ORGANIZATIONAL AWARENESS AND UNDERSTANDING OF SCENARIO PLANNING

Final Report

July 16, 2021

FINAL REPORT: ORGANIZATIONAL AWARENESS AND UNDERSTANDING OF SCENARIO PLANNING
Prepared by ICF for Metropolitan Washington Council of Governments/ Transportation Planning Board
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ABOUT THE TPB
The National Capital Region Transportation Planning Board (TPB) is the federally designated metropolitan planning organization (MPO) for metropolitan Washington. It is responsible for developing and carrying out a continuing, cooperative, and comprehensive transportation planning process in the metropolitan area. Members of the TPB include representatives of the transportation agencies of the states of Maryland and Virginia and the District of Columbia, 24 local governments, the Washington Metropolitan Area Transit Authority, the Maryland and Virginia General Assemblies, and nonvoting members from the Metropolitan Washington Airports Authority and federal agencies. The TPB is staffed by the Department of Transportation Planning at the Metropolitan Washington Council of Governments (COG).

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TABLE OF CONTENTS

FIGURES AND TABLES

REPORT PURPOSE AND CONTEXT

COG/TPB is interested in increasing organizational awareness and understanding of scenario planning. Toward this end, the agency embarked upon a study to explore scenario planning processes and tools that could complement its travel demand modeling capabilities, enabling the agency to generate and evaluate alternative possible futures quickly and efficiently across a broad range of topics. The study scope included the development of three white papers, a final report, and the facilitation of a workshop, of which this is the final report. The final report consists of a summary of findings from the research efforts and the workshop in addition to recommended next steps. The report will serve as an in-house resource for COG/TPB agency business planning and work programs that involve scenario planning applications and associated investments in tools, data and staff capabilities.

The first white paper provides an overview of scenario planning and how it can be used to support regional transportation planning. The second white paper reviews the state of the practice of the use of scenario planning by peer Metropolitan Planning Organizations (MPOs). The third paper documents the state of the practice of scenario planning tools for regional transportation decision making, with recommendations for investments in COG/TPB staff training and technical capacity.

Following the research phase of the study, the project Oversight Committee hosted two workshops for COG/TPB staff to digest the results of the research and to identify interests and priorities for applying the findings to future planning initiatives and agency capacity-building programs.

WHAT IS SCENARIO PLANNING?

Planning for an Uncertain Future
Scenario planning is a practice by which organizations or communities plan for an uncertain future by exploring multiple possibilities of what might happen. Well-crafted scenario planning exercises inspire critical thinking and creative ideas for addressing potential challenges and leveraging potential opportunities for transportation investments, community development initiatives, and other services and policies to improve economy, environment, and quality of life.

Figure 1: COG/TPB Staff Definitions of Scenario Planning

Word Cloud Source: Responses from Study Oversight Committee Members to a question about their definition of scenario planning. June 2020.

Preparing for a Desired Future Scenario planning shifts the focus away from *reacting* to a predicted future and toward *preparing* for a desired future. The story-like quality of scenarios makes it easy for the public to participate in discussions about costs, benefits, and priorities, while the quantitative rigor of the analysis enables agencies to incorporate results into technically robust, resilient plans with complementary—not conflicting—goals and strategies. In times of crisis, scenario planning can help planners let the public know that thoughtful leaders are thinking about the future and the world
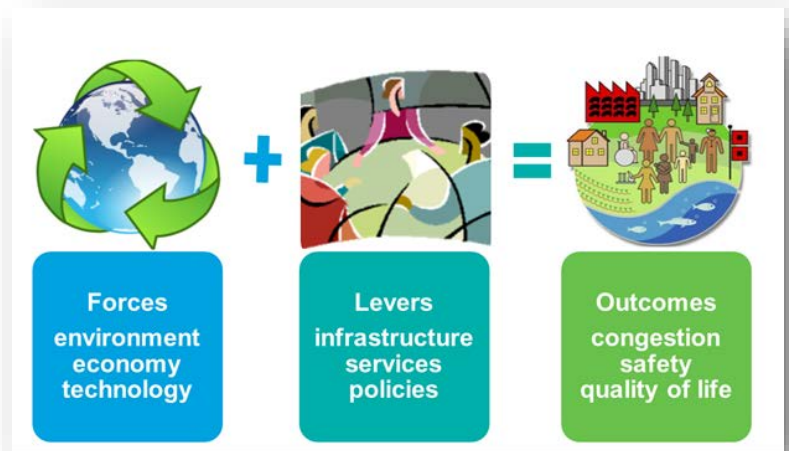
is not simply out of control; it can inspire hope and confidence among participants that, although they may not have all the answers, they can act positively to manage the forces of change. These characteristics of scenario planning make it a powerful tool for agencies committed to providing infrastructure and services that will meet communities' needs now and for decades into the future.
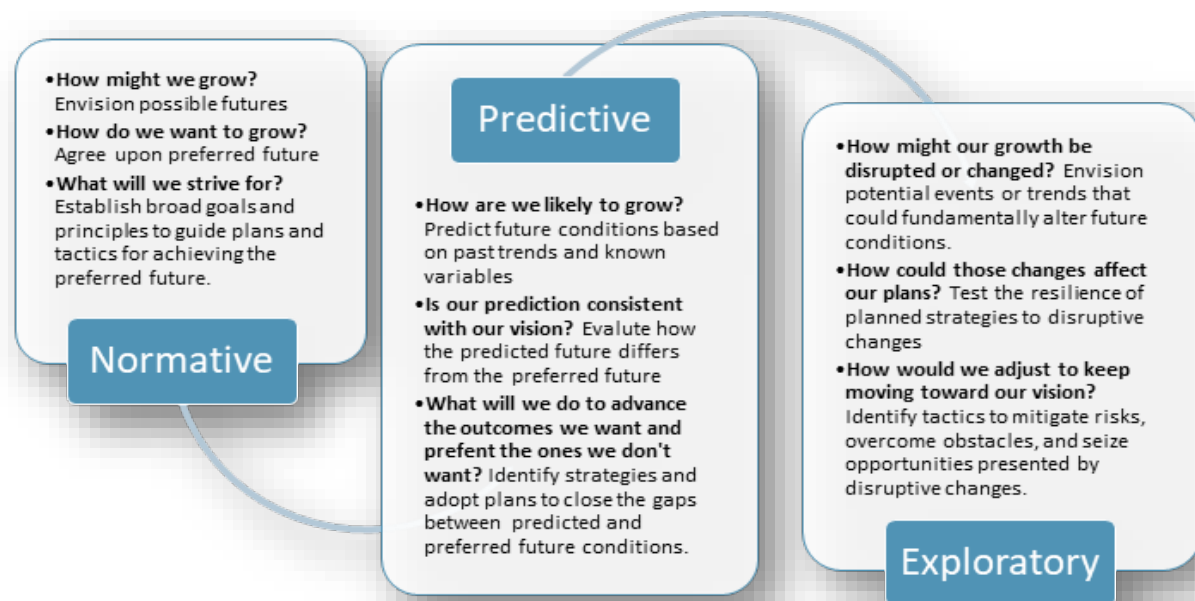
Exploring Possible Outcomes

Transportation planning scenarios describe plausible sets of future conditions that combine *external forces* outside of an agency's control (e.g., automated vehicle technologies, extreme weather patterns) with *agency actions, or "levers"* that it can influence (e.g., infrastructure investments and public policies) to shape *outcomes* (e.g., travel demand, land use patterns). The process involves assessing potential impacts of scenarios; considering implications and tradeoffs associated with alternative futures; and eliciting ideas to inform plans.

Figure 2: Scenario Building Blocks

Forces	Levers	Outcomes
environment economy technology	infrastructure services policies	congestion safety quality of life

Figure 3: Types of Scenario Planning Processes

Normative
- How might we grow? Envision possible futures
- How do we want to grow? Agree upon preferred future
- What will we strive for? Establish broad goals and principles to guide plans and tactics for achieving the preferred future.

Predictive
- How are we likely to grow? Predict future conditions based on past trends and known variables
- Is our prediction consistent with our vision? Evalute how the predicted future differs from the preferred future
- What will we do to advance the outcomes we want and prefent the ones we don't want? Identify strategies and adopt plans to close the gaps between predicted and preferred future conditions.

Exploratory
- How might our growth be disrupted or changed? Envision potential events or trends that could fundamentally alter future conditions.
- How could those changes affect our plans? Test the resilience of planned strategies to disruptive changes
- How would we adjust to keep moving toward our vision? Identify tactics to mitigate risks, overcome obstacles, and seize opportunities presented by disruptive changes.

Building Visions, Shaping Tactics Traditional transportation planning processes rely upon a *predictive* form of scenario planning in which alternative strategies are tested against a fixed forecast of future conditions. A values-driven, *normative* scenario planning process can help a community to build consensus on a broad vision. An *exploratory* scenario planning exercise can help an agency to identify tactics that are resilient under a variety of different future conditions.

HOW CAN SCENARIO PLANNING SUPPORT REGIONAL TRANSPORTATION DECISION-MAKING?

Regional agencies apply scenario planning tools and techniques to address a wide array of concerns and interests, some which lend themselves to the normative process of identifying shared values and building consensus on broad principles, and others which are better suited to exploratory initiatives that help to illuminate investments and policies that are resilient to potential risks and that position the region to leverage emerging opportunities to advance its vision. The introduction of Federal legislation and regulations promoting performance-based planning and programming, e.g., MAP-21 and the FAST Act, have intensified the need among MPOs and State Departments of Transportation (DOTs) for quantifiable analysis tools that can address a wide variety of issues in addition to the congestion-related indicators measured by travel demand models.

Normative Processes Support Visioning and Goal Setting

Regional planning councils (RPCs) metropolitan planning organizations (MPOs), and nonprofit advocacy groups have led most of America's scenario planning initiatives over the past several decades. Many of these projects applied normative scenario planning tools and techniques to support regional visioning and development of principles, policies, and investments to promote desired outcomes land use, transportation, environmental preservation, economic development, and public health.

Federal Support for Scenario Planning

Specific references to scenario planning in federal legislation first appeared in 2012, with the enactment of the Moving Ahead for Progress in the 21st Century Act (MAP-21), which encourages MPOs to develop multiple scenarios as part of a metropolitan transportation plan. For MPOs that chose to voluntarily include scenarios, MAP-21 encourages them to consider:

- **Potential regional investment strategies.**
- **Assumed distribution of population and employment.**
- **A scenario that maintains baseline performance conditions.**
- **A scenario that improves the baseline conditions.**
- **Revenue-constrained scenarios based on the total revenues expected to be available.**

The 2015 legislation Fixing America's Surface Transportation Act, commonly referred to as the FAST Act, continues the support for scenario planning with a new reference regarding the incorporation of resilience considerations.

Source: Next Generation Scenario Planning. FHWA. 2017.

