VisionEval: The Open Source Tool for Exploratory Transportation Planning

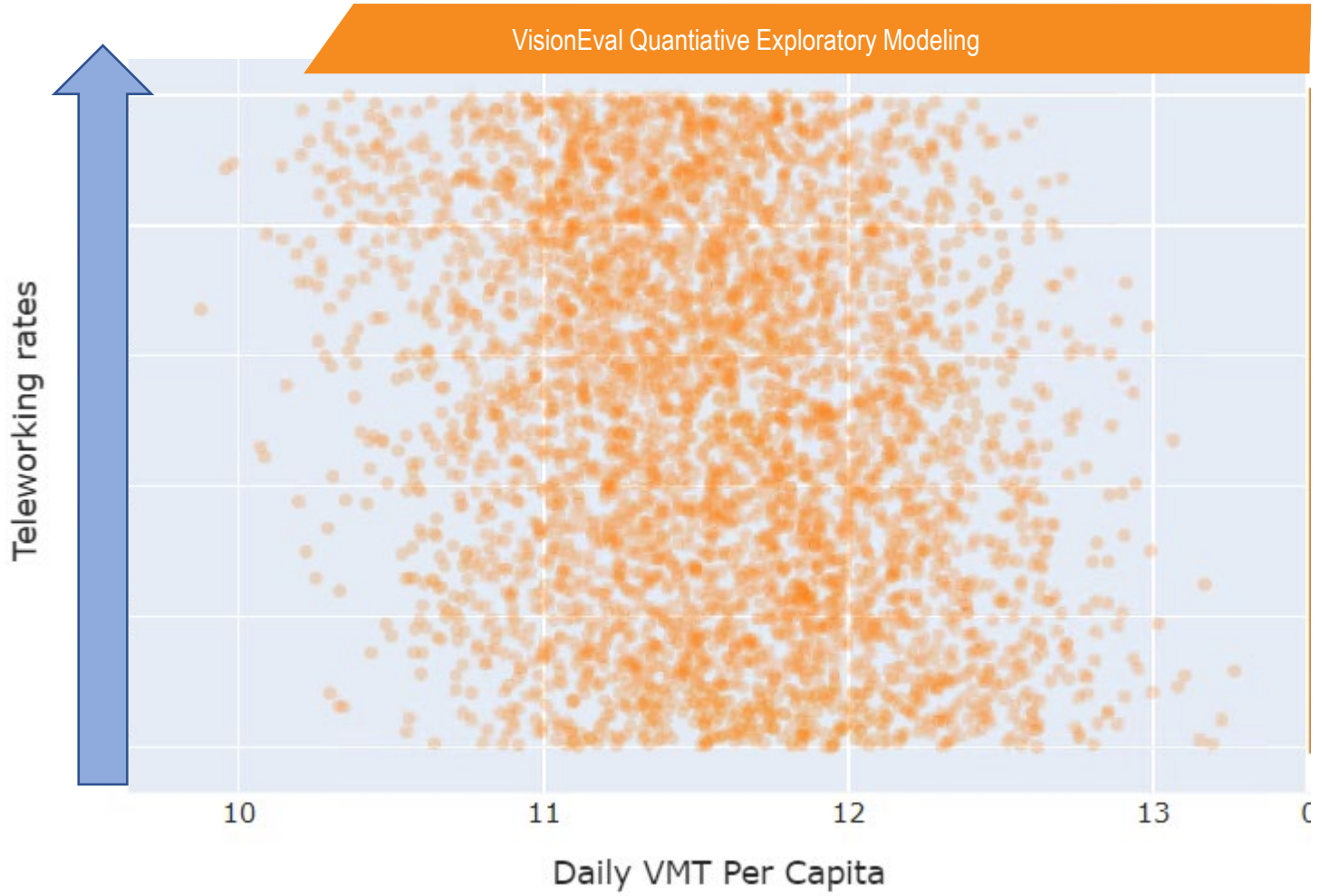
Strategic Transportation Travel Demand Modeling for Long Range Planning and Expanding the Capacity of Traditional Travel Demand Models

