to support change because business models are an <i>outcome</i> not an <i>external driving force</i></p>	<p>Named worlds and chose two key worlds (highlighted in yellow in Figure A1)</p> <p>Did not change driving force vectors</p>
<p>Phase Three: Policy Committee</p> <p>September 2020</p> 	<p>Renamed “Next Six Months, Stop Gap Measures” world to “Mobility as an Essential Service” world to characterize the full 12-month period of this timeframe</p>	<p>Renamed “Seizing the Moment” world to “Change the Conversation” world to better convey a slow economic recovery scenario</p> <p>Renamed “Resignation” world to “Focus on Infrastructure” world to designate the approach needed to support transportation in this world</p>	<p>Renamed “Entropy” world to “Déjà Vu” world to describe the similarity of the world with pre-COVID-19 transportation strategies and policies</p> <p>Chose “Entropy” world as a more likely scenario vs. “Better Status Quo” world, since a sustainability revolution would require a notable change in business models</p>
<p>Phase Four: Steering Committee</p> <p>September 2020</p>	<p>Renamed “Mobility as an Essential Service” world to “Shrink to Essential Services” world to better characterize public transit agency actions</p> <p>Renamed “New World Order, Right Transportation Bill” world to “Restore Services” world to broaden the focus beyond federal reauthorization</p> <p>Shifted wording on the funding vector to “new” and</p>	<p>Renamed “Focus on Infrastructure” world to “Downward Spiral” world to emphasize the negative character of the world vs. emphasizing a strategy in response to the world</p> <p>Shifted wording for the political will vector to include “funding,” since changes to the transportation system require both support and funding</p>	<p>Reworded the sustainability vector as incrementalism vs. evolution to lessen the polarity of this driving force</p> <p>Reworded the business models vector to clarify that old business models would be highly unlikely in this timeframe and less polarizing</p> <p>Renamed “Unbridled Innovation” world to “Unguided Innovation” world to soften the language</p>

	<p>“no additional” funding sources to better characterize the financial challenges of public transit agencies</p>		<p>Renamed “Déjà Vu” world to “Unguided Incremental Change” world to characterize a slowly evolving world</p> <p>Renamed “Responsible Business Revolution” world to “Business and Policy Transformation” world to better fit the new vectors</p> <p>Renamed “Better Status Quo” world to “Coordinated Incremental Change” world to indicate broader sustainability efforts (albeit slow)</p> <p>Focused on the “Business and Policy Transformation” world over the “Unguided Innovation” world as a more likely future scenario</p>
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Figure A1: Quadrants from Scenario World Development and Evolution*





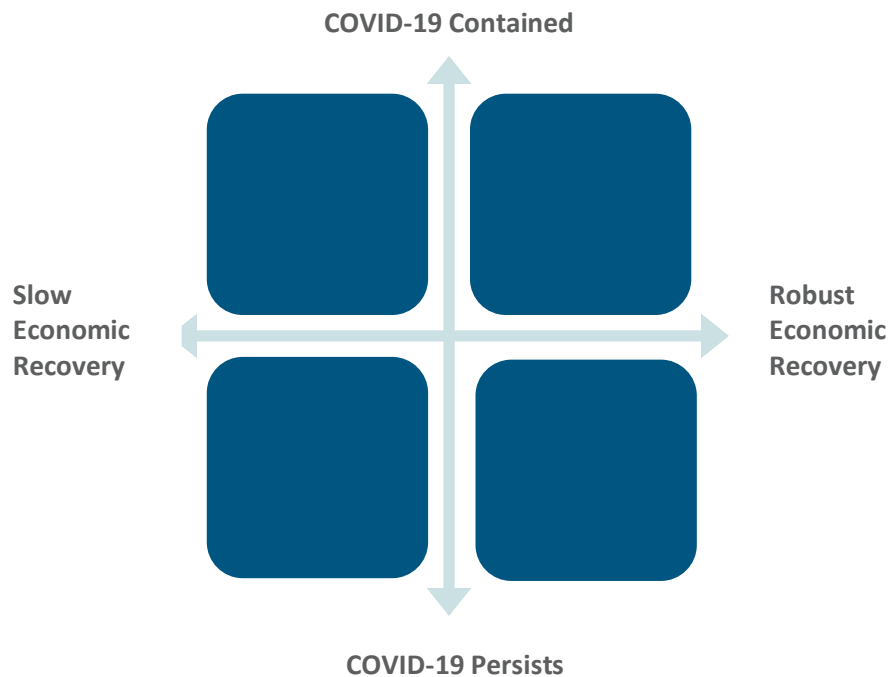
*Phase 1 is not provided in Figure A1 as the scenario names were not developed by the steering committee.

Immediate Timeframe: Declare a State of Emergency (within 12 months)

For the immediate timeframe (within 12 months), the steering committee developed the following worlds, based on two key driving forces (see Figure A2):

- Slow Economic Recovery vs. Robust Economic Recovery and
- COVID-19 Persists vs. COVID-19 Contained.

Figure A2: Initial Scenario World Driving Factors – With 12 Months



The steering committee determined that the short-term direction of the economy would be a critical driving force in how public transit and shared mobility operators provide service. The committee also felt the current state of COVID-19 would drive the direction of public transit and shared mobility services. In particular, the committee believed that the rapid dissemination of vaccines or treatments for COVID-19 would help public transit and shared mobility recover more quickly. A persistent virus, in contrast, would lead to longer-term effects within and outside of the 12-month timeframe on the sustainability of public transit and shared mobility services.

Between July and August 2020, a subgroup of six scenario planning experts met three times to fully develop two scenario worlds for the initial 12-month timeframe. The narratives developed for each scenario world provided a structure for the experts to craft policy options and research recommendations. To start, the experts agreed that the transportation industry will continue to face challenges due to the COVID-19 pandemic and its subsequent protocols, such as stay-at-home orders and social distancing guidelines, through Summer 2021. While the experts did not alter the study's focal question, they modified both initial driving forces for this timeframe as follows:

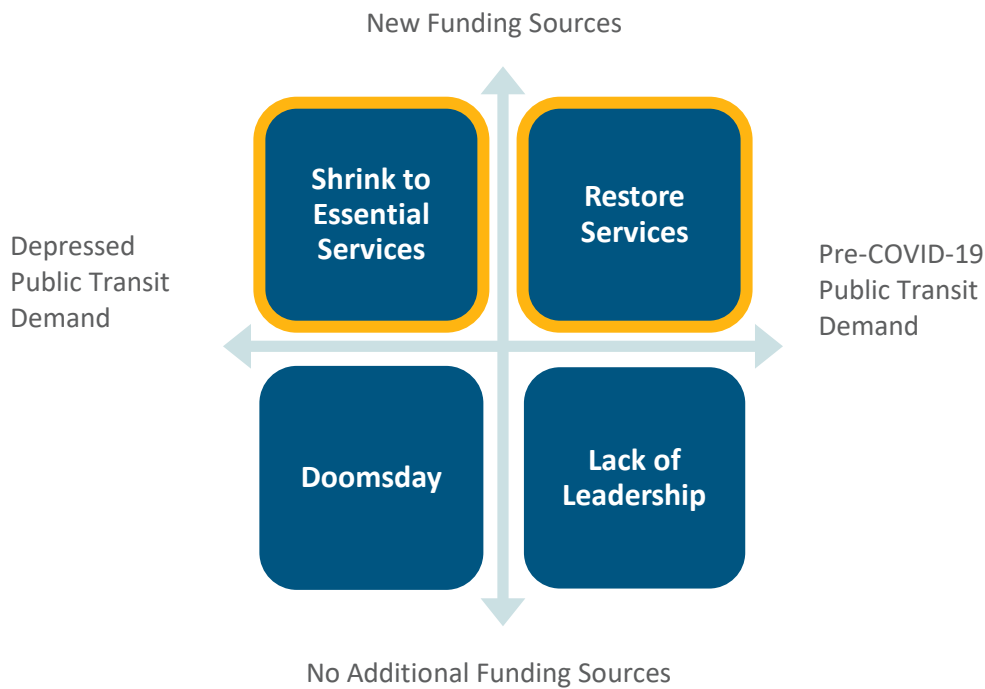
- Depressed Public Transit Demand vs. Pre-COVID-19 Public Transit Demand and
- Traditional Funding Sources vs. Alternative Funding Sources.

