

# Appendix S:

# Scenario Workshop Report



**Kentucky's Long-Range  
Transportation Vision**



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## INTRODUCTION

This memorandum summarizes the Scenario Workshop that took place in support of the Kentucky Transportation Cabinet's (KYTC) 2045 Long-Range Statewide Transportation Plan (LRSTP) on April 21, 2022. Among many other things, the workshop will help Kentucky develop policies and strategies to achieve its long-term vision. The information collected from this workshop fed directly into the development of those policies and strategies.

The workshop included participants from different parts of KYTC and from partner organizations, such as metropolitan planning organizations (MPOs). Participants were invited with different organizational responsibilities, experience in different programs, and different professional backgrounds so that together participants would be able to reflect on the scenario impact from different backgrounds. Subappendix A lists the participants.

During the Scenario Workshop, participants explored how different futures could impact transportation, and explored ways for KYTC to respond so that it can realize its vision and goals. Goals for the Scenario Workshop included:

- Reviewing four future scenarios for Kentucky.
- Providing input on how the scenarios will impact the multimodal transportation system and KYTC's policies, business practices, and the Strategic Highway Investment Formula for Tomorrow (SHIFT) process.
- Providing input on how to programmatically invest based on the future scenarios using the Decision Lens Impact Dashboard.

### Vision, Goals, and Guiding Principles

The LRSTP vision, goals, and guiding principles informed the subsequent workshop discussions around the challenges and opportunities of the four scenarios presented in this workshop. LRSTP vision, goals, and guiding principles were drafted for the 2045 LRSTP accounting for the input gathered through the discussions with KYTC leadership, multimodal stakeholders, and over 8,300 participants from across the state involved in a Kentucky Transportation Survey. The Kentucky Transportation Survey was the first of two public surveys to help KYTC set the vision, goals, and objectives.

**Vision:** The vision is an overarching statement describing the desired transportation system to be delivered regardless of the challenges or opportunities within the possible futures or scenarios. The Kentucky 2045 LRSTP vision is for a viable, reliable, and resilient multimodal transportation system to provide access and mobility for all users for the safe movement of people and goods.

**Goals:** To achieve that expressed vision, a set of five goals was derived from the collected input and was aligned with the seven national goals (shown in Figure 1), which are Safety, Infrastructure Condition, Congestion Reduction, System Reliability, Freight Movement and Economic Vitality,

Environmental Sustainability, and Reduced Project Delivery Delays.<sup>1</sup> As shown in Figure 2, the five interconnected goals which support the delivery of the 2045 LRSTP vision for the Commonwealth of Kentucky are to:

- Enhance safety
- Deliver a high level of maintenance & resiliency
- Ensure a reliable flow of people and freight
- Provide local, regional, and global connectivity for communities
- Deliver and operate a system that protects or enhances the natural or human environment

**Guiding Principles:** No matter which goal is being addressed, guiding principles provide the process framework for the delivery of improvements or policies supporting the achievement of all five 2045 LRSTP goals. Also, derived from the stakeholder and public input, the five LRSTP Guiding Principles address:

- **Equity** related to the impacts or benefits of the transportation system
- **Adaptability/Sustainability** of the system regarding emerging technologies and disruptive trends
- **Seamlessness** of movement among all transportation modes
- **Quality of Life** of a community as a potential impact from the operation or development of the system
- **Economic Vitality** as a consideration for the actions to support employment or market opportunities

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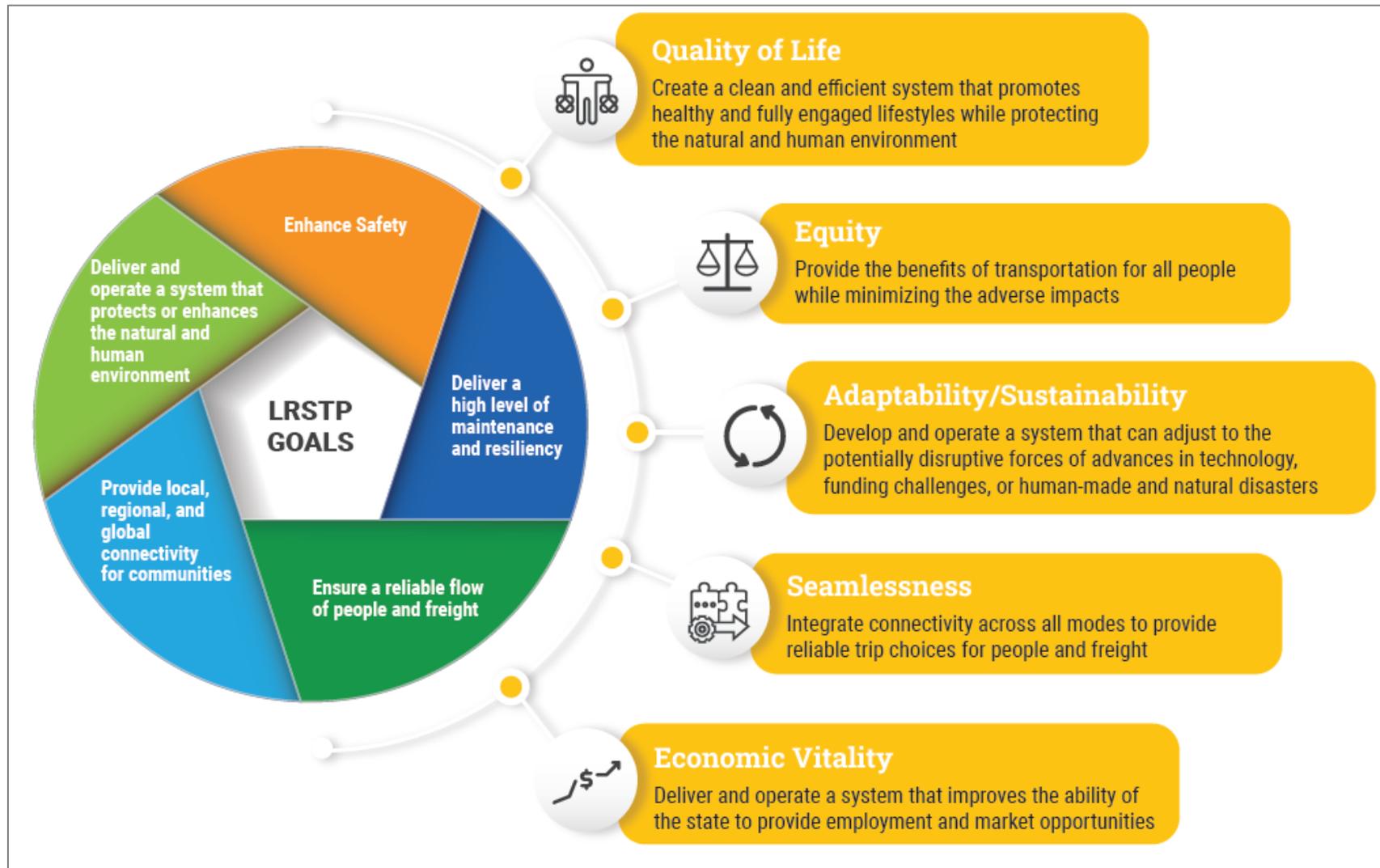
<sup>1</sup> USDOT (2019). *National Goals*. Updated November 12, 2019. Retrieved from <https://www.fhwa.dot.gov/tpm/about/goals.cfm>.

Figure 1: National Goals



Source: USDOT (2019). *National Goals*. Updated November 12, 2019. Retrieved from <https://www.fhwa.dot.gov/tpm/about/goals.cfm>.

Figure 2: Goals and Guiding Principles



### Background of Scenario Planning

The future holds surprises, as the past few years have reminded us. Even very smart people with profound knowledge about a topic can miss where things are headed. Now, as changes are coming faster than ever and the time it takes major technologies to reach a quarter of Americans is shrinking, it raises the questions of “What’s next?” and “How fast will changes come?”

Scenario planning is intended to help prepare for the unpredictable world that transportation agencies find themselves in. The crux of scenario planning is simply to prepare for different plausible futures.<sup>2</sup> This approach contrasts with traditional long-range plans, which have been built around a single future, basing their policy recommendations and strategies on that single point. By contrast, the 2045 LRSTP seeks to prepare for four very different futures. Some policies and strategies will be the same across all the futures, and KYTC should certainly adopt these since they are robust no matter what occurs. Some policies and strategies will be specific to just one or two scenarios. That means that KYTC can keep them in reserve and use them if the future ends up going in that direction.

The approach of preparing for multiple futures makes KYTC more prepared by understanding the conditions that its strategies are most relevant to, and also reveals risks through a sort of stress test. Just like after 2008 when regulators started stress-testing banks to see how they would respond in different financial scenarios,<sup>3</sup> scenario planning is a way to stress-test transportation systems and agencies to see what set of conditions could cause problems and how KYTC could respond.

Scenario planning has multiple benefits, which include the ability to:

- Explore uncertainty in external drivers of transportation needs
- Stress-test the Kentucky transportation system against different futures
- Proactively identify and manage investment risk
- Be prepared by identifying potential outcomes and developing responses

The result of scenario planning is to make KYTC more prepared and to help it finetune its investments to what the future holds.

## SCENARIOS

### Main Characteristics

The four future scenarios examined at the workshop include Survival Modes; Live, Work, Local; Global Market Growth; and Tech Innovations. Each future scenario will be compared to the Baseline Scenario. The introductory presentation summarized the main characteristics of the four scenarios that the breakout groups discussed in much more details. These main characteristics are listed in the bullet points below and in Table 1.

- **Survival Modes** is a difficult future where several negative trends converge to reduce funding for transportation and make life harder for system users. Severe weather is more frequent, and it disrupts the transportation system. Additionally, the prospect of armed conflicts makes transportation spending take a back seat to international relations and military priorities. Energy prices, including fuel and electricity, are much higher, and are not fully compensated with new technology. The economy and population grow slowly.

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<sup>2</sup> American Planning Association (2022). Scenario Planning. Retrieved from <https://planning.org/knowledgebase/scenarioplanning/>.

<sup>3</sup> Board of Governors of the Federal Reserve System (2022). "Federal Reserve Board releases hypothetical scenarios for its 2022 bank stress test." Press Release. February 10, 2022. Retrieved from <https://www.federalreserve.gov/newsevents/pressreleases/bcreg20220210a.htm>.

- **Live, Work, Local** is a future in which moderate growth and technological change accompany shortening travel patterns and changing mode choices that requires KYTC to examine how, where, and what kind of transportation infrastructure and services that it provides. An emphasis on living and working locally with short commutes and opportunities close by has become more prevalent throughout the state and has been most realizable in towns and cities.
- **Global Market Growth** is a high-growth scenario with fast adoption of new transportation technologies. In this scenario, Kentucky is one of the leading global freight hubs with a freight ecosystem composed of freight movement, logistics management, engineering, and manufacturing among other industries. Fast economic growth and growth of freight hubs in Kentucky put new demands on the transportation system across modes.
- **Tech Innovations** is one where technology changes not only how people travel, but also where and how they live. In a sense, it's the opposite of Live, Work, Local. Whereas Live, Work, Local sees growth of small towns and cities as people cluster, Tech Innovations shows people spreading around the state and into exurban and rural areas facilitated by telework, telemedicine, and electronic commerce (e-commerce). Fast adoption of transportation technology means that people can travel farther more conveniently, increasing trip lengths and shifting heavy travel outside of metro regions. Productivity increases rapidly as more and better technology is embedded into nearly every part of life. The world has gotten smaller.