RSG
the science of insight

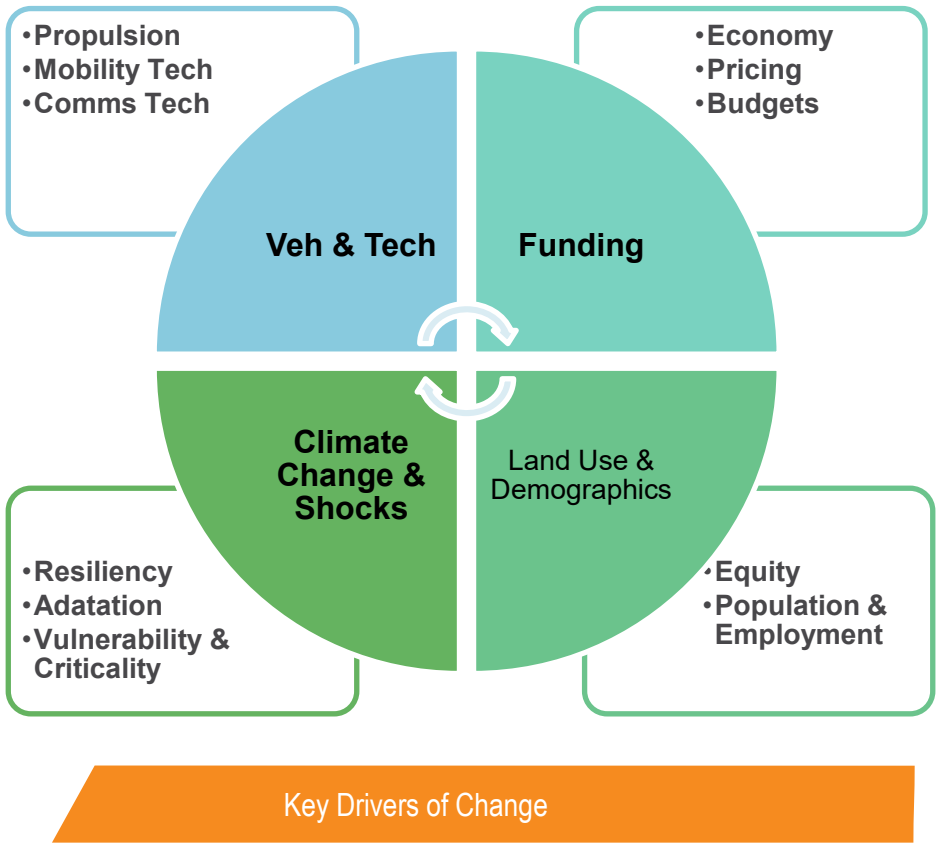
May 9, 2023

Today's Outline

- Analysis tools and approach for long range planning studies
- Scenario Planning
- What is VisionEval
- Making use of this new thing
- Case Studies
  - Oregon
  - NYSERDA
  - Chittenden County VT
- Who out there is using this?



The future is always uncertain – why do we sometimes think that we know the future?



LRTPs and CRPs and other planning efforts need to plan for an increasingly complex and uncertain future. They need to account for changing land use patterns, demographics, shifts in travel behavior, new technologies, prices, and other unknowns.

New tools are available – accounting for the complexity and interaction effects of demographics, land use, infrastructure, and travel behavior.

Frequent Common Tools

- Sketch Models (e.g.,Urban Footprint, EnvisionTomorrow)
- Land Use Models (e.g.,CommunityViz, UrbanSim)
- Regional Network Based Travel Demand Models

Scenario Planning in the early Stages

Scenario Planning is an important (and often used) method to incorporate, and plan for, uncertainty.

Scenario Planning can be used early in planning efforts to:

- Align goals
- Create a shared vision for the future amid uncertainties and risks
- Find high impact investments and policies

New methods for ***Quantitative*** Exploratory Scenario Planning

- **Predictive:** Attempts to answer ***what will happen?*** Predictive planning is used to adapt and prepare for situations that are expected to occur. Based more on trends and extrapolating existing behaviors into the future.
- **Normative:** Attempts to answer the question ***how can a specific target be reached?*** Normative planning is used for situations where the outcomes of policy actions or investment decisions are relatively certain. For example, implementing smart growth policies in response to population growth.
- **Exploratory (XSP):** Attempts to answer ***what can happen?*** Through a wide range of alternative scenarios based on possible developments and stakeholder goals. What are the effects of changing several variables. Identifying boundaries to gain confidence on the magnitude of changes.