Figure 4: Hillsborough County MPO Imagine2040 Preferred Scenario
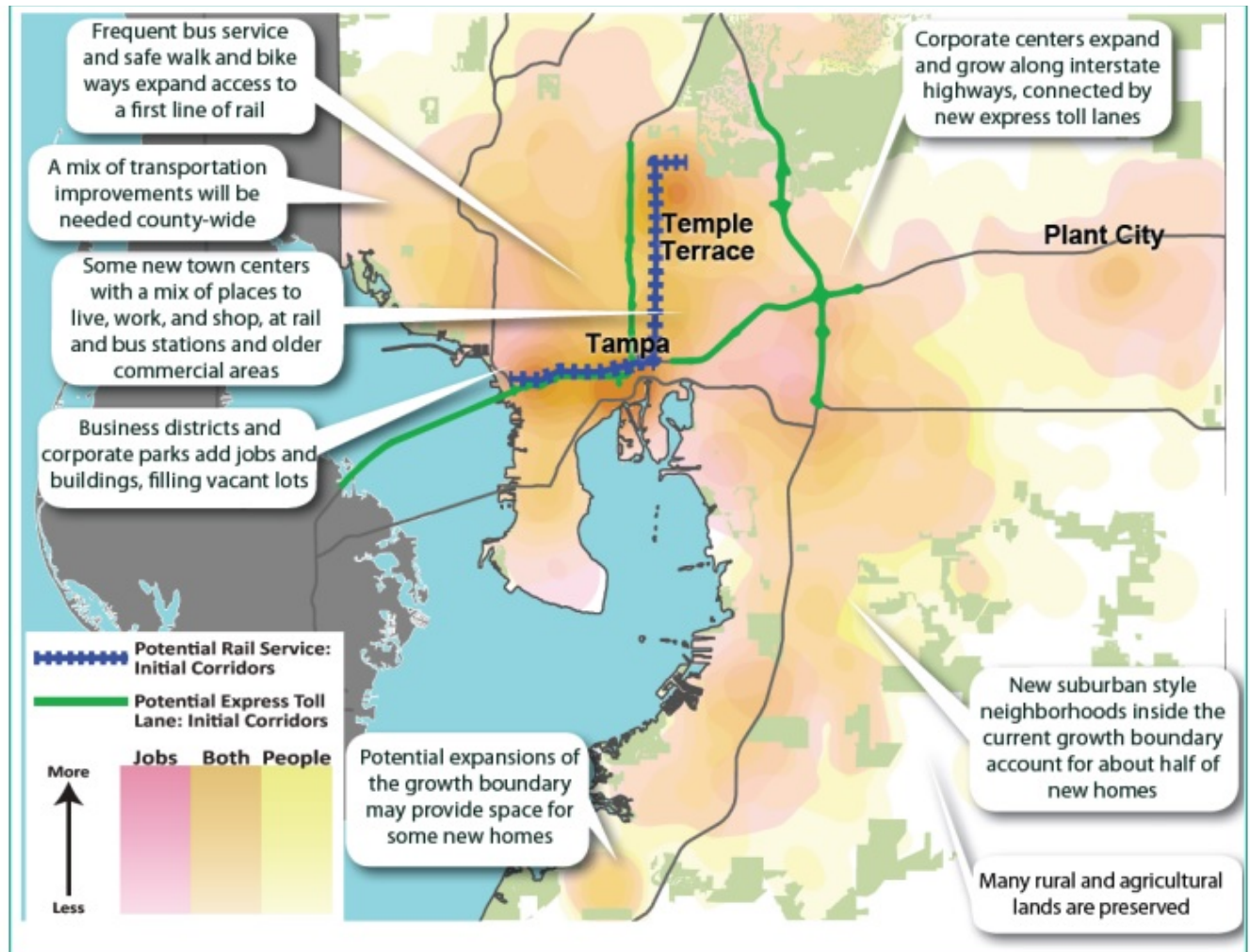
Source: Supporting Performance Based Planning and Programming Through Scenario Planning, USDOT. 2017

Example Normative Scenario Planning Process: Hillsborough County MPO (Tampa) Imagine2040 For the regional plan update conducted in 2013-14, the Hillsborough County MPO in Tampa, Florida conducted a normative scenario planning exercise to develop an Imagine 2040 vision (Figure 4). The MPO worked with the county's Planning Commission, which oversees land use planning for the county and its local governments, to design future land use scenarios and settle on a vision for the region's land use. The agency also used a predictive analysis tool to establish four overarching themes—Preserve the System, Reduce Crashes and Vulnerability, Minimize Delay for Drivers and Shippers, and Real Choices When Not Driving—and to test how low, medium, and high levels of investment would affect performance measures for each category.

Predictive Models Support Investment and Policy Plans

Predictive scenario planning tools such as travel demand models have long been the go-go resources for developing long range transportation plans (LRTP). Agencies have made adjustments to these models over time to address new principles and goals that arise from normative visioning processes, such as updating land use forecasts, adding transit data and modeling capabilities, and

adjusting tripmaking assumptions to reflect higher rates of walking and transit use and reduced single-occupant-vehicle trips in compact, mixed-use activity centers with complete transit, pedestrian, and bicycle networks.

Example Predictive Scenario Planning Process: Connections 2040 Transportation Investment Scenarios The 2012 Delaware Valley Regional Planning Commission (DVRPC) *Connections2040 Transportation Investment Scenarios* study compared total regional transportation infrastructure needs identified in the 2035 plan to potential available revenue under three scenarios. (Figure 5) The exercise was conducted during the Congressional debates over the proposed reauthorization of the then-current MAP-21 transportation bill, which was set to expire in 2014. It was intended to "facilitate regional dialogue of a collective vision for the future of Greater Philadelphia's transportation system, and how we will pay for it." Results were also used to support the financial element of the subsequent Connections 2040 Plan.

Funding assumptions for the high scenario were based on the highest funding level proposals being put forth at the time by Congress in the debate over a new transportation bill (DVRPC noted that none had identified a source of additional funding). The scenario forecasted some decline in current road and bridge conditions, achieving a state of good repair for transit, and several road and transit operational improvements.

The medium scenario represented the most likely investment level for transportation infrastructure. Funding assumptions were based on DVPRC Connection2035 long-range plan forecasts but adjusted downward to account for the fact that some of the anticipated growth in federal funding from 2009 to 2014 had not actually occurred. In this scenario, road and bridge conditions worsened considerably, transit was still far from a state-of-good repair, and there were a few road and transit operational and system expansion improvements.

Funding assumptions for the low scenario were based on 10-year Congressional Budget Office forecasts for federal gas tax revenue extrapolated to 2040. Road and bridge conditions were expected to decline substantially, with 100 state-maintained bridges forced to close. The region's transit infrastructure backlog of state-of-good repair needs would worsen to the point of compromising the service.

None of the scenarios was able to fund all needs. The agency concluded "declining fuel tax revenue and dwindling federal and state transportation trust fund balances lead to an uncertain future. Without some new way of funding transportation, the region could be looking at the low investment scenario.... Even maintaining status quo funding is an unattractive option, as it delays or lacks funding for many critical projects."

Figure 5: DVRPC Connections2040 Transit Investment Scenarios

Transit New Capacity Lines by Scenario

The Federal Transit Administration's New Starts and Small Starts are competitive grant programs that provide funds for developing new, or extending, passenger rail, subway, and light-rail systems. The investment scenarios assume that any future New Starts and Small Starts grants will be more closely tied to an agency being in a state-of-good repair, in order to ensure the long-term viability of any new facility. The region needs to add new transit capacity to help meet travel needs for future population and economic growth, while making the transportation system more energy efficient.

Investment Scenarios

In the low scenario, the region is able to fund two bus rapid transit (BRT) projects: **A** (on the map) the South Jersey BRT from Camden and Gloucester counties to Center City, and **B** the US 1 BRT in Mercer and Middlesex counties. BRT uses priority bus lanes, rail-like stations, efficient boarding and alighting, and improved passenger information to speed up service.

In the medium scenario, the region can fund both BRT projects, the rail line **C** from Camden to Glassboro, and the reactivated **D** Media-Elwyn Line to Wawa.

After accounting for the cost of building the lines in the low and medium scenarios, the high scenario would have about $2 billion, plus any New Starts and Small Starts funds the region can attract. This should allow for two to four additional new capacity projects. Potential projects include:

- **E** extending the Norristown High Speed Line to King of Prussia;
- **F** extending the Lansdale Line to Pennridge;
- **G** extending the Paoli-Thorndale Line to Atglen;
- **H** new rail line along Delaware Avenue in Philadelphia;
- **I** extending the Broad Street Line to the Navy Yard;
- **J** new Cultural Connector Line in Philadelphia;
- **K** Roosevelt Boulevard BRT; and
- **L** reactivating the West Trenton Rail Line to Bridgewater, New Jersey.

Source: DVRPC: Connections 2040 Transportation Investment Scenarios Report. October, 2012.
[1]https://www.dvrpc.org/Connections2040/pdf/Connections2040InvestmentScenarios.pdf

Exploratory Methods Support Tactical Planning for Uncertainty

Agency staff, the public and elected officials have become increasingly interested over the past couple of decades in addressing "what-if" questions that lent themselves best to exploratory scenario planning methods. Through these types of tactical exercises, agencies can "stress-test" the resilience of vision-based plans by weighing risks, identifying opportunities, and assessing potential impacts on planned transportation investments that may arise from the influence of external forces that are largely outside the purview of the transportation agency's direct control, and/ or difficult to predict with any certainty. Exploratory scenario planning exercises often address topics such as:

- Changing socio-economic conditions that could impact travel patterns and needs for equitable access to multimodal choices, such as growing numbers of older adults in cities, suburbs, and rural regions, and displacements of lower-income households within urban areas due to rising housing prices and gentrification from redevelopment projects.

- Environmental trends that could damage infrastructure conditions and connectivity, such as sea level rise, increasing incidents of coastal and inland flooding, high-heat days, and severe storms.

- Technology innovations such as e-commerce and ridehailing services that could change urban and regional passenger travel behaviors and demand for goods movement.

