OVERVIEW OF SCENARIO PLANNING

White Paper

November 20, 2020

National Capital Region
Transportation Planning Board

OVERVIEW OF SCENARIO PLANNING
Prepared by ICF for Oversight Committee on Organizational Awareness and Understanding of Scenario Planning
Approved by Oversight Committee on November 20, 2020

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).

ACCOMMODATIONS POLICY
Alternative formats of this document are available upon request. Visit www.mwcog.org/accommodations or call (202) 962-3300 or (202) 962-3213 (TDD).

TITLE VI NONDISCRIMINATION POLICY
The Metropolitan Washington Council of Governments (COG) fully complies with Title VI of the Civil Rights Act of 1964 and related statutes and regulations prohibiting discrimination in all programs and activities. For more information, to file a Title VI related complaint, or to obtain information in another language, visit www.mwcog.org/nondiscrimination or call (202) 962-3300.

El Consejo de Gobiernos del Área Metropolitana de Washington (COG) cumple con el Título VI de la Ley sobre los Derechos Civiles de 1964 y otras leyes y reglamentos en todos sus programas y actividades. Para obtener más información, someter un pleito relacionado al Título VI, u obtener información en otro idioma, visite www.mwcog.org/nondiscrimination o llame al (202) 962-3300.

TABLE OF CONTENTS

FIGURES AND TABLES

REPORT PURPOSE AND CONTEXT

COG/TPB is seeking to increase organizational awareness and understanding of scenario planning. Toward this end, the agency has 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 includes development of three white papers, of which this report is the first. It provides an overview of scenario planning and how it can be used to support regional transportation planning. The second white paper will review the state of the practice of the use of scenario planning by peer Metropolitan Planning Organizations (MPOs). The third paper will document 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 will host a workshop for COG/TPB staff and any other identified stakeholders 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. The project will conclude with a summary report of findings from the research and workshop, including 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.

WHAT IS SCENARIO PLANNING?

Scenario planning is 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.[1]

Figure 1: Scenario Planning Keywords

Source: Responses from Oversight Committee Members to a questionnaire about scenario planning. This input was used to develop a working definition of scenario planning in June 2020)

[1] This description and Fig 1 are 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.

What are Scenarios?

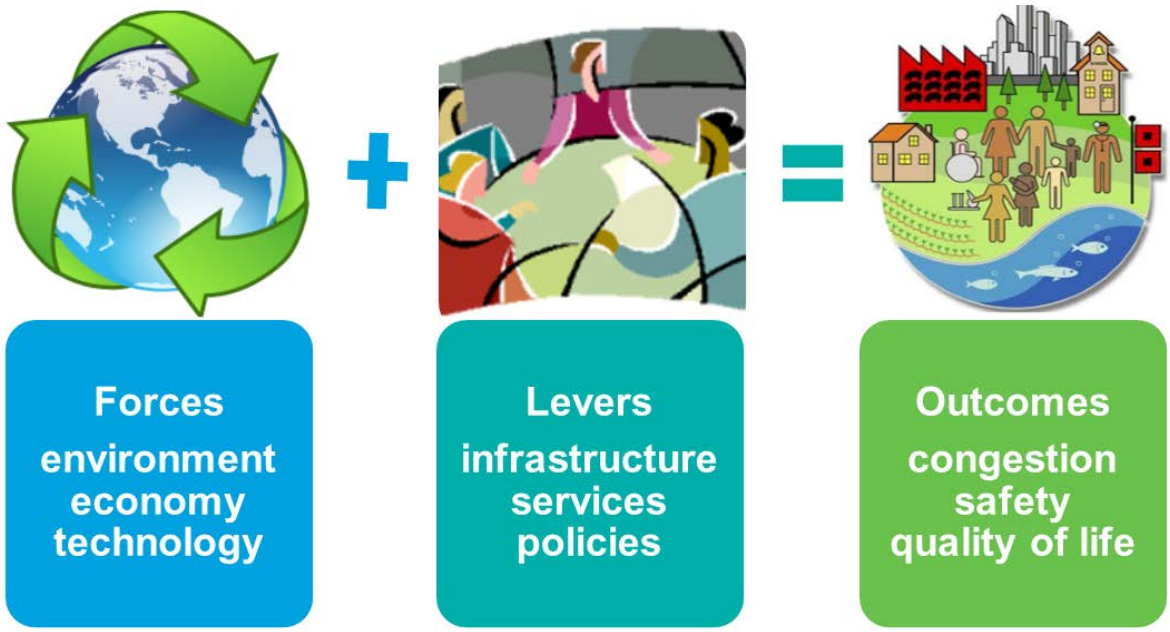
Scenarios are stories about different ways the future could unfold. Built upon a combination of forecasts, trend analyses, or qualitative trajectories, scenarios can be depicted as narratives or as charts and maps illustrating trajectories of change over time. Scenarios can be built upon a blend of qualitative speculations and quantitative forecasts.

Scenario analysts develop plausible descriptions of future conditions by combining assumptions about changes in ***external forces*** that are largely beyond the control of a single person or agency (e.g., socio-economic, technology, environmental trends) with potential actions or ***"levers"*** (e.g., infrastructure investments and public policies) that could be applied to influence ***outcomes*** (e.g., travel demand, transportation network characteristics, and land development patterns). (Figure 3).

Scenario stories need some grounding in a sense of what may happen, almost irrespective of what one would like to have happen, and what forces are at work driving change. They also should be sharply differentiated from one another and avoid "straw man" stories and predetermined favorites. They are about imagining and discovering future conditions so as to develop a readiness and agility in addressing multiple futures. The purpose of these exercises is to be able to identify the most robust and resilient actions in the face of these multiple outcomes.

Source: Sketch Tools for Regional Sustainability Planning. NCHRP 08-36 Task 117

Figure 2: Scenario Building Blocks



Predictive, Normative and Exploratory Scenario Planning

Scenario planning methods can support decision-making for many purposes and at different scales, including statewide or regional transportation planning, municipal land use planning, and business planning for public agencies or private companies. 20th century applications of scenario planning techniques evolved from military war games in the 1950s and 1960s to strategic planning exercises for international businesses such as Shell Energy, which has generated periodically updated global energy scenarios since the 1970s.[2]

Predictive **scenarios help to measure impacts of alternative investments/ strategies against a trend-based future condition.**

Normative **scenarios help to quantify characteristics of a desired future condition and to identify broad principles for reaching it.**

Exploratory **scenarios help to identify risks, opportunities, contingencies, and tactics for achieving goals amidst a variety of possible future conditions.**

Transportation planners have used travel demand modeling scenario techniques since the 1960s. In the 1980s and 1990s, Metropolitan Planning Organizations (MPOs) and other regional planning agencies began to adapt travel models and to create new analysis techniques using spreadsheets and Geographic Information Systems (GIS) to shape integrated land use and transportation scenarios for visioning exercises that addressed a growing public interest in environmental sustainability and expanded Federal requirements to plan for multimodal accessibility. During the first two decades of the 21st century, MPOs and some State Departments of Transportation have been developing additional scenario planning techniques to explore risks and opportunities associated with game-changing disruptions to economic, environmental, technological, and socio-cultural influences on travel demand and infrastructure conditions, such as the deployment of connected and automated vehicles, the rapid rise of smartphone-enabled ridehailing services, and increasingly frequent and severe incidences of extreme weather events and disasters such as hurricanes, floods, and fires.

Traditional transportation planning processes rely upon a ***predictive*** form of scenario planning in which alternative strategies are tested against a forecast of future conditions extrapolated from past trends. Travel demand models typically generate *predictive* scenarios of anticipated system performance by combining one forecast of land development conditions (e.g., predicted numbers of jobs and households allocated to traffic analysis zones) with different packages of potential transportation improvements (e.g., adding more lane miles of roadways, increasing transit service coverage, or making no new capital investments).

Using these types of predictive scenarios, planners can evaluate answers to question such as “If all the headways on the region’s heavy rail lines were cut from 12 minutes to 6 minutes during evening peak travel hours, how would the shares of trips made by transit, single-occupant vehicles, bicycling, and walking change?” The agency could use the results of this predictive analysis to help stakeholders to deliberate the potential costs and benefits of increasing transit service frequency, and to identify associated transit investments for an updated transportation plan. MWCOG’s “What Would It Take?” and “Multi Sector Working Group” studies described in appendix D applied

[2] https://www.shell.com/energy-and-innovation/the-energy-future/scenarios.html

predictive scenario planning methods to identify strategies for attaining the region's agreed-upon voluntary regional greenhouse gas reduction goals. In addition to using predictive scenario planning methods to consider strategies for achieving goals given probable future trends, an agency can use sketch-level scenario planning techniques to consider potential impacts and strategies associated with less predictable future conditions that could occur depending upon the way in which intentional actions or external forces play out. (Figure 3). Scenario planning for uncertain conditions still involves developing predictions, but the assertions about future conditions are intentionally less tied to the trajectories of past trends, and are often less precise.

Figure 3: Scenario Planning for Predicted vs. Uncertain Future Conditions

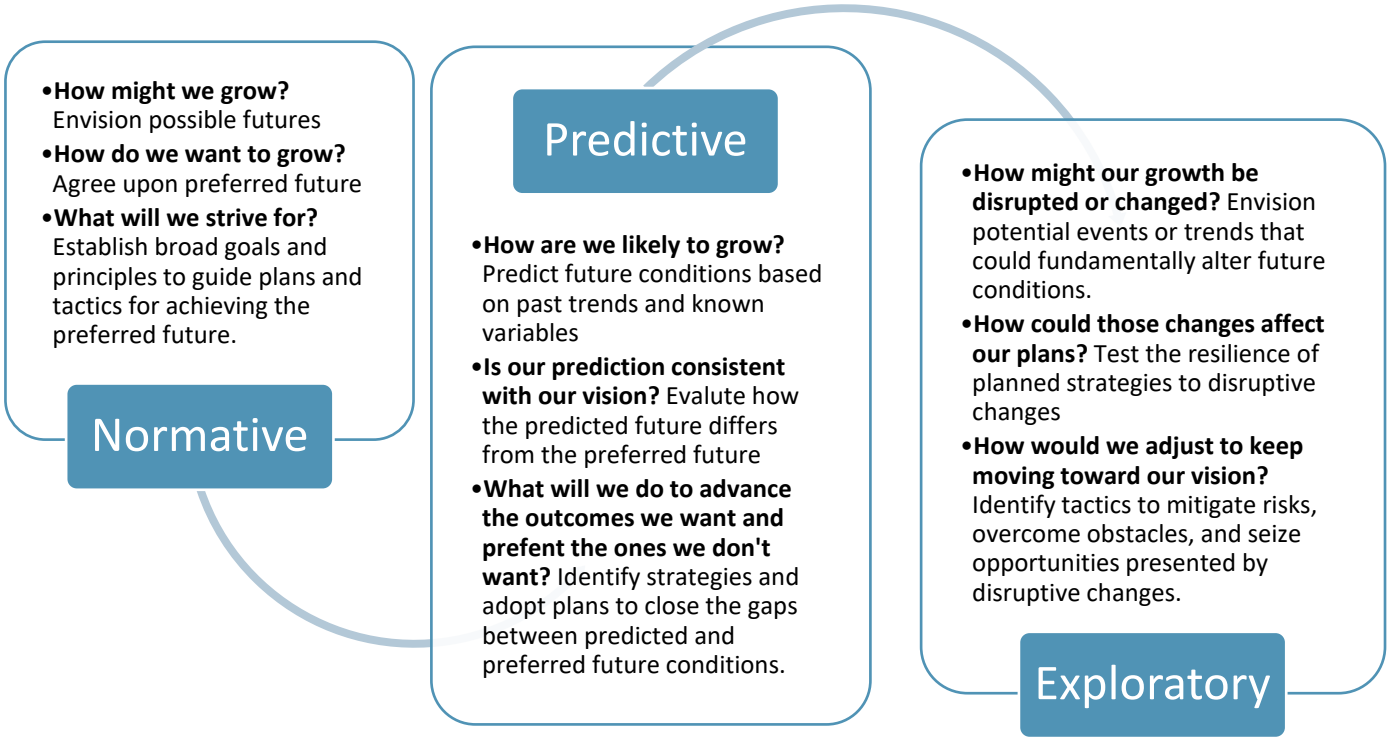
FUTURE ORIENTATION	PROBABLE FUTURES	DESIRED OR UNCERTAIN FUTURES	
PROMPTED BY QUESTIONS SUCH AS...	What is most likely to happen?	What is the future we want?	What might the future look like?
SCENARIOS ARE CONSTRUCTED BY...	Identifying likely or predictable trends and projecting them into the future. Trends could reflect conditions that may or may not be within the community's control.	Identifying future conditions or end states that reflect desires or goals based on things the community can control.	Identifying future conditions that reflect a different end state resulting from transformational changes, emerging issues, or potential threats that may or may not be within the community's control

Source: Next Generation Scenario Planning. USDOT. 2017.

Scenario planning for uncertain future conditions typically takes the one of two forms: a values-driven ***normative*** scenario planning process to build consensus toward a vision for a desired end state (such as the MWCOG Regional Mobility and Accessibility Study (Appendix D) or a tactical ***exploratory*** (or *"contingent"*) process to identify strategies for managing risks and leveraging opportunities to achieve its long-term goals under a variety of different potential future conditions (Figure 4).

Predictive scenario planning puts the focus on *reacting* to *predicted* future conditions, while normative and exploratory scenario planning emphasizes *preparing* for *desired* future conditions. For example, the MWCOG Regional Mobility and Accessibility Study was a normative scenario planning process that helped the MPO to build consensus on a regional vision and principles for more efficient and sustainable land use patterns and transportation networks. By contrast, the MWCOG Long-Range Plan Task Force initiatives included exploratory scenario planning elements to factor in the impacts of potentially disruptive changes in future conditions, such as a dramatic increases in telework, on the effectiveness of planned and proposed investments. This information helped the MPO to adjust its plans to be more resilient in the face of change. (Appendix D).