Over the next 12 months, the experts noted that economic recovery will likely be slow, and public transit agencies will continue to face financial challenges due to increased service costs (e.g., more vehicle cleanings) and reduced farebox revenues. Thus, they chose to focus on traditional vs. alternative funding sources. They discussed the need for PPPs and other transportation industry stakeholders to support public transit financially and meet travel demand during this period. They also discussed the need for another stimulus package to address the ongoing financial challenges faced by public transit. They noted how travel patterns will evolve over the next 12 months, influencing service provision and financial recovery plans. In particular, the experts noted how continued depressed demand for public transit would significantly alter strategies and actions by public transit agencies. The depth of the financial challenges faced by public transit will vary by location, as some places (e.g., transportation agencies in California) may maintain sales tax-based revenues at or slightly below pre-COVID-19 estimates.

The experts next developed names for the four alternative scenarios worlds. The four worlds include: 1) “Doomsday,” with depressed demand and traditional funding sources; 2) “Lack of Leadership,” with recovered demand and traditional funding sources in which public transit agencies defund service lines; 3) “Next Six Months, Stop Gap Measures” with stop-gap measures to address depressed demand with alternative funding sources; and 4) “New World Order, Right Transportation Bill” in which public transit agencies serve pre-COVID-19 level demand with alternative funding sources and a potential stimulus package. Since traditional funding sources are unlikely to provide enough revenue, the committee focused on the scenario worlds that examined alternative funding sources, titled: “Next Six Months, Stop Gap Measures” and “New World Order, Right Transportation Bill.”

Following the world-building exercise, the policy committee made only a small change by renaming “Next Six Months, Stop Gap Measures” to “Mobility as an Essential Service.” However, during the final study phase, the steering committee renamed this world to “Shrink to Essential Services” to better characterize public transit agency actions during the first timeframe. The steering committee also renamed “New World Order, Right Transportation Bill” to “Restore Services” in this same timeframe to broaden the world focus beyond federal transportation spending reauthorization. Finally, the funding factor was reworded to “New Funding Sources vs. No Additional Funding Sources.” The final factors are presented in Table A1 above and Figure A3 below, with the two selected scenarios highlighted in yellow.

Figure A3: Final Scenario World Driving Factors – Within 12 Months



Shrink to Essential Services World

In the *Shrink to Essential Services* world, COVID-19 vaccines have yet to be fully developed. As a result, stay-at-home orders and other restrictions continue and business operations and economic functions fail to return to previous levels. The poor economic conditions exacerbate shortfalls across government budgets, especially for public transit agencies. However, due to the length and extent of the COVID-19 pandemic, federal financial assistance is limited, and public transit agencies must tap into unconventional funding sources. All sectors within transportation are impacted by resource limitations, which perpetuate a downward spiral toward insolvency, with public transit agencies shrinking to delivering only essential services.

This world is also characterized by depressed transportation demand, especially public transit, caused in part by stay-at-home orders, job losses, and work-from-home. However, differences in transportation demand vary by geography. Denser urban areas are less impacted with respect to bus services,⁴ while more rural areas face an even greater decrease in public transit demand. Commuter services face the steepest ridership decline. Revenue challenges are exacerbated by additional operating costs (e.g., vehicle cleaning) and reduced farebox recovery. Partnerships between public transit agencies and shared mobility operators offer some limited relief in an effort for both parties to remain financially soluble. However, funding and/or policy restrictions significantly hamper partnership efforts.

Public Transit

In this world, public transit struggles significantly with revenue challenges from reduced ridership and a drop in tax revenues (e.g., gas, sales). Lower demand for public transit results from a shift to private vehicles and ongoing travel and economic restrictions. Public transit demand varies by mode with rail and commuter services experiencing the largest

⁴ Note the largest public transit declines (other than commuter rail) have been on subway services serving dense urban areas.

decreases in demand due partially to high rates of work-from-home. In some cases, public transit services used by lower-income or transit-dependent populations (e.g., buses) see steady or slightly lower demand.

To address ridership challenges, public agencies increase actual and perceived safety for riders and operators and consider alternative modes and/or technologies (e.g., using technology platforms to facilitate multimodal trips). Reallocation of street space for public transit becomes a divisive topic with increased demand for curb space by restaurants for outdoor seating and by active transportation for rights-of-way. Public transit agencies are also forced to continuously reevaluate their services, often choosing to keep service reductions that were implemented during early stay-at-home restrictions. Public transit agencies shift to survival mode, shrinking to only providing essential service to key routes and transit dependent riders. Strong local and regional coordination in some places enables the survival of public transit agencies while division in other regions accelerates the decline of public transit agencies. As the economic impacts of COVID-19 continue to result in high unemployment and reduced pay, more individuals become housing insecure. Agencies struggle with public transit vehicles becoming a shelter of last resort for houseless individuals and new encampments along rights-of-way.

Shared Mobility

Shared mobility also faces decreased demand, especially for TNC services, due to stay-at-home orders, job losses, and pay reductions that makes these modes less affordable. Concerns regarding virus transmission support a shift toward more private transportation modes (e.g., private auto travel). However, not all shared mobility modes suffer as micromobility and carsharing experience steady demand due to lower concerns of virus exposure. To maintain financial viability, select shared mobility operators turn to PPPs with public transit agencies. Some operators, especially TNCs, continue to expand into delivery services for food, packages, and goods. In some cases, operators work with agencies to replace low ridership routes and pilot on-demand services. However, public transit agencies and shared mobility operators face challenges due to staff capacity and the need for governmental approval of partnerships. Struggling shared mobility operators are forced to shrink to essential services, similar to public transit agencies.

Auto Travel/Work-from-Home

Auto travel in personal vehicles increases as people avoid possible virus exposure on public transit and shared mobility services in more urban areas. This shift toward personal vehicles results in an increase in VMT and congestion in more urban regions. Congestion, while still occupying some peak commute hours, is more spread out over the day as many people continue to work from home. Despite these trends in more urbanized regions, congestion remains low in most other areas in the U.S. due to sustained telework practices. As companies and organizations refine and improve their telework arrangements, the work-from-home option becomes more viable for the longer term.

Active Transportation

People continue to use active transportation modes at their current rate, particularly as these modes remain supported by curb space and land use changes (e.g., slow streets). However, some people express exposure concerns over using shared micromobility (i.e., bikes and scooters) as compared to personal devices. Active transportation also faces competition for curb space and rights-of-way access as other businesses (e.g., restaurants, retailers) shift their operations outdoors onto sidewalks, parking spaces, and travel lanes.

Air Travel

In the *Shrink to Essential Services* world, the commercial aviation industry will not see a meaningful recovery due to COVID-19 transmission concerns and ongoing travel restrictions. However, commercial air travel businesses begin to explore adjusting their services to meet other demand (e.g., facilitating deliveries to bolster the supply chain).