Table 1: Main Scenario Characteristics

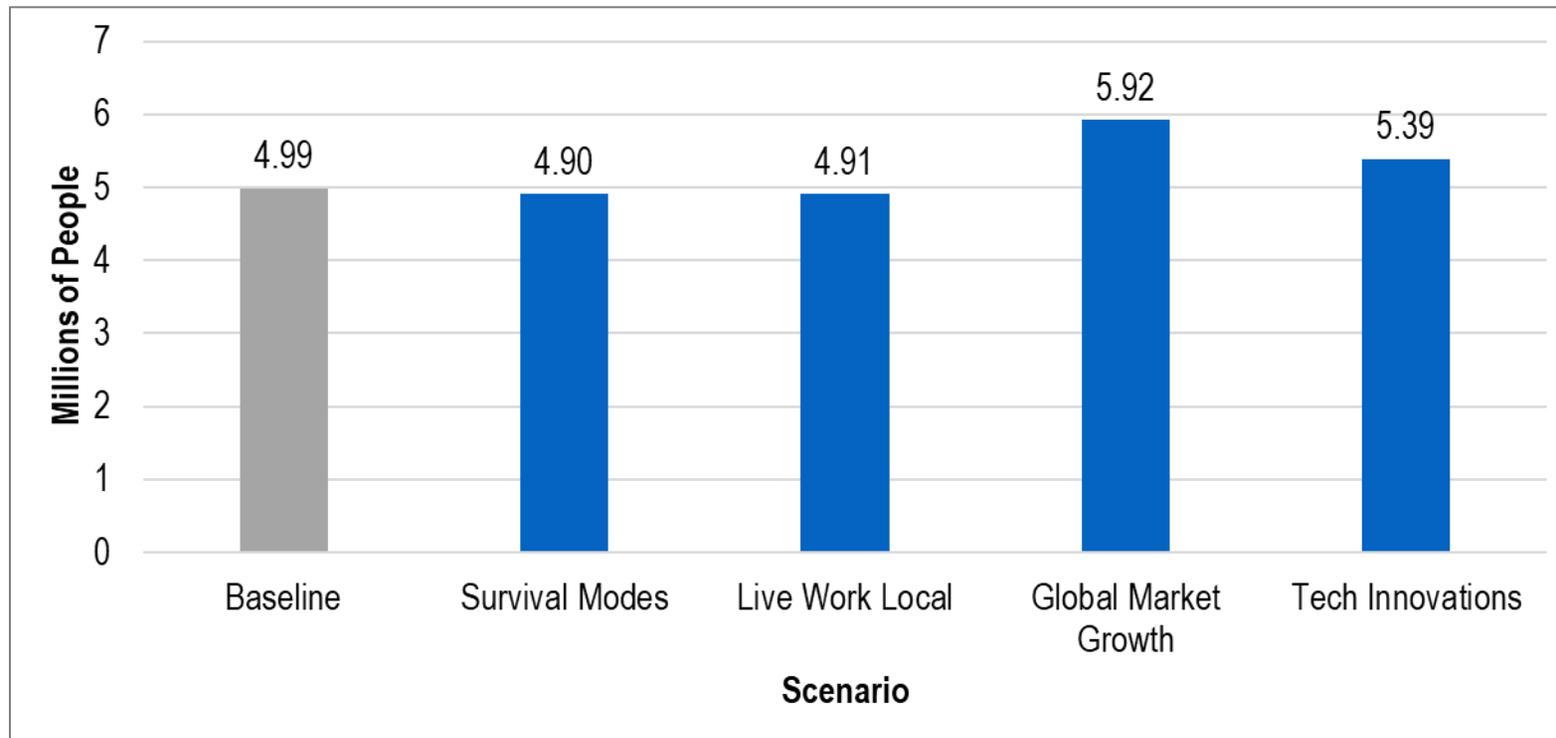
 <b>Survival Modes</b>	 <b>Live, Work, Local</b>	 <b>Global Market Growth</b>	 <b>Tech Innovations</b>
<ul style="list-style-type: none"> <li>• More severe weather</li> <li>• Expensive energy</li> <li>• Slow technology change</li> <li>• Low economic growth</li> <li>• Stable population growth</li> <li>• Much less transportation revenue</li> </ul>	<ul style="list-style-type: none"> <li>• Much more tourism</li> <li>• Much higher population and employment density</li> <li>• Steady technological changes</li> <li>• Stable economic and population growth</li> </ul>	<ul style="list-style-type: none"> <li>• Very fast economic growth</li> <li>• Fast population growth</li> <li>• Higher population and employment density</li> <li>• Fast technology adoption</li> <li>• More transportation revenue with a bit less federal funding</li> </ul>	<ul style="list-style-type: none"> <li>• Much more technology with very fast adoption of transportation technology</li> <li>• Fast economic and population growth</li> <li>• Much lower density</li> <li>• More transportation revenue</li> </ul>

The following subsections illustrate some of the key characteristics for each scenario and show how the scenarios differ on that characteristic from baseline forecasts. Baseline forecasts are derived from a combination of academic research, historical trends, professional judgement, and professional publications. The scenario forecasts were developed by varying the characteristic in ways that are consistent with the scenario descriptions that were finalized after a scenario planning workshop conducted with KYTC staff in December 2021. Additionally, the traits of each scenario were compared and adjusted to ensure consistency with each other.

## Population

Population growth is a key factor in future demand for passenger and freight movement, as well as the size of the economy, the extent of urban development, and many other factors affecting the scenarios. While each scenario projects some population growth through 2045, the amounts of growth vary substantially. The baseline forecast, which is the most likely outcome based on current trends, projects that today's population of 4.5 million Kentucky residents could grow to 4.99 million residents in 2045. As shown in Figure 3, the alternate scenarios show growth ranging from just 9% more residents over 24 years to 30% more residents through a combination of birth and migration. Thirty percent more residents represent an additional 1.5 million people.

Figure 3: Kentucky's Forecasted 2045 Population



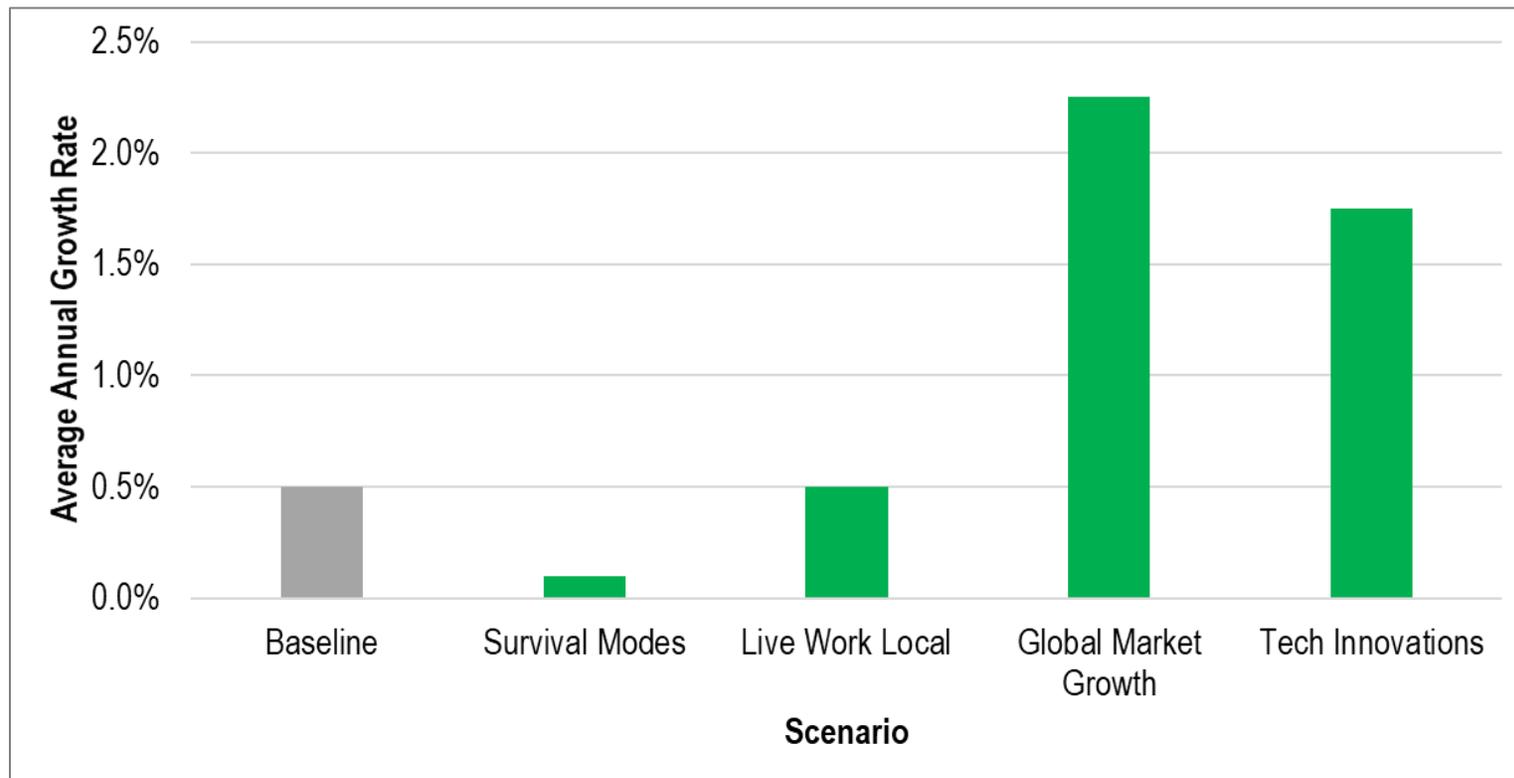
**Sources:** The baseline population forecast is derived from the Kentucky State Data Center.<sup>4</sup> For more details on its calculation, please see the *Revenue Forecast* technical memo. Population forecasts for scenarios are adjusted based on professional judgment to align with the scenario description.

<sup>4</sup> Kentucky State Data Center (2022). University of Louisville. <http://ksdc.louisville.edu/data-downloads/projections/>.

## Economy

The economy also grows at very different rates after accounting for inflation in the four scenarios. Figure 4 depicts these different annual average growth rates. While moderate continued growth is most likely, it is possible for the economy to follow unexpected paths under the influence of either macroeconomic shocks, wars, and pandemics on the one hand, or technological innovation, strong national or international demand, and population growth on the other. The scenarios portray economic development ranging from stagnation to very fast growth. Economic growth affects the financial resources that Kentuckians will have and may affect the ability to raise transportation revenue.

Figure 4: Kentucky's Annual Average Real Gross State Product (GSP) Growth Rate (2022-2045)



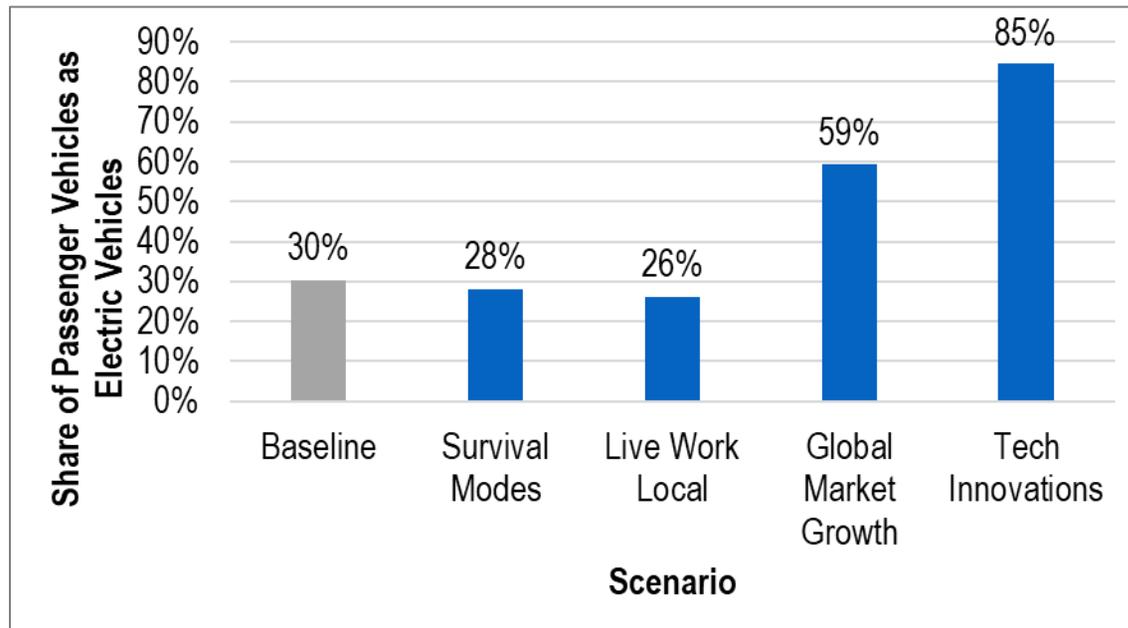
**Sources:** The baseline economic forecast is derived from the Federal Reserve Bank of St. Louis.<sup>5</sup> For more details on its calculation, please see the *Revenue Forecast* technical memo. Economic forecasts for alternative scenarios are adjusted based on professional judgement to align with the scenario description.

<sup>5</sup> Federal Reserve Bank of St. Louis (2022). Real GDP: All Industry Total in Kentucky. <https://fred.stlouisfed.org/series/KYRGSP>.

## Transportation Technology

The speeds at which transportation technologies are developed and adopted vary among the scenarios. Electric vehicles (EVs) affect fuel tax revenues, demand for electricity, air quality, and other factors. As shown in Figure 5, the baseline forecast is for 30% of the passenger vehicles on the road to be EVs by 2045. Among newly sold vehicles the percentage will be higher, and it will take time for these newly sold EVs to replace older internal combustion engine (ICE) vehicles as many vehicles will remain in the fleet for over a decade. Some futures see slower adoption of EVs as economic constraints and shorter travel distances reduce the ability and incentive to switch to EVs. There could also be long-term supply limitations and cost headwinds related to batteries. Conversely, EVs could roll out much faster if technological innovation happens quickly, raw materials are plentiful, and costs come down. Policy mandates could accelerate what technological innovation and economics might do.

Figure 5: Forecasted 2045 Share of Registered Passenger Vehicles in Kentucky That Are Electric



**Sources:** The baseline forecast for EV usage in 2045 is derived from assumption about annual passenger and commercial vehicle fleet turnover, annual sales of EVs, and growth in passenger and commercial vehicle registrations. EV forecasts for alternative scenarios are adjusted based on professional judgment to align with the scenario description.

Other transportation technologies change too. Notably, truck platooning and aerial delivery drones emerge to support freight, and there is also likely to be growth around ride-hailing and aerial drones, with Tech Innovations seeing the fastest advancement and widest adoption.

Connected and automated vehicles (C/AVs) will impact the future in one form or another in all scenarios, but they may not have the same capabilities. While it is generally expected that C/AVs will continue to advance toward full automation, it is possible that technological barriers, liability issues, policies, or conflicts with other vehicles could slow advancement.<sup>6</sup>

Table 2 shows the five different levels of C/AV capabilities and shows where C/AV technology is in 2045 in the four scenarios. Most cars today are 0 (no automation) or 1 (limited driver assistance around lanes or speed). Under level 2, the vehicle can control braking and steering in some circumstances, although the driver must do everything else related to driving and remain alert. Level 3 sees progressively more control turned over to the car, and in level 4 they can do all tasks without human intervention in most circumstances. The difference between levels 4 and 5 is that level 5 graduates to the car being in control in all circumstances.<sup>7</sup>

Table 2: Most Widespread Levels of Automation Assumed for the Scenarios

Level of Automation	Description	Relevant Scenarios
0 – No Automation	Driver is fully responsible for driving the vehicle while system provides momentary driving assistance, like warnings and alerts, or emergency safety interventions.	
1 – Driver Assistance	Driver is fully responsible for driving the vehicle while system provides continuous assistance with either acceleration/braking OR steering.	
2 – Partial Automation	Driver is fully responsible for driving the vehicle while system provides continuous assistance with both acceleration/braking AND steering	Survival Modes (mix of levels 2 and 3)
3 – Conditional Automation	System handles all aspects of driving while driver remains available to take over driving if system can no longer operate.	Live, Work, Local Survival Modes (mix of levels 2 and 3)
4 – High Automation	When engaged, system is fully responsible for driving tasks within limited service areas. A human driver is not needed to operate the vehicle.	Global Market Growth
5 – Full Automation	When engaged, system is fully responsible for driving tasks under all conditions and on all roadways. A human driver is not needed to operate the vehicle.	Tech Innovations

**Source:** National Highway Transportation Safety Administration (2022). Levels of Automation. Retrieved from [https://www.nhtsa.gov/sites/nhtsa.gov/files/2022-03/Levels\\_of\\_Automation\\_Static\\_022822-v4-tag.pdf](https://www.nhtsa.gov/sites/nhtsa.gov/files/2022-03/Levels_of_Automation_Static_022822-v4-tag.pdf).