Figure 4: Normative, Predictive, and Exploratory Scenario Planning



Plausible Scenarios to Prompt "What If" Thinking: Examples from Foresight 750

The National Cooperative Highway Research Program (NCHRP) Foresight 750 series includes six publications that provide information on how different events and emerging trends could influence transportation in the next half-century. One element of the work includes the identification of four plausible future scenarios that can be used by transportation agencies to craft exploratory scenarios at the local level. Given the uncertainty of these scenarios, the report also includes the identification of signposts or key indicators that can help agencies determine which of these future paths is becoming most likely, as conditions and trends change over time.

Momentum Scenario: Sociodemographic shifts reflect current trends; slow population growth; robust world trade; changing technology makes travel safer and more fuel efficient; urban mega regions continue to grow along with lower density suburbs. Transportation Implications: Modest travel growth, continued concern with auto safety and travel reliability; less reliable Federal funding and subsequent increase in State and local power in transportation decision making.

Global Chaos Scenario: Significant financial instability and recession in the United States; increased weather events such as storms, floods, and droughts; shortened lifespans and falling population; global destabilization leads to shortages of jobs and oil. Transportation Implications: Rising fuel prices, decreased infrastructure investment; deteriorating transportation systems; slowing travel; shrinking congestion; transportation revenue sources grow unreliable.

Tech Triumph Scenario: Fundamental shifts in technology such as autonomous cars and advanced wireless communications lead to significant changes in travel patterns and booming economic growth; rapid population growth and significantly longer lifespans; diffusion of economic activity as people are no longer physically tied to their jobs; lower density development dominates. Transportation Implications: Dramatically improved safety; travel is less degrading to the environment; new technology such as self-driving vehicles is increasing the need for new transportation infrastructure.

Gentle Footprint Scenario: Low-impact lifestyle choices dominate; greater regulation results in significant social and economic control; people are guided by a desire to live more sustainably; carbon taxes lead to reduced energy consumption. Transportation Implications: Multimodal transportation networks are expanded; reduced focus on increasing highway capacity; land use planning guides transportation investments.

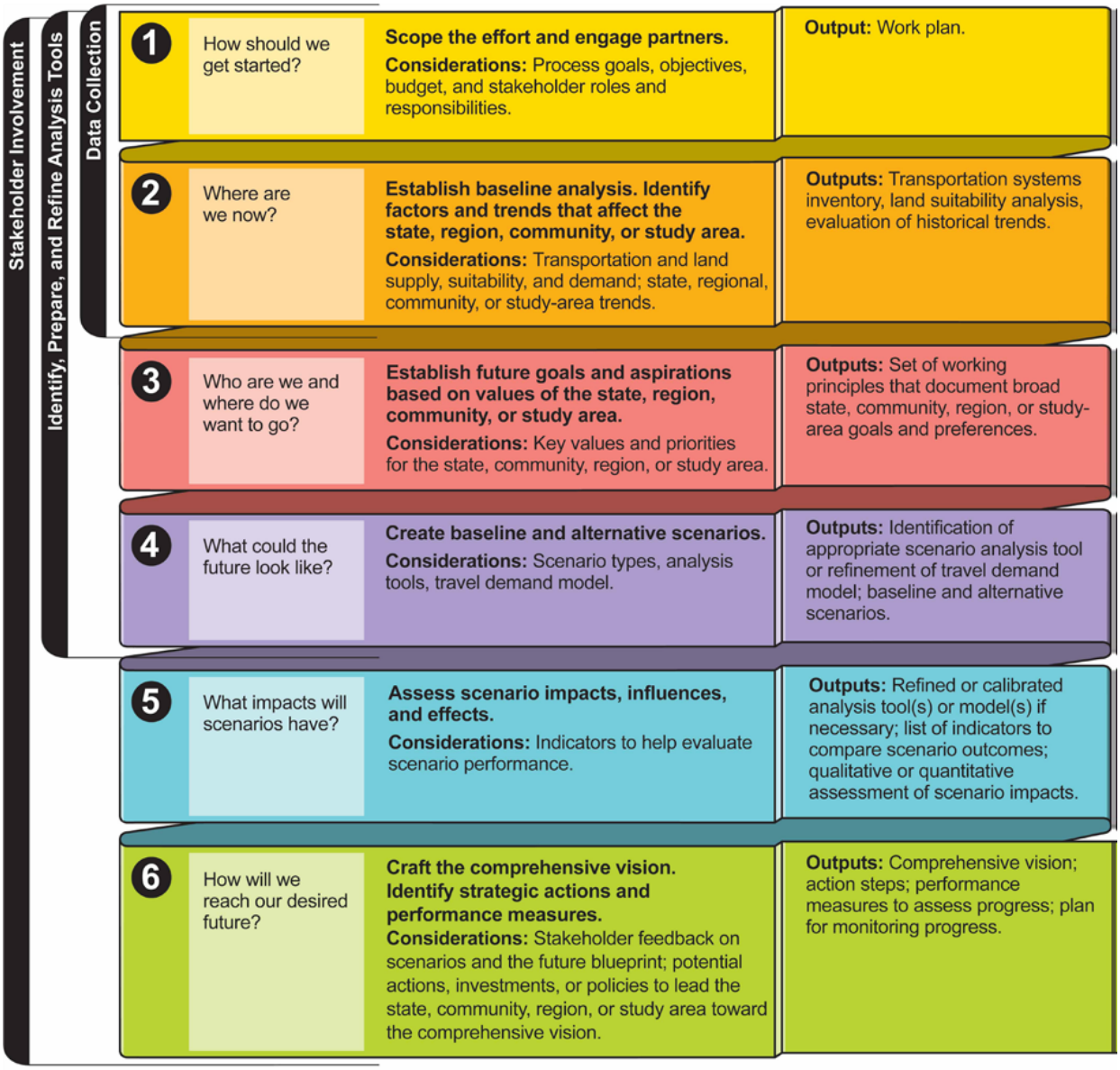
Source: Next Generation Scenario Planning. USDOT. 2017

Structuring a 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 Figures 6, 7, and 8 most scenario planning initiatives involve six basic steps that encompass initial scoping and data collection, technical analyses and interpretation, and decision-making. Figure 6 lays out the basic steps originally articulated by FHWA in 2011. Figure 7 illustrates ways in which the outputs from the scenario planning steps can inform the elements of the performance-based planning and programming process (PBPP) that many transportation agencies employ to link long-range plans to funding programs. Figure 8 provides suggestions for fine-tuning each step depending on the purpose of the exercise (i.e., normative, predictive, or exploratory). Following this series of figures, Table 1 provides a few questions that an agency can use to start mapping out a scenario planning approach.

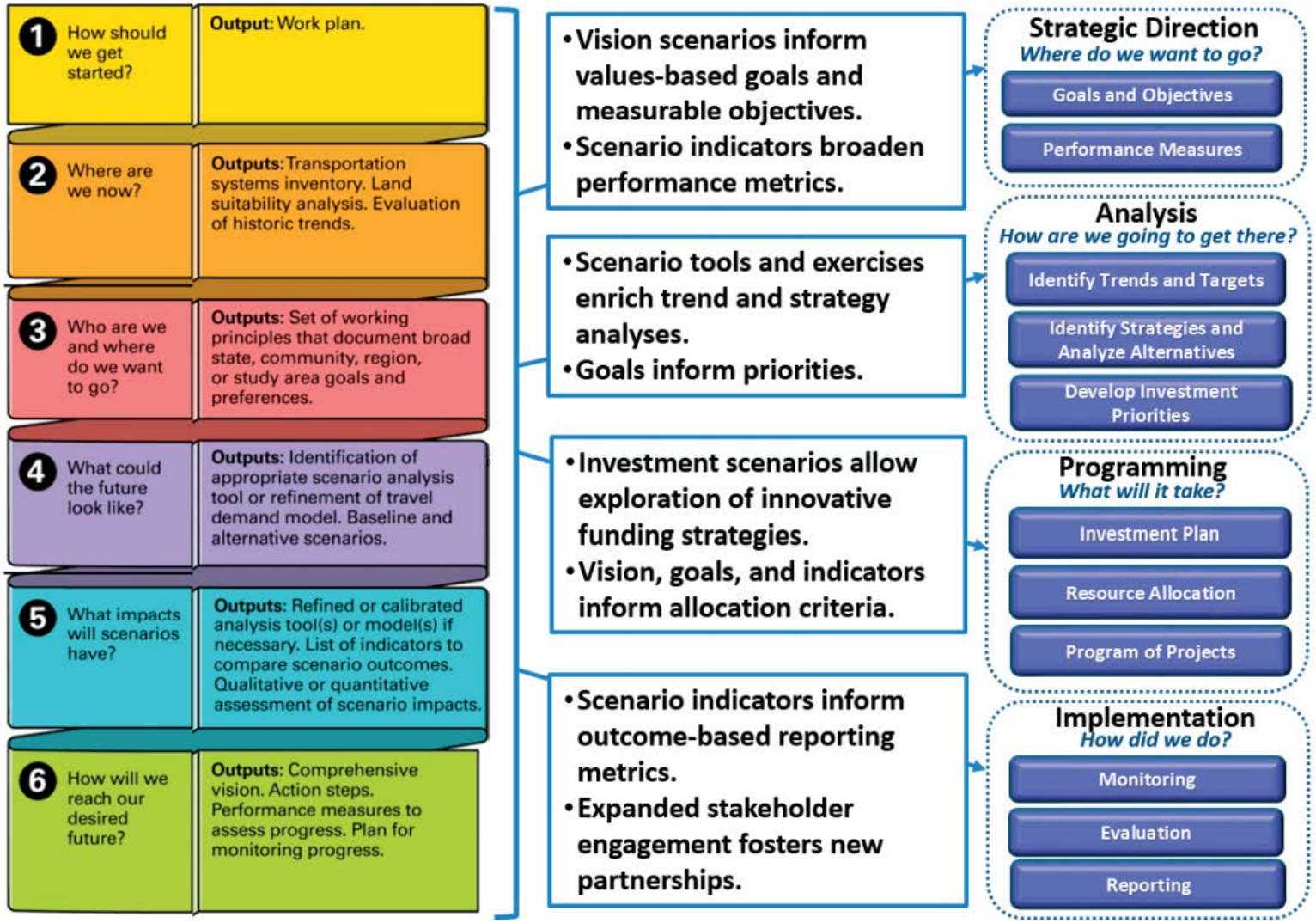
Figure 5: Six-Phase Scenario Planning Process



Source: Scenario Planning Guidebook. FHWA. 2011

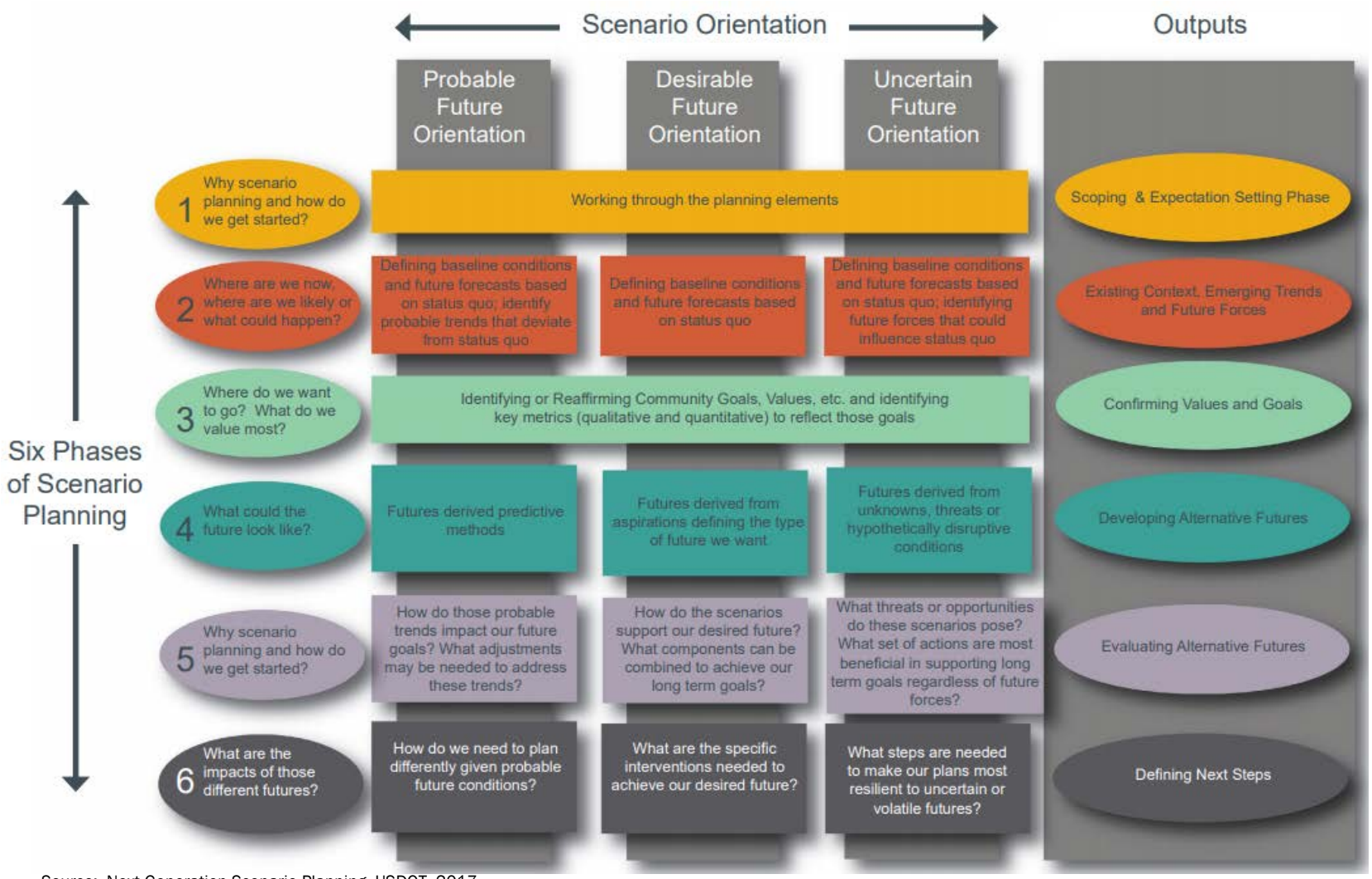
.