Signposts

Signposts were developed to help transportation agencies, mobility providers, and other stakeholders identify specific scenarios. Table A2 details these signposts which are organized by topic area. Rather than consider external events, which

may take months or years to impact transportation, the experts instead focused on transportation metrics and measures to signal this world’s arrival.

Table A2: Signposts for Shrink to Essential Services World - Within 12 Months

Topic Area	Signpost	Description
Finances	Fee structures	Return to charging for fares rather than free public transit
	Financial aid	Continuation of financial support for public agencies but with a lack of clarity regarding funding sources/amount
	Sustainability concerns	Lack of revenue/ridership, leading to concerns about longer-term sustainability
Transportation Demand	Congestion	Increased VMT and congestion as more people drive to work and services in more urbanized regions
	Public transit demand	Low demand as people continue to stay-at-home, work-from-home, and/or choose to use personal vehicles rather than public transit
	Services	Public transit and some shared mobility operators drastically cut service, providing only essential service based on transit-dependence and revenue management
Transportation Services	Cost reduction plans	Development of plans to reduce public transit service costs
	Partnerships	Opportunity to engage in new partnerships with operators facing similar challenges of scalability, underused fleets, and low demand
	Remote education	Widespread remote teaching, which impacts agency agreements (e.g., with school districts) and requires repurposed contracts and altered services
	Rights-of-way	Shifts in public rights-of-way use (e.g., slow streets, curbside dining)
Miscellaneous	Definition of essential workers	Redefinition of essential workers (e.g., including service industry employees)
	Transportation collisions and fatalities	Irresponsible driving behaviors resulting in more accidents and collisions
	Supply chain	Inability to use federal funding and/or fulfill contracts due to delays in the supply chain

Restore Services World

The most notable difference between *Shrink to Essential Services* and *Restore Services* world is the assumption that vaccines for COVID-19 will be developed, although they may not be available for the entire population at first. It is also assumed that people will begin returning to work because of vaccines, economic growth, and/or other external factors. In both worlds, mobility operators will need to restore the perception of public safety for both operators and riders.

Public Transit

While this world assumes the presence of a COVID-19 vaccine, a vaccine alone does not encourage passengers to use public transit. Agencies attempt to provide clear messaging on implementing safety protocols to decrease the overall perception of risk (e.g., janitorial and sanitizing staff on board during peak hours). Public transit agencies are resolved that ridership will only return if public trust in services increases. Agencies work to restore services to key routes, while expanding coverage to low ridership routes as funding becomes available. New funding sources help agencies retain public transit dependent riders and begin building back “core” ridership.

Public agencies also begin to develop new service strategies to better serve public transit-dependent populations (e.g., job access) and provide life-sustaining trips (e.g., trips to medical appointments). They pursue COVID-19 opportunities, such as developing contactless payment systems and capitalizing on opportunities for quick build projects (e.g., painting bus lanes, pop-up bike lanes). Some public transit agencies create partnerships with microtransit and shared mobility companies for more efficient, scalable services. Other public transit agencies spearhead the development of scalable services, building a public version of TNCs, microtransit, and carsharing. These partnerships also increase public transit ridership for multiple modes via first- and last-mile connections. However, public and private mobility operators still face resource limitations due to COVID-19, such as staff availability and funding. Agencies pursue alternative funding sources and revenue streams to restore services and support innovations, partnerships, and operations.

Shared Mobility Services

To maximize profits and meet higher transportation demand, stakeholders across the industry, cities, and different geographic areas attempt to build robust partnerships. Private operators also focus on providing first- and last-mile trips. Changes to urban form (e.g., exodus of urban residents, shift to remote work) alter the demand for transportation service. As a result, shared mobility operators benefit from providing gap-filling services to public transit riders, rather than operating a competing service.

Restore Services accelerates new business opportunities for shared mobility providers including automated goods delivery and transportation data services. The collection and use of transportation data allow shared mobility operators to offer more customized service by employing real-time schedules, integrated fare payment, and other technology-enabled services. However, shared mobility operators fiercely compete with other modes and curb space uses. Operators across shared modes attempt to gain access to rights-of-way, which are being allocated to outdoor space for restaurants, public transit bus lanes, and active infrastructure (e.g., bike lanes).

Auto Travel / Work-from-Home

With the presence of COVID-19 vaccines, some employers allow and encourage employees to return to work. With continuing concerns over COVID-19 transmission without full vaccination, many people drive instead of taking public transit or shared mobility. The result is increasing congestion, more traffic accidents, and reckless driver behavior. While employers begin to open offices and services, full and partial work-from-home continues for many. The COVID-19 pandemic has allowed businesses to increase their remote capabilities and offer telework as a longer-term option for employees. The continuation of work-from-home decreases peak commute travel but increases congestion during other times of the day.

Active Transportation

The use of active transportation modes in this world is similar to that in *Shrink to Essential Services*. People continue to opt for open-air active transportation modes, rather than enclosed, shared modes. Active transportation faces off against other modes in competing for curb space and rights-of-way access. However, safety remains a challenge due to reckless operation by users and poor infrastructure for active modes.

Air Travel

Air travel demand fails to fully return to pre-COVID-19 levels. Demand struggles due to the cancellation of many large-scale events (e.g., conferences, music festivals) and ongoing concerns about COVID-19 transmission on planes. Travel restrictions

in some countries without widespread distribution of a vaccine also dampen demand. A return-to-normal timeframe is anticipated to take two to three years, based on other major events impacting air travel (e.g., September 11, 2001 terrorist attacks).

Signposts

Signposts were also developed to provide further clarity of the characteristics of this world. Table A3 below details these signposts and are organized by topic area. Similar to the *Shrink to Essential Services* world, the experts focused on transportation metrics and measures rather than external events.

Table A3: Signposts for Restore Services World - Within 12 Months

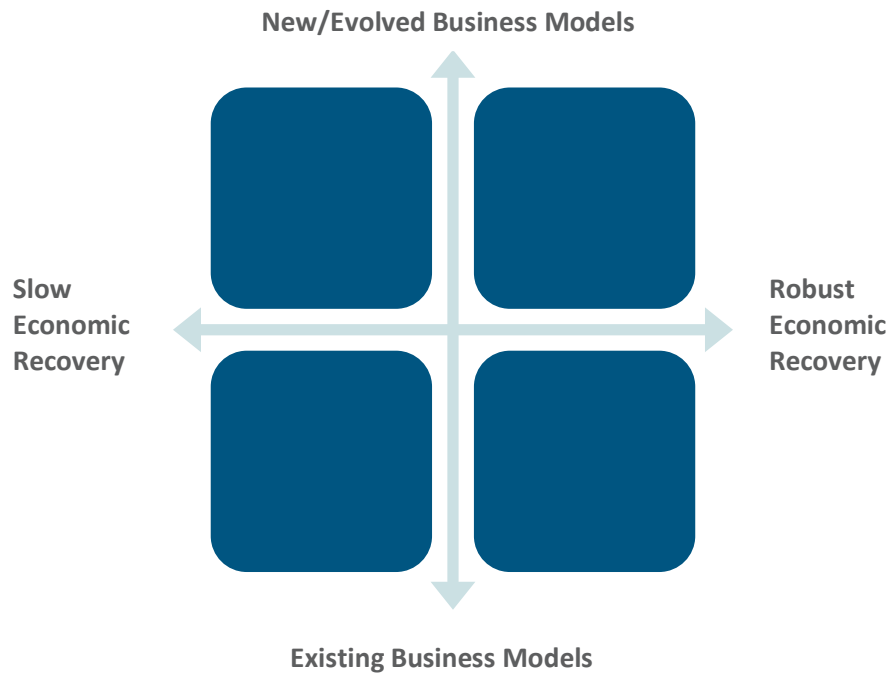
Topic Area	Signpost	Description
Funding	Budgets	Funding sources, stimulus aid packages, and budgets are finalized and clearly defined (especially federal support from a stimulus bill)
	Funding flexibility	Expanded definition of what public funding can be spent on (e.g., subsidies for riders rather than capital investments)
	Outcome-based funding policies	Shift to outcome-based and outcome-focused funding sources from federal and state agencies and restriction reductions
	Outcome-based performance metrics	Development of outcome-based performance metrics to track progress
Transportation Services	Services	Restoration of public transit and shared mobility services for public transit dependent populations and core riders
	Partnerships and services	Engagement in new partnerships and development of more flexible services that better meet the needs of urban and rural riders
	Pooling	Improved understanding of people’s willingness to share devices, vehicles, and rides
Regulations and Requirements	Communication	Creation of consistent expectations and messaging for maintenance and operational standards
	Service and partnership flexibility	Increased partnership and service flexibility while maintaining accountability through predefined standards
Miscellaneous	Transportation efficiency	Reevaluation of transportation efficiency and ability to complete life sustaining trips
	Vaccine	Availability of a COVID-19 vaccine, even if it is only available for select populations