<sup>6</sup> Bezai, N. E., Medjdoub, B., Al-Habaibeh, A., Chalal, M. L., & Fadli, F. (2021). Future cities and autonomous vehicles: analysis of the barriers to full adoption. *Energy and Built Environment*, 2(1), 65-81.

<sup>7</sup> SAE International (2021). *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*. April 30, 2021. Retrieved from [https://www.sae.org/standards/content/j3016\\_202104/](https://www.sae.org/standards/content/j3016_202104/).

Automated vehicles affect many aspects of vehicle travel, including cost, safety,<sup>8</sup> convenience, and the availability of mobility options.<sup>9</sup> Higher levels of automation are expected to remove human error from crashes,<sup>10</sup> which is a factor in most crashes.<sup>11</sup> Higher levels of automation and greater levels of C/AV market penetration may also encourage people to take more and longer automobile trips by increasing the utility of driving by allowing occupants who would otherwise be drivers to use their time in other ways.<sup>12</sup> Automation also may affect the availability of mobility for the disabled,<sup>13</sup> seniors,<sup>14</sup> and children or adolescents,<sup>15</sup> or anyone who cannot or prefers not to drive a car.

## Travel Demand

Along with population and economy, C/AVs will impact vehicle-miles traveled (VMT) and mode share. As shown in Figure 6, there are wide splits in forecasted VMT under each of the scenarios. VMT may respond to people's preferences, overall population size, how regions and cities develop, where people decide to live and work, the extent to which communication technology substitutes for travel through distance arrangements like telework or telemedicine, energy prices, vehicle prices, and technologies like automation or ride-hailing that can make it more convenient or cheaper to travel by car.

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<sup>8</sup> Arvin, R., Khattak, A. J., Kamrani, M., & Rio-Torres, J. (2020). Safety evaluation of connected and automated vehicles in mixed traffic with conventional vehicles at intersections. *Journal of Intelligent Transportation Systems*, 25(2), 170-187.

<sup>9</sup> Stocker, A., & Shaheen, S. (2017). Shared automated vehicles: Review of business models. International Transport Forum Discussion Paper.

<sup>10</sup> Wang, J., Zhang, L., Huang, Y., & Zhao, J. (2020). Safety of autonomous vehicles. *Journal of advanced transportation*, 2020.

<sup>11</sup> National Highway Traffic Safety Administration (2008). *National Motor Vehicle Crash Causation Survey*. Report to Congress. Report number DOT HS 811 059. July 2008. Retrieved from <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/811059>.

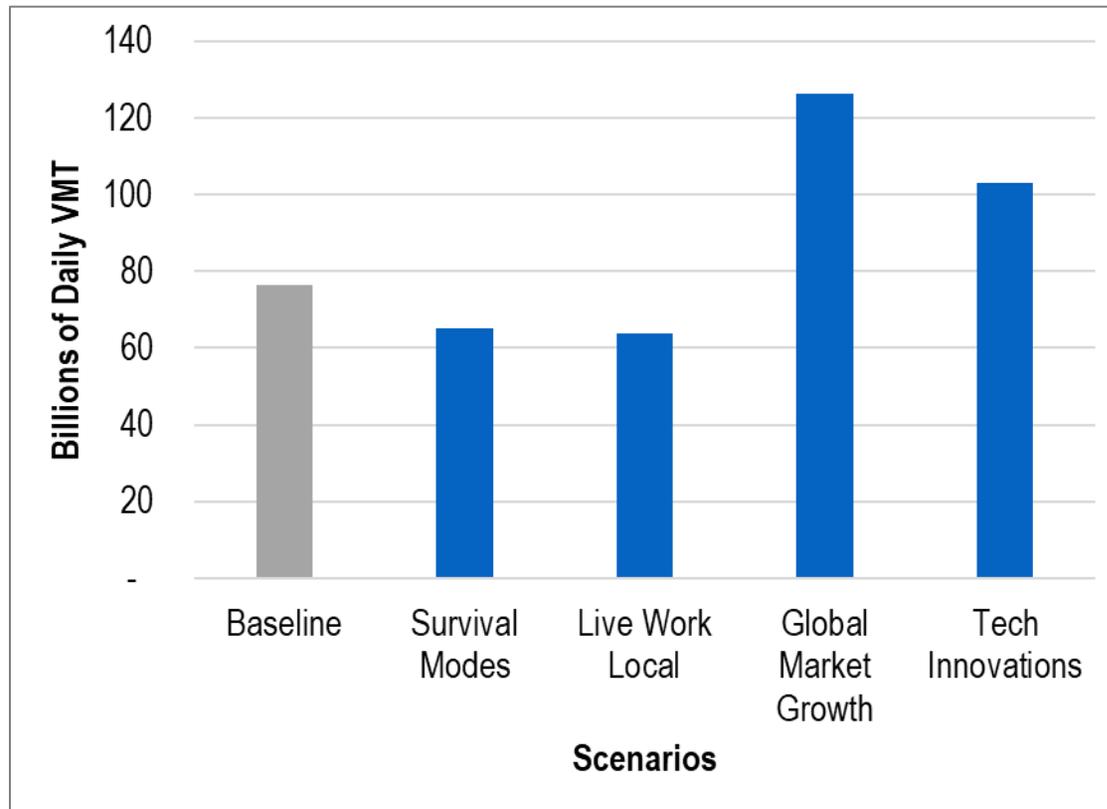
<sup>12</sup> Childress, S., Nichols, B., Charlton, B., & Coe, S. (2015). Using an activity-based model to explore the potential impacts of automated vehicles. *Transportation Research Record*, 2493(1), 99-106.

<sup>13</sup> Stenquist, P. (2014). In self-driving cars, a potential lifeline for the disabled. *New York Times*.

<sup>14</sup> Millonig, A. (2019). Connected and automated vehicles: Chances for elderly travellers. *Gerontology*, 65(5), 571-578.

<sup>15</sup> Petrilli, M. J. (2014). Coming soon: "Car-key kids": what autonomous automobiles will mean for adolescence. *Education Next*, 14(2), 87-88.

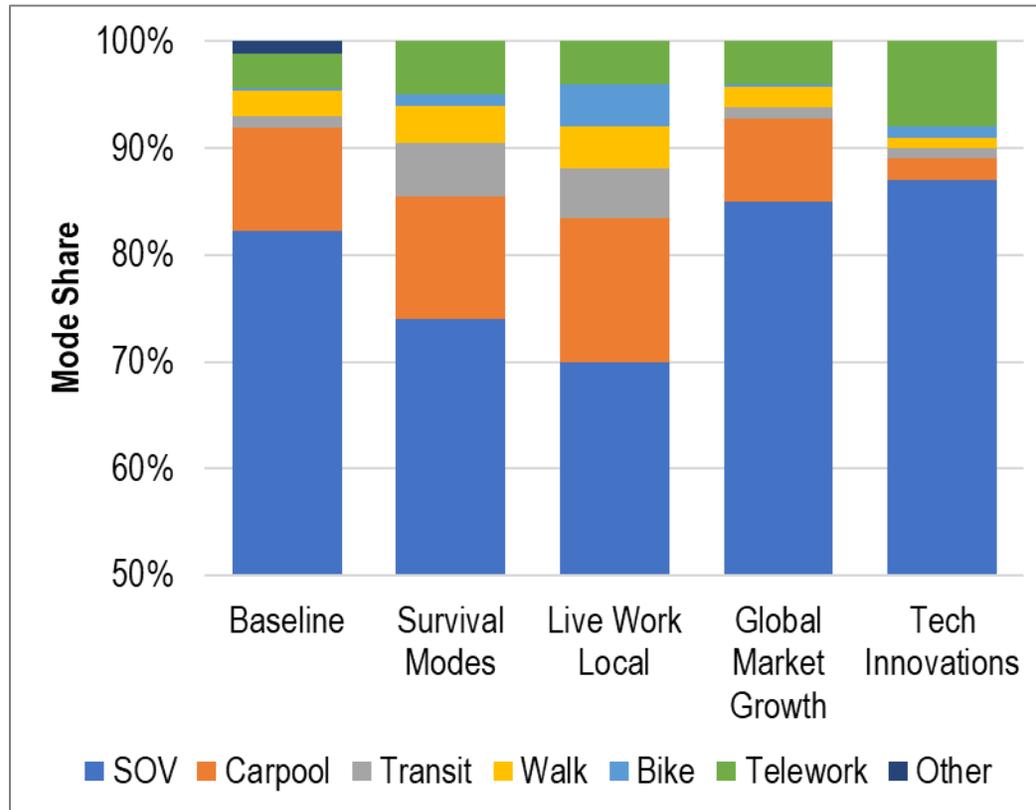
Figure 6: 2045 Daily VMT (Billions)



**Sources:** The baseline forecast for VMT is based on the Kentucky Statewide Travel Model. VMT forecasts for alternative scenarios are adjusted based on professional judgment to align with the scenario description.

As shown in Figure 7, each scenario has different commute mode shares, with the share of single-occupancy vehicles (SOV) varying and the difference being made up by active transportation, carpooling, transit, or telework.

Figure 7: 2045 Commute Mode Share

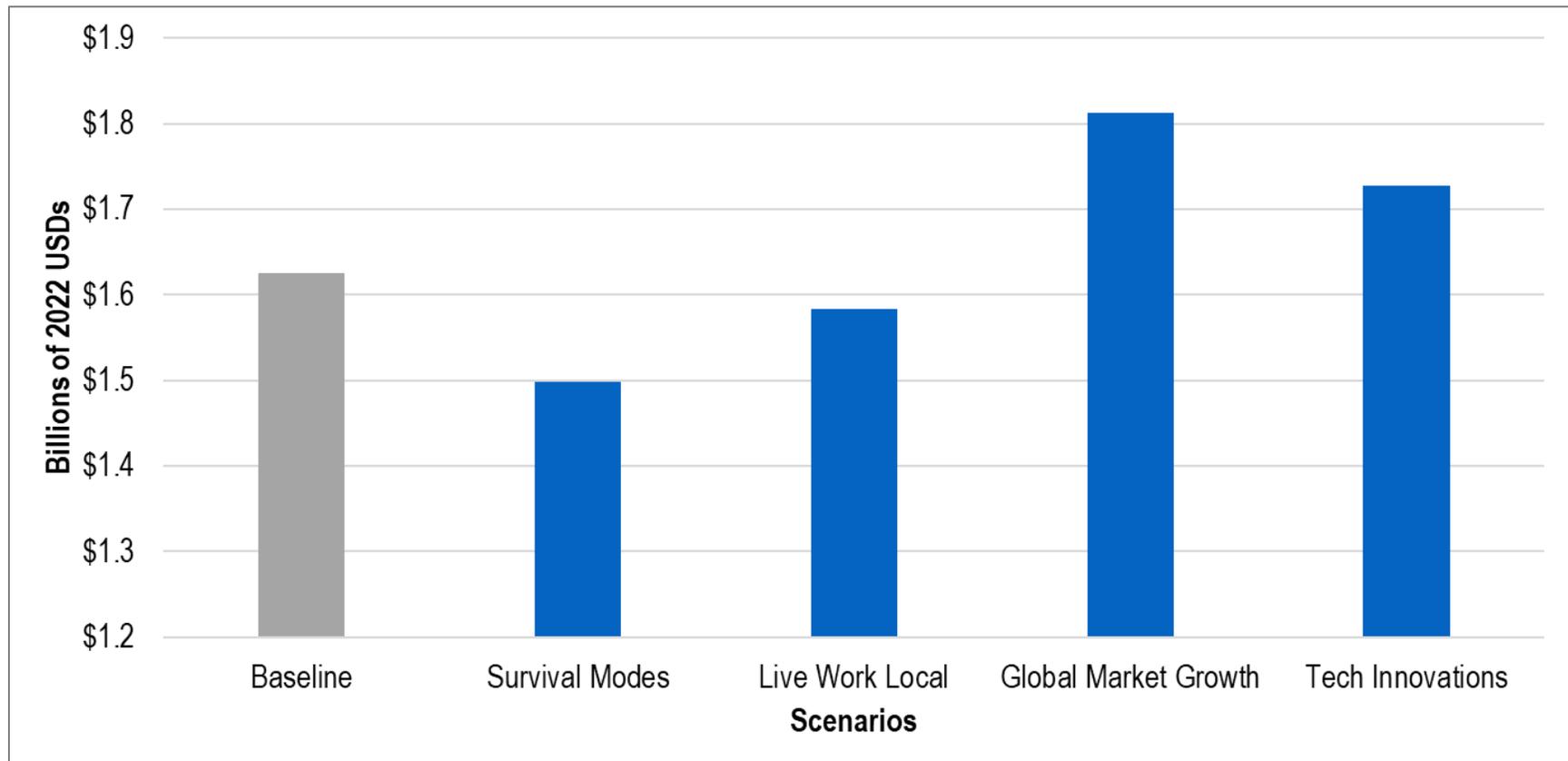


**Sources:** SOV signifies 'single-occupancy vehicles.' The baseline commute mode share matches Kentucky's current commute mode share reported by the U.S. Census Bureau. Mode shares for alternative scenarios are adjusted based on professional judgment to align with the scenario description.