Figure 6: How Outputs from Scenario Planning Phases Can Inform Performance-Based Transportation Planning and Programming



Source: Supporting Performance Based Planning and Programming Through Scenario Planning. FHWA. 2016.

Figure 7: Applying the Six-Phase Framework to Predictive (Probable), Normative (Desirable) and Exploratory (Uncertain) Scenario Exercises



Source: Next Generation Scenario Planning. USDOT. 2017.

NAVIGATING THE 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.

It's not realistic nor even desirable, however, to expect that a book, experiment, or scenario planning effort will turn out exactly the way it was originally envisioned. Although it is important to design and manage a scenario planning process carefully, it is equally important to acknowledge that scenario planning is, by its very nature, a creative process that requires iteration, innovation, and revisions. Like writers and scientists, scenario planners must dedicate time and energy to observe, interpret, learn, and adjust the process as they go. Table 2 lists a few opportunities for iteration and innovation that can occur throughout each stage of a scenario planning exercise.

Collaboration: A Fundamental Element of Scenario Planning

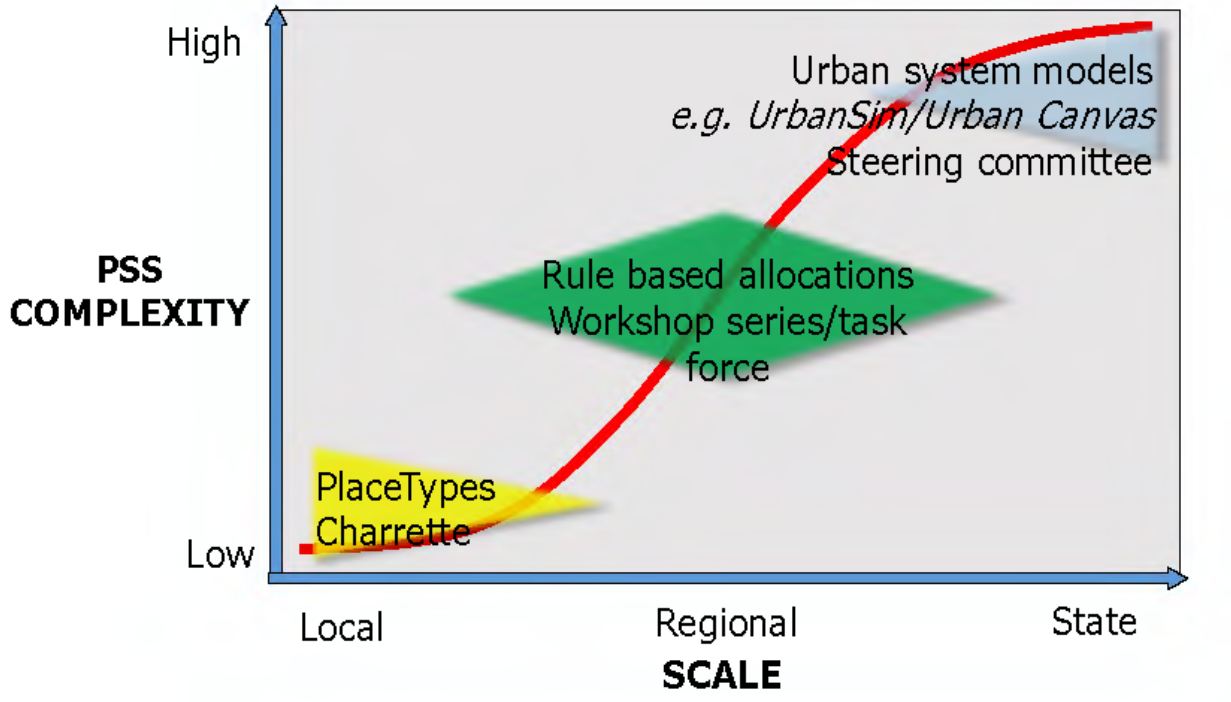
Scenario planning is a collaborative, iterative effort from beginning to end. Plausible descriptions of future-world conditions integrate quantitative forecasts and estimates with qualitative imaginings and "educated guesses." The process of building, interpreting, and evaluating scenarios requires a 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.

Scenario Planning Tools

Scenario planning enables organizations to envision possible future conditions and weigh the effects of different policy and investment options. Agencies can use a variety of planning support systems (PSS) tools and methods to build scenarios and work with stakeholders to assess their impacts. Hands-on charrettes, supported if needed by GIS spatial analysis tools or 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 9).

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

Tools for constructing and analyzing scenarios can include traditional PSS (e.g., travel demand models, GIS), "what-if" software tools designed specifically for scenario planning, risk registers, and visualization aids. Contextual data for regional scenario planning usually includes spatial data on the natural and built environment, including transportation network attributes that may be derived from a travel demand model. Normative scenario planning initiatives often involve testing alternative combinations of land use and transportation assumptions, using variables such as the "6 Ds."

The 6 Ds: Land Use and Transportation Policies That Affect System Performance

Many scenario planning exercises include GIS-based analyses of quantifiable variables representing land development patterns, urban design characteristics, and transportation-related investments and programs. Changes in the values of these variables affect important trip distances, mode choices, and other factors that influence system performance outcomes such as vehicle miles traveled. These scenario analysis methods typically involve classifying a region into subareas (typically sized to a radius of ¼ mile or ½ mile) according to a set of "place types" that represent different combinations of these variables, which have been nicknamed "the Ds" by researchers over the past 30 years. The number of "D" variables continues to evolve over time; to date, researchers have quantified metrics for at least six Ds:

"D" Variable	*Example "D" Variable Metrics*
Density	Per/acre persons, households, jobs, buildings
Diversity	Mix of residential, commercial, and other activities within ¼ mile or ½ mile subareas
Design	Walkable street grids with sidewalks lining 300-600 foot blocks, buildings fronting sidewalks with parking lots behind or underneath
Destination	Proximity of residential centers to essential destinations such as jobs, stores, health services, schools, and parks.
Distance to transit	Proximity of households and jobs to transit stations and routes
Demand management	Programs and policies to promote mode choices and reduce reliance on single-occupant motorized vehicles

HOW CAN SCENARIO PLANNING SUPPORT REGIONAL TRANSPORTATION DECISION-MAKING?

NORMATIVE PROCESSES SUPPORT VISIONING AND GOAL-SETTING

Regional planning councils (RPCs) and metropolitan planning organizations (MPOs) have led most of America's scenario planning initiatives over the past several decades. Many initiatives have been funded by Federal programs for regional transportation planning and/ or environmental planning. The Federal Partnership for Sustainable Communities, a joint DOT/HUD/EPA program that existed in the early 2000's under the Obama administration, funded a wide array of urban and rural regional scenario planning initiatives that produced innovative analysis tools and expanded the body of knowledge about performance metrics. Nonprofit organizations whose missions address economic development and/ or environmental preservation have sponsored other innovative regional and statewide scenario planning studies, often in partnership with public sector agencies.

Nonprofits sponsored some of the nation's first civic scenario planning initiatives and analysis tools, starting in the 1980s with the Land Use, Transportation, Air Quality Connection (LUTRAQ) visioning process and scenario analysis tools sponsored by 10,000 Friends of Oregon for the Portland metropolitan region, and continuing through the 1990s with projects such as Envision Utah. Public sector RPCs and MPOs began sponsoring similar initiatives in the 1990s and the early 2000s, such as the "Blueprint" series sponsored by the Sacramento Area Council of Governments (SACOG). 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.

Scenario Planning Outcomes

The degree of information sharing and decision making that comes out of the scenario planning process is influenced by the desired outcomes. The bullets below provide a sampling of hypothetical outcomes:

- **Identify specific policy changes and project investment needs to meet performance targets through the long range transportation planning process – desired future orientation**
- **Inform community members, elected officials and other interested parties about driving forces that could influence regional goals – uncertain future orientation**
- **Identify specific resilience strategies in response to specific future threats or uncertainties – uncertain future orientation**
- **Engage participants in tradeoff discussions to address value conflicts and reach consensus on a vision and associated implementation strategies – desired future orientation**
- **Identify strategies for achieving community and transportation system performance goals given likely changes in future funding streams – probable future orientation**
- **Identify cross-organizational implementation strategies and build consensus for achieving regional goals – desired future orientation**

Source: Next Generation Scenario Planning. USDOT. 2017.

Envision Utah

The Salt Lake City region of Utah continues to seek opportunities for creating more sustainable growth patterns. Recognizing some of the challenges with implementation of the Envision Utah vision crafted more than 20 years ago, and emerging new issues and opportunities associated with transportation funding, housing affordability, technology advances, and other factors, planners used a scenario planning process. The process helped to further identify implementation opportunities and build support for achieving the desired vision and doing so considering some variability associated with future uncertainty and shifting trends.

One of the earliest scenario planning efforts, Envision Utah brought together people from all walks of life, including developers, conservationists, business leaders, and the public to consider alternative futures for the growth of Utah and to create a "Quality Growth Strategy" rooted in community values and informed by data. In 2015, Envision Utah's "Your Utah, Your Future" effort significantly expanded and updated the Quality Growth Strategy. "Your Utah, Your Future" included eleven topics ranging from water, transportation, and land use to housing, agriculture, education, public lands use, and more.

Between 1997 and 1999, Envision Utah held over 200 workshops and obtained input from 20,000 residents to create the Quality Growth Strategy, a shared vision for the future of Utah. A wide range of quality-of-life measures were projected for each scenario that allowed participants to understand the consequences of the land-use and transportation strategies embodied in each scenario. The 2015 Envision Utah's "Your Utah, Your Future" process included eleven topic areas and each issue area had three to five scenarios that presented alternative sets of choices and outcomes for that topic and modeled those out to 2050. These scenarios demonstrated specific implementation strategies and options that reinforced long-term vision goals in light of future uncertainties.

Source: Next Generation Scenario Planning, USDOT. 2017

PREDICTIVE MODELS SUPPORT INVESTMENT AND POLICY PLANS

Within the first decade of the 21st century, visioning initiatives based on normative scenario planning processes had been conducted by a wide array of MPOs and regional planning organizations. Having done the difficult work of building regional consensus on broad principles for growth and development, and invested significant resources in developing planning tools and data, the logical next step was to develop more detailed analysis tools to support strategic plans for investments and policies that advanced the vision.

Predictive scenario planning tools such as travel demand models continued to be the go-go resources for developing long range plans. Agencies made adjustments to these models to address the principles in the vision, 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.

EXPLORATORY METHODS SUPPORT TACTICAL PLANNING FOR UNCERTAINTY

Among many regional planning agencies, the process of engaging stakeholders and the public in visioning and long-range planning exercises, supported by increasingly sophisticated scenario analysis tools, opened the door to new "what-if" questions that lent themselves best to exploratory scenario planning methods. Agency staff, the public and elected officials became increasingly interested in weighing risks, identifying opportunities, and assessing potential impacts on the efficacy of transportation investments associated with external forces that were largely outside the purview of the transportation agency's direct control, and/ or difficult to predict with any certainty, 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.

Meanwhile, the introduction of Federal legislation and regulations promoting performance-based planning and programming intensified the need among MPOs and State Departments of Transportation (DOTs) for quantifiable analysis tools that could address a wide variety of issues in addition to the congestion-related indicators measured by travel demand models.

Today, regional agencies are applying 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.

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.

National Scenario Planning Examples

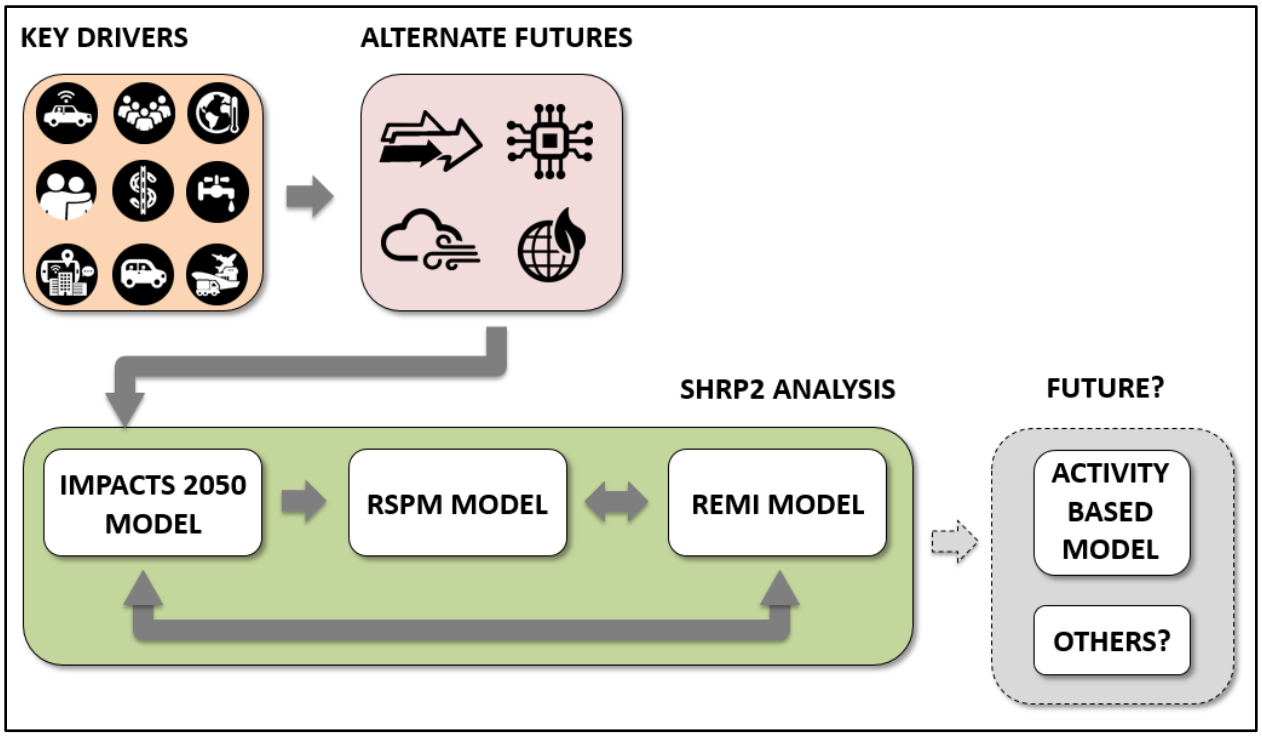
This section provides a snapshot of scenario planning exercises conducted by regional transportation planning agencies across the country over the past 30 years.[3] The high-level list of representative studies provides a starting point for a comprehensive scan of peer agency experiences to be conducted as part of this study.