Example Exploratory Scenario Planning Process: Metropolitan Transportation Commission (San Francisco) Plan Bay Area and Horizons2050 The Metropolitan Transportation Commission (MTC), which conducts long range transportation planning for the San Francisco Bay Area, provides an example of how performance measures can be used in all phases of planning, including the direction phase, and how scenarios can influence the measures. MTC considered expected future trends and a variety of investment scenarios to identify performance objectives for its LRTP, Plan Bay Area, adopted in 2013. The performance measures then were used to conduct quantitative evaluations of projects to score projects on how well they would address and support the agency's goals. A Regional Equity Working Group comprised of stakeholders representing equity interests from the nonprofit, public, and private sectors assisted MTC in developing and evaluating scenarios. The vision planning step and its supporting scenario planning process i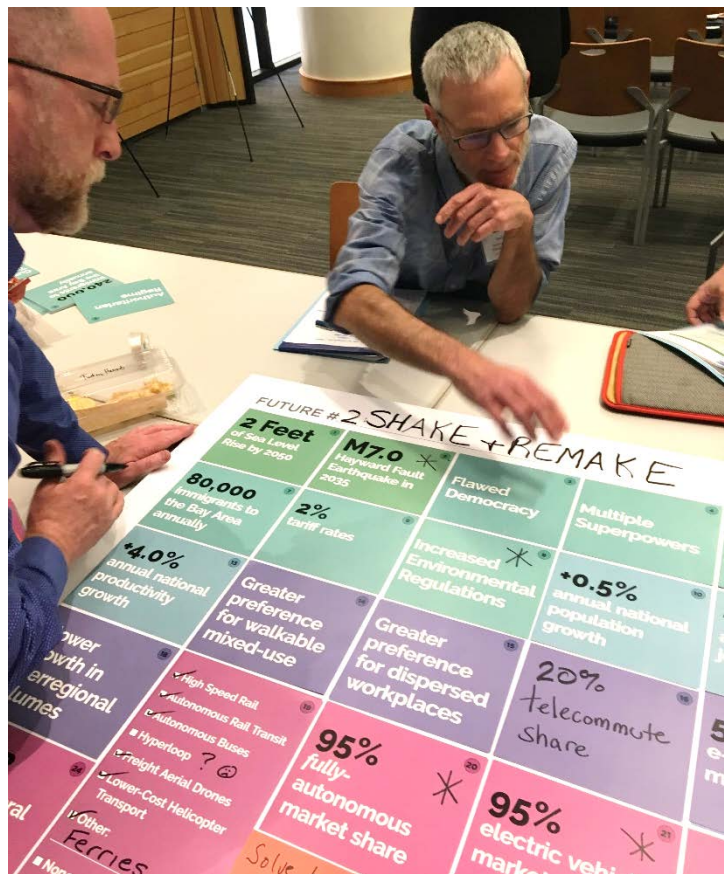s the critical link for establishing goals and performance measures. The 2050 long-range plan updated involved an extensive exploratory scenario planning initiative, *Horizons 2050*, that involved dozens of stakeholders and expert panelists in work sessions and gaming exercises.

Figure 6: MTC Horizons2050 Workshop

Photo by Hannah Twaddell

Scenario Planning Initiatives in the COG Region

COG and TPB have conducted a variety of predictive and normative scenario planning activities over the past two decades that have helped analyze the impacts of differing investment, policy, and operational strategies in support of achieving regional goals such as meeting voluntary greenhouse gas (GHG) reduction targets and adhering to the principles adopted in the TPB Vision. The following six studies are summarized in the Scenario Planning Overview white paper for this project (Appendix D, Table 4):

- Regional Mobility and Accessibility Study (Posted: November 2006)
- Regional Value Pricing Study (Posted: February 2008)
- What Would it Take? Scenario (Posted: May 2010)
- CLRP Aspirations Scenario (Posted: September 2010)
- Multi-Sector Approach to Reducing Greenhouse Gas Emissions in the Metropolitan Washington Region (Posted: January 2016)
- Long Range Plan Task Force (LRPTF) Assessment of Regional Initiatives (2017)

More recently, between 2018 and 2020, TPB provided travel demand model data to the Union of Concerned Scientists to support an exploratory scenario assessment of potential impacts of autonomous vehicle (AV) adoption on low-income communities and communities of color in the Washington, D.C. area. The project team used data from the COG regional travel demand model to quantify how transportation outcomes may differ across jurisdictions and communities in the region under a variety of future AV scenarios.[1]

Following the Union of Concerned Scientists' study, the District Department of Transportation co-sponsored a broader assessment of AV impacts with a regional nonprofit transportation advocacy group (DC Sustainable Transportation). Potential benefits across all scenarios included economic growth, housing affordability, and mobility choices for vulnerable populations. The principal negative impact under all scenarios was increased Vehicle Miles Traveled (VMT) and congestion generated by individuals shifting from transit, bike, and walking modes to single-occupant or shared AV usage, and by zero-occupant vehicles (ZOVs) such as AVs traveling empty between passenger and cargo pickups. To mitigate the negative impacts, the study recommended interventions and incentives to support shared rides and alternative modes of transportation. [2]

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[1] https://www.fehrandpeersdc.com/project/autonomous-vehicles-and-equity/

[2] https://lims.dccouncil.us/downloads/LIMS/44545/Introduction/RC23-0172-Introduction.pdf

NAVIGATING THE SCENARIO PLANNING PROCESS

An agency can use scenario planning techniques for many different purposes: to build consensus on a vision, to fine-tune tactics, or simply to educate people about emerging external forces or critical issues. That said, the activities conducted during a scenario planning process are generally similar regardless of the purpose and type of effort: agencies assess the potential impacts of different scenarios on goals; convene stakeholders to consider implications and tradeoffs associated with alternative futures; and elicit values, concerns, and ideas to inform subsequent plans. As depicted in Figure 7 most scenario planning initiatives involve six basic steps that encompass initial scoping and data collection, technical analyses and interpretation, and decision-making.

Collaboration: A Fundamental Element of Scenario Planning

Scenario planning is a collaborative, iterative effort from beginning to end. Plausible descriptions of future-world conditions integrate quantitative forecasts and estimates with qualitative imaginings and "educated guesses." The process of building, interpreting, and evaluating scenarios requires a variety of skills, including technical analysis, visualization, journalistic and technical writing, teaching, and facilitation. It is helpful, therefore, to form a multidisciplinary planning team to support a comprehensive scenario planning exercise.

The process of evaluating alternative scenarios, weighing tradeoffs, and making decisions can involve a diverse array of people—technical staff, community stakeholders, officials, and the general public. Not every scenario planning effort requires all these types of participants. Extensive public and stakeholder engagement is critical for building consensus on a regional vision, whereas engagement for a strategic exploratory exercise, such as considering potential impacts of emerging vehicle technologies on system performance, may focus more technical experts and key stakeholders. Regardless of the scope of the project, the effectiveness of any scenario planning exercise depends on getting the right people around the table and facilitating the discussion in a carefully planned way.

Figure 7: Six-Step Scenario Planning Process
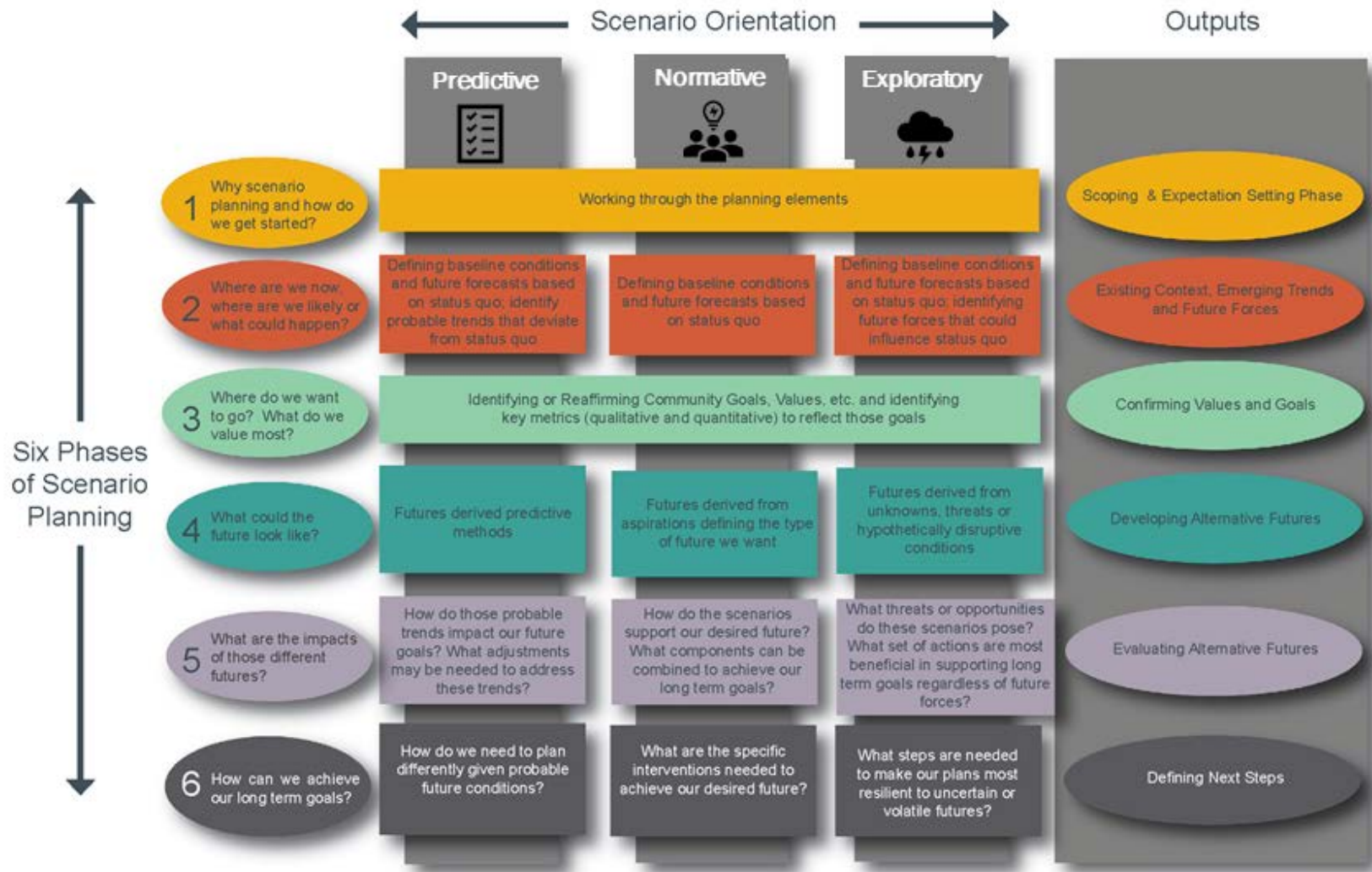
Based on information from Next Generation Scenario Planning. USDOT. 2017.

Scoping a Scenario Planning Process

Just as a writer outlines a plot for a novel, or a scientist establishes a hypothesis and proposed method to guide a research project, a scenario planning manager maps out an initial plan for the exercise with elements such as the study purpose and general approach; anticipated / desired outcomes; goals and indicators that will likely be important to consider; and a general approach for technical analysis and stakeholder/ public engagement. Referring to this blueprint frequently can help the project team stay on track throughout the process of data collection, tool selection, analysis, engagement, and decision-making. Table 1 provides a few questions that an agency can use to start mapping out a scenario planning approach.