## Revenue Forecasts

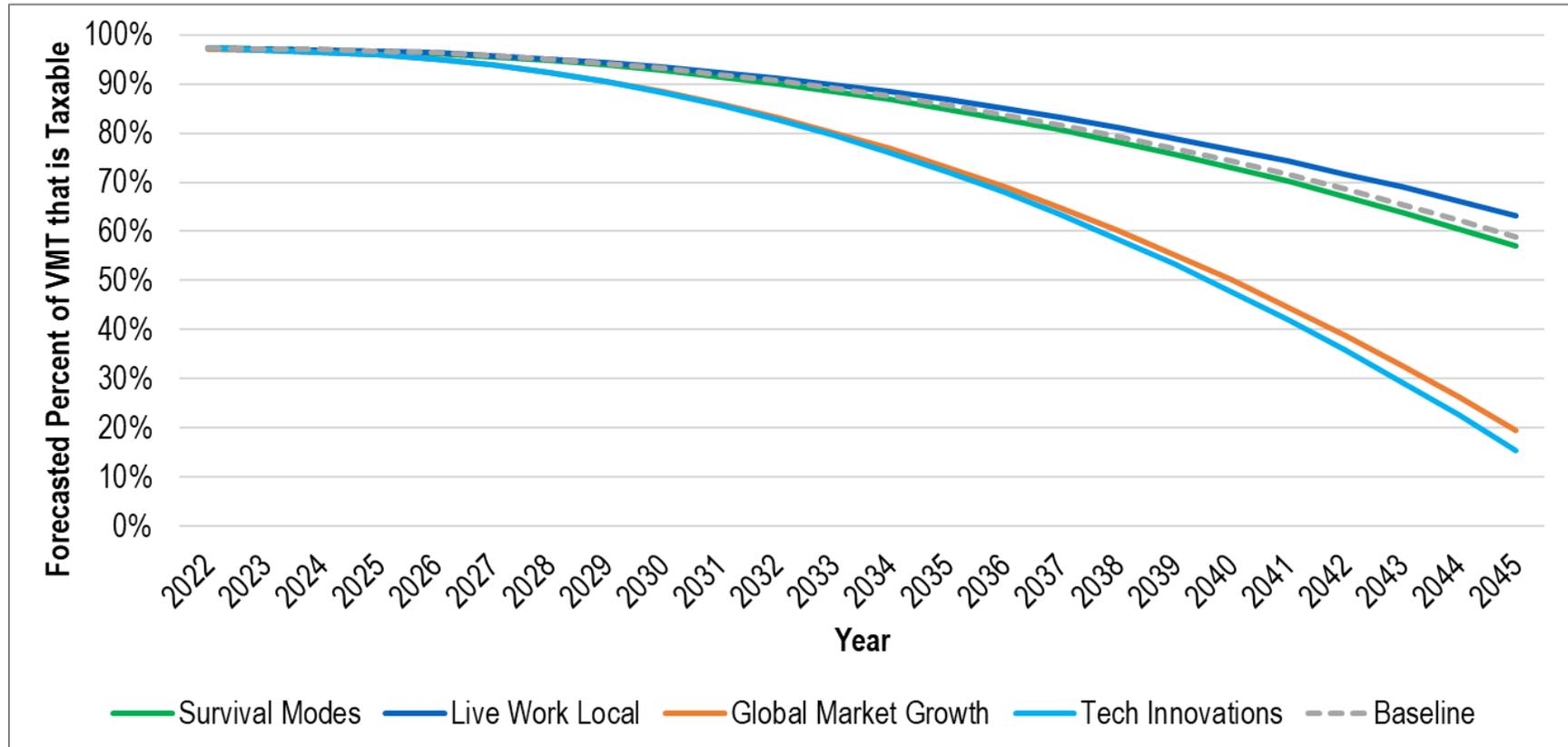
Revenue has been forecasted for each of the scenarios under current laws based on relevant factors such as projected VMT, forecasted changes in fuel efficiency, and forecasted EV fleet share. These forecasts are detailed in the *Revenue Forecast* technical memo. Figure 8 summarizes the forecasts with average annual net revenue projections between 2022 and 2045. The Baseline revenue forecast was developed based on current federal and state laws, and the four scenario revenue forecasts were developed based on that particular scenario's future population, employment, EV adoption rates, economy, VMT, and other factors. Since today's revenue is heavily related to the fuel tax, increasing vehicle efficiency and use of EVs are expected to lead to revenue declines in most scenarios, which is partially counterbalanced by rising VMT in the fastest population growth scenarios.

Figure 8: Forecasted 2022-2045 Average Annual Net Revenue (2022 U.S. Dollars)



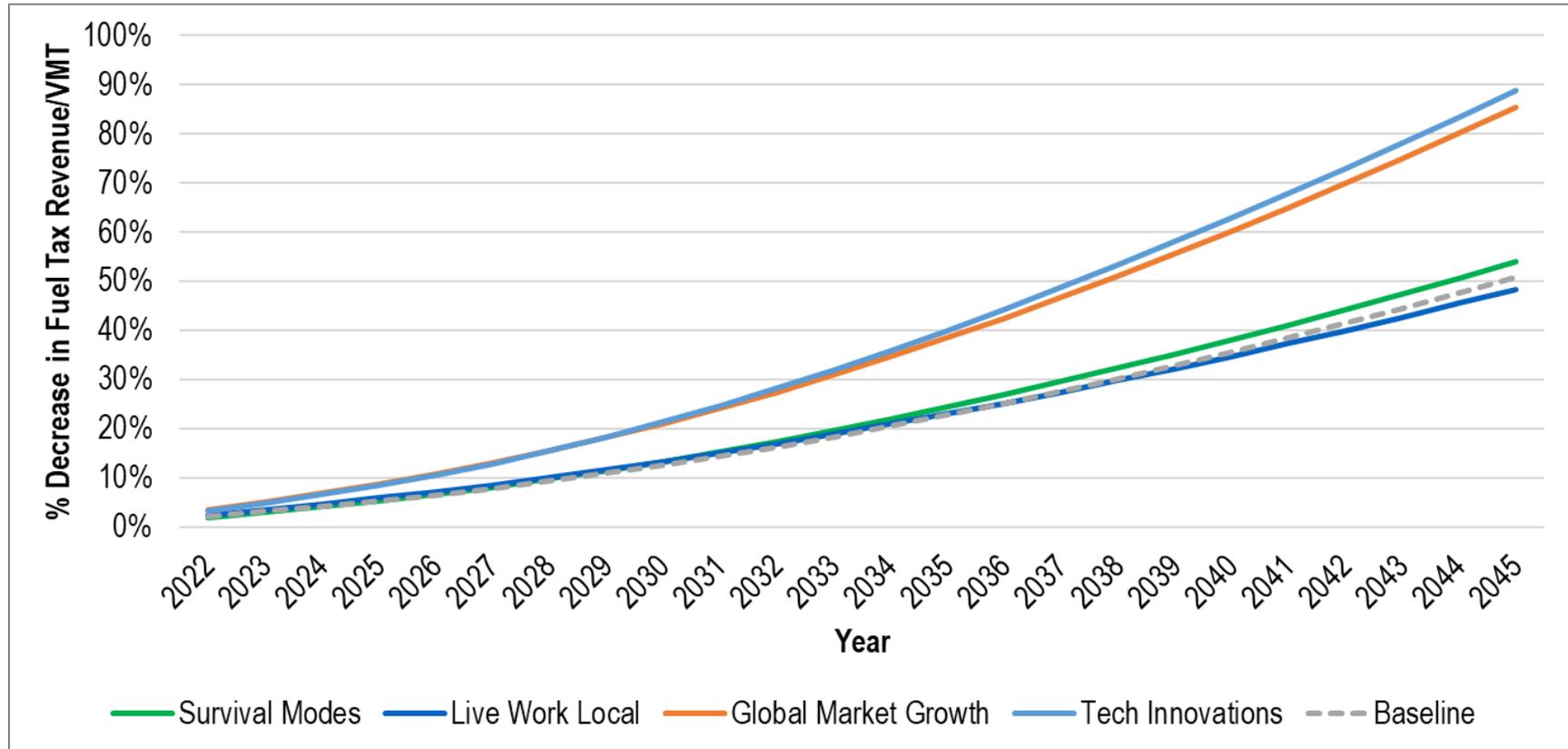
In all scenarios, EV penetration means that the share of VMT that is taxable falls dramatically as shown in Figure 9. These forecasts are based on current laws, and higher shares of VMT may be taxed if the Kentucky General Assembly passes legislation to address EV effects on revenue.

Figure 9: Forecasted Percent of VMT That Is Taxable



As shown in Figure 10, there is a decrease in fuel tax revenue per VMT, which can also be described as there being less revenue available per mile of travel. These forecasts are also based on current laws and may change depending on legislation passed by the Kentucky General Assembly.

Figure 10: Lost Revenue due to EV Adoption and Increased Fuel Efficiency (Compared to 2022 Baseline)



## BREAKOUT GROUPS

After the introductory presentation, participants were split into four virtual breakout groups that convened in separate Microsoft (MS) Teams rooms. Each breakout group had a facilitator to lead discussion and a scribe to record key points about the discussion. Participants were distributed among the breakout groups so that each group had a range of experiences representing multiple programmatic areas. The breakout sessions began with a short presentation by the facilitators to describe the scenario in detail and to contrast the forecasts for population, economic activity, VMT, mode share, technology, and urban development with current conditions and baseline forecasts.

Next, facilitators introduced the two tools that would be used in the discussion. The first is Poll Everywhere (<https://www.polleverywhere.com/>), which is a web-based tool allowing participants to submit written responses to questions via an internet browser or cell phone texting to the workshop organizers, and for those written responses to appear in the slide deck in real time for other participants to see and react to. The discussion portion of the breakout sessions began by allowing participants to send written responses and continued with verbal discussion as needed to flesh out or react to responses. Before each question, facilitators primed discussion by providing key information about the topic, listing KYTC programs that may be relevant to the question, or providing several examples. Breakout groups addressed the following five questions, for which answers are provided in the next section of this memorandum.

1. What network vulnerabilities or lack of preparedness do you see in relation to the demands of this scenario?
2. What network investment strategies are needed in relation to the demands of this scenario?
3. What policies and policy changes are needed in relation to the demands of this scenario?
4. How might internal business processes and structure need to change in relation to the demands of this scenario?
5. How might the SHIFT process and key attributes need to change in relation to the demands of this scenario?

After the discussion, participants examined programmatic investments for the scenario using a Decision Lens Impact Dashboard<sup>16</sup> to visualize performance impacts of different programmatic investment levels and make trade-offs. The dashboard is a web-based software that allows users to interactively adjust investment levels and see expected performance for pre-selected measures for most major programs in real time. The facilitator shared a single version of the tool that he or she adjusted as participants requested. The dashboard allowed participants to adjust annual spending and see performance for the following programmatic areas.<sup>17</sup>

- Pavement asset management
- Bridge asset management
- Highway capacity
- Safety
- Transportation systems management and operations (TSMO) (excluding safety)
- Maintenance
- Active transportation
- Transit
- Ferries

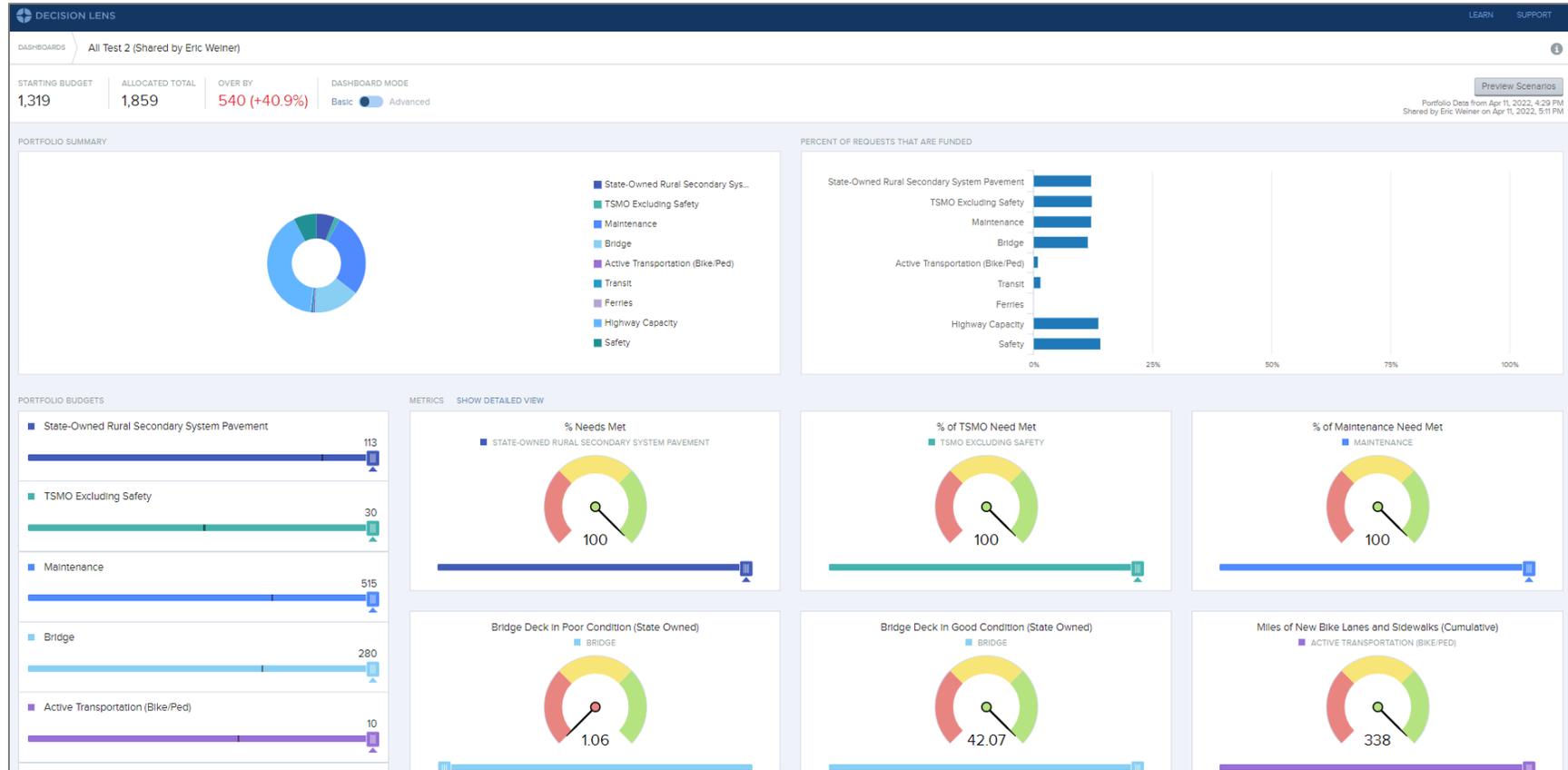
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<sup>16</sup> [www.decisionlens.com](http://www.decisionlens.com)

<sup>17</sup> The list of programmatic areas includes most but not all major KYTC programs. To be included in the dashboard, it was necessary to both quantify KYTC's long-term spending needs for that program and to forecast future revenue related to that program. Programs for which one of both of these could not be done in the LRSTP were not included in the dashboard.