Name	Type	Key Features
1) Atlanta Regional Commission Impact2050	Exploratory	Development of sketch planning models and analysis tools
2) Baltimore Regional Transportation Board PlanIt2035 and Maximize2040	Normative and Exploratory	Progression from visioning to exploratory process over the course of two plan updates.
3) Central New Mexico Climate Change Scenario Planning Project	Exploratory	One of the first comprehensive climate-related regional scenario impact analysis studies.
4) Champaign-Urbana Sustainable Choices 2040	Exploratory	Development of sketch planning models and analysis tools
5) Chicago Metropolitan Agency for Planning (CMAP) GoTo2040	Normative	Extensive public engagement with virtual MetroQuest tool.
6) Delaware Valley RPC Connections2035 and Connections2045	Normative, Predictive, and Exploratory	Progression from visioning to exploratory processes; engagement of experts and stakeholders in crafting exploratory futures analyses.
7) Hillsborough County MPO Imagine2040	Normative and Predictive	Coordination with local land use planning agency to develop scenarios and vision; public education/ engagement in considering fiscal constraints and tradeoffs among desired investment priorities.
8) Metropolitan Transportation Commission (San Francisco) Plan Bay Area, Horizons2050	Normative and Exploratory	Progression from visioning to exploratory processes; engagement of equity stakeholders advisory group.
9) Sacramento Area Council of Governments (SACOG) Blueprint	Normative	One of the first MPO scenario planning processes; established frameworks, methods, and tools that have been adapted nationally.

1) Atlanta Regional Commission (ARC) Imagine2050 Long Range Plan Scenarios: ARC conducted exploratory exercises to support its regional long range plan update that involved identifying the Atlanta region's key drivers of change through expert review and stakeholder surveys. Two sketch planning models "IMPACTS 2050" and "Regional Strategic Planning Model" (RSPM) were used for modeling the future scenarios. Figure 10 illustrates the chain of planning and modeling procedures in ARC's exploratory scenario planning process.

[3] Source material for the summaries and graphics in this section, except where otherwise noted, was drawn from "Advancing Performance Based Planning and Programming Through Scenario Planning. FHWA. 2016."

Figure 9: Planning and modeling procedures in ARC's exploratory scenario planning process.



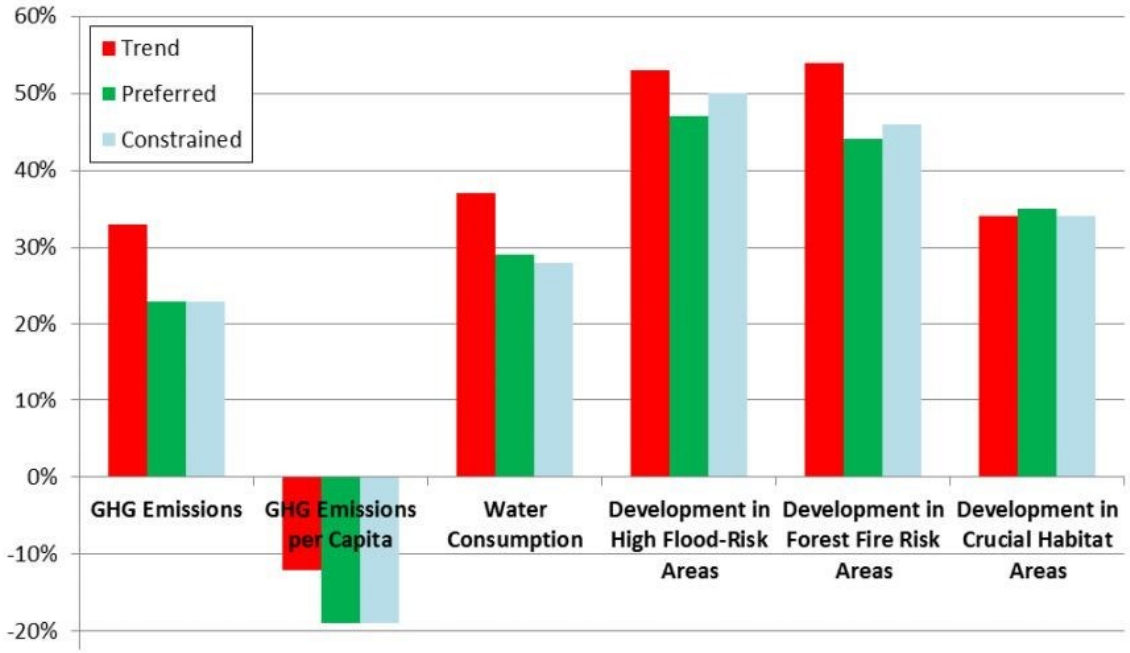
Source: Webinar delivered by ARC to COG/TPB. January 2017

2) Baltimore Regional Transportation Board (BRTB) PlanIt2035 and Maximize2040 Long Range Plan Scenarios: In developing the *PlanIt2035* transportation plan, approved in 2011, the BRTB undertook a normative visioning process involving land use and transportation scenarios to develop the "Imagine 2060" vision. For the *Maximize2040* regional plan, the agency developed and tested three exploratory scenarios: "Wash Overflow" in which Washington DC's population and job growth extends to the Baltimore region; "Simmered Up" representing sea level rise and extreme weather events due to climate change; and "Zuber Connected" picturing advances in vehicle-to-vehicle and vehicle-to-network communication systems and sensors (Figure 11).

Figure 10: Baltimore Regional Transportation Planning Board Exploratory Scenarios

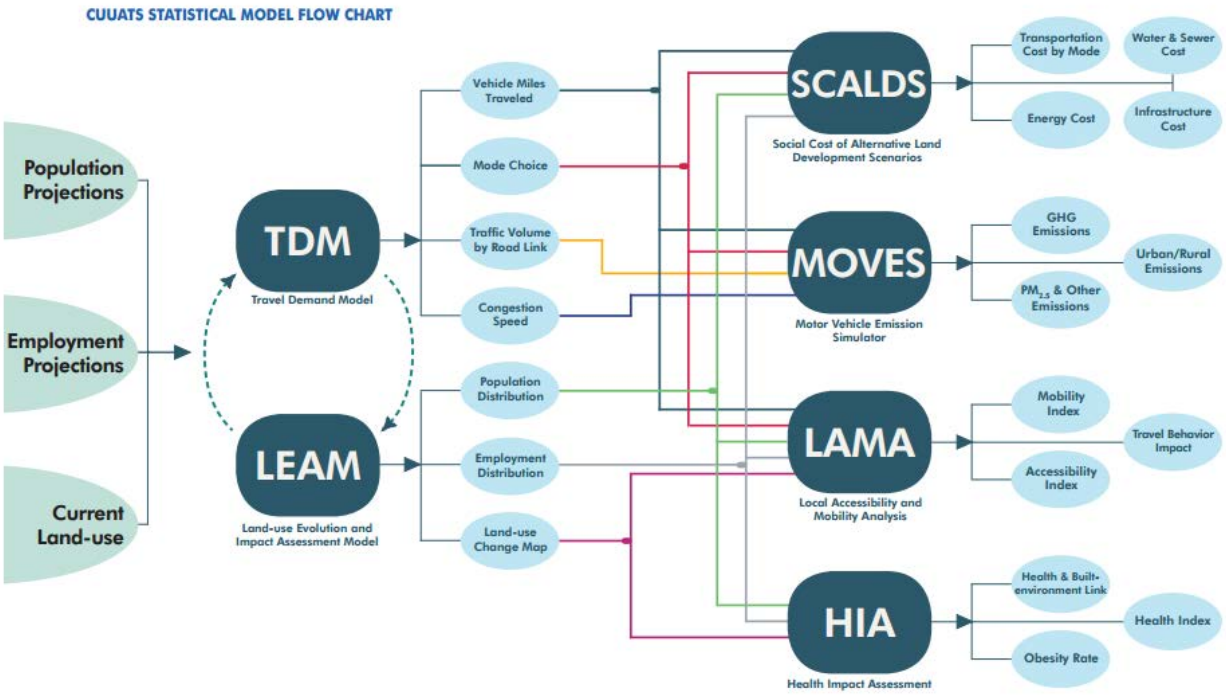
3) Central New Mexico Climate Change Scenario Planning Project: Through the Central New Mexico Climate Change Scenario Planning Project (CCSP), Mid-Region Council of Governments (MRCOG), which serves the Albuquerque region, analyzed transportation and land use scenarios to determine how best to manage congestion, reduce emissions, and adapt to the potential impacts of climate change. MRCOG analyzed the performance of three scenarios—trend, preferred, and constrained—with respect to a set of six potential future climate-related challenges to understand the region's susceptibility to hazards such as droughts, wildfires, and flooding. Agency staff used MRCOG's four-step travel demand model and the UrbanSim land use model to analyze the three scenarios. As Figure 12 shows, the preferred scenario outperformed the others on most of the climate-related measures. Although the agency ultimately adopted the Trend scenario, as it reflected existing local plans, the MRCOG policy board adopted the preferred scenario as a policy vision toward which it would continue to work. The goals in the Metropolitan Transportation Plan are aligned with this preferred scenario. MRCOG also modified its long-range plan Project Prioritization Process to reflect the preferred scenario-based policy vision, as well as project selection criteria for the TIP.

Figure 11: Mid-Region COG Climate-Related Scenario Impact Analysis



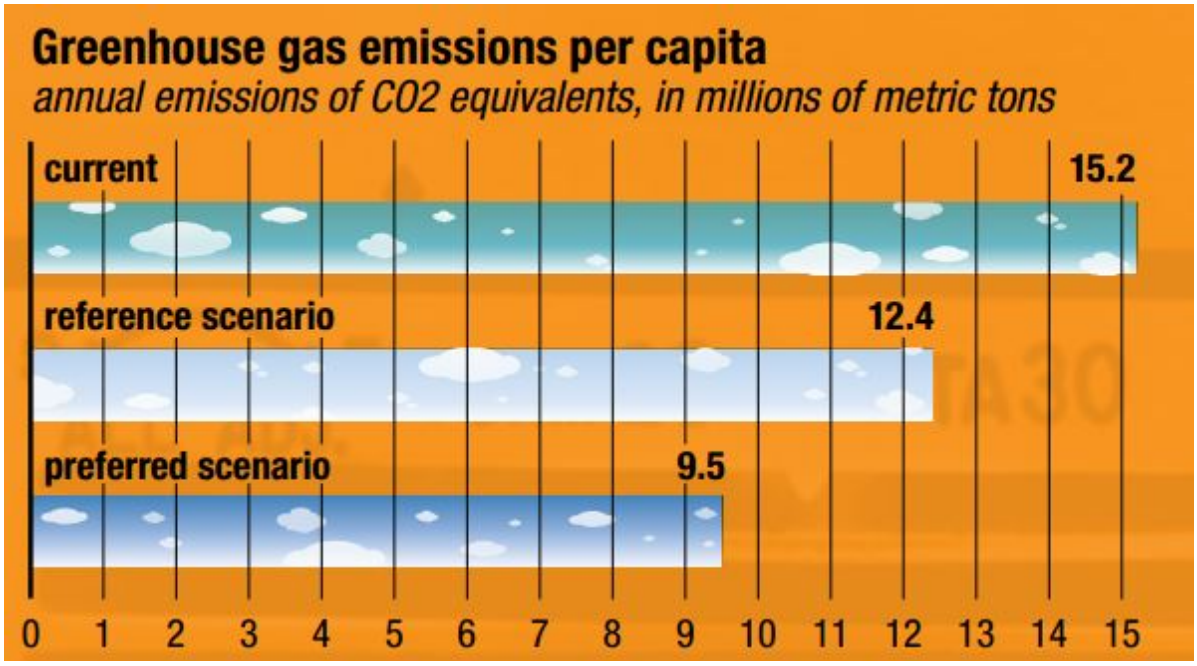
4) Champaign-Urbana Sustainable Choices 2040 Scenarios: To develop scenarios for a normative visioning exercise to support the 2040 regional long range plan, the Champaign-Urbana Urbanized Area Transportation Study (CUUATS) partnered with a University research team and the public health department to use data from a Health Impact Assessment to measure the relationship between the built environment and obesity, and from a local mobility and analysis to develop regional active transportation analyses. Figure 13 depicts the suite of tools that supported the 2040 scenario modeling process.