Short-term Timeframe: Emphasize Systematic Change (one to three years)

The steering committee concluded that between 2021 and 2023 (i.e., second timeframe), transportation will continue to face the direct and indirect effects of COVID-19. The committee identified two key driving forces for presenting the initial world for the short-term timeframe of one to three years for members of the scenario committees to consider (Figure A4):

- Slow Economic Recovery vs. Robust Economic Recovery and
- Existing Business Models vs. New/Evolved Business Models.

Figure A4: Original Scenario World Driving Factors – One to Three Years



The steering committee concurred that the strength or weakness of the economy throughout the duration of the pandemic would significantly influence transportation and present different opportunities for, and barriers to the industry’s recovery. This committee also felt that business models (e.g., finances, funding, services, partnerships, operations, scaling [e.g., ability to grow], permanence [e.g., longevity]) would drive the direction of public transit and shared mobility services. They observed that the pandemic was already causing public transit agencies and private companies to rethink and alter their business models to survive.

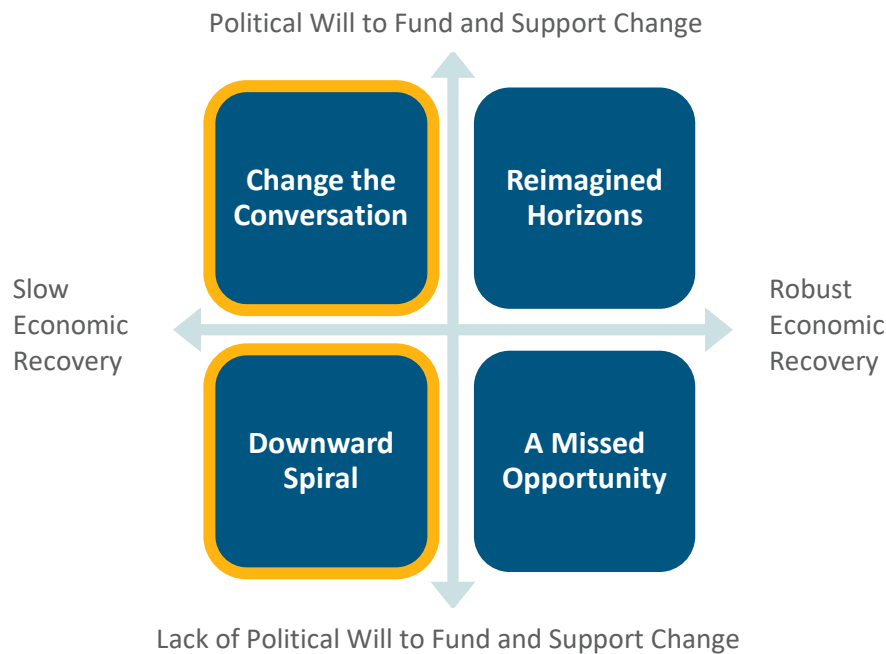
The next subgroup of six scenario planning experts was given the opportunity to review/revise the focal question and reconsider the top two driving forces for this timeframe. The group quickly agreed that the economy would significantly affect public transit and shared mobility. After some discussion, however, the group decided that business models were an *outcome* rather than an *external driving force*. Rather than choose from the list of external forces previously created by the steering committee, this scenario committee developed a new driving factor: level of political will. The committee settled on the following two factors for the one- to three-year timeframe:

- Slow Economic Recovery vs. Robust Economic Recovery; and
- Political Will to Support Change vs. Lack of Political Will to Support Change.

Next, the scenario planning committee developed names for the four possible combinations (see Figure A1). The committee decided to focus on the two most likely scenarios for 2021 to 2023, not the most extreme scenarios. While they recognized that robust economy recovery would be a preferable scenario, the experts discussed how a slow economic recovery was more probable, especially if development of vaccines and/or treatments for COVID-19 took longer than a year. The scenario committee selected the “Seizing the Moment” world (more optimistic) and “Resignation” world (less optimistic).

The policy committee renamed the “Seizing the Moment” world to “Change the Conversation” to better convey a slow economic recovery, while “Resignation” was renamed to “Focus on Infrastructure.” In Phase 4, this world was changed once again by the steering committee to “Downward Spiral,” emphasizing the negative outcomes of the world. The steering committee also added funding to the political will driving factor, as transportation will require both funding and political will to succeed. Figure A5 displays the final and chosen worlds and factors.

Figure A5: Finalized Scenario World Driving Factors – One to Three Years



Change the Conversation World

Between 2021 and 2023, society continues to face the long-term economic impacts of COVID-19. Unemployment, stagnant wages, and little growth in gross domestic product signal slow economic recovery. Yet, in this world, the political will to fund and support change is strong at all levels of government (federal, state, regional, and local). The pandemic has opened the door for new policies, ideas, and strategies to boost public transit and shared mobility use in a more equitable manner. Following the lifecycle of the virus, some businesses fail, while other startups and innovations expand to offer alternate transportation services. An innovative mobility ecosystem emerges that strives to lessen the growing income divide by leaning on multi-jurisdictional cooperation. In the first year, COVID-19 persists despite progress in vaccination and treatment development. As COVID-19 is expected to be contained in two to three years, day-to-day life returns, and many shared modes see moderate ridership returns. Due in part to strong political will and despite only modest ridership gains, many negative impacts on public transit and shared mobility use have been mitigated. Transportation reorients to provide more equitable access to jobs and services for people struggling in a pandemic-induced recession. Most importantly, a new conversation starts that embraces increased funding and a culture focused on “transportation as a right.”

Public Transit

Overall, reduced ridership on public transit endures, failing to fully bounce back to pre-COVID-19 levels. Funding for public transit deficits is tenuous, and some revenue sources (e.g., sales tax) bring in less money due to slow economic growth. The combination of lower ridership and funding levels for public transit continues to require operators to redesign routes, emphasizing service for essential and low-income workers predominately but also for some choice riders. Strong political will enables new creativity in funding streams, business models, and operations. In this world, public transit agencies focus on customer service in transit ridership and preferences. Operators explore flexible funding streams, subsidize low-income riders, and prioritize public transit assets to support the public good. Public agencies deploy on-demand transportation pilot projects with an eye toward fiscal sustainability, boosting operational efficiency, and improving sanitation with advanced technologies. Despite economic challenges, agencies work to increase transit coverage and frequency (where most needed) and forge partnerships with private companies to fill gaps. Sustained work-from-home policies enable agencies to reduce peak-level service and create more frequent and regular service for more transit-dependent individuals.