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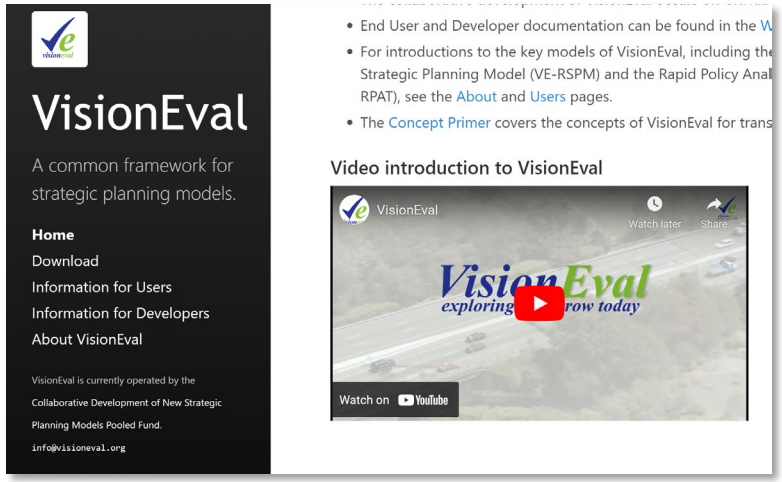
What is it? : VisionEval Strategic Model

- VisionEval is the most robust, quantitative strategic model that can be used for scenario planning.
- Estimated on readily available data including National data such as the National Household Travel Survey (NHTS) then calibrated to local conditions (PUMS, HPMS, travel surveys, travel models).
- Econometric framework for monetized costs (time & out of pocket) via a household travel budget. (e.g., congestion charges, fuel taxes, electrification effects)
- Sensitive to land use, operational tactics, and policy tactics (e.g., TDM, induced travel, signal coordination, teleworking).
- Runs quickly (run hundreds of scenarios in a short timeframe) because it lacks a specific network to assign trips. It is a daily travel model rather than a trip model.
- Results can be viewed in an interactive visualizer and are available in output files (CSVs, SQL, Excel, etc.)

VisionEval is supported through a Pooled Fund managed by FHWA.

For more information www.VisionEval.org



Covers more tactics more quickly than full travel models.

This makes them particularly compelling – they compliment existing models well.

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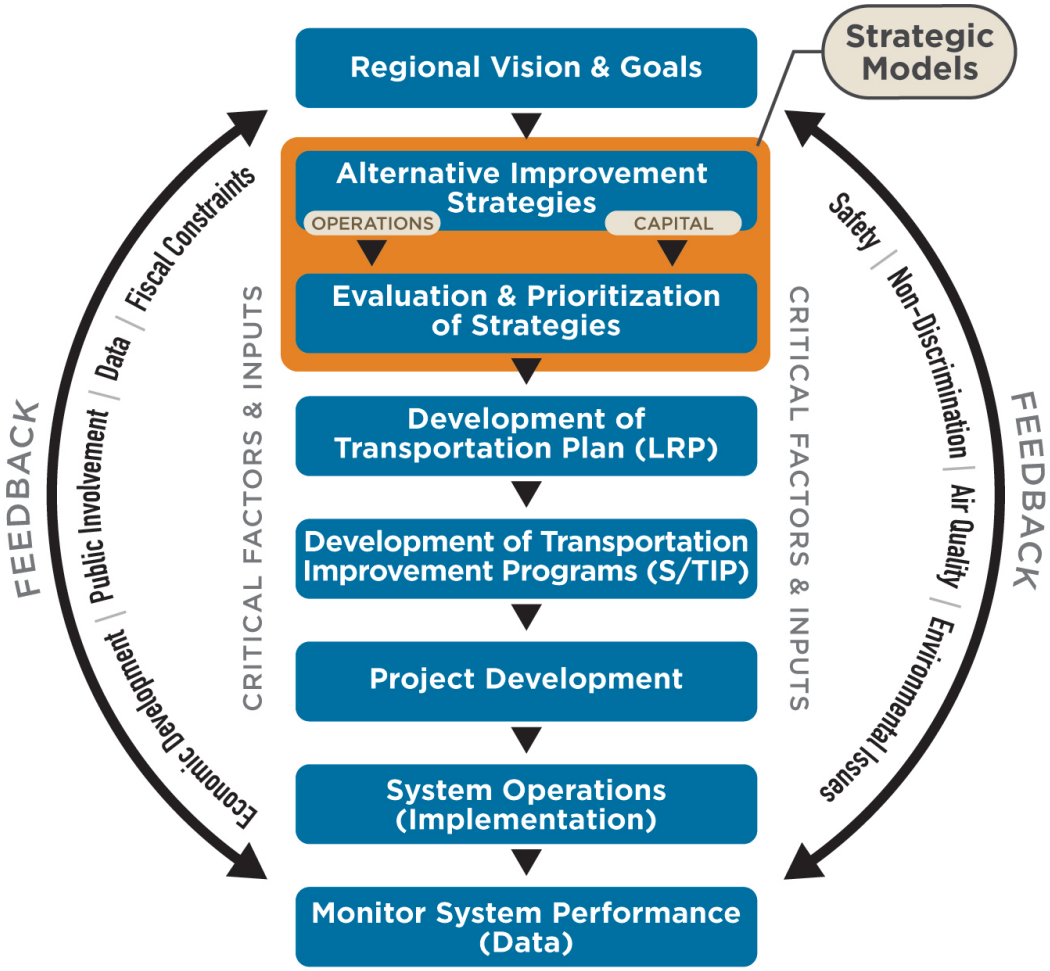
Strategic Modeling in the Planning Process