Each breakout group used a version of the dashboard whose revenue forecast had been customized to its scenario. Breakout groups were encouraged to attempt to remain within or close to their scenario's revenue forecast, which required participants to make trade-offs among programmatic areas to prioritize the transportation needs of that scenario. There was performance vs. investment curves behind the scenes in the tool relating programmatic spending to outcomes, whose derivation is summarized in the Subappendix B along with the meaning of each of the performance measures. Figure 11 shows a screenshot of the dashboard.

Figure 11: Screenshot of Decision Lens Impact Dashboard



## Discussion

This subsection summarizes the response to each of the questions that the breakout groups addressed. The responses combine written answers submitted through Poll Everywhere and verbal discussion, and they have been condensed and organized to highlight key topics of discussion within the breakout groups. The responses reflect the opinions of the participants as a function of their professional experience and provide insights into

how the future represented by the scenario may affect Kentucky or KYTC's ability to fulfill its mission. The responses do not necessarily represent participants' final thoughts, which may have continued to evolve during the course of the discussion or after the workshop, or the position of KYTC as a whole.

## Survival Modes

**Network Vulnerabilities:** What network vulnerabilities or lack of preparedness do you see in relation to the demands of this scenario?

- **Safety and security threats**
  - Security and safety
  - Theft and hacking (e.g., hacking related to C/AVs)
- **Severe weather**
  - Too many communications utilities and electrical infrastructure are not hardened against weather, which can result in damage to the infrastructure
  - Limited redundancy of assets on network to keep travel moving when an asset is damaged
  - Maintenance of infrastructure condition in an environment with more severe weather
  - Infrastructure damage and the need for more repairs
- **Limited staff and materials to complete work**
  - Supply chain of materials for repairs and maintenance
  - Limited personnel and contractors to fix transportation issues in a timely manner
- **Equity:**
  - Challenges maintaining equity for lower socio-economic groups
- **Funding**
  - Discussing with the Legislature to reach a proper allocation of funding
  - KYTC doesn't consistently allocate resources in amounts needed to the necessary areas (e.g., such as to increase redundancy to keep travel moving when an asset is damaged)
  - Less funding overall is expected in the future
- **Inadequate transportation network and services**
  - Need for more public transit vehicles
  - Crowded healthcare routes
  - More congestion

**Investment Strategies:** What network investment strategies are needed in relation to the demands of this scenario?

- **Equity-focused investment**



- Equity in low-income areas
- Active transportation for low-income population; more sidewalks
- More public transportation
- More sidewalks and public transportation (particularly to help serve the needs of low-income Kentuckians)
- **Emergency response**
  - More emergency response
  - Specific funding for emergency response
  - More ITS for messaging in emergencies
  - Education and sensor-type monitoring for public information
- **Focus on durable and resilient materials and methods**
  - Go back to better methods and materials
  - Buried utility lines
  - Routes that would avoid/provide redundancy in disaster-prone areas
- **Focus on asset preservation:**
  - Maintaining what we have to proper level
- **Public-private partnerships:**
  - Creative public-private investments, like stocks. This helps make up for deficiencies in the revenue stream.
- **Specific investments in energy, traffic calming, sidewalks, public transportation, and security**
  - Alternative energy infrastructure
  - More traffic calming vs. increased capacity where feasible
  - More security funds

**Policies and Policy Changes:** What policies and policy changes are needed in relation to the demands of this scenario?

- **Revenue and spending flexibility**
  - Give the Executive Branch flexibility to reallocate money within the transportation budget or decrease taxes if there is too much poverty
  - Funding policies to allow state funding to remain fluid while waiting for federal reimbursements
  - Increase tax for road funds
  - Incorporate funding policies to allow state funding to remain fluid while waiting for federal reimbursements for emergencies
- **Deterrent laws**
  - Hacking and information laws
  - Review transportation laws for theft and privacy

- **Consideration of resiliency in design:**
  - Consideration of resiliency (e.g., scour, flooding) during design phase of replacement of assets
- **Emergency response coordination:**
  - Military rule or emergency response coordination. This may relate to funding coordination at the federal level to get or use necessary funding related to emergencies.
- **Other**
  - Public transportation access
  - Supply chain and business incentives
  - Possible travel time restrictions

**Internal Business Processes and Structure:** How might internal business processes and structure need to change in relation to the demands of this scenario?

- **Partnerships for data sharing:**
  - Expand partnerships and more technology to allow sharing of data more quickly
- **Staff to track trends**
  - Possible office for each mode to track them
  - Have a 'megatrends' staff, within Division of Planning or as separate office
- **Safety and security personnel and tools**
  - Roadside safety patrol-type personnel
  - More communication security technology
- **More personnel and training for and focus on emergency response**
  - More maintenance education for emergency response
  - More staffing dedicated to meeting documentation requirements for federal reimbursements for disasters and emergencies
  - Consider KYTC infrastructure expansion (talent and resources) for emergency response
- **Flexible size of agency:**
  - Smaller government in some areas if money is too tight. Possibly bigger government in security type areas

**SHIFT Process:** How might the SHIFT process and key attributes need to change in relation to the demands of this scenario?

- **Different weights**
  - More weight for safety, asset management, and congestion
  - Less weight for economic development and benefit-cost ratio

- **More scoring indices**
  - Add scoring index for resiliency
  - Give weight to degree of connectivity of an asset.
- **Local input:**
  - Possibly more local meetings if there are rapid changes
- **Limited changes:**
  - SHIFT is a short-term program selection tool. No immediate changes should happen based on long-term scenarios since long-term projections are updated every decade or more.

## Live, Work, Local

**Network Vulnerabilities:** What network vulnerabilities or lack of preparedness do you see in relation to the demands of this scenario?

- **Safety on rural roads:**
  - Lack of safety on rural routes
- **Bridges closures:**
  - Bridge closures on local routes
- **More stress on local roads:**
  - Local roads receive more demand under this scenario
- **New transportation needs, including the needs for**
  - More data collection for non-automotive modes
  - Accommodation of first- and last-mile freight, including by accommodating first- and last-mile freight and box truck services
  - Safer bike and pedestrian movement
  - More multimodal facilities, including rural transit services
- **Funding**
  - Small local tax base
  - Funding program limitations
  - Funding deficits due to decreased VMT
- **Lack of needed services of infrastructure, including**
  - Transit for aging population
  - Lack of transit, especially inter-city
  - Bike / pedestrian facilities in rural areas and small towns
  - Need for better bike/pedestrian infrastructure especially in rural areas



### **Investment Strategies:** What network investment strategies are needed in relation to the demands of this scenario?

- **Multimodal and non-automotive investment**
  - Enhance interconnectivity between modes
  - “Complete streets” and active transportation investment
  - Investment in downtown cores via strategies such as complete streets
  - Regional bike and pedestrian facilities
- **Interregional connections:**
  - Enhance interconnectivity between suburban and rural areas
- **Local collaboration in investment:**
  - More enhanced collaboration with local, city, and county governments
- **Preservation and system maintenance**
  - Focusing on system preservation over system expansion
  - Still need to maintain road network, plus additional bike, pedestrian, and transit facilities

### **Policies and Policy Changes:** What policies and policy changes are needed in relation to the demands of this scenario?

- **Policies related to complete streets**
  - Utility agreements related to complete streets
  - Completion of complete street policy
  - Strong complete streets policy
- **Statewide and regional active transportation plans**
  - Completion of statewide and regional bike and pedestrian plans
- **Greater coordination between transportation and land use**
  - Enhanced policy connection between local governments’ planning and zoning, and state transportation planning
- **Funding mechanisms that are flexible or less VMT-dependent**
  - Different funding mechanisms that do not rely on vehicle travel/fuel consumption
  - Need a sustainable, flexible state funding source
- **Investment in communication technologies**
  - Strong investments in statewide broadband
- **Funding reallocation among programmatic areas, with more for non-SOV modes**
  - Allocate more funding to non-SOV modes, less to highway expansion
- **More local initiatives with corresponding funding**
  - Funding will need to be shifted to local communities

**Internal Business Processes and Structure:** How might internal business processes and structure need to change in relation to the demands of this scenario?

- **Telework focus**
  - Internal personnel policies focus on performance instead of presence
  - Leveraging virtual world in real time to maintain staffing
- **Local jurisdictions:**
  - Reduce the number of KY counties
- **More multimodal focus:**
  - More focus on multimodal planning; need to look at other ways to identify needs and measure effectiveness of projects
- **More flexible funding for districts**
  - Leverage virtual world skills throughout the districts to project "best fit" scenarios.
  - May need to give more funding flexibility for the District offices.

**SHIFT Process:** How might the SHIFT process and key attributes need to change in relation to the demands of this scenario?

- **Leveraging local plans and data**
  - Work more directly with local governments to obtain more consistent plans and data sources in which we can utilize their planning resources
  - Collection of city and county roadway and multi-modal infrastructure data to leverage and enhance existing infrastructure
- **Inclusion of non-highway projects**
  - Incorporate transit projects into the process
  - Change the SHIFT scoring criteria to include non-motorized transportation
- **Refining measures of economic impact:**
  - Re-evaluate economic impacts of projects in light of more localized economies
- **Greater share to regional priorities**
- **Greater weight for asset management:**
  - Asset management weight would need to increase
- **Outcomes focus on mid-sized communities:**
  - Increased investment in mid-sized communities

## Global Market Growth

**Network Vulnerabilities:** What network vulnerabilities or lack of preparedness do you see in relation to the demands of this scenario?

- **Technology**
  - **Risks of investing in technologies that do not last:** What happens if lithium batteries for EVs become obsolete and newer types of fuel cells come on the market?
  - **Gaps in EV charging network and responsibilities for filling them:** Will this be a private endeavor or a government responsibility?
  - **Fast technology changes:** Technology infrastructure must grow exponentially
- **Funding**
  - **Needs growing faster than funding:** With ever-increasing transportation system demand and disproportionately less funding, keeping up with facility needs will be an ever-present problem
  - **Funding under current laws:** Legislature does not have an appetite to increase taxes
  - **Debt payments:** Pressure of debt on available funding
- **Freight**
  - **Last-mile freight challenges:** Like today's freight deliveries, the "last mile" may be the most difficult part of a trip, creating unforeseen congestion on local street networks
  - **Intermodal facilities**
  - **Truck operations:** Truck parking and backups on Interstate highways continue to be an issue
  - **Congestion and operational issues due to high freight volume:** Strain on roadway network because of freight unless there is growth in other modes (rail, waterways, etc.). Decline in freight reliability due to urban congestion
- **Other**
  - **River crossings**
  - **Need to complete planned projects**

**Investment Strategies:** What network investment strategies are needed in relation to the demands of this scenario?

- **Technologies**
  - **Investment to accommodate new technologies:** Investment strategies will need a transition to new types of vehicle technologies (e.g., C/AVs mixed with non-automated vehicles)

- **Communications infrastructure investments:** Investment in communication infrastructure (e.g., broadband) to allow interconnectivity of vehicles, people, and equipment
- **Materials research:** Research and deployment of advanced materials and construction techniques to extend the useful life of facilities
- **Economic development**
  - **Domestic technology manufacturing:** Investment in computer chips that are manufactured in the U.S.
  - **Investment to retain the state's air freight hub:** Investment in aviation to ensure KY remains a hub for air freight
- **Freight**
  - **Freight infrastructure investments:** Larger investments in riverports, rail, etc. to help with movement of freight goods

**Policies and Policy Changes:** What policies and policy changes are needed in relation to the demands of this scenario?

- **Private investment:**
  - More private investment is essential
  - Funding strategies that leverage private investment would be a new policy
  - Currently, a development is only responsible for the network that is immediately adjacent to the improvements
  - Florida has a policy that places some of the transportation investments on developers
  - This scenario is the most extreme case and requires swift shifts in many paradigms. Privatization has greater investment capacity. Easing of society's perception on monitoring, greater use of flexible work schedules (to leverage the existing network).
- **Public private partnerships:** More legal flexibility in Public Private Partnerships
- **New revenue mechanisms:**
  - New revenue/taxing mechanisms to replace the fuel tax
  - Alternative funding sources to ensure our infrastructure is capable of handling future demand
  - Consider new revenue streams for congestion in order to focus the available funds on other priorities
- **Staff to accelerate projects:** KYTC needs to increase staff to manage the project development process and environmental documentation/clearance to move projects faster. More money for projects means nothing if projects cannot through the review and approval process.
- **Safety:** Policies considering safety of new delivery methods interacting with current methods

**Internal Business Processes and Structure:** How might internal business processes and structure need to change in relation to the demands of this scenario?