Shared Mobility Services

Shared mobility operators face substantial challenges as ridership drops due to the slow economic recovery. Demand decreases most for non-essential trips and trips to the airport. Experiencing record declines in revenue, TNCs and other shared mobility providers look to adapt to the new landscape by shifting their business models. Companies repurpose their assets (e.g., for delivery), redesign vehicles to improve sanitation, and develop new funding structures (e.g., membership models). Some companies agree to complementary partnerships with public transit agencies, providing services for low-density and low-ridership routes and supporting first- and last-mile connections. These are subsidized and/or backed by private sector funding. Some shared mobility operations — including TNCs, carsharing, scooter sharing, and bikesharing — are integrated directly into public transit agencies as public transportation options, reflecting a more seamless platform of booking and payment. While some agencies adopt software from shared mobility operators, others develop their own on-demand systems as an extension of public transit. Political will to fund and support change has also fostered new opportunities for mobility wallets, flexible payment systems, and sustained discounts for low-income communities. Shared mobility companies, facing increased government pressure (e.g., AB 5 in California⁵), pay drivers a living wage and offer sufficient benefits packages. Overall, shared mobility is now viewed as offering complementary services to public transit in part due to an emphasis on streamlining data standards, sharing, and management practices.

Auto Travel / Work-from-Home

Despite poor economic recovery, VMT rebounds to pre-COVID-19 levels or higher as some people remain distrustful of the safety of public transportation, especially in 2021 and early 2022. Work-from-home policies are sustained in certain sectors with some employees switching permanently to work-from-home and others conducting only periodic travel to the office. Consequently, peak commute auto trips decrease somewhat, but auto trips across all other times increase. The result is more congestion across more hours of the day, especially bottlenecks in neighborhoods where drivers contend with more delivery vehicles competing for road space. However, higher unemployment due to poor economic conditions may counteract congestion increases. Car ownership remains largely stable in this world as people purchase more used vehicles but fewer new vehicles.

Work-from-home continues to grow, driven by labor unions, employers, and employees. With changing travel patterns and greater teleworking capabilities, transportation demand management (TDM) strategies rely on engagement with employers but shift to address new challenges with localized congestion and sporadic commuting behavior. Agencies begin to recognize that job type greatly impacts a worker's transportation needs. Work-from-home has also shifted the concept of workspaces. New spaces in neighborhoods (e.g., community centers, coffee shops, libraries) have become opportunities for telework and collaborative work when needed. They also incur less travel costs, a benefit to employees in a more sluggish economy. Yet, access to broadband Internet and a severe digital divide (e.g., difference in technology access and usage) remain key challenges to overcome. Work-from-home and telework levels differ significantly by geographic region and sector.

Active Transportation

Leaner personal budgets within households amidst the slow economic recovery lead to an increase in active transport interest. Traditional bike and e-bike purchases surge as more people begin to realize the cost savings of cycling. Micromobility (bikesharing and scooter sharing, as well as privately owned devices) become more attractive options for

⁵ On November 3, 2020, Proposition 22 passed in California to exempt TNCs and other gig-economy workers (e.g., drivers for DoorDash, Instacart) from Assembly Bill 5, which would have classified them as employees. As a result, drivers remain independent contractors and are now guaranteed a wage floor of 120 percent of minimum wage, along with \$.30 per mile (for engaged time only, not including wait times for a ride or delivery). For individuals who make more than this, their pay would remain unchanged. Tips, cleaning fees, and airport fees are not included in wage rates. Finally, workers must average at least 25 hours of engaged work a week over a three-month period to receive a full healthcare subsidy or 15 hours to receive one half.

travel. Increases in active transportation lead more cities to consider transforming temporary measures adopted during the initial COVID-19 shutdowns into long-term infrastructure changes (e.g., slow streets, dedicated bike lanes, wider sidewalks). Political will has enabled broader support for changes to rights-of-way, integration of social equity and justice into policies, and new considerations for street and fare enforcement by police and public transit personnel, as well as connections to schools. Community-based planning, especially for active transportation, becomes an important mechanism to capture the political will to support change.

Air Travel

Air travel is recovering very slowly, driven by the poor economy and lingering concerns of COVID-19 transmission on planes. With this massive reduction in demand (especially business travel that is now fulfilled through telework), airlines look for ways to reinvent themselves with new service offerings, changes to plane layouts, and improved sanitation procedures. Other sectors dependent on air travel (e.g., airport vendor commerce, TNCs, ground parking) are forced to adapt to the new conditions presented by the pandemic.

Signposts

The committee experts developed several signposts that signal the beginning of the *Change the Conversation* world (Table A4). The experts focused on political, transportation, and land use metrics and events that would arise and influence a one- to three-year timeframe.

Table A4: Signposts for Change the Conversation World – One to Three Years

Topic Area	Sub-Topic	Signpost Description
Political	Federal COVID-19 response	Strong federal response (e.g., federal initiative and guidance)
	COVID-19	Fast development, acceptance, and distribution of vaccines
	Transportation culture	Shift toward “transportation as a right” and a mobility ecosystem
Public Transit	Metrics	Disillusionment with ridership and fare box recovery as metrics of public transit success Acceptance of headways, which denotes frequency and quality of service, as a metric for public transit
	Ridership	Stable ridership of public transit (but still below pre-COVID-19 levels)
Transportation Demand	Congestion	Reduction of congestion during peak-commute hours
	Vehicle purchases	Rise of used vehicle sales and fall of new vehicle sales
	Micromobility	Growth in use/availability of micromobility options
	Cycling and walking	Increase in cycling and walking miles and new infrastructure
Land Use	Housing	High housing vacancies (apartments and single-family homes) in large cities
	Commercial buildings	High commercial Class A building vacancies in downtown cores
	Rents	Reduced rents in urban cores

Downward Spiral World

In the one- to three-year timeframe (2021 to 2023), the economy is growing slowly as it continues recovering from COVID-19. The economic forecast resembles the *Change the Conversation* world: high unemployment, stagnant wages, and little growth in gross domestic product. However, political will to fund and support change has cratered, leaving few viable government-led options for transportation. Most concerning is the lack of consistent funding as public transit must bounce from stimulus to stimulus without sufficient revenue from economically driven sources (e.g., sales tax, farebox). Even the passage of federal stimulus packages, which include public transit, proves to be tenuous and inconsistent without political will. Gridlock and divisions in public opinion only add to the lack of political will. Gridlock also leads to ongoing challenges in containing COVID-19, especially in 2021. Minimal federal guidance and leadership leads to state-by-state strategies, sometimes pitting states against each other for supplies, access to a more slowly developed vaccine, inconsistent stimulus funding, and other resources. The recovery period for transportation extends as people stay home, and income inequality increases without economic relief. The *Downward Spiral* world paints a dim picture for both short- and long-term sustainability of public transit and shared mobility.

Public Transit

With low political will, public transit agencies experience significant financial setbacks. While agencies received an initial stimulus package through the CARES Act, longer-term and consistent funding opportunities have stalled. Public transit experiences a rapid contraction of services including frequency of service, number of routes, and programs to assist essential workers and public transit-dependent riders. With low ridership across most systems and service reductions, public transit agencies experience a vicious cycle of falling ridership, less revenue, and more service cuts. Suburban and rural systems are particularly impacted, losing viability in many communities. In many cities, public transit is cut to just essential service, and capital projects are suspended. Public transit agencies also face challenging negotiations with labor unions as operators are laid off. In some extreme cases, agencies default and collapse without the political will to sustain service, leaving limited to no transportation options for residents who previously relied on public transit.