- Scenarios and future visions can be informed and tested
- Assess validity of many approaches
- Key metrics of VMT, GHG, Energy
- Identify likely policies and investments with high ROI
- Used for LRTPs at the MPO and DOT level
- Can be used to support CRPs and other GHG and emission work.

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Big Picture - How does this differ?

Typical Planning Process

- Vision & Goals
- Public engagement and involvement
- Future Scenario Development: **a** handful of specific inputs to test. – toll pricing, ***a*** specific amount of transit or roadway miles, ***a*** land use scenario
- Modeling and Analysis: Individual model runs for each scenario
- Trade-Offs and Iteration

Process incorporating an Exploratory Scenario Process

- Vision & Goals
- Public engagement and involvement
- Future Scenario Development: Identifying ***a range*** of investments and policies. Using low and high, or several specific input values. 75% to 150% of transit service, 50%-150% of parking costs, 75%-150% of pricing…
- Strategic Modeling that explores hundreds and thousands of scenarios
- Identify the scenarios which produced desirable results which support the Vision & Goals. Identify the inputs which lead to desired outcomes.

“Goal Seeking” exploratory modeling

The structured approach can run thousands of possible future options. Using exported data (SQL databases and CSVs) we can 'goal seek’ for desired performance results and identify the types of investment and policy inputs which produced desirable outcomes.

Many solutions to common outcome! And can allow for multicriteria optimization to balance and weight specific types of outcomes.

Identify particular policy objective(s)

i.e., lowest VMT per capita and high transit use

Define the conditions

i.e., high population growth, greater urban intensity, and high consumer adoption of shared AVs

Set the constraints

i.e., acceptable level of user revenues & minimize travel cost burden on lower income households