Table 1: Questions to Consider When Scoping a Scenario Planning Process

Defining study purpose and general approach
• What is the purpose of this scenario planning exercise?
o Do we intend to build consensus on an overall vision and broad goals or principles?
o Are we developing a plan or program for formal adoption (e.g, CLRP or TIP)?
o Are we "stress-testing" an existing or proposed plan to identify resilient strategies and potential alternative tactics to mitigate problems and leverage opportunities presented by sudden or gradual changes in conditions?
• How will the results be used, and who will use them?
o Who will make decisions based upon the results of the exercise? What is the impact of those decisions?
o Who else might use the information from this exercise? For what purposes?
Identifying necessary metrics, data, tools, and resources
• What will be important to convey in the final description of findings and recommendations?
• What metrics and benchmarks may be needed for evaluating alternative options, weighing tradeoffs, and supporting decisions?
• How much time and resources will be needed to acquire and learn to use tools and data, build scenarios, conduct iterative analyses, and make adjustments along the way?
o Will we need to adapt and /or procure tools and data?
o What kind of training may be needed?
Planning to engage partners, advisors, and the public
• Who should be involved in the project team?
o What kinds of perspectives and disciplines will be needed to conduct meaningful assessments and generate useful insights?
o Who could be helpful with technical elements such as assembling data, identifying performance measures, evaluating scenarios and interpreting results?
• Should the general public be engaged in this exercise?
o If so, how will we use their input and manage expectations about the outcomes?

SCENARIO PLANNING TOOLS

Choosing a Scenario Planning Method

Before choosing a scenario planning method and tools, it is critical to be clear about the desired outcomes of the process. Agencies can design scenario planning exercises to support specific decisions and plans, or they can intentionally suspend the goal of arriving at firm decisions in order to focus on expanding awareness of important issues and building relationships among stakeholders and with the general public. (Table 2). Predictive scenario analysis methods and tools are most useful for supporting precise decision-making, while exploratory processes are high-level thought exercises that often do not produce specific plans or strategies. Normative methods can use a wide variety of scenario planning tools and can be paired with predictive or exploratory methods. The distinguishing characteristic of a normative method is the emphasis on building consensus toward a shared vision or approach.

Table 2: Example Outcomes for Different Types of Scenario Planning Processes

Desired Outcome	Primary Scenario Analysis Method
Engage the public and stakeholders in tradeoff discussions to address value conflicts and reach consensus on a vision and associated implementation strategies	Normative
Convene agency departments and partner agencies to identify cross-organizational implementation strategies and build consensus for achieving regional goals	Normative
Identify specific policy changes and project investment needs to meet performance targets	Predictive
Identify strategies for achieving performance goals given likely changes in future funding streams	Predictive
Inform community members, elected officials, and other interested parties about driving forces that could influence regional goals	Exploratory
Identify potential resilience strategies in response to future threats or uncertainties	Exploratory

Based on information from Next Generation Scenario Planning. USDOT. 2017.

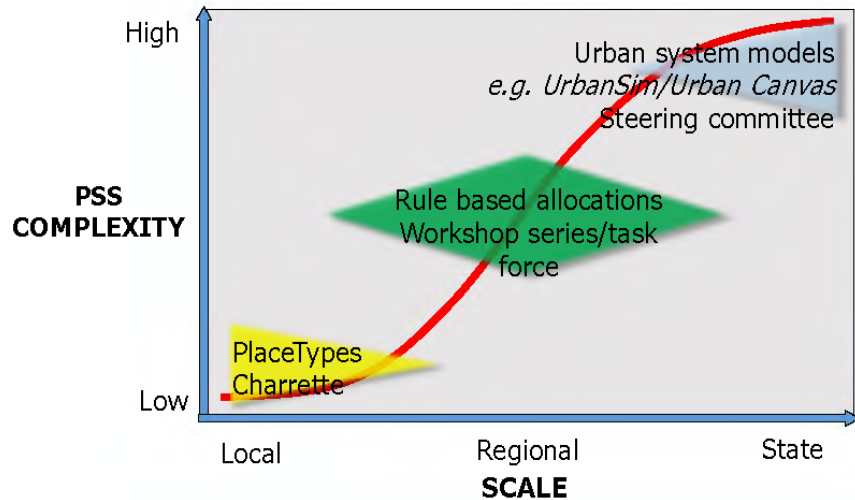## Definition of a Scenario Planning Tool

For the purposes of this study, scenario planning has been defined as a practice by which organizations or communities plan for an uncertain future by exploring multiple possibilities of what might happen. A scenario depicts a potential future generated by external forces beyond an agency's control combined with actions within its purview.[3] Therefore a scenario planning tool is defined as any planning support system (PSS) or method used to build these scenarios and work with stakeholders to assess their impacts.

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[3] This description is drawn from the definition of scenario planning developed by the Oversight Committee for this project. A more detailed version of the definition is available as a separate document.

Detailed GIS spatial analysis tools and spreadsheet-based fiscal calculators are appropriate for locally scaled scenario planning initiatives such as development sites, neighborhoods, towns, and smaller cities. Regional and statewide scenario planning initiatives usually call for more sophisticated modeling tools that can calculate results of policy decisions (e.g., zoning and fiscal incentives for compact development, parking fees) and capital investments (e.g., transportation capacity projects, water and sewer systems), and typically involve technical committees and advisory groups as well as broader public engagement methods (Figure 8).

Figure 8: Scenario Planning Tools and Engagement Methods in Relation to Geographic Scale

Source: Sketch Tools for Regional Sustainability Planning. NCHRP 08-36 Task 117. 2016.
PSS = Planning Support Systems

Scenario Planning Tool Descriptions

Scenario planning analysis models and software tools play a crucial role in the scenario planning process. For this study, in-depth profiles were developed for three scenario planning tools: TMIP EMAT, TRIMMS, and VisionEval, along with snapshot profiles for nine additional tools: CityEngine, CommunityViz, Cube Land, Envision Tomorrow, Remix, TDM+ (Fehr & Peers), Uplan, UrbanFootprint/RapidFire, UrbanSim/UrbanCanvas.

PROFILED TOOLS

Travel Model Improvement Program Exploratory Modeling and Analysis Tool (TMIP EMAT)

TMIP EMAT is a methodological approach to exploratory modeling and analysis. It provides a window to rigorous analytical methods for handling uncertainty and making well informed decisions using travel forecasting models of all types. It is designed to integrate with an existing transportation model or tool to perform exploratory analysis of a range of possible scenarios. In the documentation of TMIP EMAT, we refer to the existing model or tool as the "core model". The core model should take a collection of inputs and generate one or more outputs, or "performance metrics", of interest. Inputs can include variable inputs (e.g., fuel cost) as well as model parameter inputs (e.g., the elasticity of vehicle travel with respect to fuel cost). It is useful for examining model forecasts as a range of model outcomes rather than a single outcome, and it provides a mechanism for defining uncertainties and visualizing outputs.

Trip Reduction Impacts of Mobility Management Strategies (TRIMMS)

Developed in partnership with national and university research institutes, TRIMMS is a scenario planning and analysis tool that augments predictive travel models by considering Travel Demand Management (TDM) policies and investments. TRIMMS is used to understand how transportation

and TDM strategies impact air quality and emissions, and is a stand-alone tool separate from a travel demand model. The tool analyzes TDM strategies that 1) directly impact the cost of travel 2) impact access, travel time, and employer-based programs, or 3) impact transit ridership through land use controls (e.g. – zoning). Tool outputs include change in mode share, social externalities, vehicle miles traveled (VMT), and emission pollutants, annual benefits and costs of strategies, and benefit/cost ratios. The outputs are viewed in a spreadsheet. TRIMMS is appropriate for regional and employer-based (worksite level) analysis. It is worth noting that TRIMMS was used as part of COG/TPB/MWAQC's Multi-Sector Working Group Study, the National Capital Region Climate Change Report.

VisionEval

VisionEval is a scenario planning suite of tools designed to evaluate potential transportation-related environmental impacts of policy decisions and is used by MPOs to answer questions that the regional travel demand model cannot answer. It is appropriate to analyze the relative potential transportation system performance and environmental impacts of policies at an aggregated local or regional scale, but VisionEval is not designed to evaluate scenarios involving specific projects, as there is no road network built into the model. It is most useful to apply before, or in conjunction with, analyses involving a travel demand model.

Hosted by FHWA, VisionEval is operated by the Collaborative Development of New Strategic Planning Models Pooled Fund. The VisionEval framework enables new model features to be added in a 'plug-and-play' fashion so they can be easily shared among models. The framework is built on the following "GreenSTEP family" of models:

- GreenSTEP – the first model in the strategic planning family, developed by the Oregon Department of Transportation (ODOT). The model was created to assist in the development of plans to reduce GHG emissions from light-duty vehicles and to meet Oregon State statutory goals. GreenSTEP models the effects of many different factors (e.g., transportation supply, prices, land use, etc.) on household vehicle ownership and use, and the effects on emissions, traffic congestion, and other responses.

- Regional Strategic Planning Model (RSPM) – developed by Oregon DOT, RSPM is an offshoot of the original GreenSTEP tool. RSPM goes beyond GHG emissions by including non-motorized travel outcomes and subdivides metropolitan areas into districts.

- Rapid Policy Analysis Tool (RPAT) – developed under the federal Strategic Highway Research Program (SHRP2) also uses part of the GreenSTEP code. RPAT assists in the evaluation of potential effects of growth polices on regional travel.

The three selected tools for in-depth evaluation all help organizations answer some of the biggest uncertainties. They offer the broadest flexibility in analyzing and understanding the impacts of policy decisions. TMIP EMAT and VisionEval require significantly more time to prepare and use than TRIMMS. TMIP EMAT and VisionEval are relatively newer tools while TRIMMS has been on the market longer. Despite being available longer, TRIMMS has less market penetration or industry buzz than TMIP EMAT and VisionEval. TMIP EMAT and VisionEval are both supported by robust github websites while TRIMMS has a more traditional PDF manual and Microsoft Excel platform. All three tools complement and interact differently with a travel demand model. VisionEval is more appropriate prior to or in parallel with a travel demand model, while TMIP EMAT is used after a travel demand model has been run. TRIMMS is a standalone tool, that can be used with or without a travel demand model. Table 3 compares the three tools.

Table 3: Comparison of TMIP EMAT, TRIMMS, and VisionEval

	TMIP EMAT	TRIMMS	VisionEval
Subject Matter	Infrastructure projects, technology (automated/ connected/ electric / shared); land use; resiliency; demographics.	Economic, environmental.	Uncertainty, transportation, environmental, land use, public health.
Tool Type	Scenario planning and analysis.	Scenario planning and analysis to augment predictive travel models with consideration of TDM policies and investments.	A robust scenario planning suite to evaluate potential transportation-related environmental impacts of policy decisions.
Application	Exploratory scenario planning, particularly uncertainties.	Predictive and exploratory scenario planning.	Exploratory scenario planning.
Input Values	Performance measures generated by the core regional travel demand model (e.g., regional vehicle miles traveled, total transit boardings, regional mode share); "Risk variables" from core regional travel demand model inputs (e.g., land use, transportation network) and/or core model parameters (e.g., value of time, auto operating costs, freeway capacities). Risk variables are used as independent variables and performance measures as dependent variables to design an experiment that covers the uncertainty space and estimates a regression-based metamodel. All needed input values are available from the core model.	Analysis Details: project details at a regional or employment site level (e.g. number of affected employees, occupations, industries; program duration and cost. Employer-based Programs: worksite characteristics (e.g., bike facilities near site, shopping onsite); selection of programs for analysis (e.g. TDM subsidies, telework). Transportation and Employer-based Strategies: parking/ trip costs, access, travel times by mode (transit, cycling, and walking) Land Use Controls: area-wide analysis of policies to influence population density, retail density, transit station accessibility, transit-oriented development	Employment count and characteristics (e.g., industry); employment and land use attributes (e.g., location type, built form density, diversity, design ('D') values); parking policies; transportation demand management (TDM) programs.