Figure 12: Champaign-Urbana Scenario Modeling Suite of Tools



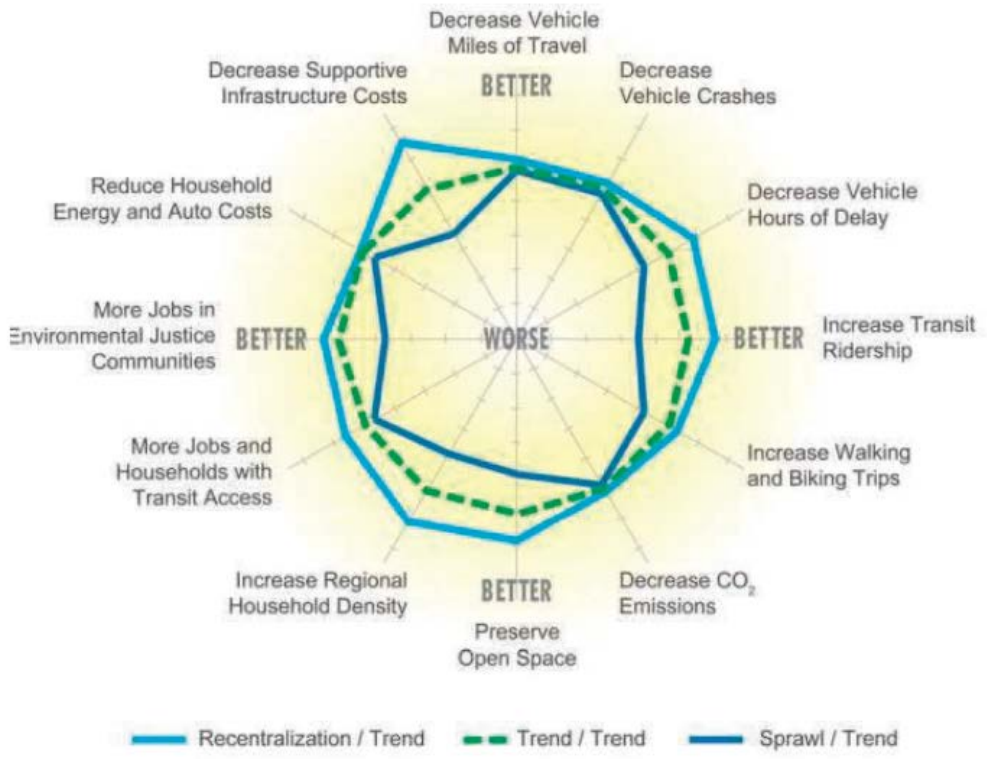
5) Chicago Metropolitan Agency for Planning (CMAP) GoTo2040: To develop its GO TO 2040 Comprehensive Plan, CMAP undertook an extensive scenario planning exercise, in which the agency received feedback from stakeholder groups and residents regarding several future scenarios. By using interactive online tools that used MetroQuest's "Invent the Future" public engagement software, and through public meetings, the agency gathered input from 35,000 residents (Figure 14). The input emphasized the need for a scenario in which the agency focuses on maintaining the existing system and making improvements to improve the system's efficiency. The agency used the public's input to develop the preferred regional scenario, which includes a combination of actions that will best prepare the region to achieve its goals for 2040. The analysis, in which the agency compared the preferred scenario to current performance and a reference scenario based on expected trends, went beyond the broad goal statements of the Regional Vision to identify the best courses of action to reach the public's goals.

Figure 13: CMAP GOTO2040 Scenarios



6) Delaware Valley Regional Planning Commission (DVRPC) (Philadelphia) Connections2035 and Connections2045 Scenario Exercises: For its Connections2035 long range plan, DVRPC conducted a normative scenario planning exercise to develop a vision and priorities for integrating land use and transportation (Figure 15). DVRPC then combined the information collected from multiple rounds of scenario planning into an online tool called Choices and Voices, which engaged stakeholders and the public in the analysis of fiscally-constrained system performance scenarios.[4] For the Connections2045 plan, DVRPC conducted an exploratory exercise that involved assembling a Futures Group of regional experts to identify "Five Forces of Change" that were modeled over a 30-year horizon: enduring urbanism, the free agent economy, severe climate, transportation on demand, and the US energy boom. The impacts and challenges that arose under different scenarios led to the identification of potential action steps the agency could take to position itself more strategically to confront the challenges. The agency used Impacts 2050, a sociodemographic system dynamics model developed through the NCHRP 750 Foresight series and FHWA's Rapid Policy Analysis Tool (RPAT). The agency published a Future of Scenario Planning White Paper to summarize its previous and current scenario planning work.

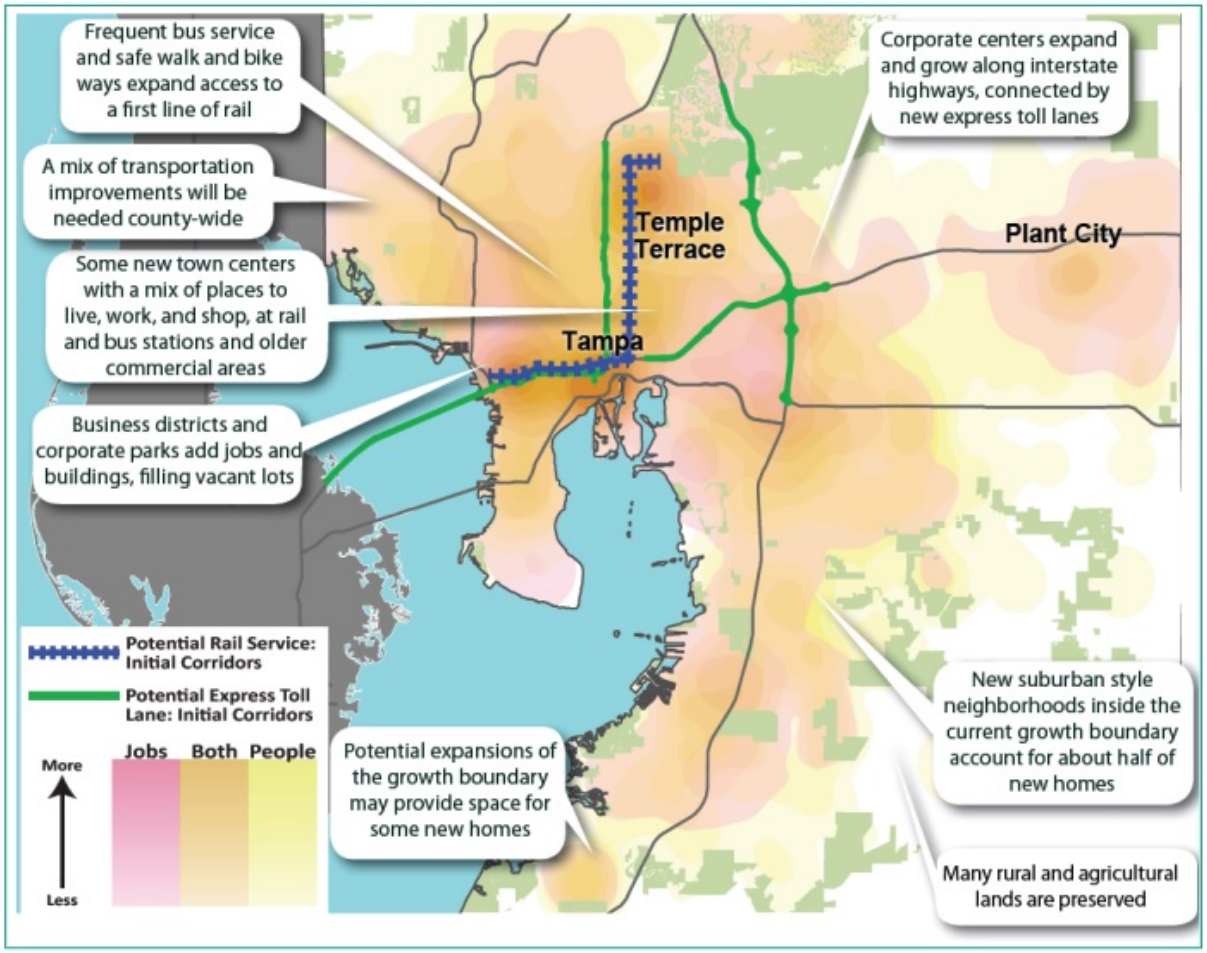
Figure 14: DVRPC Connnections2035 Land Use / Transportation Scenarios



[4] The DVRPC Choices and Voices tool is interactive and enables users to identify their preferred transportation focus (e.g., emphasis on roadways or on new modal choices) and preferred housing/land use development types for the region. It also gives users the option to identify the condition of different components of the transportation system they would prefer to have the region maintain and then see the cost associated with different levels of investment. By adjusting their preferences with respect to a variety of investment types and levels, and identifying specific transit projects to support, users can see the anticipated impacts on budget and performance. Regarding performance, users can see the expected outcomes on the following measures: acres of land developed; VMT; biking, walking and transit trips; transportation and energy costs; hours of congestion, greenhouse gas emissions; and roadway fatalities. The exercise requires achieving a balanced budget before submitting the vision, which forces users to comprehend and make difficult trade-offs that resemble those that must be made by agencies like DVRPC. This allows users to see the corresponding performance results. The tool links to social media, so users can publicly share their visions with those in their social networks.

7) Hillsborough County MPO (Tampa) Imagine2040: For the regional plan update conducted in 2013-14, the MPO conducted a normative scenario planning exercise to develop an Imagine 2040 vision (Figure 16). 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.

Figure 15: Hillsborough County MPO Imagine2040 Preferred Scenario



8) 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 is the critical link for establishing goals and performance measures. The recent update of the long range plan involved an extensive exploratory scenario planning initiative, Horizons 2050, that involved dozens of stakeholders and expert panelists in work sessions and gaming exercises.

9) Sacramento Area Council of Governments (SACOG) Blueprint: One of the first scenario planning initiatives in the nation, the Sacramento Blueprint adopted in 2004 is an example of a regional vision for growth and development. Regional leaders from various disciplines were concerned about the effect on quality of life of adding 1.7 million new residents to the region between 2000 and 2050. They came together to study how the growth could be accommodated through different land use and transportation patterns before arriving at a preferred scenario that the Sacramento Area Council of Governments (SACOG) unanimously adopted. The Sacramento Blueprint set direction for the region's Metropolitan Transportation Plan for 2035. For more than a decade, the Blueprint has served as a strong, frequently referenced vision to guide transportation and land use planning throughout the region. The process also spurred the development of scenario planning tools such as the iPlaces3 suite, which have been applied to other initiatives beyond the region.

Scenario Planning Initiatives in the COG Region

COG/ TPB-Led Initiatives

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 GHG reduction targets and adhering to the principles adopted in the TPB Vision. The following six studies are summarized in 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)

Other State, Local and Regional Initiatives

VTrans2040 Scenario Analysis: VTrans, Virginia's multimodal long-range plan for 2040 acknowledges that projecting current trends beyond 10 years doesn't account for changes to values, travel behavior, and the global economy. Therefore, the 2040 component of the plan incorporated scenario-based analysis. The analysis combined alternative assumptions for each of four types of drivers: demographic and social changes, economic changes, influences of technology, and energy and environment considerations. The results of the scenario analysis were used to gauge the resilience of the transportation investment plan and to identify policy recommendations that address the implications of the scenarios. The analysis used a sketch planning approach that combined quantitative and qualitative data. For each scenario driver, the project team pulled information from research, expert panels, focus groups and other public outreach to develop scenario assumptions and alternatives. Scenario components included land use place types, population age cohorts, and employment/ industry types. To address technology drivers, the analysis included extensive research on autonomous and connected vehicles and related topics such as mobility-on-demand services. This research provided insights on specific components of future travel demand that the technology drivers would likely affect, allowing for the project team to incorporate assumptions into each of the scenarios.[5]

Maryland Scenarios: The Maryland Scenarios project is a multi-year effort led by the National Center for Smart Growth (NCSG) in consultation with Maryland Department of Transportation (MDOT) and Maryland Department of Planning (MDP) to explore alternative futures for the State of Maryland and to identify policy interventions that would lead to more desirable transportation-related outcomes.[6]

Maryland U.S. 40 Carbon Neutral Corridor Study: The objective of this study was to "develop a comprehensive corridor vision for the Maryland Department of Transportation (MDOT) that integrates energy efficiency and emission reduction strategies from land use, land conservation, multimodal transportation, energy supply, and energy consumption to significantly reduce greenhouse gas (GHG) emissions from the corridor across all emission sectors." [7] The study process examined potential benefits of three scenarios: 1) Transportation Activity, Efficiency, and Emissions, 2) Land Use and Development, and 3) Energy Consumption, Energy Supply, Land Conservation, and Sequestration. The composite successful scenario maximized GHG reduction by integrating the most effective strategies of the three separately analyzed scenarios.

Baltimore-Washington Region PRESTO Study: The PRESTO project utilizes the latest methods in scenario planning in order to develop strategies for a more sustainable Baltimore Washington Region. With support of the Scientific Advisory Committee, the project team examined major outside driving forces that will impact the sustainability of the region, including the price of energy, the rate of technological development, and the level of government intervention in land use policies. These driving forces combine in four divergent scenarios for the future of the Baltimore Washington Region. By examining a range of possible futures, the research team will be able to determine which policies are robust in all potential futures for advancing sustainability outcomes in the region. [8]

---

[5] Next Generation Scenario Planning. USDOT. 2017.