Identify the best mix of investments and policies

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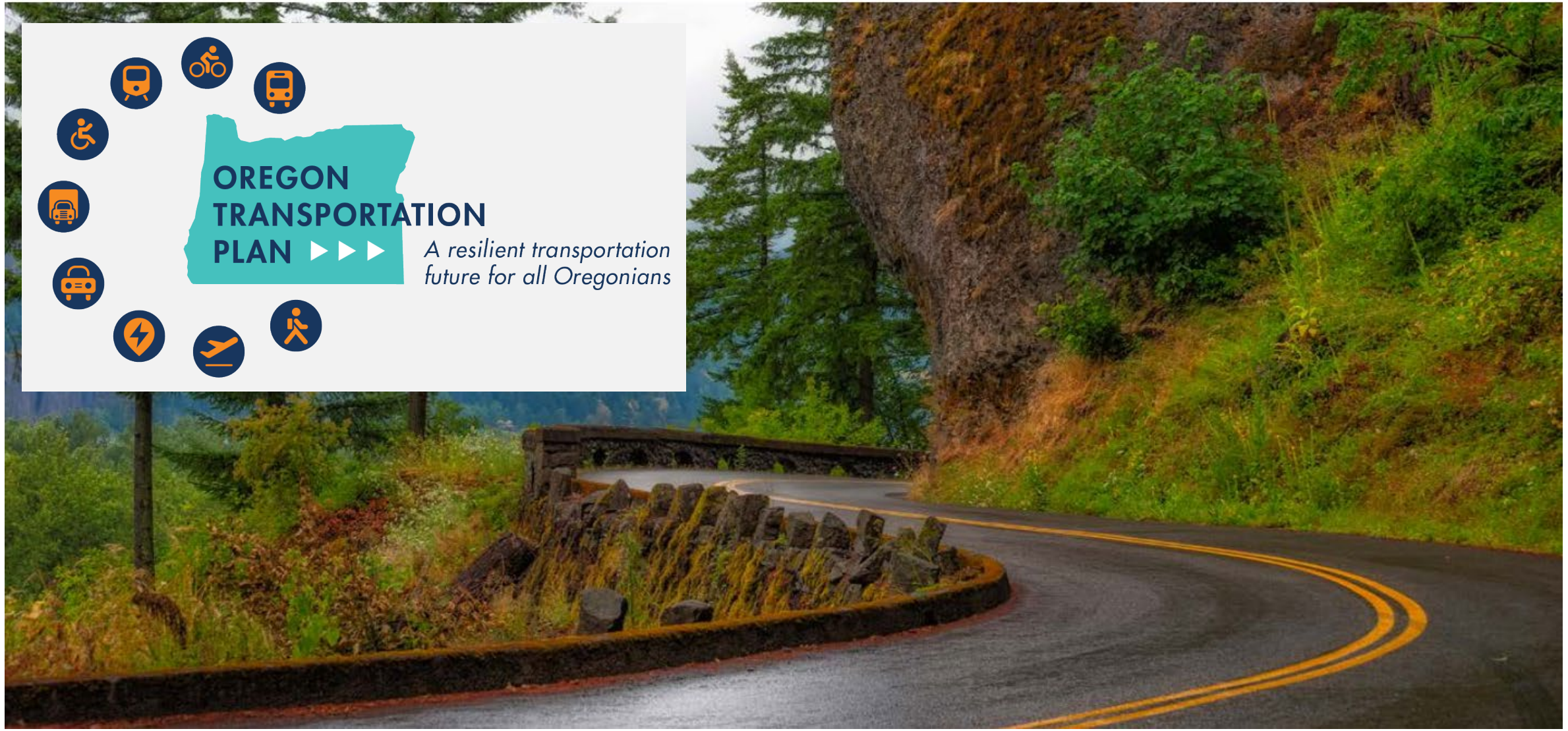

Oregon Transportation Plan
VE-State Application used in the recent Long-Range Plan Update

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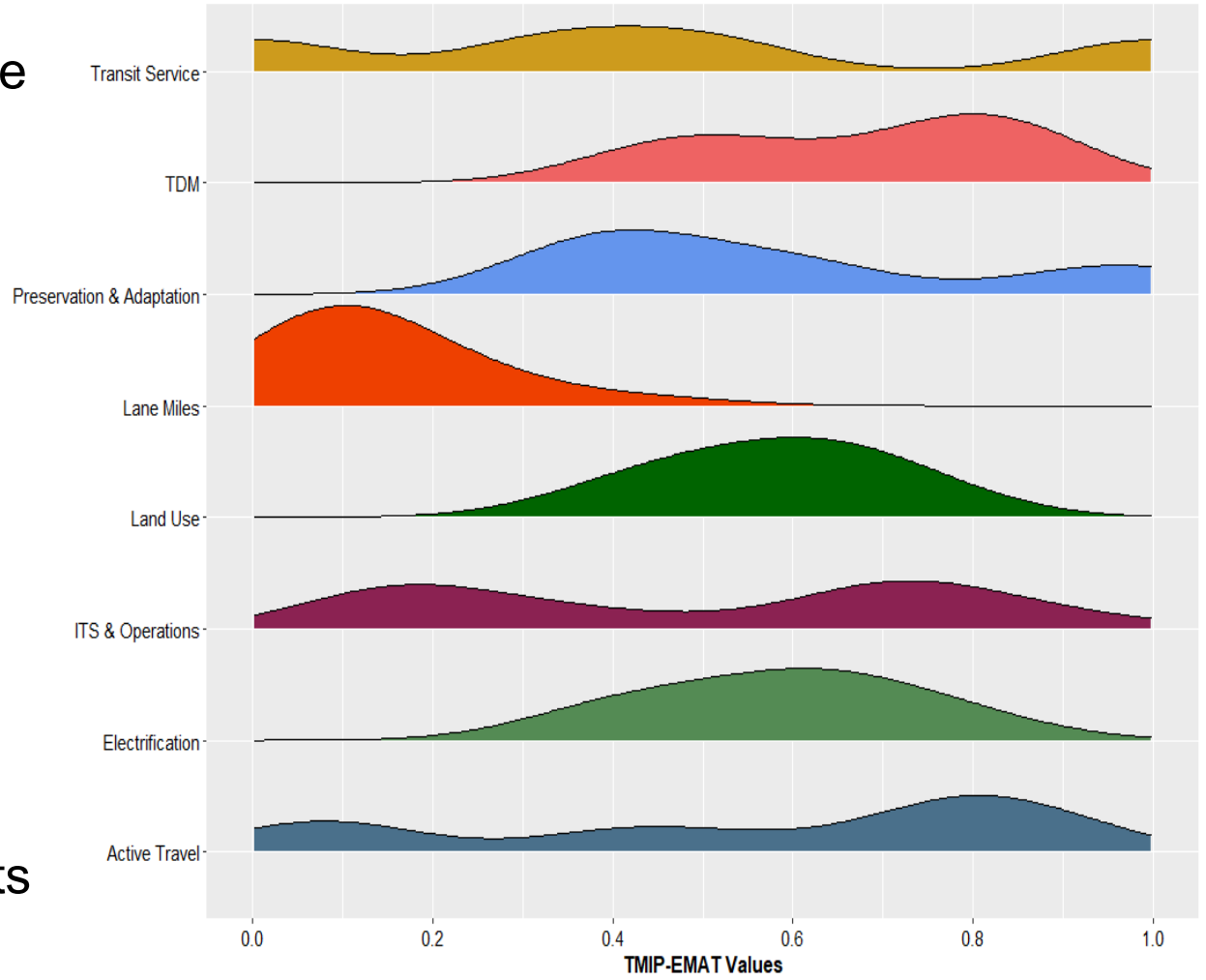
Testing a Range of Inputs