	TMIP EMAT	TRIMMS	VisionEval
Input Types	Application Programming Interface (API) connection established directly to core model.	Area-wide or site-specific numeric values (e.g., cost of parking) or binary yes/no selections (e.g., flexible working hours offered, shopping onsite or within ¼ mile). Single input value per parameter and analysis; no geographic granularity.	Population, employment, land use, and transportation characteristics.
Output Values	Meta-model exports fall into risk analysis and exploratory analysis categories and are unique to the performance measures input by the user. Risk analysis displays a probability distribution of inputs. Exploratory analysis also uses a range but is focused more on existence and not probability.	Change in mode share, social externalities, VMT, and emission pollutants; annual benefits and costs; and benefit/cost ratio.	Default performance measures and dependent upon the module being used. Output metric categories include travel, cost, safety, and environmental metrics.
Output Types	Visualizations and spreadsheets.	Spreadsheets.	ScenarioViewers: interactive web maps/interfaces with outreach tools such as voting.
Geography and Scale	Corridor, neighborhood, and region.	Regional and employer-based (worksite level).	Aggregated region or regional zones.
Customizability	Highly customizable; based on risk variables and policies examined by core model.	Limited.	Relatively customizable using an open-source plug-n-play format.
Resources Required	API Connection.	Microsoft Excel.	R or Rstudio.
Public Engagement Visualization Capabilities	No	No.	ScenarioViewers: online quick responsive tools that allow the public to "play with" scenario options to learn how certain policies would impact the region.
Comparison to Travel Demand Model	TMIP EMAT is an add-on tool for a regional travel demand model and does not replace traditional models.	TRIMMS is a stand-alone estimation tool that looks at specific impacts of TDM programs for a region or worksite.	VisionEval should be run before or in conjunction with developing a travel demand model. VisionEval is more agile but less detailed than a traditional model.

	TMIP EMAT	TRIMMS	VisionEval
Organizations that Have Used Tool	Chicago Metropolitan Agency for Planning (CMAP),IL; Metropolitan (Met) Council, Minneapolis, MN; Oregon DOT; Sacramento Area COG (SACOG), CA; Southern California Association of Governments (SCAG), Los Angeles, CA; Greater Buffalo-Niagara Regional Transportation Council, NY	French Broad River MPO, Asheville, NC; San Diego Association of Governments (SANDAG), CA; San Joaquin Council of Governments, Stockton, CA	Atlanta Regional Commission (ARC), GA; Corvallis Area MPO, OR; Delaware Valley Regional Planning Commission (DVRPC), Philadelphia, PA; Durham-Chapel Hill-Carrboro MPO, NC; Metropolitan (Met) Council, Minneapolis, MN; Sacramento Area COG (SACOG), CA
Open Access	Yes.	Yes.	Yes.
Cost	Free.	Free.	Free. Optional to be a collaborative MPO partner for $15,000 annually for three years.
Website	tmip-emat.github.io	trans.com	visioneval.org

SNAPSHOT TOOLS

The nine tools selected for snapshot reviews are described in Table 4.

Table 4: Snapshot Tool Descriptions

Tool	Description
CityEngine	ArcGIS CityEngine is a 3D modeling software which can rapidly generate urban environments. CityEngine can use real-world GIS data, and iterate various design scenarios for urban planning and transportation projects. CityEngine is extensible for entire urban areas or localize areas of specific plans. 3D visualizations allow stakeholders to view project details and contemplate various scenarios. CityEngine is applicable software for jurisdictions to create a Digital Twin of their built environment
CommunityViz	CommunityViz is an ArcGIS extension capable of scenario planning, suitability analysis, build out potential, impact analysis, site planning, and comprehensive planning. The tool illustrates alternative land development patterns and associated impacts on criteria that the user can select from a pre-defined list. CommunityViz offers Scenario 360, an ArcGIS extension that adds interactive analysis tools and a decision-making framework.
Cube Land	Cube Land is an econometric land-use allocation model that brings realistic land-transport interactions into the modeling process. Cube Land identifies the impacts of economic growth, changes in population, employment and wealth, urban growth management policies, real estate development projects, and transportation projects and policies.
Envision Tomorrow	Envision Tomorrow is an open-access scenario planning package that allows users to analyze how their community's current growth pattern and future decisions impacting growth will impact a range of measures from public health, fiscal resiliency, and environmental sustainability. A design-based model capable of comparing five scenarios against existing conditions.
Remix	Remix is an online browser-based tool primarily used for public transit planning. It provides rapid route design and allows users to create complex scenarios and communicate ideas visually, quickly, and easily. Remix has multiple tools including Transit, Shared Mobility, Multimodal Street Planning, and Exploring. Each tool can be used individually or with others. Remix strives for user-friendly and fast acting interfaces that provide real time insight to the public and decision makers.
TDM+ by Fehr & Peers	TDM+ is a tool developed by Fehr & Peers that enables agencies, employers, and developers to estimate how a Transportation Demand Management plan affects vehicle trip generation and corresponding vehicle miles traveled (VMT).
Uplan	Uplan is a simple, rule-based urban growth model intended for regional or county level modeling on an ArcGIS platform.
Urban Footprint / RapidFire	UrbanFootprint is a geospatial bottom-up tool that evaluates existing conditions, explores urban markets, analyzes the impacts of future scenarios, and supports transparent communication with easy-to-understand maps reporting. The companion tool RapidFire is a spreadsheet-based top-down tool that tests data input impacts on land use patterns and policies across metrics.
UrbanSim / UrbanCanvas.	UrbanSim is a complex and powerful modeling platform available to simulate metro real estate markets and impacts of land use and transportation plans. It is used to predict behaviors or interaction within a network or system to illustrate the cause and effect of different scenario variables relative to environmental, transportation, economic, and development goals. It can be used in conjunction with activity-based travel models to analyze alternatives and explore strategies to achieve target outcomes. Urban Canvas

Tool	Description
	provides access to block, zone, and parcel-level UrbanSim models. UrbanCanvas is similar to CityEngine, but is integrated with UrbanSim. It provides 3D visualization and scenario comparisons but with lower analytical capability than CityEngine.

Discussions with 15 peer MPOs queried during the course of this study about the use of the nine "snapshot" profiled tools indicate UrbanSim is the most widely used. A few MPOs had explored Remix for transit service planning. The issue of incompatible geographic units across data sets was identified for a few tools. Geographic units for UrbanSim, Urban Footprint, Envision Tomorrow, and Remix data outputs are larger than parcel level, making these tools difficult to use for agencies whose GIS datasets and/ or travel demand models are based on parcel-level data. Another theme among the "snapshot" profiled tools was limited functionality, which reduced the cost-effectiveness of investing in software and data development. Two MPOs cited this as the reason for not fully using Remix, while another noted cost issues as the rationale for not using Remix.

PRACTICES AMONG PEER MPOS

For this study, the research team issued a questionnaire to 15 peer MPOs that were experienced in applying scenario planning methods and tools. Criteria to identify MPOs that could be considered COG/TPB peers included attributes such as regional population size and growth rates, economic generators, and transportation assets as well as agency structure and staff capacity. Two agencies did not respond to the questionnaire, and three others (DVRPC, DRCOG, and SACOG) completed web-conference interviews in lieu of filling out the questionnaire. The study team incorporated the notes from these discussions into a standard questionnaire and added information available from agency reports and websites. Table 5 lists the 13 MPOs that responded to the questionnaire, the scenario planning initiatives that were referenced within each individual questionnaire, and the tools used to support each featured study.

Table 5: Peer MPOs Studied

Agency	City	Featured Study	Tool(s) Used for Study
ARC Atlanta Regional Commission	Atlanta	Widening the Future, Sharpening our Focus: SHRP2 Element C08. 2016.	VisionEval, GreenSTEP, Regional Strategic Planning Model, (RPSM), and Rapid Policy Analysis Tool (RPAT), Conveyal
CMAP Chicago Metropolitan Agency for Planning	Chicago	ON TO 2050. 2018	Envision Tomorrow (ET), UrbanSim and UrbanCanvas
DRCOG Denver Regional COG	Denver	2050 Metro Vision Regional Transportation Plan 2020.	UrbanSim, In-house analysis built on travel demand model
DVRPC Delaware Valley Regional Planning Commission	Philadelphia	Dispatches From Alternate Futures: Exploratory Scenarios For Greater Philadelphia. 2020.	Uplan, UrbanSim/ Urban Canvas, VisionEval (RPAT)

Agency	City	Featured Study	Tool(s) Used for Study
MARC Mid-America Regional Council	Kansas City	Connected KC 2050 and Integrated Planning Framework 2020	Envision Tomorrow (ET); UrbanSim/ UrbanCanvas; Conveyal
Met Council	Minneapolis	2040 Transportation Policy Plan. 2020	Cube Land
Metroplan Orlando	Orlando	2045 Metropolitan Transportation Plan 2020.	In-house analysis built on travel demand model
Miami-Dade Transportation Planning Organization	Miami	Smartplan Beach Northeast Corridors Land Use Scenario and Visioning Planning. 2020.	ESRI 3D Land Use Evaluation Tool; Remix
MTC Metropolitan Transportation Commission	San Francisco	Horizon Futures 2050 Resilient And Equitable Strategies For The Bay Area's Future. 2020.	Fehr & Peers TDM+, Conveyal
PSRC Puget Sound Regional Council	Seattle	VISION 2050 Supplemental Environmental Impact Statement (SEIS). 2020.	UrbanSim/ UrbanCanvas; "Sound Cast" Travel Model; also (in previous studies) Transit Competitiveness Index (TCI) tool and Transit Sketch Planning tool
SACOG Sacramento Area COG	Sacramento	2020 Metropolitan Transportation Plan/Sustainable Communities Strategy. 2020.	Envision Tomorrow (ET) and VisionEval, TMIP_EMAT
SCAG Southern California Association of Governments	Los Angeles	Incorporating Decision Making Under Deep Uncertainty (DMDU) Pilot Study. 2020-21 (in progress)	TMIP-EMAT, VisionEval
WFRC Wasatch Front Regional Council	Salt Lake City	Wasatch Choice 2040 Regional Transportation Plan. 2015.	Envision Tomorrow (ET); UrbanSim/ UrbanCanvas

Agency Structure and Resources

Most of the nation's MPOs are housed within a regional council of governments (COG) or function as a stand-alone public sector agency. The MPOs selected for this research were similar to the national profile; nine (70 percent) were housed within a COG, and four (30 percent) were structured as stand-alone agencies.