[6] http://www.ce.memphis.edu/smishra/PDFs/Projects/2012_msp_final_20120823.pdf

[7] https://www.camsys.com/publications/case-studies/case-study-%E2%80%93-us-40-carbon-neutral-corridor

[8] https://www.umdsmartgrowth.org/wp-content/uploads/2018/04/39317-UMD-Printing-Presto-Long-report-FINAL-1.pdf

Washington D.C. Regional Connected/ Automated Vehicles Scenario Studies: The Union of Concerned Scientists conducted a study to assess how autonomous vehicles (AVs) could impact 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.[9]

District Department of Transportation Autonomous Vehicles Study: Published in April 2020, this scenario study described potential socio-economic and transportation system performance impacts of autonomous vehicle adoption on the Washington DC region. Scenario themes included:

- **Freeway Automation:** increased personal AV ownership and suburban growth;
- **Shared Fleets**: increased AV microtransit options replacing traditional bus services and off-peak Metrorail and reducing car ownership;
- **HOV:** increased mix of shared and personally owned AVs operating on HOV lanes; and
- **Congestion Fee**: increased mix of shared and personally owned AVs supplemented by neighborhood AV shuttles operating within a framework of congestion fees charged on all major roads.

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. The DDOT study was sponsored by a regional nonprofit transportation advocacy group (DC Sustainable Transportation) and conducted by AECOM. [10]

Pros and Cons of AV Adoption in the DC Region

Pros:

- Mobility for all, especially seniors, people with disabilities and youth.
- Safety, assuming predictions of autonomous vehicles are correct.
- Improved traffic flows carrying more people faster.
- Greater economic growth.
- Fewer vehicles and less space devoted to parking them.
- Improved transportation accessibility and affordability.

Cons:

- More driving and more people in cars with fewer people using traditional transit.
- Increased congestion, including during off-peak times.
- More driving leading to increases in pollution – unless offset with electrification.
- More suburban and exurban sprawl.
- Over $340 million in revenues generated by nonautonomous vehicles.
- Job losses in industries related to driving.

Source: https://landline.media/report-autonomous-vehicles-would-cause-more-congestion-in-d-c/

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

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

RESOURCES

This section provides a brief list of publications and web-based resources that are particularly useful for transportation agency staff that want to learn more about scenario planning applications, methods, and tools.

Comprehensive Guidebooks and Overviews

Scenario Planning Guidebook (2011) This was a landmark FHWA publication that drew upon much of the work done in the transportation field in the 1990s and early 2000s. It articulated a step-by-step process for normative (values-based/ visioning) scenario planning processes. A visioning process typically resolves in the selection or creation of a single preferred scenario that guides the subsequent development of plans and strategies. The framework was widely adopted and gradually adapted by practitioners and researchers toward a wider variety of applications including exploratory "what-if" testing and risk assessments.

Supporting Performance Based Planning and Programming Through Scenario Planning (2016) This FHWA guidance expanded upon the "normative" approach described in the 2011 guidebook, adding more specifics about using quantifiable measures. It also provided descriptions of the evolving practice of "exploratory" scenario planning, in which agencies consider the potential risks and opportunities associated with changing conditions, but do not necessarily strive to select or craft a preferred scenario or vision. Instead, they use the information from the scenario planning exercises to come up with strategies and tactics to minimize risks and maximize opportunities.

Next Generation Scenario Planning: Transportation Practitioner's Guide (2017) This FHWA guidebook dives deeper into methods and practices associated with exploratory scenario planning, particularly for conditions that are difficult to quantify or predict such as climate change, evolving transportation technologies, and global socio-economic trends.

How to Design Your Scenario Planning Process (2019) This Planning Advisory Services Memo from the American Planning Association written by Janae Futrell, director of the Lincoln Land Institute Consortium for Scenario Planning, provides structured guidance and examples for mapping out the use of scenario planning techniques and tools to support a variety of planning processes, including transportation and community development.

Topical Guidance and Research

Advancing Transportation Systems Management and Operations (TSMO) Through Scenario Planning (2015) This FHWA publication was sponsored by the FHWA Office of Operations, rather than the Office of Planning where most of FHWA's scenario planning resources are collected. It provides an adapted approach to the 2011 Guidebook framework, and several hypothetical case study exercises around topics such as planning for system operations functionality and recovery in the event of a natural disaster.

Sketch Tools for Regional Sustainability Planning (2016) This NCHRP 08-36 program study (Task 117) for AASHTO provides an overview of concepts, case studies, and tools applied by transportation agencies for scenario planning, primarily in the realm of visioning and normative exercises. Tools evaluated include CommunityViz, Envision Tomorrow Plus, iPlaces3S, SparkINDEX, UPlan, and Urban Footprint.

Advancement of Performance-Based Scenario Planning for Regional Planning and Decision-Making (2017) This FHWA report synthesizes key content and outcomes identified as the result of a two-day scenario planning convening held in January 2016; interviews with regional planning organizations held in December 2015; and subsequent research. The study describes applications and tools used by different agencies, and provides recommendations for promoting more widespread use of scenario planning methods.

Study on Metropolitan Planning Scenario Development: Costs and Benefits (2018) This FHWA report summarizes results of surveys and studies by FHWA and Florida Center for Urban Transportation Research (CUTR) on the levels of effort and technical tools applied by MPOs to different types of scenario planning processes.

Roadmap to Risk Management for Transportation Planning (2018) This FHWA report and accompanying recorded webinar describe frameworks and techniques for applying risk management methods to transportation planning, and includes descriptions of tools and techniques such as Monte Carlo simulation analyses, which can help planners to generate and compare hundreds/ thousands of alternative trajectories for various indicators.

NCHRP Report 750 Foresight Series (2008-2014) In 2008, the American Association of State Highway and Transportation Officials (AASHTO) Standing Committee on Research (SCOR) established the forward-looking NCHRP Project 20-83 research series. Published as NCHRP Report 750: Strategic Issues Facing Transportation in Volumes 1-6, with publication dates ranging throughout the 20-teens, the series examines global and domestic long-range, strategic issues and their implications for state departments of transportation (DOTs). Each volume explores fields as varied as freight movement, climate change, technology, sustainability, energy, and socio-demographics and explains how events and trends may shape the transportation system of 30-50 years in the future. The project website includes not only PDFs of the reports, but also webinars, videos, presentations, and workshops-in-a-box.

USDOT Websites

FHWA Office of Planning Website on Scenario Planning and Visualization Repository for numerous guidebooks, studies, and reports from peer exchanges and other information-exchange venues. Most of the publications listed in this report are on this site, along with a variety of resources published before 2010.

Federal Transit Administration (FTA) Website on Scenario Planning Provides useful links to Federal planning requirements and recommendations involving scenario planning, along with links to other sites, most of which are included in this list.

FHWA/FTA Transportation Capacity Building Program Scenario Planning Website Provides a variety of peer-exchange reports, case studies, and links to guidance documents, along with information for transportation agencies on how to apply for technical assistance such as customized peer exchanges.

FHWA Travel Model Improvement Portal/ Freight Model Improvement Portal An online Community of Practice sponsored by the FHWA Transportation Performance Management program to encourage and facilitate information sharing, the exchange of ideas, and capacity building within the travel and

freight modeling and planning communities. Built with contributions from practitioners around the nation, the site includes a Travel Model Improvement Toolbox with links to information about a variety of scenario planning resources and initiatives.

FHWA VisionEval Framework A collaborative project in development to integrate the GreenSTEP family of strategic tools for performance-based transportation planning into a single open-source programming framework. Strategic tools are designed to evaluate many alternative futures and policies to help state and metropolitan area governments address pressing issues, despite uncertainty. The common framework enables new model features to be added in a 'plug-and-play' fashion so they can be easily shared among models. During 2020, FHWA began to explore the possibility of adding a module to the VisionEval suite that would enable planners to test potential impacts of Connected/Automated Vehicle policies and investments on transportation system performance.

National Associations and Research Institutes

Lincoln Land Institute Consortium for Scenario Planning A nonprofit community of practice for community planning and development practitioners, providing access to technical assistance, educational resources, and a network of fellow innovators. The website provides links to peer exchanges, knowledge exchange forums, and books (some of which must be purchased from academic presses).

MIT Center for Transportation and Logistics Scenario Planning Toolkit A set of online resources designed to help transportation planners in any organization design, plan, and run a Scenario Planning Workshop using the four global scenarios developed for Economic Changes Driving Future Freight Transportation). The tools include a guidebook, videos and slide decks about the scenarios, and workshop material templates such as invitations and discussion guides.

Society for Decision Making Under Deep Uncertainty A collaborative association sponsored by the Rand Corporation Frederick S. Pardee Center for Longer Range Global Policy and the Future Human Condition. The Society for Decision Making Under Deep Uncertainty (DMDU) is a multi-disciplinary association of practicing professionals, scholars and students working to improve processes, methods, and tools for decision making under deep uncertainty, facilitate their use in practice, and foster effective and responsible decision making in our rapidly changing world. Its focus is on developing, disseminating, and using DMDU approaches across multiple policy domains such as energy, health, social and economic well-being, defense, water, environment, and transport.

University of Maryland National Center for Smart Growth A research and public service institute dedicating to advancing sustainable development research, collaboration, engagement and thoughtful policy development. The Center is, by statute, a member of Maryland's Smart Growth Subcabinet and Sustainable Growth Commission and works closely with Montgomery County's Park and Planning Commission and the Baltimore Regional Sustainability Planning effort. In addition to the Maryland Scenario Planning Project referenced in the Regional Scenario Planning Initiatives section of this report, the Center supports other models and analysis tools for statewide and regional transportation and sustainability planning initiatives.

APPENDIX A. DESIGNING A SCENARIO PLANNING PROCESS

Table 1: Considerations for Designing 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?
	A visioning process helps a group to identify shared values, generate a tangible "picture" of a desired future condition, and to agree upon core principles for subsequent planning and decision making. Once established, the organization can conduct normative and/or exploratory exercises periodically to ensure the vision's continued relevance to, and consistency with, the group's core values, but the vision should not need to be completely "overhauled" for many years. On a more frequent and iterative basis, agencies can use predictive scenario planning methods to shape plans and strategies, and exploratory methods to consider the potential performance of a proposed or adopted plan under a variety of hypothetical conditions.
	
	Within the regional transportation planning realm, predictive scenario analysis methods using travel demand models and related tools (e.g., air quality models) directly influence planning and project selection decisions by the MPO policy board (the TPB) for the long-range plan (CLRP) and the Transportation Improvement Program (TIP). It is critical to gain understanding and acceptance among stakeholders and the public about the accuracy and credibility of model forecasts and analyses. Normative and exploratory scenario planning processes (whether conducted to support a CLRP/TIP update or as independent studies) can inform Board decisions about policies and overall investment priorities, but they are not typically used as the primary basis for specific investment decisions. This is an important distinction to clarify and emphasize in project communications. Assuring participants that the exercise is NOT intended to result in a formally adopted plan or program can help them to feel freer to generate the sorts of informed speculations, educated guesses, and entirely new ideas that make scenario planning a uniquely valuable, eye-opening experience.
	
	Partner agencies (e.g., State DOTs, local jurisdictions, transit providers) and other stakeholders can use regionally sponsored scenario planning analyses, recommendations, and data to support their own studies and initiatives. For example, a city might use the study information to help shape land use policies and infrastructure investments that support regional principles developed from a normative scenario planning initiative.

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?	A useful technique for structuring the analysis and identifying potential tools and data sources, is to "start with the end in mind" by sketching an outline of the final report. Creating this initial outline helps the project team to clarify its understanding of the purpose of the project, and to develop an initial scope and budget for the technical analysis. For example, an exploration of the potential impacts of new transportation technologies on travel demand could require research on the trends in the anticipated market share of connected and automated vehicles among passenger and freight fleets, and the use of web-enabled ridehailing services. The project would also require some investments to investigate and develop or procure analytical tools and datasets necessary to consider the impacts of these trends on goals such as safety (e.g., crashes and fatality rates among motorized and nonmotorized travelers); roadway and transit capacity (e.g., level of service, volume/capacity ratios); congestion and reliability (e.g., hours of recurring and nonrecurring travel delay); travel behavior (e.g., mode shares, trip lengths); land development patterns (e.g., density, employment/residential mix, and design of urban, suburban, and rural areas); the natural environment (e.g., GHG emissions); and economic vitality/ social equity (e.g., access to jobs, services, and essential destinations). It is important to recognize that the process of identifying appropriate indicators and evaluation measures for a scenario planning exercise is iterative. Once the project gets underway and stakeholders begin to contribute questions and new ideas, project teams often realize that they need to consider additional issues, or that a selected indicator is less relevant than originally anticipated. It is important to allocate time and resources throughout the project for weighing the costs and benefits of developing new measures and/ or dropping ones that were initially identified. For example, one of the environmental metrics initially considered in a trends analysis for a statewide scenario planning exercise in Virginia was the acreage of wetlands restored, created or enhanced with roadway project development funds. Data for this metric was readily available from the DOT, and it was included under the assumption that increased wetland acreage represented a positive environmental trend. Environmental experts on the study committee pointed out, however, that DOT wetland investments are usually triggered by Section 404 of the Clean Water Act, which allows the legal destruction of wetlands in exchange for restoration, creation, or enhancement of other wetlands. Tracking trends in the acreage of created or restored wetlands without accounting for the parallel reductions caused by destroyed wetlands, therefore, would lead to a misleading positive or negative indicator of environmental impacts. After investigating the data more fully, the study team decided to drop the measure from the analysis.

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?
	In order to build plausible, comprehensive "future world" scenarios and to consider a wide array of potential factors that could affect travel demand and supply, transportation planners often call upon professionals and experts outside of their field. These could include, for example, land use planners, urban designers, environmental scientists, economic development specialists, and public health experts, to name a few. They can share insights, data, and technical resources from the analysis tools and planning methods unique to their disciplines.
	