Shared Mobility

In the shared mobility sector, operators shift their business models to ride out the economic challenges. TNC operations primarily devote services to their highest performing markets, which amplifies service inequities. Some companies try to find new business opportunities in expanding shared micromobility (especially e-bikes) and delivery services. Other operators attempt to build partnerships with public transit agencies to fill gaps on cut routes and late-night service. However, a significant portion of shared mobility companies exit the market completely, leaving fewer transportation options for many communities, especially public transit-dependent neighborhoods. Only after COVID-19 is contained, operators return to carsharing to lower the costs for riders hit hard by the economy.

Auto Travel / Work-from-Home

With drastic cuts in public transit and difficulty in containing COVID-19, auto use and active transportation are preferred modes. With a sluggish economy, VMT is not likely to increase overall due to less travel. Private vehicles are viewed as a safer option than public transportation. Congestion across the road network at all hours throughout the day becomes more commonplace. While peak-commute congestion decreases somewhat due to telework in some locations, many public transit trips are replaced with auto trips. GHG emissions rise and essential workers struggle to get to work on time. Car ownership becomes a lifeline for workers and families who must make ends meet with multiple jobs.

The difficulty in containing COVID-19 due to low political will leads to a higher percentage of full-time and part-time work-from-home. Employers continue to keep offices closed and a growing number of companies begin implementing long-term work-from-home policies (as least for some portion of their workforce, e.g., 20 percent). As many employees grow accustomed to work-from-home, preferences begin to shift toward flexible working hours for some. While early impacts on peak-commute congestion are promising, VMT might rise for non-work trips if employees take off time in the middle of the day to engage in other activities. Work-from-home remains an employer- and employee-driven option, reserved for non-essential work — reinforcing social equity issues as many low-income essential workers must continue to pay high

transportation costs. The lack of political will to guide work-from-home at all levels of government leads to an ad hoc system that differs between states, regions, and companies. Challenges persist in overcoming the digital and income divide and providing broadband Internet access, especially in rural areas.

Active Transportation

With slow economic growth, cheaper forms of transportation including walking, biking, and scootering become more popular. Regular bike and e-bike sales increase, and shared micromobility expands in core city locations. However, infrastructure improvements for active modes during COVID-19 (e.g., slow streets, bike lanes) are stalled or removed due to growing auto congestion and parking needs. Governments lack the will to invest in supportive infrastructure and a safe network for active transportation. While some small-scale changes are made in certain local areas with more resources, infrastructure improvements are neither institutionalized nor equitable. Political gridlock on who deserves space on the rights-of-way stalls many large-scale projects.

Air Travel

Demand for flights remains low at the beginning of this timeframe due to COVID-19 concerns. Nevertheless, airline trips remain depressed at the end of the timeframe due to the slow economy and the availability of virtual meetings. Airports in smaller and poorer communities are closed without adequate stimulus funding. Other airports attempt to reinvent themselves, as airport vendors lose revenue with fewer passengers.

Signposts

The scenario committee developed several signposts that would signal the beginning of the *Downward Spiral* world (Table A5). Similar to the *Change the Conversation* world, the signposts reflect metrics and events that would arise and influence a one- to three-year timeframe.

Table A5: Signposts for Downward Spiral World – One to Three Years

Topic Area	Sub-Topic	Signpost Description
Political	Federal COVID-19 response	Weak federal response (e.g., little federal initiative or guidance)
	COVID-19	Slow development, acceptance, and distribution of vaccines
Public Transit	Metrics	Maintained use of ridership and fare box recovery as metrics of public transit success
	Ridership	Dropping ridership of public transit (substantially below pre-COVID-19 levels)
	Capital projects	A hold on public transit capital projects
Transportation Demand	Congestion	Reduction of congestion during peak-commute hours
	Vehicle purchases	Rise in used vehicle sales and fall in new vehicle sales
	Micromobility	Growth in use/availability of micromobility options
	Cycling and walking	Increases in cycling and walking miles but minimal to no new active transportation infrastructure
	Telework	High percentage of telework
	Shared mobility	End to service expansion by many shared mobility companies
Land Use	Housing	High housing vacancies (apartments and single-family homes) in large cities

Topic Area	Sub-Topic	Signpost Description
	Commercial buildings	High commercial Class A building vacancies in downtown cores
	Rents	Reduced rents in urban cores

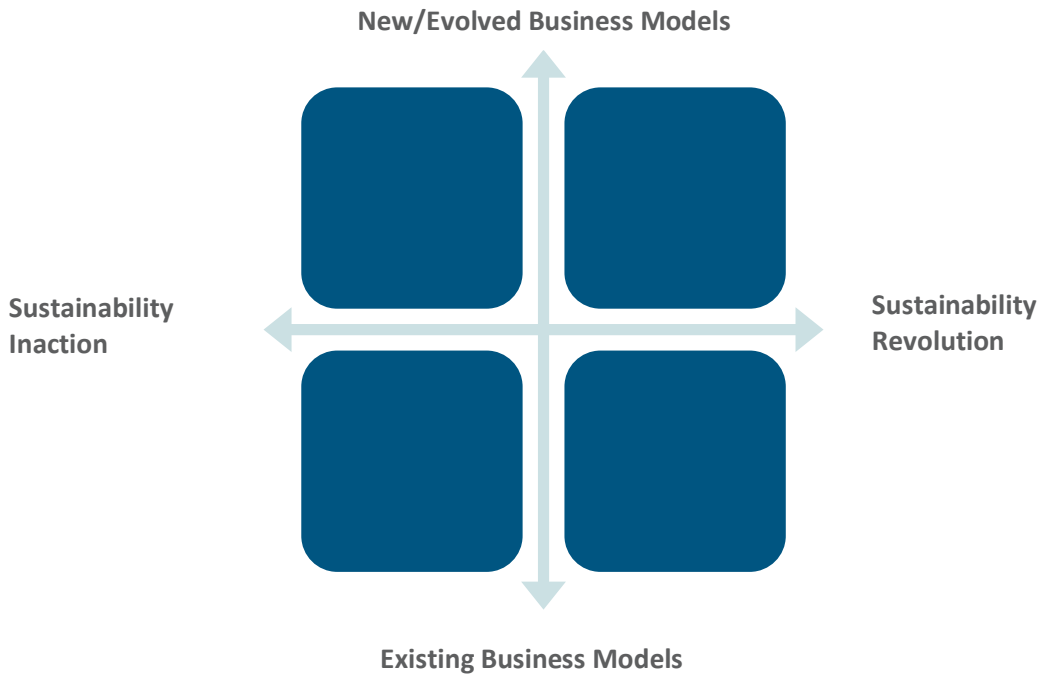
Medium-Term Timeframe: Build a Mobility Ecosystem Around Public Transit (four to six years)

Finally, in the medium-term timeframe between 2024 and 2026, transportation will likely be stabilized but probably not fully recovered from COVID-19. The steering committee identified two key driving forces for presenting the initial world for the immediate timeframe of four to six years for the those in the scenarios committee to consider (Figure A6):

- Sustainability Inaction vs. Sustainability Revolution and
- Existing Business Models vs. New/Evolved Business Models.

The steering committee identified other external driving forces but settled on ones related to business models and sustainability. In this case, business models include finances, funding, services, partnerships, operations, scaling, and permanence. Sustainability was described in terms of the three Es (i.e., environment, equity, and economy). Consequently, the steering committee combined other driving forces related to social equity and the economy into a single driving force of sustainability.