Unified Planning Work Program (UPWP) budgets, typically expressed in two-year increments, varied from as little as $2 million in Salt Lake City (WFRC) to as much as $93 million in Southern California (SCAG). Transportation Improvement Program (TIP) allocations of funding for regionally significant transportation projects and services varied as well, with amounts that were not necessarily proportionate to the relative dollar value of UPWP budgets among the group. SCAG had the highest TIP allocation at $35 billion, followed by CMAP at $17 billion. One reason for the wide variation in TIP

allocations is the different approach to transportation funding from one state to another. In states such as California, localities and regions routinely manage millions or even billions of dollars of transportation revenues from taxes and bonds authorized by local referenda. By contrast, state Department of Transportation in Virginia and North Carolina build and maintain local streets with relatively small financial contributions from county governments.

The MPOs reported a wide range of staff counts represented a wide range, from as many as 330 in San Francisco (MTC) to as few as 17 in Orlando (Metroplan). (The questionnaire directed MPOs not to double-count people that served more than one function). Despite this range, the numbers of GIS analysts and travel demand modelers were similar across all agencies, ranging from four to ten GIS analysts (except for SCAG which reported 20 GIS staff) and three to ten travel demand modelers.

In addition to discussing their experience with scenario planning tools, MPOs described their travel modeling tools. Most of the peer MPOs used a hybrid of in-house tools that were built upon traditional trip-based modeling (TBM) platforms. All the MPOs except DVPRC were currently running both TBM and Activity-Based Models (ABM), and DVRPC noted it is in the process of upgrading its TIM 2.0 model to an activity-based platform.

The MPOs were also asked about data sources for their studies. Very few purchased the data they needed. Two MPOs bought some datasets to support forecasting for other MPO work, but not specifically for the scenario planning initiative. When asked if training was required for staff to become proficient with the methods and tools being used to produce the scenario planning products, all the MPOs said no specific training was required. Some noted that staff have enough technical skills to learn what is needed throughout the projects.

Scenario Planning Project Scoping and Engagement

Most of the MPOs who responded to the questionnaire developed exploratory scenario planning process to examine potential trends and disruptors that could affect (negatively or positively) the region's ability to meet its goals. Topics typically included evolving transportation technologies, socio-economic trends, and, in at least one case, potential long-term impacts of the COVID-19 pandemic on travel demand.

Each MPO provided links to and/ or copies of scoping documents, often incorporated into study technical reports. DVRPC noted the agency did not develop a stand-alone scope document, but recommended the Ralston Wilson Book Handbook for Scenario Planning as a very useful technical resource for scoping a scenario planning process.

Most the MPOs could not provide an exact budget for their featured scenario planning study because the project was bunded into the overall UPWP. Broadly, the project budgets ranged from a lower end of about $200,000-$400,000 to a moderate range of $800,000-$900,000, with one project (CMAP) budgeted at nearly $3 million. Most of the initiatives were completed in about two years.

MPO project managers and planners were closely involved in nearly all aspects of the studies. Travel demand modeling staff was closely involved in 42 percent of the projects, and partially involved in 50 percent. GIS analysts were closely involved in 16 percent of the projects, and partially involved in 66 percent. Consultants were closely involved in 33 percent of the studies, and partially involved in another 50 percent. Other types of staff and partners engaged in some processes included agency

communications and public/government affairs staff, outside subject matter experts, and nonprofit organizations.

The MPOs were asked to think about the overall Level of Effort (LOE) (e.g., time, staff resources, consultants, budget) required for the study. Tasks that required the highest LOE were data preparation (cleaning, coding) followed by selecting and maintaining scenario planning tools. The activity that required the lowest LOE was data collection (baseline, historical trends). Preparing reports and development analysis methods were also considered relatively low LOE tasks.

The MPOs provided rough estimates of the division of labor among MPO staff, consultants and other parties associated with application of technical tools to their selected scenario planning study. On average, about three quarters of the work across all the studies was handled by MPO staff and the rest was handled by consultants. In a few cases, contributions were made by local government staff, State DOT staff, or other partners.

Figure 9: Division of Labor for Study Process
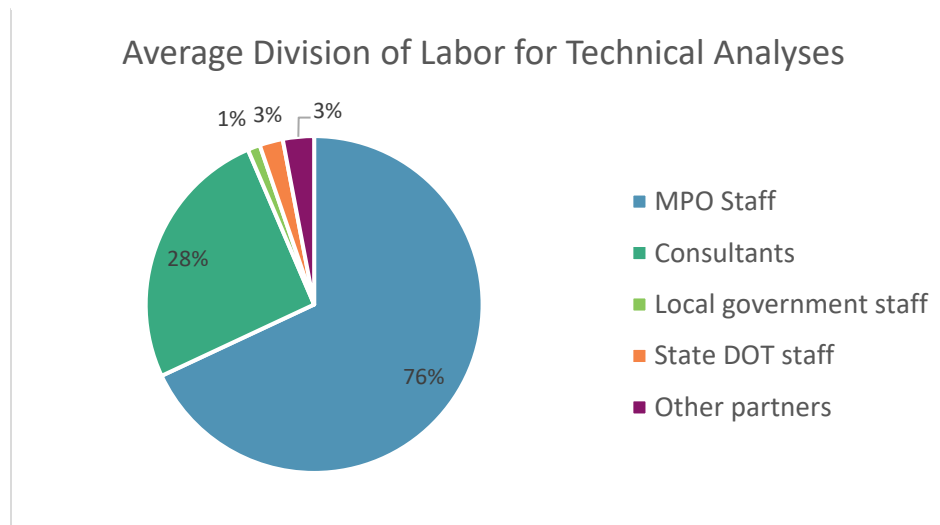
When asked what sorts of challenges were particularly associated with a high Level of Effort, the MPOs cited the time and effort required to structure the model inputs, measures, and reporting mechanisms; the need for close coordination between the project planners and modeling staff; and the preparation and facilitation of stakeholder meetings.

In response to a question about the types and roles of organizations involved in their study processes, 85 percent of MPOs indicated the MPO Board served as a decision maker. About 56 percent of the studies placed decision making roles with Project Oversight Committee or MPO Technical Committee(s). Some studies included multiple kinds of decision makers.

When asked about key decision points in the scenario planning process MPOs noted that a variety of stakeholders were consulted, including the public, MPO staff, numerous committees, and consultants. Final decisions were made by MPO staff, often in consultation with the MPO Board.

The MPOs were asked which engagement techniques they used within their study. Over 90 percent of the MPOs conducted public forums and workshops, and 75 percent of studies featured stakeholder forums or workshops and public surveys or polls.

Scenario Planning Outcomes

MPOs were asked about the typical outcomes and responses to their scenario planning activities. Frequently cited results included generating a broad vision and goals, updating the long-range transportation plan, and creating an action plan. At least half of the MPOs also noted that the scenario planning initiative generated follow-up studies, fostered partnerships to implement the vision, and resulted in adopted regional policies.

In response to a follow-up question about their sense of the study's most significant outcomes, many of the MPOs noted the importance of the clarity and direction provided by the scenario planning exercises as a foundation for long-range plans or corridor studies. Several also said the scenario planning studies helped them to facilitate discussions with stakeholders and raise awareness of different topics.

In response to a two-part question about what worked and what they would have done differently with regard to their scenario planning initiative, many MPOs said the engagement and awareness generated by the process was very valuable. A few described some of the improvements to the technical rigor of their analyses. Considering what they would do differently in the future, many of the MPOs said they would plan more time for engaging staff and stakeholders in challenging discussions about initial assumptions and scenario design, and to allow for iterative processes to update or change the analysis based on feedback. Several expressed an interest in using a different type of scenario planning process, e.g., some who had completed normative visioning processes wanted to try exploratory processes, while others wanted to conduct narrowly focused strategic issues, such as financial feasibility assessments.

Many of the MPOs provided insights and suggestions they would offer to peer MPOs that wanted to conduct a scenario planning process. Common messages included thinking carefully about the key questions and engagement process in order to figure out an appropriately detailed technical approach; communicating clearly with board members and the public; and networking with other agencies through consortia.

Table 6: Advice From Peer MPOs

MPO	"What scenario planning advice do you have for other MPOs?"
ARC	Don't focus too much on trying to measure the outcomes in precise metrics for comparison purposes to decide which scenario is "best". That's not how the world works. Exploratory scenario planning should be about engaging in a dialogue about what's possible and anticipating both good and bad things that can happen (and how can we incentivize/ mitigate those impacts through proactive policy decisions). The pandemic has demonstrated that we need to be prepared for the possibility of major upheaval in our lives and to never assume that the status quo is a given or change is gradual. Expand the definition of plausibility and game out the possibilities so you can be as prepared as possible when/if the next big disruption occurs.
CMAP	We didn't use a technical approach for alternative futures primarily because there were various separate technical analyses taking place for ON TO 2050 that we felt served as the best way to engage technical/policy audiences. To engage the general public, we wanted something a bit more lighthearted and fun that would draw people in. To determine whether a scenario planning process or tools are right for your agency, it may be helpful to think about what your ultimate goals are in the process. Although scenario planning can be very helpful to evaluate policy alternatives, the time and effort that the modeling and other technical components take may not always be necessary.
DVRPC	Shifting the paradigm to start from the narrative. We've continually used this Impacts2060 model which has some built-in elasticities such as the relationship between urban development and walk trips – it's pretty sophisticated but really just a linked spreadsheet that allows us to see the ripple of impacts. The TMIP_EMAT process told us more about what the model does than what the outcomes would be.
Met Council	Think through the purpose and evaluation up front and ensure that you have the resources to accomplish it all so that the engagement on the results in meaningful.
Metroplan	Take more time to thoroughly communicate key issues / drivers of change. Global pandemic impacted original engagement plan and technical timeline.
Miami-Dade TPO	The scenario planning process proved to be a very useful tool as a supporting role to the transit studies and the Locally Preferred Alternative. This process has undoubtedly helped in the efforts of moving the SMART Plan forward and seeking federal funds.

MTC	Have a conversation early on with executives, board members and all decision makers on the need to keep the scenario planning within a reasonable scope. Make sure there is understanding of the resource required to take on expansions in scope. Have a strong project manager in the lead, who is not responsible for any tasks other than project management. Robust scenario planning is likely to require the collaboration of many making strong project management key. Do your best to start from an as-solid-as-possible data + modeling foundation to begin with. As the scenario planning process unfolds it is surely to stress the weakest and most unstable elements of the model.
SCAG	Joining a consortium or user community of scenario planning tools before making determination is a good starting point to learn experiences from existing users.

COG/ TPB AGENCY WORKSHOPS

Workshop Process

The capstone event of the research project involved two half-day virtual workshops with agency staff held May 21 and June 8, 2021. Sponsored by the Oversight Committee and facilitated by the consultant team, each workshop drew more than 20 participants representing a total of five departments: Plan Development and Coordination, Travel Forecasting and Emission Analysis, Systems Performance Planning, Planning Data and Research, and Department of Community Planning. Each workshop included presentations of the research by the consultant team and participant brainstorming / action planning activities on Mural digital whiteboards.