- **Increasing expertise within KYTC:** KYTC has been getting leaner and leaner with respect to personnel at the expense of subject matter expertise. The scenario demands expertise to grow within. This change is difficult because of the legislative branch of government's control. A paradigm would be to give KYTC salary control.

- **Gaining new skillsets:** New skillsets would seem to be imperative considering technological advancements that are happening in transportation

**SHIFT Process:** How might the SHIFT process and key attributes need to change in relation to the demands of this scenario?

- **More weight**
  - **More emphasis on safety and asset management:** In order to assure a reliable and resilient transportation network, shift more emphasis on Safety and Asset Management. The funding needs greatly outstrip federal and state dollars. It is necessary to identify other revenue streams or change policy in ways that encourage the legislature to balance project costs to revenue.
  - **More emphasis on congestion and freight:** Greater emphasis on congestion, freight, and benefit/cost metrics and input that goes into them
- **Flexibility related to inflation in benefit-cost ratio:** Benefit/cost (B/C) ratio outcome is dependent on the investment rate of return (or interest rate) utilized. Need to have flexibility to adjust to inflationary pressures
- **Evaluation of process to avoid overprogramming Highway Plan:** If the Highway Plan continues to sometimes be overprogrammed (i.e., containing more projects than are programmed), the SHIFT process may merit evaluation and adjustment to avoid overprogramming
- **Consider including non-highway projects:** Consider expanding SHIFT to address other modes as they become more prevalent, including unmanned aerial vehicles (UAVs), water, rail, and connected vehicles
- **Remain adaptable:** Be fluid and adjust as the future becomes reality

## Tech Innovations

**Network Vulnerabilities:** What network vulnerabilities or lack of preparedness do you see in relation to the demands of this scenario?

- **Technology**
  - **Needs for more communications infrastructure (e.g., fiber/conduits):** There is currently a lack of fiber/conduit infrastructure to support C/AVs alongside existing facilities, particularly outside of urban areas.
  - **EV charging infrastructure outside of alternative fuel corridors (AFC):** EV charging outside of AFCs may remain an issue, such as EV charging in eastern Kentucky. The Infrastructure Investment and Jobs Act (IIJA) is providing the first batch of money for EV charging infrastructure within AFCs. Market forces may provide some or all of needed EV infrastructure.
  - **The load that large numbers of EVs will put onto the electrical grid:** The current electrical grid can likely not support large numbers of EVs.
  - **Cybersecurity:** Will be a major issue for all connected infrastructure.
  - **Dealing with automated vehicles operating alongside non-automated vehicles:** There will likely be a mixed fleet under this scenario (i.e., mixture of CAVs and non-automated vehicles). In this situation, signage, striping, and regulatory requirements for a mixed fleet are a tremendous unknown.

- **Platooned trucks:** Platooned trucks could also create difficulties for other vehicles because of the platoon's length. For example, vehicles may have challenges merging into or exiting from freeways if a truck platoon is in the lane adjacent to the exit or entrance ramp, potentially obstructing it. Trucks typically travel in the righthand lane, but truck platoons in the righthand lane could obstruct exits.
- **Uncertainty about congestion:** It is uncertain if congestion will increase or decrease even if VMT increases as much as expected. More VMT may be counterbalanced by changes in traffic operations such as closer following distances. Moreover, traffic is likely to be more distributed than the current focused traffic areas. Automation and platooning may also allow more efficient use of the roadways.
- **Changes in demand due to C/AVs:** C/AVs may open the transportation system to a large share of the population that cannot currently drive for reasons of age or ability. While this is an opportunity to increase access, it will also change the demands on the transportation system.
- **Effects of CAVs on traffic patterns:** Traffic patterns may change, and traffic may no longer be clustered during the day as it is now, such as with morning and afternoon peak periods.
- **Development patterns**
  - **Untethered home location:** People will have many more choices of where to live if communication technology allows for their residential location choice to be fully or partially untethered from where work or school is located. This untethering will present challenges for the transportation system. KYTC's longer-term investment needs are uncertain, along with needs for specific modes like pedestrian or bicycle infrastructure.
  - **Dispersal of growth:** If development spreads out and is less concentrated than today in select areas, then there will be a need to build and continually maintain and attend to many more miles of roadway and bridges.
  - **Maintaining non-automotive infrastructure at low population density:** If population densities fall and development is decentralized, will it be possible to widely support infrastructure for pedestrians and bicyclists?

**Investment Strategies:** What network investment strategies are needed in relation to the demands of this scenario?

- **Reimagining intermodal facilities:** Intermodal facilities may need to be reimagined, with "truck ports" as an idea. If trucks are automated primarily on highways and driven by a human in some or all 'last-mile' routes, is there a need for truck ports near the highways to transfer cargo between trucks or bring aboard a driver?
- **Roadside infrastructure:** Signage, striping, conduits, connected infrastructure for CAVs to be able to 'read the road.'
- **C/AV infrastructure:** Dedicated C/AV routes, lanes reserved for C/AVs, and/or lanes reserved for truck platooning
- **Minimum engineering standards for C/AVs:** Define minimum standards for roadways due to AVs, platooning, and distributed traffic. Ensure minimum AV visibility of roadway elements (e.g., signs, striping), bridge truck weights, and avoid signals everywhere with more robust roundabout implementation strategy.
- **Traffic management centers (TMCs):** TMCs may require major upgrades to deal with the data and connected infrastructure.

### **Policies and Policy Changes:** What policies and policy changes are needed in relation to the demands of this scenario?

- **Federal regulation and legislation:** Federal regulation of aerial drones and federal legislation of other new technologies may be necessary. For instance, drone deliveries will likely require federal legislation and/or regulation as opposed to state regulations to create a seamless system.
- **Data:** Policies related to data sharing (including between the public and private sectors), use, and security (including cybersecurity) will all be critical.
- **TSMO:** Develop a plan for leveraging emerging transportation data in TMCs.
- **Mixed traffic:** Policies related to the integration of CAVs and non-CAVs on the same roadways.
- **Cybersecurity:** Will be much more important than it has been in the past and may require additional policies.
- **Revenue replacement strategies:** Alternative funding strategies may be needed to account for EV penetration, lower energy costs, and higher, more distributed VMT.
- **Enabling legislation:** Enabling legislation may be needed for driverless vehicles. Current laws require a driver in a vehicle. Laws around following distance may also require update.

### **Internal Business Processes and Structure:** How might internal business processes and structure need to change in relation to the demands of this scenario?

- **Changes in KYTC's focus:** Now KYTC staff reflects the industry as a whole in being composed of traditional engineering "Green Book" designers. Staffing will need to expand to be more tech-focused and TSMO focused, which would require different standards around signing, striping, etc. than what KYTC currently uses.
- **Command center** may need to be beefed up because of cybersecurity threats. Something like Office of Information Technology (OIT) and TMC might eventually need to increase collaboration.
- **Changes to Cabinet's scope of work:** Would KYTC's work around driver's licensing, motor vehicles, and motor carriers shrink or change depending on adoption of automated vehicles?
- **Data science group** may be needed. How do you build this workforce?
- **Evaluate organizational capabilities to support emerging transportation technologies**
- **Establish a dedicated and sustainable funding category for emerging transportation technologies**
- **Data management framework** needs to be designed to allow real-time data integration from multiple data sources (e.g., historical KYTC data, automobiles, transit vehicles, trucks, mobile devices, infrastructure) and communication channels (e.g., fiber optics, Wi-Fi, 5G, digital short-range communications [DSRC], and other radio communications)
- **Making time for exploratory data analysis:** Making time for employees or groups or data scientists to take sufficient time to explore large data sets for potential applications, which takes more time than employees currently have after their "day job." This data exploration is a risk because you do not know how it will be used until you get into it.

**SHIFT Process:** How might the SHIFT process and key attributes need to change in relation to the demands of this scenario?

- **Change in investment categories:** There may be more of a focus on projects that are not currently included in SHIFT, such as for TSMO projects. They're currently handled through FE and budgets, which may not be adequate in the future. There will be a need for more FE (maintenance) and FJ (district operations) types of projects, which will become major investment categories.
- **Changing criteria weights:** High levels of automation might reduce the emphasis on safety and increase the weight of reliability relative to recurring congestion.
- **Economic development roads:** Will aerial drones change the need for economic development roads in at least some cases? Conversely, will people spreading out require more economic development roads? Economic development transportation infrastructure is a high priority.

### Programmatic Investments

The breakout groups allocated spending to each programmatic area (i.e., pavement asset management, bridge asset management, highway capacity, safety, TSMO (excluding safety), maintenance, active transportation, transit, ferries) based on the needs of that scenario. The Decision Lens Impact Dashboard allows participants to see estimated performance for each programmatic area as a function of the selected spending levels. *Appendix B* summarizes the measures and their calculation. Breakout groups attempted to remain within the annual budget for the scenario, which is equal to the average annual revenue that was forecasted for the scenario, although groups could allocate more or less than the annual budget. Table 3 shows the total spending that each group allocated compared with the scenario's annual budget.

Table 3: Allocated Spending Compared with Scenario Budget (Annual, Millions of 2022 USDs)

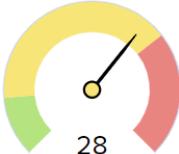
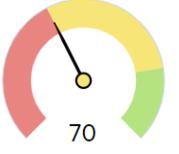
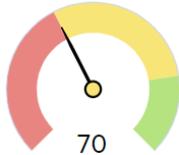
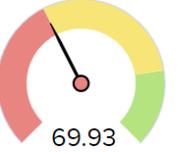
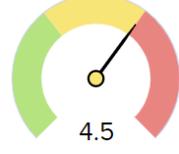
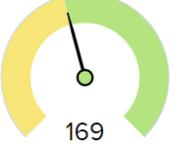
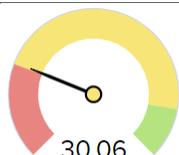
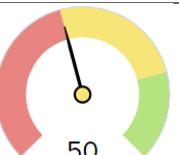
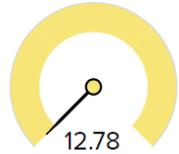
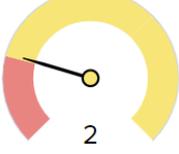
	Survival Modes	Live, Work, Local	Global Market Growth	Tech Innovations
Allocated Spending	\$1,581	\$1,621	\$1,883	\$1,798
Budget	\$1,495	\$1,580	\$1,806	\$1,723
Share Over Budget	6%	3%	4%	4%

### Survival Modes

The Survival Modes breakout group allocated slightly less revenue than the baseline scenario due to an economic slowdown and also lost transportation revenue due to EV adoption and increased fuel efficiency. Table 4 shows how the group allocated that revenue and the associated system performance. In addition to these spending allocations, the breakout group noted the following key points.

- Increasing active transportation spending would require a change to the Kentucky constitution because all the money comes from the fuel tax. This discussion assumes that over the long-term necessary changes would be made.
- Highway capacity should be a lower priority than other areas in this scenario because of the low population growth rate and limited funding, though some capacity work will need to be done because population will still increase compared to today.

Table 4: Breakout Group Spending (Millions of 2022 USDs) and Associated Performance (Survival Modes)

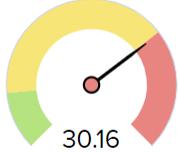
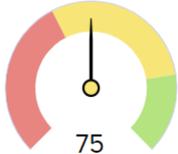
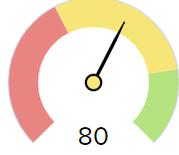
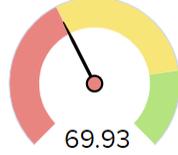
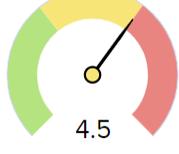
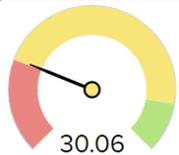
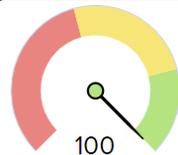
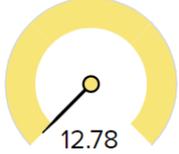
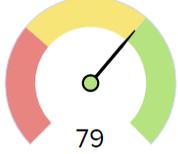
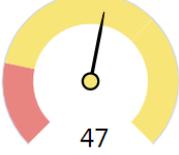
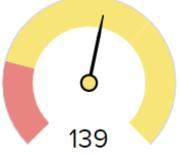
Program	Annual Spending	System Performance	Performance Measure	Program	Annual Spending	System Performance	Performance Measure
<b>Pavement Preservation - Non-Rural Secondary</b>	\$500		Share of State-Owned Non-Rural Secondary Pavement Lane-Miles in Poor Condition	<b>TSMO Excluding Safety</b>	\$21		Share of TSMO Need Met (Excluding Safety)
<b>Pavement Preservation - Rural Secondary</b>	\$79		Share of Pavement Need Met on Rural Secondary System	<b>Maintenance</b>	\$465		Share of Maintenance Need Met
<b>Bridge Preservation</b>	\$188		Share of State-Owned Bridge Deck Area in Poor Condition	<b>Active Transportation (Bike/Ped)</b>	\$5		Miles of New Bike Lanes and Sidewalks (Cumulative Over 24 Years)
			Share of State-Owned Bridge Deck Area in Good Condition	<b>Transit</b>	\$8		Share of Transit Vehicle Condition Backlog Met
<b>Highway Capacity</b>	\$250		Annual 2045 Person-Hours of Delay Reduced per Capita	<b>Ferries</b>	\$4		Share of Ferry Need Met
<b>Safety</b>	\$60		Annual Fatalities Prevented				
			Annual Serious Injuries Prevented				

## Live, Work, Local

The Live, Work, Local breakout group allocated annual funds among programmatic areas, and the associated performance condition as shown in Table 5. In addition, the breakout group noted the following key points for their discussion.