Figure A6: Initial Scenario World Driving Factors – Four to Six Years



The next subgroup of six scenario experts was given the opportunity to review/revise the focal question and reconsider the top two vectors (new vs. evolved business models, and incremental changes in attitudes toward sustainability vs. an evolution in sustainability). The scenario committee spent minimal time discussing the key vectors and concurred that the established two vectors would define the worlds in the four-year to six-year timeframe. Next, the experts focused their attention on naming and choosing the top two scenarios to explore (see Table A1). Discussions centered largely around choosing scenarios that were more likely to occur and could significantly change the transportation sector for the long term (i.e., 7+ years). Ultimately, the scenario committee determined that both scenarios related to a sustainability revolution were most likely.

In the next meeting, the research team encouraged the scenario committee to revisit their scenario decisions; the group decided to consider a scenario exhibiting sustainability inaction. The committee decided to focus upon “Unbridled Innovation” as it seemed more likely than “Entropy” world. “Better Status Quo” world was kept as the other most likely scenario.

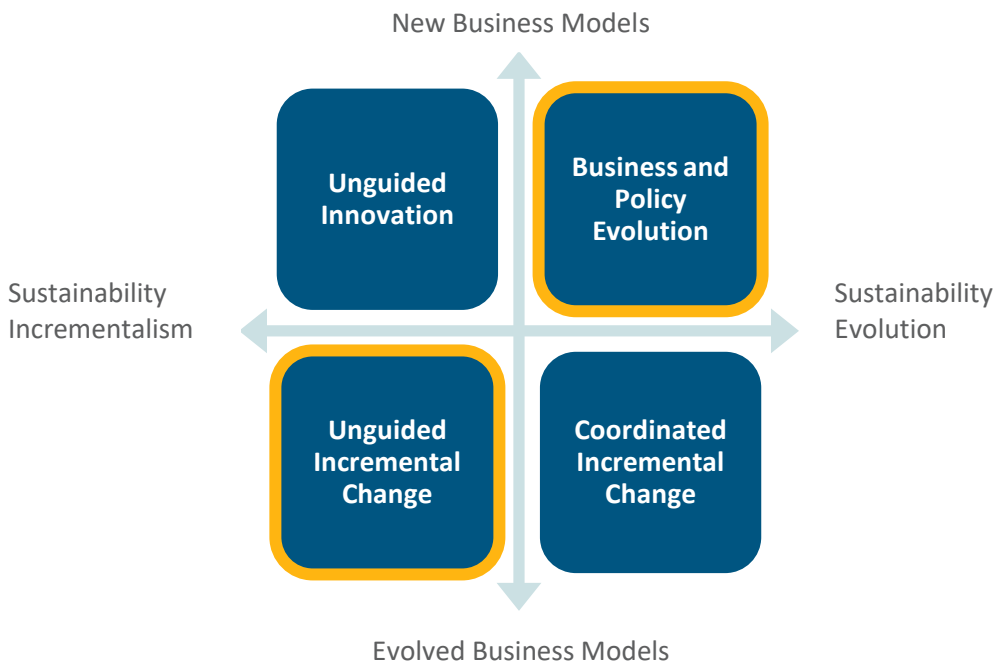
Following the scenario committee, the policy committee uncovered several inconsistencies in the “Better Status Quo” world. Rather than rebuild the world, the committee recommended that the description could be shifted to the “Entropy” world (renamed to “Déjà Vu” world) with some modifications. They noted that a sustainability revolution would require a change in business models and the “Better Status Quo” world would be highly unlikely. The committee was also pessimistic about any meaningful sustainability revolution within four to six years.

The steering committee also made substantial changes to the worlds. First, they changed the vectors to: New Business Models vs. Evolved Business Models and Sustainability Incrementalism vs. Sustainability Evolution. The committee believed that these vectors would be more likely extremes (i.e., lessen the polarity of the worlds), especially since a sustainability revolution would take too long and all business models would have to evolve to some extent in a four- to six-year timespan. The world names were also changed to better reflect the new vectors:

- “Unbridled Innovation” → “Unguided Innovation,”
- “Déjà Vu” → “Unguided Incremental Change,”
- “Responsible Business Revolution” → “Business and Policy Evolution,” and
- “Better Status Quo” → “Coordinated Incremental Change.”

The steering committee also chose to focus on policy development in the “Business and Policy Evolution” world rather than the “Unguided Innovation” world. The group agreed that this more optimistic world was more likely for the future, partially because policymaking in the previous timeframes could set the foundation for a sustainability evolution in transportation. The scenario world building in the following sections reflect these final worlds of “Business and Policy Evolution” and “Unguided Incremental Change.”

Figure A7: Finalized Scenario World Driving Factors – Four to Six Years



Business and Policy Evolution World

In the four- to six-year timeframe (2024 to 2026), businesses are changing at a rapid pace, replacing traditional models with new and innovative ideas. In particular, public transit agencies are able to keep pace with innovations by shared mobility operators. Sustainability action from all levels of government, influenced by evolving policy, leads to green and equitable innovation. Environmental and social equity concerns are joined with the economic pillar of sustainability (the Three “E’s”) in the transportation sector, leading to a path toward fighting climate change and the inequality gap. Sustainable strategies to coordinate land use and transportation planning and policies are also considered and implemented. Ultimately, in this “Business and Policy Evolution” world, transportation is regarded as a cooperative opportunity. Regional and local governments collaborate and cooperate in innovation, developing regional models and tools to support and maintain a complementary mesh between the public and private sectors. During this timeframe, public and private mobility across modes becomes connected, complementary, and integrated.

Public Transit

In the *Business and Policy Evolution* world, the policy playing field is leveled across modes. Measurement and metrics are integral to advancing outcomes. Public transit investment emphasizes customer service quality with the goal of public transportation services being “the best option.” High trust of public transit agencies to provide quality service enables a multimodal ecosystem with public transit at the center. Public transit dependent, core, and choice riders are all well served by frequent, fast, and clean public transportation. Social, racial, and environmental equity are guiding principles for public transit decision-making.

Public transportation services expand upon MOD/MaaS, growing to include mobility wallets for all travelers, including subsidies for vulnerable populations. Integrated payment systems are far along and include subscription bundles and a new system of taxes, fares, and fees to fund transportation. Public transit agencies also begin to employ right-sized vehicles (i.e., converting to a more appropriate physical size of a vehicle for demand and service needs) and gain federal and state support for sustainability programs (e.g., electrification of buses). New training and jobs programs for transportation workers increase social equity and combat job loss with newly arrived automated transit vehicles. Finally, public transit is viewed as a primary tool for combatting climate change, receiving necessary infrastructure, operations, and maintenance funding to significantly reduce GHGs.

Shared Mobility

With sustainability guidance, funding, and guardrails (e.g., environmental requirements), shared mobility businesses become more environmentally friendly and equitable. Higher trust in shared mobility to deliver high-quality service helps to accelerate collaboration between public transit agencies and integrated mobility ecosystems. This refinement of integrated payment systems and MOD/MaaS platforms build a multimodal system that blurs the line between public and private. Partnerships proliferate to capitalize on this new ecosystem. Moreover, shared mobility operators prioritize social equity and GHG reductions in their business models, encouraged by social responsibility and pushed by strong sustainability policies from all levels of government.

With the decrease in travel due to higher work-from-home rates, some shared mobility companies (e.g., ridehailing, carsharing) shift toward providing delivery services. More sustainable business models for delivery include green and equity-based optimization of supply chains and routing. While contract and non-unionized labor grow to form an expanded gig economy, benefits for workers are high. Development of AVs resume following a lull during COVID-19, and new vehicle designs for delivery, passengers, and an on-demand lifestyle are developed and tested. Shared mobility services are largely electrified, spurred by sustainability incentives and regulations.