The objectives of each workshop were as follows:

- Learn/refresh knowledge of key scenario planning concepts (May 21) and tools (June 8).
- Identify opportunities for/ challenges to applying scenario planning methods (May 21) and tools (June 8).
- Generate next-step ideas and strategies for applying scenario planning methods (May 21) and tools (June 8) to agency projects and practices.

Workshop summaries, presentations, and other supporting materials are included with the digital folders of project deliverables provided to MWCOG by the consultant team. This report provides highlights from each workshop and concludes with recommendations generated by workshop participants for potential follow-up actions.

MAY 21, 2021 WORKSHOP: SCENARIO PLANNING PROCESS

Scenario Planning Overview
After an introductory exercise in which participants noted topics they were interested in exploring, the consultant team presented an overview of the following scenario planning concepts and information:

- Definition of scenario planning, noting "Scenarios are stories, not plans."

- Reasons agencies use scenario planning

- Building blocks of scenario planning (forces plus levers = outcomes)

- Types of scenario planning (normative, predictive, exploratory)

- General structure/scope of six-step SP process

Highlights of the subsequent discussion included the following questions and comments:

- *Question:* How can we include something in a scenario without sounding like an advocate for it? Example: scenario planning for CAVs. *Response:* Frame conversations around agency goals and focus on principles. Also, be intentional about naming scenarios, to avoid unintentional positive or negative connotations.

- *Question*: Could we use ranges for predicting? Ranges can serve as a helpful technique for risk analysis. *Response:* A "Monte Carlo" scenario tool (available as an Excel extension) is a useful resource for developing probabilistic ranges of potential future outcomes, such as a set of minimum to maximum population forecasts for a region like Las Vegas where growth rates are subject to unpredictable "boom and bust" cycles.

- *Comment*: The board's attitude has changed in recent years, creating a more permissive and exploratory atmosphere, especially on land use. Increasingly, the region is being pressured to develop more aspirational forecasts, which can sometimes conflict with existing policies built into our model assumptions.

- *Comment:* We are ready to dive deeper on some efforts; distilling those focus areas into quantifiable inputs is important. For example, 80 percent of current land use forecasts are on the ground now. We need to be cognizant about managing expectations around changing the future.

- *Comment:* An area for growth could be more intentionally linking scenario planning to long-range planning.

Ideas for Applying Scenario Planning Methods

Using the Mural whiteboard, the group then generated the following list of ideas for applying scenario planning methods and tools to current, pending, and potentially new projects and services. The first four topics, highlight in bold-faced type, were identified as top-ranked ideas for further discussion.

- **Institutional needs/strategies:**

  o Using a "scenario on-demand" tool.

  o Implementing continuous scenario planning.

  o Dealing with staff turnover

  o Acquiring scenario planning expertise.

  o Addressing future factors from the long-range plan.

  o Planning for long-range outcomes with regional priorities that shift more quickly.

  o Transitioning to new statistical software.

  o Using assumptions from other MPOs' scenario planning.

  o Looking at applications with land use forecasting vs conventional (and official) cooperative forecasting process.

- Post COVID-19 impacts on regional travel patterns

- Climate/sustainability/electrification:

    o Changes in carbon-based fuel availability and pricing.

    o Lowering GHG emissions by 50% by 2030.

    o Using scenario planning for resiliency efforts.

    o Vulnerability analysis.

    o Planning for future infrastructure for electrification.

- Equity:

    o Scenario planning as a tool for robust public engagement.

    o How to define equity outcomes in the context of scenario planning.

    o Impacts of climate migration on equity / socio-economic factors

- Funding/pricing/incentives:

    o Scenario analysis to explore road pricing and to better understand its impacts/what it would take to implement.

    o Use of VMT taxes in lieu of motor fuel taxes.

    o Using scenario planning to provide members with orders of magnitude for various initiatives.

- CAV

- Active transportation

- Travel behaviors/consumer preferences

- Freight

Challenges and Opportunities
Participants brainstormed the following challenges and opportunities that the adoption of scenario planning could create for the agency.

CHALLENGES
- Internal

    o Time and resources.

    o Technical capacity.

- External

    o Setting expectations.

    o Managing assumptions.

    o Participants making up their mind in advance.

- Internal/external

  o Figuring out who should be involved.

  o Building internal and external confidence.

  o Staff capacity for communications and public engagement.

- Creating the models

  o Layering of assumptions.

  o Agreeing on time frames, scenarios, factors, outcomes to consider.

  o Measuring outcomes.

  o Data availability and fusing data from multiple sources.

OPPORTUNITIES
- Internal

  o Opportunity to improve staff knowledge and expertise.

- External

  o Engagement with stakeholders.

  o Opportunity for consensus-building.

  o Stakeholder buy-in.

- Exploring possibilities

  o Moving beyond metrics to storytelling.

  o Addressing new topics/non-traditional topics.

  o Mixed methods approach.

  o Making holistic shifts in planning approaches and focusing more on equity.

- Planning capabilities

  o Ability to quickly test a large set of scenarios.

  o Use scenarios to make the unconstrained element of LRP more compelling and to inform those strategies.

Moving Forward

Drawing from the initial brainstorming exercise, the group used the Mural whiteboard to map out action planning ideas regarding institutional needs and strategies (the highest rated current/future project in Exercise 1). The following lists summarize ideas for desired outcomes, potential implementation partners, potential resources, and next steps.

DESIRED OUTCOMES
- Being prepared/proactive and able to respond quickly:

  o Plan ahead so that we can properly fund studies and conduct outreach.

  o Operate in an assertive rather than reactive mode for scenario planning.

  o Be ahead of questions from the TPB.

- Coordination: Being able to coordinate easily between various teams.

- Expertise:

    o Build staff expertise and add to the planning toolset.

    o Be able to answer new questions.

- Long-range planning: Coordinated scenario planning with long-range plan development.

POTENTIAL IMPLEMENTATION PARTNERS

- Local governments and State DOTs

- Universities

- SMEs on various regional topics

- Tool developers

- Public and other stakeholders

- Cross-departmental staff, board, committees, task force

POTENTIAL RESOURCES

- Dedicated staff hours (medium effort, medium likelihood of success)

- Acquiring scenario planning tools (medium effort, high likelihood of success)

- Confidence from board and stakeholders (high effort, medium likelihood of success)

NEXT STEPS

Participants listed several specific action items that could be accomplished within varying time frames over the coming three or more years. The list is incorporated into the Recommendations for Follow Up Action at the end of this report.

JUNE 8, 2021 WORKSHOP: SCENARIO PLANNING TOOLS

Compelling Aspects of Scenario Planning Tools

The June 8 workshop kicked off with an introductory exercise in which participants were asked to answer the question: *What is most compelling to you about the idea of applying scenario planning tools?* Responses (subsequently categorized by the consultant team) included the following:

- Engage stakeholders and the public:

    o Quick and dirty basic analysis- starting point for further discussion

    o Encourage discussion

    o Opportunity to engage the public and to supplement with existing analytical approaches

    o Seeing which scenarios are most popular to staff, stakeholders, and public

- Respond to the board and members:

    o Help us address questions from our board about how to most effectively address our policy priorities

    o Be able to more quickly respond to questions from the TPB

- o   Provide answers to board members questions on strategies that are outside of historic trends

    - o   Explore how our members can advance their aspirational initiatives

    - o   New ways to engage our membership and spark dialogue

- Explore/ prepare for uncertainty:

    - o   Explore and plan for uncertainties about the future

    - o   Prepare for an uncertain future

- Explore new ways of thinking:

    - o   Look at bolder approaches to address the issues facing the region (rather than the usual)

    - o   Something new

    - o   An alternative to the regional travel model for analyzing scenarios

- Expand analysis capabilities:

    - o   Screen scenarios from a larger to a smaller set of scenarios

    - o   Quick data analysis

    - o   Provide more analysis with our plans

Key Concepts and Terms

The consultant team provided an overview of the following tool-related concepts and terminology:

- Scenario planning tool definition: Any planning support system (PSS) or method used to build information about future potential conditions and work with stakeholders to assess impacts.

- Scenario building blocks and time horizons: Predictive tools such as travel demand models are based on time horizons that can support credible forecasts, e.g. 20-30 years; normative and exploratory tools may reflect longer time horizons, e.g. 50 years, intentionally avoiding the premise of accurate forecasts in favor of broader ranges of possibilities.

- When to choose tools: Decisions about which tool(s) to use can be made anywhere within the first three stages of the six-stage scenario planning process but should not be firmly established until after the first step of stage 1: articulating why the process is being conducted. Examples from peer MPO responses to the question "why did you conduct your scenario planning process" featured a blend of specific, quantifiable topics to be addressed and qualitative elements such as desired levels and types of engagement with stakeholders, the public, and agency staff. The process of selecting tools should consider both the quantitative and qualitative elements.

- Data-related key terms

    - o   Forecasts: the process used to predict travel behavior.

    - o   Projections: used with precision for predictive scenarios; can support but are not always required to be as precise for normative and exploratory scenarios

    - o   Trends: used to support all types of scenarios, can be expressed quantitatively and qualitatively; exploratory scenarios often focus on potential disruptions that can change the trajectory of expected trends

- o Probabilistic ranges: used to demonstrate the likelihood or chance that a particular outcome will occur. Particularly useful for risk assessments and other types of exploratory scenarios, because they establish boundaries of potential extreme outcomes for trends or events that could vary widely (e.g., high/ low future population or environmental conditions).

- Platform-related key terms

  - o Geographic information systems (GIS): support spatial analysis such as development patterns; tools such as UrbanSim are built on GIS platforms

  - o Spreadsheets: support numerical analysis such as probabilistic ranges; Monte Carlo simulations can be run on spreadsheets.

  - o R programming code: support statistical analysis such as relative levels of impacts across a variety of outcomes; VisionEval tool relies upon R.

- Types of scenario planning tools

  - o Sketch Planning Tool – a simplified, agile spatial tool that requires limited data and can generate multiple scenarios to provide rapid feedback on impacts. Supports normative and exploratory scenarios. *[N.B. sketch planning tools are not necessarily easy and quick to set up and run, per the subsequent discussion on the importance of differentiating sketch planning from strategic planning tools]*

  - o Monte Carlo Simulation – a numerical model used to predict the probability of different outcomes when the intervention of random variables is present by relying on repeated random sampling. Helps explain the impact of risk and uncertainty in prediction and forecasting models. Supports probabilistic ranges.

  - o Travel Demand Model – a computer model used to estimate travel behavior and travel demand for a specific future time frame, based on a number of assumptions. Supports predictive scenarios.

DIFFERENTIATING "SKETCH PLANNING" AND "STRATEGIC PLANNING" SCENARIO ANALYSIS TOOLS

Because the term "sketch planning" tended to conjure up different meanings to different people, participants were asked to discuss their understanding of the phrase, noting that COG/TPB Board member conceptions of sketch planning may influence how quickly they expect scenarios to be generated. The key takeaway from the discussion was the importance of distinguishing, and being clear with stakeholders about, the differences between *strategic* planning tools and *sketch* planning tools. This can help to clarify expectations about the associated level of time and effort required to develop and interpret scenarios.