- In this scenario, it is most critical to spend more on TSMO, maintenance, and safety.
  - **TSMO:** TSMO strategies make sense very often in the higher density areas that are common in this strategy.
  - **Maintenance:** The prior long-range plan showed the importance of maintaining the existing infrastructure.
  - **Safety:** One of the reasons for which safety deserves more focus is the increase in the number of vulnerable roadway users, namely bicyclists and pedestrians.
- For some of the smaller-budget programmatic areas, there's more flexibility to increase spending by a large percentage and make a big difference for the programmatic area without dramatically increasing spending in absolute terms.
- The breakout group set maintenance to \$465 million, which is where the group felt the programmatic area needed to be even though it put the scenario about 3% over budget.

Table 5: Breakout Group Spending (Millions of 2022 USDs) and Associated Performance (Live, Work, Local)

Program	Annual Spending	System Performance	Performance Measure	Program	Annual Spending	System Performance	Performance Measure
<b>Pavement Preservation - Non-Rural Secondary</b>	\$485	 30.16	Share of State-Owned Non-Rural Secondary Pavement Lane-Miles in Poor Condition	<b>TSMO Excluding Safety</b>	\$23	 75	Share of TSMO Need Met (Excluding Safety)
<b>Pavement Preservation - Rural Secondary</b>	\$90	 80	Share of Pavement Need Met on Rural Secondary System	<b>Maintenance</b>	\$465	 69.93	Share of Maintenance Need Met
<b>Bridge Preservation</b>	\$188	 4.5	Share of State-Owned Bridge Deck Area in Poor Condition	<b>Active Transportation (Bike/Ped)</b>	\$10	 338	Miles of New Bike Lanes and Sidewalks (Cumulative Over 24 Years)
		 30.06	Share of State-Owned Bridge Deck Area in Good Condition	<b>Transit</b>	\$16	 100	Share of Transit Vehicle Condition Backlog Met
<b>Highway Capacity</b>	\$250	 12.78	Annual 2045 Person-Hours of Delay Reduced per Capita	<b>Ferries</b>	\$4	 79	Share of Ferry Need Met
<b>Safety</b>	\$90	 47	Annual Fatalities Prevented				
		 139	Annual Serious Injuries Prevented				

## Global Market Growth

Table 6 shows how the Global Market Growth group allocated that revenue and the associated performance condition. The breakout group noted the following key points during discussion around setting the spending levels.

- KYTC cannot easily afford to reduce maintenance spending much since this has caused problems in the past when attempted. Likewise, having adequate preservation spending will be important in this high-growth scenario.
- TSMO spending may ultimately be supplemented with in-vehicle technology, which may also improve safety beyond what is reflected in the performance measures.



Table 6: Breakout Group Spending (Millions of 2022 USDs) and Associated Performance (Global Market Growth)

Program	Annual Spending	System Performance	Performance Measure	Program	Annual Spending	System Performance	Performance Measure
<b>Pavement Preservation - Non-Rural Secondary</b>	\$567	18.35	Share of State-Owned Non-Rural Secondary Pavement Lane-Miles in Poor Condition	<b>TSMO Excluding Safety</b>	\$15	50	Share of TSMO Need Met (Excluding Safety)
<b>Pavement Preservation - Rural Secondary</b>	\$102	90	Share of Pavement Need Met on Rural Secondary System	<b>Maintenance</b>	\$532	80.01	Share of Maintenance Need Met
<b>Bridge Preservation</b>	\$224	3	Share of State-Owned Bridge Deck Area in Poor Condition	<b>Active Transportation (Bike/Ped)</b>	\$5	169	Miles of New Bike Lanes and Sidewalks (Cumulative Over 24 Years)
		34.24	Share of State-Owned Bridge Deck Area in Good Condition	<b>Transit</b>	\$13	80	Share of Transit Vehicle Condition Backlog Met
<b>Highway Capacity</b>	\$350	14.95	Annual 2045 Person-Hours of Delay Reduced per Capita	<b>Ferries</b>	\$5	100	Share of Ferry Need Met
<b>Safety</b>	\$70	17	Annual Fatalities Prevented				
		49	Annual Serious Injuries Prevented				



## Tech Innovations

Table 7 shows how the Tech Innovations group allocated that revenue and the associated performance condition. In addition, the group noted the following key points during discussion.

- Rural pavement asset management spending will need to be much higher in this scenario than it is today. Likewise, bridge asset management spending will also have to be higher than today.
- Technology may allow for some additional improvements in safety beyond what is reflected in the performance expectation in Table 7.
- Much more TSMO spending will be needed to allow and leverage new technologies.
- Shared mobility might displace some transit in this scenario, allowing spending to be adjusted.
- Active transportation spending was set at a nominal increase, while ferry spending was kept approximately constant.



Table 7: Breakout Group Spending (Millions of 2022 USDs) and Associated Performance (Tech Innovations)

Program	Annual Spending	System Performance	Performance Measure	Program	Annual Spending	System Performance	Performance Measure
<b>Pavement Preservation - Non-Rural Secondary</b>	\$533	23.25	Share of State-Owned Non-Rural Secondary Pavement Lane-Miles in Poor Condition	<b>TSMO Excluding Safety</b>	\$30	100	Share of TSMO Need Met (Excluding Safety)
<b>Pavement Preservation - Rural Secondary</b>	\$107	95	Share of Pavement Need Met on Rural Secondary System	<b>Maintenance</b>	\$598	89.93	Share of Maintenance Need Met
<b>Bridge Preservation</b>	\$223	3	Share of State-Owned Bridge Deck Area in Poor Condition	<b>Active Transportation (Bike/Ped)</b>	\$10	338	Miles of New Bike Lanes & Sidewalks (Cumulative Over 24 Years)
		34.24	Share of State-Owned Bridge Deck Area in Good Condition	<b>Transit</b>	\$2	10	Share of Transit Vehicle Condition Backlog Met
<b>Highway Capacity</b>	\$250	12.78	Annual 2045 Person-Hours of Delay Reduced per Capita	<b>Ferries</b>	\$5	100	Share of Ferry Need Met
<b>Safety</b>	\$40	-32	Annual Fatalities Prevented				
		-97	Annual Serious Injuries Prevented				

## CONCLUSIONS AND COMMON THEMES

This section synthesizes the individual breakout groups' responses (detailed in the prior section) to develop themes that span the groups and scenarios. These themes complement the breakout groups' unique responses. The groups' unique responses can help KYTC respond if the future ends up resembling a particular scenario, while the themes that span scenarios may lead to policies and implementation strategies that can be relevant no matter the future. The following subsections summarize the themes that derive from multiple breakout discussions.

### Network Vulnerabilities

**Question:** What network vulnerabilities or lack of preparedness do you see in relation to the demands of this scenario?

#### Common Themes

- **Revenue:** Most breakout groups (all except Tech Innovations) perceive funding instability as a threat to fulfilling KYTC's mission. The breakout groups for scenarios with the lowest revenue projections (namely Survival Modes and Live, Work, Local) naturally perceive the threat to be most severe but worries about revenue also appeared in discussions in the Global Market Growth breakout session because of the scenario's very high spending needs.
- **Technology:** Breakout groups for most scenarios discussed vulnerabilities related to technology, ranging from cybersecurity and hacking of C/AVs (Survival Modes) to the need for more EV charging infrastructure and risks associated with investing in potentially obsolete technologies (Global Market Growth). Additionally, most of the network vulnerabilities discussed for the Tech Innovations scenario relate to technologies because high tech adoption is so prominent in this scenario. The technology-related vulnerabilities are divided into two groups, which can be described as 'protecting technology from harm' (which is the case for cybersecurity and hacking) and 'adequate investment to support new technologies.'
- **Changing Nature of Demand for Transportation:** All breakout groups expressed fear about not being able to keep up with the changes in transportation demand. The ways in which transportation demand is changing varies across the scenarios, but in all scenarios these changes are a challenge to KYTC in and of themselves. The Survival Modes breakout group was concerned about potentially not having enough public transportation service to meet demand. Similarly, the Live, Work, Local group worried about not having a non-motorized and local road network that can keep up with growing demand for local, short-distance movement. The breakout group for Tech Innovations felt that KYTC might not move fast enough in building and maintaining a spatially dispersed transportation network to meet spatially dispersed demand. Finally, the breakout group for Global Market Growth worried instead about having adequate infrastructure (e.g., EV chargers) to support new passenger and freight technologies. Thus, while each group worried about keeping up with the changing nature of transportation demand for that scenario, the form of this future demand varies among the scenarios.

## Investment Strategies

**Question:** What network investment strategies are needed in relation to the demands of this scenario?

### Common Themes

- **Preservation:** All breakout groups except Tech Innovations explicitly named asset management and preservation as a priority. The Survival Modes breakout group discussed using durable and resilient materials and methods for infrastructure construction and thought that asset preservation should remain a KYTC focus. While Live, Work, Local does not emphasize the environmental disruptions that Survival Modes does, limited population growth led that breakout group to assert that preserving existing roadway and non-motorized infrastructure should take precedence over capacity expansion in the context of the scenario. The Global Market Growth discussion also recognized opportunities to research and deploy advanced materials and construction techniques to extend facilities' useful life.
- **Partnerships:** Several breakout groups emphasized partnerships (Survival Modes; Live, Work, Local; and Global Market Growth). KYTC's limitations sometimes require partnerships, particularly related to revenue since KYTC can leverage public-private partnerships to make up for revenue deficiencies. The population in the Live, Work, Local scenario is increasingly concentrated in cities, and non-state-owned infrastructure supports an increasing share of movement. Because of this, the breakout group raised the possibility of more local partnerships to address the resulting transportation demand. The breakout discussions for Global Market Growth also raised the needs for partnerships to address the greater investment needs required by faster growth as well as opportunities presented by technology.
- **Technology:** Breakout groups discussing the two high-tech scenarios (Global Market Growth and Tech Innovations) both supported large amounts of investment to accommodate new technologies, help the transition to new types of vehicles such as C/AVs, and build new communication infrastructure (e.g., broadband). The groups also discussed other technology investment related to upgrading TMCs to handle the new data that they may receive, and issues related to managing operations with C/AVs or mixed C/AV / non-automated fleets.
- **Freight:** Breakout groups for the two highest-growth scenarios (Global Market Growth and Tech Innovations) emphasized transportation investment to support freight. The Global Market Growth group saw freight investment as very urgent since freight and logistics are that scenario's largest economic engine. Investment to support freight also appeared in discussion for the Tech Innovations scenario in the form of "freight ports" and other intermodal centers where shipments can be transitioned from long-haul automated vehicles to short-distance and last-mile vehicles, especially if automation is less prevalent on local roads than in more predictable highway environments.
- **Complete Streets:** Breakout groups for both Survival Modes and Live, Work, Local believed that the scenarios would induce substantially more non-automotive transportation demand, which led them to suggest investment strategies for 'complete streets' specifically and for more transit, pedestrian, and bicycle service and infrastructure generally.

## Policies and Policy Changes

**Question:** What policies and policy changes are needed in relation to the demands of this scenario?

### Common Themes

- **Revenue:** All breakout discussions addressed the need to replace lost revenue or to have flexibility to spend revenue where it is needed most. Breakout groups for three scenarios (Live, Work, Local; Global Market Growth; and Tech Innovations) all raised the question of how to develop new revenue streams that are more stable in the face of future improvements to overall fleet efficiency. In some cases, this took the form of looking for funding partnerships with private entities (e.g., public-private partnerships) or local public entities. Additionally, the Survival Modes breakout group discussed the need for flexibility to reallocate money within the transportation budget or to decrease taxes if they impose too large a burden on the population due to the scenario's economic stagnation. The Global Market Growth breakout group believes that there is a potential for technology-based partnerships to shift funding responsibilities from KYTC and believes that new revenue sources for congestion and capacity would allow limited available funds to be focused on other needs. Breakout groups recognize that some of the changes to raise revenue or increase flexibility in allocating funding among programmatic areas depend on decisions taken by the Kentucky General Assembly.
- **Planning:** Several breakout groups saw a need for follow-up planning to address key issues or needs that the scenarios raised. For instance, the Live, Work, Local breakout group encouraged the completion of statewide and regional bike and pedestrian plans that would ultimately produce projects and expand the modes' networks to meet rising demand. The breakout group for Survival Modes also encouraged greater policy connections between statewide transportation planning and local government planning and zoning. By contrast, the Global Market Growth group focused on TSMO and leveraging transportation data for TMCs. While not planning per se, the Survival Modes breakout group did highlight the importance of thinking ahead to promote resiliency in infrastructure design.
- **Programs and Projects:** Scenarios may require some changes to funding allocations among programs. The breakout group for Survival Modes supported allocating more funding to non-SOV modes and less to highway expansion in response to the scenario's low population growth and limited economic opportunities for individuals. Discussion in Global Market Growth focused more on accelerating project development so that projects are completed faster and can address system needs sooner.

## Internal Business Processes

**Question:** How might internal business processes and structure need to change in relation to the demands of this scenario?

### Common Themes

- **Skills:** Nearly all breakout groups discussed the need to get the right staff and the right skills within KYTC, although the particular functions and skills needed vary based on the scenario's prominent traits. In Survival Modes, the biggest new staff needs relate to safety, security, and emergency response, including having adequate staff to meet documentation requirements for federal reimbursements for disasters and emergencies. Breakout groups for Global Market Growth and Tech Innovations both focused more on having staff that are ready for the

technological changes, including building more subject matter expertise within KYTC, gaining data science skills, and attracting employees skilled in the sorts of technologies that will be prominent in the transportation system. Groups recognized that attracting employees with the right skills may require KYTC to offer salaries in line with market rates that are beyond what it is currently authorized to do, and that being able to offer those market-rate salaries depends on action by the Kentucky General Assembly.