	There are many ways to engage outside experts, such as conducting individual interviews, focus groups, and discussions with boards and committees; convening advisory panels for a few milestone-related meetings throughout the course of the process; tapping individuals or small groups to flesh out specific technical aspects, such as qualitatively evaluating impacts of scenarios on variables that are difficult to quantify; and forming partnerships with organizations that can dedicate staff time or technical resources through their agency work programs and/ or allocations from a grant-funded project.
	
	Most scenario planning initiatives conducted by public sector agencies include some level of public engagement, especially normative process that reflect community values and priorities, and predictive processes that support development of a formally adopted plan or TIP. Sometimes, however, it makes sense to focus most or all of the engagement for an exploratory process on advisors and stakeholder organizations whose expertise and local knowledge are particularly relevant to the topics at hand, rather than attempting widespread public engagement. Agency staff can also use scenario planning methods to facilitate internal planning for workforce development, organizational management, or to organize strategic planning retreats and brainstorming sessions with technical committee and the Policy Board.

APPENDIX B. OPPORTUNITIES TO INNOVATE AND ITERATE

Table 2: Opportunities for Innovation and Iteration

Scenario Planning Stage	Opportunities to Promote Productive Innovation and Iteration Throughout the Process
1) Scope the effort and engage partners	Start with the end in mind by identifying the questions that need to be answered by the study and "mocking up" a resulting report, map, regional agreement, and/ or other materials and outcomes that the study might produce. The purpose of this initial visioning is not to pre-define the answers or outcomes of the process, but to make sure the questions are clearly articulated and that the type of process (normative, predictive, or exploratory) and associated analysis methods and tools are appropriate for addressing the key questions. Try working backwards from the imaginary end product to map out the timing of each milestone product and engagement activity, and how the information and activities associated with each stage build upon and inform other stages. Include regular "pause and reflect" periods in the project schedule to assess potential opportunities for innovation or needs for iteration Reserve contingency time/ budget for revising the technical approach or engagement process. This includes some "debriefing" time at the close of the project for project team members and stakeholders to examine the value of the process and products, and to identify potential investments and initiatives that can build upon the data, analyses, tools, and policy or investment decisions that resulted from the project. Clarify the roles of partners, stakeholders, and the public in the study process. Is it necessary for everyone to be involved in every stage? How will the input from each engagement affect the technical analysis? How will people know that their input has been considered? What are some visualization and communication techniques that can help make the study information understandable and useful for different audiences?
2) Establish baseline analysis of existing conditions and identify influential factors and trends	Cast a wide net when identifying elements and metrics to include in the baseline conditions and trends analyses; seek input from a wide variety of people and resources in order to identify aspects and topics that aren't traditionally considered or that seem irrelevant at first glance. Toward this end, stage 2 is often done simultaneously/ iteratively with stage 3, with the findings of stage 3 helping to inform the indicators and trends examined in stage 2. For example, the stage 3 discussions may reveal strong public concerns about topics such as socio-economic inequities, which can be examined in the trends analyses and reflected in the baseline conditions assessment. Transportation-related performance analyses associated with equity issues could include, for example, assessments of multimodal accessibility to jobs and essential services and nonmotorized traveler safety among low-income populations compared to other income cohorts. Think ahead to stages 4 and 5 (scenario development and evaluation) when selecting trends and factors to research, and when organizing the research outputs and reports. The trends reports should provide clearly organized information

Scenario Planning Stage	Opportunities to Promote Productive Innovation and Iteration Throughout the Process
	and data that can be used in stages 4 and 5 to craft the scenario building blocks and shape the scenarios: external drivers and potential policy / investment "levers" that collectively affect transportation network supply, travel demand, and performance outcomes.
3) Establish or validate community goals and aspirations, with associated performance measures for developing and evaluating scenarios	Take time to thoughtfully review and verify the relevance and importance of documented goals in existing plans and be willing to expand or elaborate upon them. It is not necessary or desirable to raise political hackles by calling established plans into question, but scenario planning exercises provide an opportunity to think beyond the book. Make it clear that the study respects formally adopted policies, but it also considers new or emerging priorities and conditions that may not be reflected in existing plans and studies. Goals expressed in conversations and planning documents are often vaguely defined, which means they can mean different things to different people. The process of pinning down tangible measures of success with stakeholders and the public can unearth conflicting viewpoints or confusion that may take some time and skillful facilitation to resolve. These definitions are fundamental to the validity of the entire process; rushing this step or imposing a definition without adequate buy-in may give stakeholders and decision makers cause to criticize or dismiss the results of the study later on.
4) Create baseline and alternative scenarios **5) Assess scenario impacts, influences, and effects**	Stages 4 and 5 often involve some iterative trial-and-error, some of which happens before engaging stakeholders or the public, and some of which may take place after input is gathered. For example, the analysis tools selected for the stage 5 analysis may require Stage 4 technical inputs that don't translate smoothly from the scenario datasets to the tool on the first try. Or the analysis may produce puzzling results that could indicate errors in the data or the algorithms; and if no errors are detected, the study team may have to take some time and engage experts to figure out the reasons for the unexpected results. For example, an analysis of a "compact development" scenario in which future jobs and households are allocated to tightly confined urban centers can indicate tremendous increases in traffic congestion if the analysis method does not include algorithms to shift a logical percentage of vehicle trips to nonmotorized or transit modes in densely populated areas. Additionally, the lively engagement of stakeholders and the public during stage 5 tends to spark new ideas and questions that may not have been considered up until that point. Sometimes it is feasible to go back and build in more analyses and scenario elements to address the new questions; sometimes it makes more sense for the project team to acknowledge and address the concerns qualitatively without substantively revising the technical approach.
6) Articulate vision, principles, and /or strategic actions, supported by performance measures	If the goal of the scenario planning exercise was to secure a commitment by the MPO Board and local stakeholders to a vision, plan, or strategy, the scenario planning team should anticipate—from the beginning—the possibility that this outcome may be infeasible due to political resistance, fiscal constraints, or other reasons. It is not easy to build consensus and gain tangible buy-in to a vision or strategies that will require substantive changes to the status quo, such as shifting regional transportation investment priorities away from roadway capacity expansion in rural and suburban

Scenario Planning Stage	Opportunities to Promote Productive Innovation and Iteration Throughout the Process
	areas and toward pedestrian, bicycle, and transit connectivity in urban and suburban communities, or allocating limited resources toward increasing the resilience of transportation infrastructure to anticipated future impacts of weather patterns or new transportation technologies that are not currently evident nor entirely predictable. Ideally, the entire scenario planning process leading up to stage 6 has prompted a clear, shared awareness and meaningful, productive debates about the tradeoffs and implications of fundamentally new policies and priorities. But even the most well-informed and well-intentioned political officials may balk at committing to goals or strategies that risk public disapproval or negative consequences (real or perceived) to the constituents they have been elected to represent. This outcome does not necessarily mean, however, that the scenario planning process had no value. For example, the MPO for the Waco, Texas region produced three alternative development scenarios for a visioning process in the early 2000s, but, unlike many other similar initiatives of the era, the MPO Board decided not to adopt a single "preferred vision." Instead, they documented and acknowledged the usefulness of the lessons learned through the process and made a commitment to continue investigating ways to advance the valuable ideas it yielded. This "behind-the-scenes" commitment, coupled with the interest and enthusiasm the process sparked among local residents and community leaders did lead to a variety of subsequent plans and policy initiatives, such as updated policies and priorities in the Connections2035 long-range plan and an innovative revision of the regional thoroughfare plan to reflect context-sensitive design principles. Regardless of whether the most ambitious aims of the project were achieved, it's helpful for the study team to close out the project by reviewing progress toward all of the anticipated and desired outcomes they outlined in stage 1. This internal assessment – which can be augmented by debriefings with partners and stakeholders – can yield useful insights and ideas for advancing the study findings in future plans, programs, and technical analyses by the MPO and partner agencies.

APPENDIX C. SCENARIO PLANNING TOOLS

Table 3: Scenario Planning Tools

Tool	Description	Tool Type	Scenario Planning Applications
CommunityViz	A land use scenario sketch-planning tool usually used to develop regional long-range visions. It illustrates alternative land development patterns and associated impacts on criteria that the user can select from a pre-defined list.	Sketch planning for land development scenarios	Normative
Community Vision Metrics	This FHWA-developed tool helps planners identify performance measures relevant to their context and goals. It provides a customized list of metrics but does not provide information about how to calculate the measures or identify data sources. Informs all types of scenario planning processing, particularly during the early stages of identifying performance measures for scenario development and evaluation.	Guide for planners to identify performance measures	Normative, predictive, and exploratory
CrowdGauge	CrowdGauge is an open-source framework for creating educational online games. Users rank a set of priorities and "spend" game coins on actions and policies; the tool illustrates impacts of the user's budget choices on the priorities. Applications have been developed for MPOs in Des Moines, IA and the New River Valley region in southwestern Virginia. This tool is designed to support tradeoff analyses including during the investment prioritization stage of a long-range plan or TIP	Public engagement, visualization to communicate impacts and tradeoffs	Normative and exploratory
CubeLand	Part of Cube modeling software, CubeLand forecasts land use and land price by simulating the real estate market under different economic conditions. For a user-defined scenario, CubeLand forecasts the supply and the demand for different types of properties and estimates the location of households and non-residential activities. This tool builds alternative housing and employment data sets for other modeling and analysis tools; interfaces with Cube travel demand models	Forecasting model for real estate supply/ demand scenarios	Predictive
Energy and Emissions Reduction Policy Analysis Tool (EERPAT)	Planners can use this high-level scenario analysis tool to evaluate effects of various GHG emissions reduction strategies at the statewide level. It includes sub-models addressing household characteristics, travel demand, fuel economy, electric vehicles, energy consumption, and tailpipe / electricity CO2 emissions. It can evaluate GHG reduction strategies and strategy interactions not directly addressed by conventional travel demand and emissions models. It may not be suitable for evaluating effects of individual projects.	Sketch model for GHG impact analyses in large regions/ statewide	Predictive and exploratory

Tool	Description	Tool Type	Scenario Planning Applications
Envision Tomorrow (ET)	ET provides a quick, sketch-level glimpse of the possible impacts of policies, development decisions and current growth trajectories, and can be used by communities to develop a shared vision of a desirable and attainable future. It can be applied at scales from a single parcel to a metropolitan region. Analysis tools allow users to investigate aspects of their current community using commonly accessible GIS data, such as tax assessor parcel data and Census data. A scenario design tool allows users to "paint" alternative future development scenarios on the landscape and compare scenario outcomes in real time. Outputs include variables such as infill development or redevelopment, cost of infrastructure, building value and revenue, housing mix, affordability, parking costs, jobs-to-housing ratio, distribution and employment space, connectivity, land cover and availability, impervious cover in special areas (e.g. aquifers), water, wastewater, energy consumption, enhanced return on investment (ROI), and building energy consumption.	Sketch planning for land development scenarios	Normative
INDEX	A tool that simulates impacts associated with land-use and transportation scenarios. Based on ESRI ArcView shapefile inputs for transportation network attributes, socioeconomic, and land use data, the tool can produce tables and maps for more than 50 indicators such land consumption, housing and employment density, proximity to transit, and emissions. Capability to address a variety of performance indicators closely tied to transportation system performance and travel demand (e.g., "the 5 Ds" – density, diversity, design, distance to transit, and destination).	Sketch planning for land development scenarios	Normative
iPlaces3S	Web-based scenario modeling platform managed by Sacramento Area Council of Governments (SACOG). Evaluates how alternative development approaches or transportation investments may impact indicators. Developed by the CA Energy Commission (CEC), the CA Dept. of Transportation and the U.S. Dept. of Energy. Private company provides programming, maintenance and web hosting. Internet-based, so no specialized hardware or software is required.	Sketch planning for land development scenarios	Normative
Konveio	An online public engagement portal to share progress and gather public input on planning initiatives, including scenario planning, through a variety of venues such as idea walls, discussions, surveys and polls. May be used to help educate the public and collect opinions/ ideas/ preferences to inform identification of goals, performance measures, and tradeoff analyses.	Public engagement, visualization to communicate impacts and tradeoffs	Normative and exploratory

Tool	Description	Tool Type	Scenario Planning Applications
MetroQuest	Interactive web-based scenario visualization platform that works on kiosks, tablets, and smartphones. Versatile interfaces on templates customized by the user allow voting, ranking, map commenting, and other types of inputs on scenarios. It has a tool to detect and negate ballot-stuffing. Offers cloud-based data storage. Modeling and calculations are prepared using other tools and programmed into the MetroQuest interface for public viewing and interactivity.	Public engagement, visualization to communicate impacts and tradeoffs	Normative and exploratory
PECAS	PECAS is a spatial economic input-output model supporting the MEPLAN and TRANUS systems. PECAS assesses two components of planning to model economic flows: "space" (including both land and floor space), and "activity allocation." Outputs include allocations of activity categories to zones, commodity flow quantities from production zone to consumption zone via exchange zone, imports and exports by exchange zone and exchange prices by commodity by exchange zone.	Predictive economic model	Predictive
PlanWorks Visioning and Transportation Application	This Application is a guide, not a model, that details the steps in a visioning process, organizing the timeline and providing answers to frequently asked questions. It includes case studies and a guide for generating consensus on desired outcomes for transportation projects. Intended to help practitioners assess the possibilities of visioning, to identify visioning steps, and to establish links between outcomes and transportation planning and project development processes.	Guide for planners to scope a visioning process	Normative
Regional Eco-system Framework (Eco-Logical)	Eco-logical is not a stand-alone tool, but a step-by-step guide for overlaying GIS data about transportation infrastructure and regional natural and cultural resources to identify priority areas for conservation, avoidance, and mitigation. It can be used to evaluate impacts of plans on natural resources. Outputs include a map of ecological priorities and intersections with transportation infrastructure.	Guide for planners to conduct GIS environmental analysis	Normative, predictive, and exploratory
Sustainable Communities Index	Similar to Community Vision Metrics but more detailed, this tool provides lists of performance measures, calculation methods, and data sources for a variety of topics.	Guide for planners to identify performance measures	Normative, predictive, and exploratory
Travel Model Improvement Program Exploratory Modeling and	A utility that can be integrated with existing “core” travel demand models to generate exploratory, rather than predictive, scenarios. It can be used to explore uncertainties in input variables and model parameters that are outside the policy-maker’s control, and the impact that those uncertainties have on performance metrics. It is useful for examining model forecasts as a range of model outcomes rather than a single outcome and provides	Sketch planning and analysis to augment predictive travel models with consideration of	Exploratory