Auto Travel / Work-from-Home

With increasing public transit ridership and multimodal travel, congestion and VMT decrease, especially in cities and downtown areas. New land use policies encourage denser housing development near public transit. While a significant number of people travel predominately by auto, most new car purchases are EVs. Companies begin devoting more resources toward shared and electric AVs. Policies, through a mix of incentives and regulations from all levels of government, encourage sustainable transportation planning and design. This expansion of guided development leads to significant GHG reductions. Overall congestion drops in many cities, aided by new pricing mechanisms such as road user charges and continuing high rates of work-from-home following the pandemic. Companies evolve their business strategies to increase the efficiency of work-from-home employees. Telehealth also becomes more acceptable and accessible for a growing aging population.

Active Transportation

With more shared mobility options and greater focus on sustainable modes, walking increases. Micromobility, in both shared and private forms, becomes a sustainable success story, connecting travelers to public transit. Investment in walking and cycling infrastructure and incentives to purchases e-bikes helps spur more active transportation use. New business models prioritize social equity and broader service coverage, giving many marginalized communities the opportunity to

connect to jobs and services. Through a combination of innovative business models and thoughtful sustainable policies, an expansion in active transportation leads to socially equitable outcomes.

Air Travel

Shared mobility operators and new companies begin to test urban air mobility (UAM) systems for point-to-point trips. Growing interest in electrified and automated UAMs drives innovation and technology. Airports reinvent themselves to welcome UAMs and new land-side AV mobility options. The industry also begins to slowly develop alternative fuels and airplane designs to reduce GHGs. Federal aviation policy provides incentives and rules to achieve GHG reductions.

Signposts

Experts focused on signposts related to political forces, transportation demand, transportation operations, and land use (Table A6). They did not give specific metrics, preferring to identify general trends.

Table A6: Signposts: Business and Policy Evolution – Four to Six Years

Topic Area	Signpost	Description
Political and Social Will	Public opinion	High prioritization of sustainability in daily life and politics
	Political action	Significant compromise or sweeping reform, especially on sustainability legislation and funding
	Funding	New funding and investments for sustainability and operations
Transportation Demand	Public transit riders	Integration of service for all types of public transit riders
	Delivery	Substantial rise in delivery services, e-commerce purchases, and business-to-business partnerships
	Auto purchases	Decrease in car registrations overall but increase in share of EV purchases and registrations
Operations	Public transit	Routes and service increase, especially frequency of service
	Shared mobility	Expansion in services and toward shared, electric, and AV fleets
	Integration	Meshing of public and private operators to form an innovative mobility ecosystem that is integrated and multimodal
Land Use	Migration	Movement of people back to cities from suburbs and rural areas measured by population and real estate sales
	Repurposing of space	Decrease in large retail chains and conversion of stores into housing, public transit centers, and fulfillment centers
	Office space	Higher demand and prices for office space in downtown cores

Unguided Incremental Change World

Between 2024 and 2026, the globe recovers from COVID-19 and attempts to move forward. The worldwide effort to combat the virus has depleted energy and resources for fighting climate change. Sustainability actions are incremental, sparse, and highly localized. Slowly evolving business models dampen sustainability improvements as transportation contends with shrinking budgets, inefficient operations, reactive planning, and minimal multi-jurisdictional coordination. Trust in public transportation systems to deliver quality service remains low, while social equity remains an afterthought for many shared mobility operators. Land use strategies to promote transit use, including transit-oriented developments (TODs), fail to evolve. If containing COVID-19 takes longer than expected, migration patterns away from urban cores may be irreversible. Businesses and services follow suit, setting up shop away from downtowns in suburbs and neighborhoods.

Political gridlock also weakens proposed sustainability actions as companies with slowly evolving business models (and businesses themselves) retain control of economic sectors. Incrementalism (i.e., slow and ad hoc response) and policy disorder rule this world, leading to a lack of transportation guidance. The *Unguided Incremental Change* world has failed to capitalize on the innovative ideas, policies, and strategies launched during COVID-19.

Public Transit

Public transit operators have little funding for innovation and even basic services, experiencing full (e.g., bankruptcy) or partial closures (e.g., select routes). Operators continue to do more with fewer resources. Consequently, agencies make minimal strides toward environmentally friendly, socially equitable, and economically viable service. In particular, agencies struggle with overcoming bureaucratic inertia and make only small changes to their business structure. The result is a patchwork advancement of public transit agencies that is dependent on geography and economic context. Urban public transit agencies with more innovative operations before and during COVID-19 pivot to a hybrid model between on-demand service (e.g., point-to-point) and a traditional hub-and-spoke model. However, these models and MOD and MaaS models are only pilots and demonstrations with no wide-scale adoption.

A select few agencies make progress in electrifying their public transit fleets and expanding rail, but progress is incremental. Data sharing and privacy issues remain unsolved challenges. Traditional funding structures (e.g., gas tax, sales tax, farebox) endure, slowing sustainability progress and producing more incremental improvements. A lack of federal guidance plagues progress for public transit. In a world without sustainability action, philanthropy offers a lifeline funding opportunity to advance societal goals. Discussions about climate change and the need for public transit are advanced by NGOs, CBOs, and philanthropic organizations, not by federal or state agencies.

Shared Mobility

Many shared mobility operators, after halting expansion during COVID-19, resume growing services in suburbs, small towns, and rural areas. Yet, full integration across modes through MaaS is unrealized. Rather, corporate transit (e.g., employer-based shuttles) and dockless micromobility expand and proliferate in new service areas. Reacting to expanded micromobility, some cities expand rights-of-way for bikes and scooters and improve curb management. While shared mobility operators slowly electrify their fleets, the status quo tension between operators and government persists. Due to slowly evolving business models, gig economy workers and contractors continue to fight for pay and benefits.

Auto Travel / Work-from-Home

Long-term impacts from COVID-19 have pushed many public transit riders into private vehicles permanently. Car ownership maintains high levels following COVID-19, and people move farther from their jobs, enabled by telework and work-from-home arrangements. VMT and congestion rise across cities. However, a slowly growing transition to battery electric vehicles (BEVs) offers some reductions in GHG emissions. Sustainability improvements, such as zero-emission neighborhoods and car free zones in urban cores, gain some traction, but progress is slow in most localities. Work-from-home remains relatively high.

Active Transportation

Shared micromobility and other active transportation modes expand to more markets and offer accessible transportation options to more communities. However, expansion is driven by companies seeking profit not by governments aiming to advance environmental goals. E-bikes are especially popular and appeal to non-cyclists. Most new riders consist of teleworkers and those who have not returned to public transit.

Air Travel

Following a collapse in air travel from COVID-19, mega carriers consolidate further and edge out small, regional carriers. Regional and low ridership routes are cut, and short haul air travel takes a hit. In many markets, trains and buses are preferred as cheaper options.

Signposts

The experts focused on signposts related to political forces, sustainability, and transportation demand (Table A7). In general, the experts avoided setting specific benchmarks for the signposts in favor of more general trends. The experts were generally unsure of what would constitute a significant enough metric to signal a new world. Some of these signposts were modified by the researchers based on shifts in driving factors and world names by the experts.

Table A7: Signposts: Unguided Incremental Change – Four to Six Years

Topic Area	Sub-Topic	Signpost Description
Political and Social Will	Political will	Low political will across levels of government
	Regulations	Little political will for sustainability regulations
	Multi-jurisdictional coordination	Minimal improvements in collaboration between cities and regions on sustainability topics
Sustainability	Public transit	Some early public transit fleet electrification
	School buses	Some right-sizing and early electrification of school buses in suburban and rural districts
	EV purchases	Some new EV sales
Transportation Demand	Work-from-home	High work-from-home rates near or above levels during COVID-19
	Corporate transit	Expansion of corporate transit options
	Mode shift	Several percentages points increase in TNCs