- **Sketch** planning tools can support quickly generated, high-level analyses that rely on coarse assumptions and professional judgement.

- **Strategic** planning tools (such as VisionEval) may generate qualitative, sketch-like results intended for relative comparison (e.g., a given travel demand management strategy may have a high impact on congestion, but a low impact on GHG emissions), but they are not necessarily simple nor quick to set up and run.

Overview of Scenario Planning Tools

The consultant team presented high-level summaries of the 15 selected tools reviewed in the Tools white paper. In-depth profiles were developed for three tools: VisionEval, TMIP EMAT, and TRIMMS. Each description included the tool's purpose, inputs and outputs, interactivity with travel demand

models, a case study application, and a summary of strengths and weaknesses. As a supplement, the consultants shared information about Trendlab+, a tool developed by Fehr and Peers.

Guest speaker Jonathan Slason of the consulting firm RSG, provided additional insights and information about VisionEval based on his firm's experience developing and applying the FHWA-sponsored tool with Oregon DOT, and other states and MPOs. Following the discussion of these three tools, the consultant team briefly reviewed "snapshots" of the 13 additional tools studied. To cap off the tool presentations, guest speaker Paul Waddell of the University of California Berkeley and founder of UrbanSim, provided an overview and demonstration of UrbanSim capabilities.

Tool Application Lessons from Peer MPOs
The consultant team reviewed lessons learned from the Peer MPO Questionnaire and advice from Peer MPOs related to tool selection and application. Key takeaways included the following:

- Developing the analysis approach, determining which models were most appropriate for expectations

- Determining what measures to track and report that represent the values of the region, and are technically feasible.

- Data-driven storytelling; distilling the information down to something that can be communicated, understood and helpful for the process

- Collaborating between model staff and project staff to get the assumptions right

- Determining the numbers of scenarios and level of detail

- Managing a significant amount of data in order to create scenarios; preparing new sets of data for input; reviewing results to ensure logical outcomes

- Extensive local knowledge of current conditions, planned development, and future opportunities

- Budgeting time for the various modeling phases: design assumptions, code and run model, validate/ QA-QC and interpret results / ensure logical outcomes.

- Creating inputs and feedback loops across several different modeling tools and data sets; it would have helped to create "modules" for different feedback areas.

- Budgeting time to collect, make sense of, and use stakeholder feedback.

Discussions with DVRPC and DRCOG
Guest speakers Brett Fusco from DVRPC and Robert Spotts from DRCOG joined the meeting to share their experiences with scenario planning tools. Highlights of the discussion included the following:

DELAWARE VALLEY REGIONAL PLANNING COMMISSION (DVRPC)
- DVRPC has developed a suite of in-house and off-the-shelf tools over the past 15-20 years in more of an ad-hoc fashion, including UrbanSim and the Impacts 2050 model developed through the NCHRP 750 Foresight research process. Leading up to their recent exploratory scenario planning processes, DVRPC conducted a land use scenarios study in 2010, followed up by a study looking at funding scenarios and development of an online "Choices and Voices" scenario tool for stakeholder input.

- For the exploratory scenario planning process featured in the Peer MPOs research for the COG/TPB study, DVRPC wanted to do a better job at telling stories about what the future could look like. The goal was to inform the vision. They worked to bring together a diverse group of

people from across the region and to create an open process that would engage the public. They built an email outreach list of more than 400 people and conducted a series of different events to foster discussion. Participants were enthusiastic and really enjoyed the process.

- DVRPC kicked off UrbanSim use in early 2019. It has taken a couple of years to really get it running the way they wanted it to. UrbanSim estimated that they could have something up and running in six months. Timeframes are usually longer than expected. DVRPC's model has 12 land use types – that was probably the hardest thing to get into the model.

DENVER REGIONAL COUNCIL OF GOVERNMENTS (DRCOG)
- Over the past 14 years, DRCOG has conducted two major scenario planning exercises. In the first exercise, the staff used their travel demand model and MetroQuest to elicit public input about scenarios. MetroQuest is a popular platform that many agencies use, but it is a visualization and engagement tool for public input, based on data that the agency develops. It is not an in-depth analysis tool.

- One lesson learned from the first exercise was to avoid getting stuck in the weeds with the board and public about technical inputs. For the second exercise (the 2050 plan), the staff handled more of the technical decisions in house and focused external discussions on exploring more basic relationships and trends, and identifying what topics and issues to test.

- For the 2050 plan exercise, DRCOG used UrbanSim and the travel demand model, working with the UrbanSim team to figure out techniques for developing alternate inputs to the model, e.g., developing assumptions about use of e-scooters to increase active transportation trips. The UrbanSim tool is being used by different groups making the case for our shared regional vision. In addition, Colorado recently passed a very aggressive GHG reduction bill, so there will be some substantive transportation rulemakings coming up soon. This tool has been very helpful for informing these kinds of exercises and decisions.

General discussion between the participants and peer MPOs yielded some observations about the expectations placed on transportation agencies and the challenges of conveying what is in the purview of the agency. For example, COG/TPB staff noted GHG scenario studies indicated pricing may have the biggest impact on GHG reduction but pricing strategies may raise equity issues. It can be hard to convey this kind of big picture. Similarly, it may be challenging, but will be important, to address the potential impacts of CAVs in the upcoming COG/TPB long range transportation plan update.

POTENTIAL TOOL APPLICATIONS AND STRATEGIES TO MOVE FORWARD
Participants brainstormed ideas for applying VisionEval, TRIMMS, TMIP_EMAT, and UrbanSim, as well as identifying general questions that could apply to any tool. In a subsequent brainstorming session, the group discussed strategies for moving forward, considering topics such as staff development, retaining consultants, investing in software and data, developing partnerships, and generating funds. The results of these discussion are incorporated into the Recommendations for Follow Up Action at the end of this report.

RECOMMENDATIONS FOR FOLLOW-UP ACTION

Based on the results of the research process and workshop discussions, this section provides a synthesis of next-step recommendations for the MWCOG/TPB staff to consider in developing a subsequent strategic plan for agency investments and actions:

Potential Applications of Scenario Planning Methods and Tools

- VisionEval: Examine combinations of policies to determine which will have the most significant impact on our desired outcomes/ goals (e.g., GHG reduction, VMT reduction), and the levels of outcomes needed to move the needle. Screen many potential scenarios to decide which scenarios to evaluate further with the travel demand model. N.B.: MWCOG/TPB is testing an application of VisionEval during 2021-22 for the Climate Mitigation Study supported by the ICF team.

- TRIMMS: Quantify impacts of a specific GHG reduction strategy, like travel demand management.

- TMIP-EMAT: Explore CAV implantation scenarios to get a range of potential outcomes.

- UrbanSim: Explore elasticities/ impacts between changes in urban form, development patterns, and growth rates and changes in transportation infrastructure, services, policies, and investments. For example, relationship of low, medium, high CAV adoption rates to urban form and development patterns. N.B. Although UrbanCanvas is being developed as a web-based standalone tool, it is currently built on UrbanSim, which requires a major investment of staff time and data to set up.

- Estimate/evaluate the Transportation Emission Reduction Measure (TERM) (any tool can help with this)

- Coordinate scenario planning with long-range plan development.

Staff/ Organizational Development

- Continue to convene the scenario planning oversight committee or another cross-disciplinary group.

- Create a forum apart from the existing Committee and Board structure (which is so packed with Federally required activities) to develop and reflect upon scenario related issues/ topics/ processes (perhaps create a separate Futures Group with stakeholders like DVRPC, or a cross-departmental task force or committee).

- Establish an ongoing Scenario Planning task in the UPWP starting in FY 2023 (if not before) with dedicated staff and/or consultant resources.

- Practice developing a mock scenario process or approach[4]
  - o Identify key question(s) to be addressed
  - o List desired quantitative output and qualitative outcomes
  - o Conceptualize 3-4 scenarios
  - o "Work backwards" from conceptual scenarios to identify analysis methods and stakeholder engagement approach
  - o Identify the necessary performance measures and data

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[4] Resource recommended by Brett Fusco, DVRPC for scoping a scenario planning process: Ralston, Bill and Ian Wilson. The Scenario Planning Handbook: Developing Strategies in Uncertain Times. 2006. Texare Thomson/South-western. ISBN: 0-324-31285-7

- o Identify tool(s) that support the desired analysis method and stakeholder engagement
- o Test the mock scenarios with the tools; see how the scope and priorities may change based on lessons learned.
- Learn more about the Decision Making Under Deep Uncertainty framework.
- Share output from this project with other stakeholders and develop partnerships:
  - o Localities
  - o State DOTs
  - o Universities (particular recommendation to contact <u>Uri Avin, University of Maryland School of Architecture)</u>
  - o Tool developers
  - o Public and other stakeholders
  - o Cross-departmental staff, board, committees, task force
- Consider how to engage Board and stakeholders, considering lessons from agencies such as DRCOG on determining the appropriate topics and technical details to discuss externally.
- Build storytelling skills.
- Recruit PhD candidates or graduate students that could help explore ideas and test free tools
- Join a consortium
  - o <u>Lincoln Land Institute Scenario Planning Consortium</u>
  - o <u>UrbanSim Discussion Forum</u>
  - o <u>Society for Decision Making Under Deep Uncertainty</u>

Tool Development

- Schedule some more demos, talk further with peer MPOs and partner agencies (including WMATA)
- Use Climate Change Mitigation Study (with ICF) as a starting point to try VE.
- Develop a list of key questions to consider when selecting a tool:
  - o What could we do with this tool, in the short term and the long term? How do those potential applications support our agency's work plan and technical resources/ needs?
  - o How frequently we might be able to change the way we use the tool?
  - o How much does investing in the tool impact the questions we can ask?
  - o What's the process for developing model inputs, e.g. data and staff level of effort?

Next Steps

Staff proposed the following action steps during the May 21 workshop.

- 6-11 months:
  - o Have more conversations about scenario planning.
  - o Identify a couple of specific scenario planning initiatives that could be useful and start scoping them.
  - o Reconvene Scenario Planning Oversight Committee.
  - o "Game out" some scenario planning exercise to implement.
- 1-2 years:
  - o Scope a scenario planning element for the next LRTP update.
  - o Build consensus on staff capacity/needs.
  - o Determine staffing structure with point person/team for scenario planning.
- 3+ years:
  - o Implement scenario planning with the next LRTP update.
  - o Continue to develop and maintain capability.

RESEARCH MATERIALS

In addition to this report, the following research materials have been provided to COG/TPB in electronic format:

- Scenario Planning Overview, including folder of supporting materials such as reports cited in the report, and a two-page "Scenario Planning Definition" handout
- Scenario Planning Tools, including Excel spreadsheets of Tools research
- Peer MPO Research, including questionnaire, complete responses, and Excel spreadsheets of tabular results
- COG/TPB Agency Workshop annotated agendas and meeting summaries (May 21, 2021 and June 8, 2021)

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