- **Change in Focus:** Several discussions highlighted a need to change KYTC's focus. According to these discussions, the Live, Work, Local scenario requires more focus on multimodal transportation than today, while the Tech Innovations scenario requires more of a TSMO focus than KYTC has traditionally had due to transportation technology adoption (e.g., C/AVs, truck platooning).
- **Structural Changes:** Three breakout groups discussed possible changes to KYTC's structure that may help respond to the scenarios. In Survival Modes, the world is especially unpredictable and KYTC is subject to many potential threats. A potential solution is to develop an office for each mode to track threats or to have a 'megatrends' staff either as a standalone office or located within the Division of Planning. The breakout group in Tech Innovations suggested a different structural change, namely the increased collaboration of the Office of Information Technology (OIT) and TMC to deal with large cybersecurity threats that arise in this scenario. In Live, Work Local, the focus is on local decision making and decentralization, leading the breakout group to recommend more resources and giving more funding flexibility for the District offices.

## SHIFT Process

**Question:** How might the SHIFT process and key attributes need to change in relation to the demands of this scenario?

### Common Themes

- **Local Input:** Within the context of their scenarios, two breakout groups (Survival Modes and Live, Work, Local) called for more local input in the form of local meetings and working with local governments to obtain consistent plans and data sources.
- **Change in Projects Included:** Breakout groups for two scenarios (Live, Work, Local and Global Market Growth) encouraged potentially expanding the types of projects included in SHIFT within the context of their scenarios to include transit and non-motorized transportation (Live, Work Local) or other non-highway projects related to aerial drones, waterways, and rail (Global Market Growth). The Tech Innovations breakout group called for the inclusion of TSMO projects.
- **Changes in Criteria Weights:** While there is not complete agreement about which criteria will need more or less weight, some trends stand out. For instance, three breakout groups recommended more weight for asset management (Survival Modes; Live, Work, Local; and Global Market Growth), while two recommended more weight for congestion in the context of their scenarios (Survival Modes and Global Market Growth). The groups are split on other criteria. Notably, two groups recommend more weight for safety in their scenarios (Survival Modes and Global Market Growth), while one group calls for less weight due to greater adoption of in-vehicle safety-enhancing technology (Tech Innovations). Similarly, the groups are split about the benefit/cost ratio in SHIFT, with one breakout group recommending more weight (Global Market Growth) and one recommending less (Survival Modes).



## SUBAPPENDIX A: WORKSHOP ATTENDEES

Name	Organization	Position
James Ballinger	KYTC	State Highway Engineer
Jason Blackburn	KYTC	Planning Supervisor D-10, SHIFT Manager
John Carr	KYTC	Former Deputy State Highway Engineer for Planning, Innovation, and Research
Stephen De Witte	KYTC	Planning: Corridors, TSMO
Jeremy Edgeworth	KYTC	Planning: Freight
Jamie Emmons	KYTC	Chief of Staff
Mike Hancock	KYTC	Deputy Secretary
Tonya Higdon	KYTC	Highway Design (Formerly Planning LRSTP)
Jacob Huber	KYTC	Planning, LRSTP PM
Keith Lovan	KYTC	Planning: Active Transportation
John W Moore	KYTC	Assistant State Highway Engineer
Tracy Nowaczyk	KYTC	Assistant State Highway Engineer
Mikael Pelfrey	KYTC	Director of Planning
Eric Perez	KYTC	Office of Transportation Delivery
Jason J Siwula	KYTC	Assistant State Highway Engineer
Amanda Spencer	KYTC	Innovative Finance Manager
Scott Thomson	KYTC	Planning Branch Manager
Thomas Witt	KYTC	Planning, MPO Coordinator
Chuck Wolfe	KYTC	Office of Public Affairs
Randall Embry	KIPDA MPO/ADD	
Eunice Holland	KY River ADD	
Mike Skaggs	Lincoln Trail MPO	
Dirk Gowin	Metro Louisville Public Works	KBT Safety Committee
Bob Koehler	OKI MPO	
Nick Allen	Michael Baker International	
Paul Cozzens	Michael Baker International	
Patty Dunaway	Michael Baker International	
Eric Hirsch	Michael Baker International	
Jeff Moore	Michael Baker International	



Name	Organization	Position
Lorna Parkins	Michael Baker International	
Morgan Ruziecki	Michael Baker International	
Alice Beattie	High Street Consulting	
Jeff Carroll	High Street Consulting	
Erin Dean	High Street Consulting	
Peter Hylton	High Street Consulting	
Mimi Rasor	Rasor	
Haley Taylor	Rasor	
Eric Weiner	Decision Lens	

## SUBAPPENDIX B: EXPLANATION OF PERFORMANCE MEASURES

### Pavement - Share of State-Owned Non-Rural Secondary Pavement Lane-Miles in Poor Condition

**Explanation of measure:** This measure signifies the share of the lane-miles owned and maintained by KYTC that are expected to be in poor condition on the entire state-owned system excluding the Rural Secondary System. KYTC is targeting having at least 92% of its pavements in good or fair condition, which means that no more than 8% of pavement can be in poor condition.

**Calculation of curve relating performance and spending:** The performance curve was derived based on a High Street model that was informed by KYTC's pavement treatments, treatment costs, treatment effects on pavement condition, and times of application. Different budget amounts were run through the model to identify the share of lane-miles that would be in poor condition under each budget amount, and a curve was fit to the resulting points to describe the relationship.

### Pavement - Share of Pavement Need Met on Rural Secondary System

**Explanation of measure:** This measure signifies the percentage of KYTC's spending need for preserving Rural Secondary System pavement that can be met with the allotted annual spending. Rural Secondary roads are "routes of sub-regional significance which might include urban arterial streets and other collectors, often with access to land use activity such as farm-to-market routes as their main function."<sup>18</sup>

**Calculation of curve relating performance and spending:** The performance curve was derived based on 24-year (2022-2045) spending needs. Needs were derived by extrapolating historical spending from fiscal years (FY) 2007-2021 for the portions of CB01 and CB06 that are related to pavement preservation. KYTC does not model pavement condition on the Rural Secondary System, which is why the need was derived from historical spending rather than an asset management model.

### Bridge - Share of State-Owned Bridge Deck Area in Poor Condition

**Explanation of measure:** The measure signifies the percentage of deck area (bridge length times bridge deck width) for state-owned and maintained bridges that is expected to be in poor condition in 2045 according to federal National Bridge Inventory (NBI) definitions of condition.

**Calculation of curve relating performance and spending:** The performance curve was derived from six 10-year Bridge Management System model runs that KYTC conducted at different spending levels. A relationship between the amount of spending during this time period and change in condition was derived using statistical regression, which was then applied to the future to estimate change in condition in 2045 at different future spending levels. Several minor adjustments were made to this relationship to account for different definitions of condition categories between the Bridge Management System and NBI and to account for other factors related to bridge aging.

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<sup>18</sup> KYTC (2022). State Primary Road System. Retrieved from <https://transportation.ky.gov/Planning/Pages/State-Primary-Road-System.aspx>.

## Bridge - Share of State-Owned Bridge Deck Area in Good Condition

**Explanation of measure:** The measure signifies the percentage of deck area (bridge length times bridge deck width) for state-owned and maintained bridges that is expected to be in good condition according to federal National Bridge Inventory (NBI) definitions of condition.

**Calculation of curve relating performance and spending:** The performance curve was derived the same way as for the previous measure.

## Highway Capacity - Annual Person-Hours of Delay per Capita Prevented

**Explanation of measure:** This measure signifies the reduction in annual person-hours of delay that each Kentuckian on average is expected to experience in 2045 compared with a hypothetical “no build” scenario where Kentucky did not invest further in new highway capacity.

**Calculation of curve relating performance and spending:** The performance curve was derived from forecasts of project impact prepared for the Strategic Highway Investment Formula for Tomorrow (SHIFT), which is KYTC’s project prioritization process, and from expected delay reduction calculated for the *Kentucky Statewide Corridor Plan*.<sup>19</sup> First, the 10-year SHIFT forecasts for projects’ delay reduction were extrapolated to 24 years. Then, project categories that would not affect delay were removed. Project benefit/cost ratios were calculated, and projects were ordered by decreasing benefit cost ratio. To account for the fact that there is a limited amount of “low-hanging fruit” with the greatest benefits, several average benefit-cost ratios were derived, where the lowest amounts of spending have the greatest effect on delay and the highest amounts have the least effect (since the low-hanging fruit has already been picked). The same process was done for delay reduction for projects in the *Kentucky Statewide Corridor Plan*. Several performance curves were derived from these benefit/cost ratios, and those curves were averaged before being incorporated into the Decision Lens tool.

## Safety - Annual Fatalities Prevented

**Explanation of measure:** This is the number of fatalities on Kentucky roads that are expected to be avoided in 2045 versus a future in which KYTC continues to spend the amount it does today on safety. The fatality count covers all roads (e.g., state-owned, locally owned) and all users (e.g., automobile users, pedestrians, cyclists).

**Calculation of curve relating performance and spending:** The performance curve was derived from a statistical relationship that the consultant team found between historical spending on safety and law enforcement by the state, and changes in the fatality rate. The historical data started in 2005, which is the year that the Highway Safety Improvement Program (HSIP) was adopted, which modified KYTC’s project selection processes compared with earlier years. Once a good regression equation linking the fatality rate with safety spending, other spending types, and a time trend was identified, the model was applied to different forecasted spending amounts to describe changes in performance at different spending levels.

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<sup>19</sup> Kentucky Transportation Cabinet (2021). *Linking Kentucky*. Retrieved from <https://transportation.ky.gov/linkingkentucky/Pages/Home.aspx>.

## Safety - Annual Serious Injuries Prevented

**Explanation of measure:** This is the number of serious injuries on Kentucky roads that are expected to be avoided in 2045 versus a future in which KYTC continues to spend the amount it does today on safety. The serious injury count covers all roads (e.g., state-owned, locally owned) and all users (e.g., automobile users, pedestrians, cyclists).

**Calculation of curve relating performance and spending:** The performance curve was derived from the previously described performance curve for annual fatalities prevented. The ratio of fatalities to serious injuries was extrapolated into the future using several years of historical data, and this extrapolated ratio was used to convert the forecasted number of fatalities prevented to serious injuries prevented.

## TSMO (Excluding Safety) – Share of TSMO Need (Excluding Safety) Met

**Explanation of measure:** This is the average annual spending need between 2022 and 2045 that has been identified for transportation systems management and operations (TSMO) for KYTC. These needs comprise capital, operations, and ITS device maintenance on state-owned roads only. TSMO includes intelligent transportation systems, operations, traffic signals, and other electrical roadside devices.

**Calculation of curve relating performance and spending:** The performance curve is the share of the average annual spending need that can be met. The spending need was primarily derived by extrapolating historical spending from several TSMO-related accounts. Extrapolated amounts related to maintenance were grown to make up for the fact that historical spending was not kept pace with cost increases. Additional costs related to traffic signals such as for new controllers were also added.

## Maintenance - Share of Maintenance and Pavement Marking Need Met

**Explanation of measure:** This is the average annual spending need between 2022 and 2045 that has been identified for roadway and roadside maintenance and for pavement marking for KYTC. It includes only state-owned roads.

**Calculation of curve relating performance and spending:** The performance curve is the share of the average annual maintenance spending need that can be met. The maintenance spending need was primarily derived by extrapolating historical spending for FE01, FE02, FE04, FE06, and FE07. Extrapolated amounts were grown to make up for the fact that historical spending has not kept pace with cost increases and to account for needs that have not been met by historical funding. The sign and pavement marking need was primarily derived by extrapolating historical spending for both in-hour and contract costs, and adding in unfunded needs. Pavement marking needs were also adjusted to account for extra costs due to changes in striping width and savings due to additional use of thermoplastics.

## Active Transportation – Miles of Sidewalks and Bike Lanes

**Explanation of measure:** This is the average number of miles of sidewalks and bike lanes that could be built on state-owned roads. These are based on costs for building a single side of the road, although the costs for building on both sides of the road are likely less than double costs for building on a single side.

**Calculation of curve relating performance and spending:** Costs for pedestrian and bicycle infrastructure vary widely based on infrastructure details and location-specific factors, and these amounts relate to averages that were derived from project cost estimates from several Kentucky MPOs and from applying a tool developed by the North Carolina Department of Transportation (NCDOT) to Kentucky. The mileage in this curve is based on splitting the spending evenly between bike lanes and sidewalks where sidewalks are assumed to cost approximately \$824,000 per mile and bike lanes are assumed to cost \$622,000 per mile. The upper spending range is roughly equal to FY 2021 expenditures for bike/ped facility-type work on any route in Kentucky, which were \$10.4 million.

### Transit – Share of Transit Vehicle Condition Backlog Met

**Explanation of measure:** This is the share of spending needs in the state related to maintaining transit vehicles at a good enough condition to meet transit agency targets related to the percentage of vehicles beyond their useful life, which is a federally required performance measure. The spending need relates to urban and rural transit provides throughout Kentucky. It does not include transit needs related to facility condition, system expansion, or operations.

**Calculation of curve relating performance and spending:** The spending need was estimated by collecting the transit vehicle condition inventory with age compared to useful lifespan from the Federal Transit Administration's National Transit Database (NTD). Vehicles' estimated replacement cost was collected from agencies' Transit Asset Management (TAM) plans. Then, vehicles in the inventory were aged through 2045, and costs were applied to replace enough of them to meet the agency's goals for the percentage of the fleet that had exceed its useful life benchmark (ULB).

### Ferries – Share of Ferry Need Met

**Explanation of measure:** This is the share of KYTC's spending need related to ferries. It does not include spending by private ferry owners or other state governments that co-fund ferries to Missouri and Illinois.

**Calculation of curve relating performance and spending:** The ferry need was derived by extrapolating historical spending, adding additional known budget requests, adding costs associated with extra personnel to be required by federal regulations under "subchapter M" requirements, and known capital needs for ferry replacements.