Tool	Description	Tool Type	Scenario Planning Applications
Analysis Tool (TMIP-EMAT)	a mechanism for defining uncertainties and visualizing outputs. It can also be used to understand how uncertainties interact with policy decisions or "levers" (e.g., extending a transit line), which are expressed as model inputs that are within the policy-maker's control. It is compatible with EMA Workbench, an open-source tool with automated scenario discovery and robust search capabilities.	influential uncertainties	
Trip Reduction Impacts of Mobility Management Strategies (TRIMMS)[11]	TRIMMS is a visual basic (VB) application spreadsheet model that estimates the impacts of a broad range of transportation demand management initiatives (e.g., transit subsidies, parking pricing, telework) and provides program cost effectiveness assessment, such as net program benefit and benefit-to-cost ratio analysis. Outputs include changes in mode shares, social externalities (i.e., the impact of car use on the environment, congestion, safety, etc.), program benefit/cost ratio, and detailed emission impacts by pollutant.	Sketch planning and analysis to augment predictive travel models with consideration of TDM policies and investments	Predictive and exploratory
UPlan[12]	UPlan is a simple rule based urban growth model intended for regional or county level modeling on an ArcGIS platform. The needed space for each land use type is calculated from simple demographics and assigned based on the net attractiveness of locations to that land use (based on user input), locations unsuitable for any development and a general plan that determines where specific types of development are permitted. It is a free tool available through the University of California-Davis.	GIS model for allocating land development according to user-defined parameters	Normative and exploratory
UrbanFootprint and RapidFire	UrbanFootprint gives users access to land use, policy, and resource planning tools across a range of sectors. Its detailed data 'canvas' of existing buildings, land uses, and other details of the built environment, combined with functionality for testing the application of land use or policy changes, serves to inform policy, planning, and funding decisions and aid in implementation and monitoring. RapidFire is a spreadsheet-based tool that is a companion to Urban Footprint. It is used to evaluate scenarios at the national, state, regional, and local scales. It constitutes a single framework into which data and research-based assumptions about the future are loaded to test the impacts of varying land use patterns and policies across a range of critical metrics.	Sketch planning for land development scenarios	Normative, exploratory

[11] TRIMMS description sources: http://trimms.com/ and Integrating Demand Management into the Transportation Planning Process: A Desk Reference. FHWA. 2012.

[12] UPlan description source: http://ice.ucdavis.edu/project/uplan

Tool	Description	Tool Type	Scenario Planning Applications
UrbanSim, CityEngine and UrbanCanvas	UrbanSim is a complex modeling platform to simulate metro real estate markets and impacts of land use and transportation plans. 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. Can be used in conjunction with activity-based travel models to analyze alternatives and explore strategies to achieve target outcomes. It's a free, open source program but may require technical assistance to use. CityEngine is an ESRI visualization tool that creates a 3D model of the city. This tool can be integrated with ArcGIS and used to compare land use planning scenarios, or to perform simple network analysis. UrbanCanvas is similar to CityEngine, but is integrated with UrbanSim. Provides 3D visualization and scenario comparisons but with lower analytical capability than CityEngine. Some components it lacks may be available through UrbanSim.	Predictive modeling and visualization suite of tools for augmenting travel models with alternative land use inputs	Normative, predictive, and exploratory
VisionEval[13] GreenSTEP Regional Strategic Planning Model (RPSM) Rapid Policy Analysis Tool (RPAT)	VisionEval is a collaborative project in development to integrate the GreenSTEP family of strategic tools for performance-based transportation planning into a single open-source programming framework. Strategic tools are designed to evaluate many alternative futures and policies to help state and metropolitan area governments address pressing issues, despite uncertainty. The common framework enables new model features to be added in a 'plug-and-play' fashion so they can be easily shared among models. Hosted by FHWA, VisionEval is operated by the Collaborative Development of New Strategic Planning Models Pooled Fund. The VisionEval 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 greenhouse gas (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.	Sketch planning suite to evaluate potential transportation-related environmental impacts of policy decisions	Exploratory

[13] VisionEval description source: https://visioneval.org/

Tool	Description	Tool Type	Scenario Planning Applications
	• RSPM – under ODOT, the model was designed to support the preparation of metropolitan area scenario plans. The name reflects a broadening of the policies, beyond state statutory requirements. • RPAT- under the federal Strategic Highway Research Program (SHRP2), the model was designed to evaluate the potential effect of growth policies on regional travel. Portions of the GreenSTEP model were used in RPAT, but substantial revisions were made to the code, including use of land use place type categories.		

Sources: Advancing Performance Based Planning and Programming Through Scenario Planning. FHWA. 2016. Supplemented by additional research by TPB study team.

APPENDIX D. COG/TPB SCENARIO PLANNING INITIATIVES

Table 4: Summary of COG/TPB Scenario Planning Initiatives

Initiative	Context	Scope	Methods	High-Level Findings
Regional Mobility and Accessibility Study Posted: November 2006 Type: Normative	The desire of the TPB in authorizing this study was to examine additional transportation improvements beyond those that currently could be included in the region's long-range transportation plan, together with potential changes in future land use in order to improve the performance of the region's transportation system.	Study activities included: (1) development of Measures of Effectiveness (MOEs), (2) analysis of the 2000 CLRP using the study MOEs and identification of its shortcomings relative to the TPB Vision, (3) specification of the elements of a regional congestion management scenario to be tested as part of the study, and (4) development of five alternative land use and transportation scenarios for analysis and testing.	The travel demand and air quality impacts of the alternative land use and transportation scenarios were analyzed using the latest version of the TPB's travel demand forecasting model and air quality emissions models. Land use, environmental and other impacts of these scenarios were also evaluated using selected "measures of effectiveness" and "measures of information" identified specifically for this study.	Land use and transportation strategies that would put more housing and jobs in closer proximity, focus mixed use development around transit stations and implement supportive transit investments can have a positive impact on future travel conditions.
Regional Value Pricing Study Posted: February 2008 Type: Predictive	The TPB has had an active interest in variably priced highway lanes since 2003 when the TPB, in conjunction with the Federal Highway Administration and the Maryland, Virginia, and District Departments of Transportation, sponsored a successful one-day	The study included several different scenarios for adding new priced highway lanes, pricing existing highways, and enhancing bus services. This analysis included three major variably-priced highway facilities that were being developed through project planning studies for	The TPB's regional travel demand model was utilized to forecast the demand and performance characteristics of these scenarios for the year 2030.	Toll rates on the variably-priced lane network would have to vary significantly by segment, direction and time-of-day in order to maintain free-flowing conditions. The study also found that toll revenues only partially supported the costs of expanded highway network capacity explored

Initiative	Context	Scope	Methods	High-Level Findings
	conference on value pricing for the region. Following the conference, the TPB created a Task Force on Value Pricing to examine how value pricing could benefit the region.	inclusion in the region's CLRP: the Inter-County Connector in suburban Maryland, the Northern Virginia Capital Beltway HOT lanes project, and the I95/395 HOT lanes project.		in the scenarios. Further, the study found that high quality transit could have a significant impact on transit use, HOV use, and total system revenue in a few "high transit demand" corridors.
What Would it Take? Posted: May 2010 Type: Predictive	In November 2008, COG approved voluntary short, medium, and long-term regional emissions reduction targets that were based on international goals. The report examines what it would take in the National Capital Region to meet these aggressive regional climate change mitigation goals in the transportation sector.	The report includes a baseline inventory and forecast of carbon dioxide (CO2) emissions in the region, identification and analysis of potential mitigation strategies, and an analysis of whether any combination of these strategies meets long-term mitigation goals.	The study followed five steps to determine what may be necessary to meet these aggressive regional climate change mitigation targets: (1) Created a baseline inventory of mobile source CO2 emissions (2) Determined sources of reduction potential (3) Identified potential reduction strategies (4) Analyzed individual strategies for effectiveness, cost-effectiveness, and timeframe for implementation (5) Combined additive strategies to determine different pathways toward meeting goals	It was found that meeting early targets in transportation is possible if a wide range of short-term actions are taken by local governments immediately, but system-wide actions would be needed to achieve later targets. The study also found that transportation strategies are unlikely to be implemented for CO2 reduction alone and will have various other benefits from criteria pollutant reduction to increasing mobility and accessibility that should be factored into decision-making.
CLRP Aspirations Scenario Posted: Sep 8, 2010	This document provides a summary of the development, analysis and results of the "CLRP	This report includes a summary of past scenario studies and how this scenario fills a gap, an	The analysis was supported by the regional travel demand model and informed by multiple	The CLRP Aspirations Scenario represents the first time that the TPB has developed an alternative

Initiative	Context	Scope	Methods	High-Level Findings
Type: Normative	Aspirations" scenario, which is one of two scenarios in the TPB Scenario Study. This scenario examines the effects of a long-range land use and transportation vision for the National Capital Region out to horizon year 2030.	overview of the scenario development and methodology, and an analysis of how the integrated land use and transportation scenario meets TPB Vision goals. The scenario consists of a smart growth land use strategy, a network of variably priced lanes, and an extensive BRT network running on priced lanes.	discussions with planners from local jurisdictions to ensure reasonable consistency with local land use and transportation plans. The analysis examined potential impacts of significant land use and transportation changes to the baseline forecast for the region, such as aggressive smart growth assumptions, extensive BRT serving new and existing mixed use centers, new priced road capacity, and pricing of some existing roadways to ensure efficient road use. A land use sensitivity scenario that included no change in transportation assumptions beyond the 2008 CLRP was also run to control for the effects of the land use portion in the full scenario.	land use and transportation scenario whose purpose is not just to explore a single regional challenge or experiment with a single strategy, but instead to take a holistic, comprehensive approach to aligning land use and transportation planning with the goals of the TPB Vision and of the previous RMAS initiative. The scenario in its completed form is intended to achieve these goals to the extent possible by creating highly accessible and developed activity centers served by an extensive transit network.
Multi-Sector Approach to Reducing Greenhouse Gas Emissions in the Metropolitan Washington Region Final Technical Report	This study represents a focused effort to examine all sectors of the economy to identify local, regional, and state actions to significantly reduce GHG emissions in accordance	The purpose of this study included: (1) to identify potentially viable, implementable, and stretch local, regional, and state strategies for reducing GHG emissions across key	Sketch planning methods – relying upon available literature, recent studies, and simple analysis tools – were used to analyze the potential of 22 strategies for analysis years of 2020,	The study made the following high-level findings: (1) Existing Policies Are Making a Difference (2) Additional Regional Strategies Can Reduce GHG Emissions Considerably but

Initiative	Context	Scope	Methods	High-Level Findings
Posted: January 2016 Type: Predictive	with COG's voluntarily adopted goals.	sectors (Energy, the Built Environment, Land Use, and Transportation); (2) to analyze the potential GHG benefits of these strategies in relation to the adopted goals using the best available sketch planning tools and analysis; and (3) to identify co-benefits, costs, and implementation timeframes associated with these GHG reduction strategies.	2040, and 2050. This analysis contained two dimensions: (1) Temporal (considering timeframe of implementation), and (2) Level of stringency or "stretch" strategies.	Not Achieve the 80% Reduction Goal (3) Many Strategies have Multiple Co-Benefits (4) Strategy Costs Vary, but Many Have Net Cost Savings and (5) Additional Strategies are Needed to Attain 2050 Goal.
Long Range Plan Task Force (LRPTF) Assessment of Regional Initiatives Posted: 2017 Type: Exploratory	The TPB had designated the Long Range Plan Task Force to identify a limited set of regionally significant projects, programs, and policies above and beyond what was in the then-current Constrained Long-Range Transportation Plan (CLRP) given expected intensification of highway and transit crowding.	The project included three phases: (Phase 1) development of a baseline report that focused on an analysis of three future alternative scenarios in 2040; (Phase II) Identification of a set of unfunded regional priority initiatives to identify and analyze approximately 6-10 projects, policies, or programs (initiatives) to determine if they make significantly better progress towards achieving the goals laid out in TPB and COG's governing documents; and (Phase III) incorporation of	The analysis entailed selection of a set of unconstrained transportation improvements (project, policies, or programs), development of measures of effectiveness (MOEs) that could be used to gauge how well each initiative performed against a set of agreed upon regional challenges, and use of sketch-planning techniques to show each initiatives performance on the MOEs at a regional scale compared to the 2040 CLRP.	Based on an evaluation of performance, the task force agreed to advance five of the ten initiatives to the TPB for its endorsement for future concerted TPB action: Initiative 1: Express Travel Network; Initiative 4: Regionwide Bus Rapid Transit and Transitways; Initiative 6. Metrorail Regional Core Capacity Improvements; Initiative 8. Optimize Land-Use Balance; and Initiative 10: Amplified Employer-Based Travel Demand Management

Initiative	Context	Scope	Methods	High-Level Findings
		unfunded regional priority initiatives into the region's long-range plan and promoting future implementation of these initiatives.		

National Capital Region
Transportation Planning Board

Metropolitan Washington Council of Governments
777 North Capitol Street NE, Suite 300
Washington, DC 20002

mwcog.org/tpb