A wide range of values among 13 different dimensions within Oregon's sphere of influence are tested. These largely include items such as:

- Transit investments
- Walking and Biking infrastructure
- Demand management policies
- Roadway capacity
- Land use density and mix of uses
- Roadway taxes (fuel and VMT)

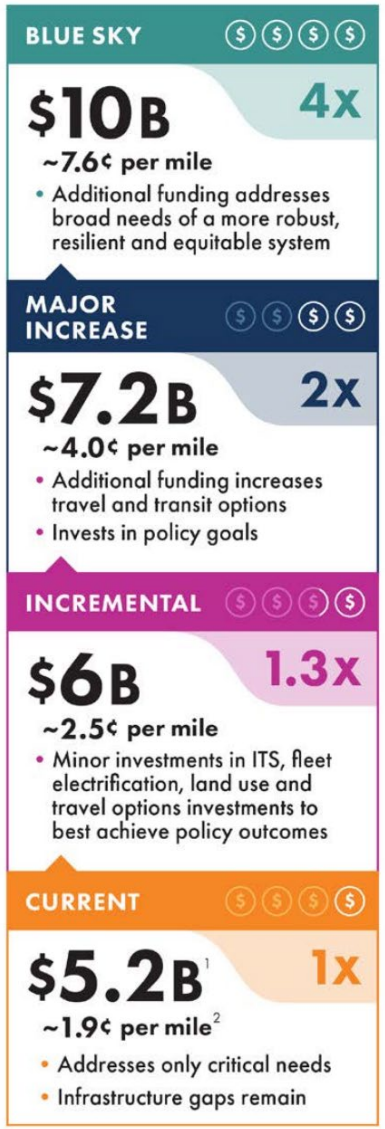
Then tested a range of largely uncertain inputs including:

- L3 and L5 Driverless vehicles
- Teleworking
- Fuel & energy prices, and other ownership costs
- Shared rides and ride-hailing prices



Distribution of Model Inputs Using the TMIP-EMAT System

Setting up a Set of Scenarios



4 Funding Levels

(1x, 1.3x, 2x, 4x)

✖

4 Emphasis Areas

- Balance all goals
- GHG reduction & equity
- Travel time reliability & Preservation
- Multimodal trips

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16 Core Scenarios

(4,000 futures per scenario = 64,0000 possible futures were analyzed)

The Scenarios changed the level of investments across the dimensions and constrained by the funding (and budget) limits.

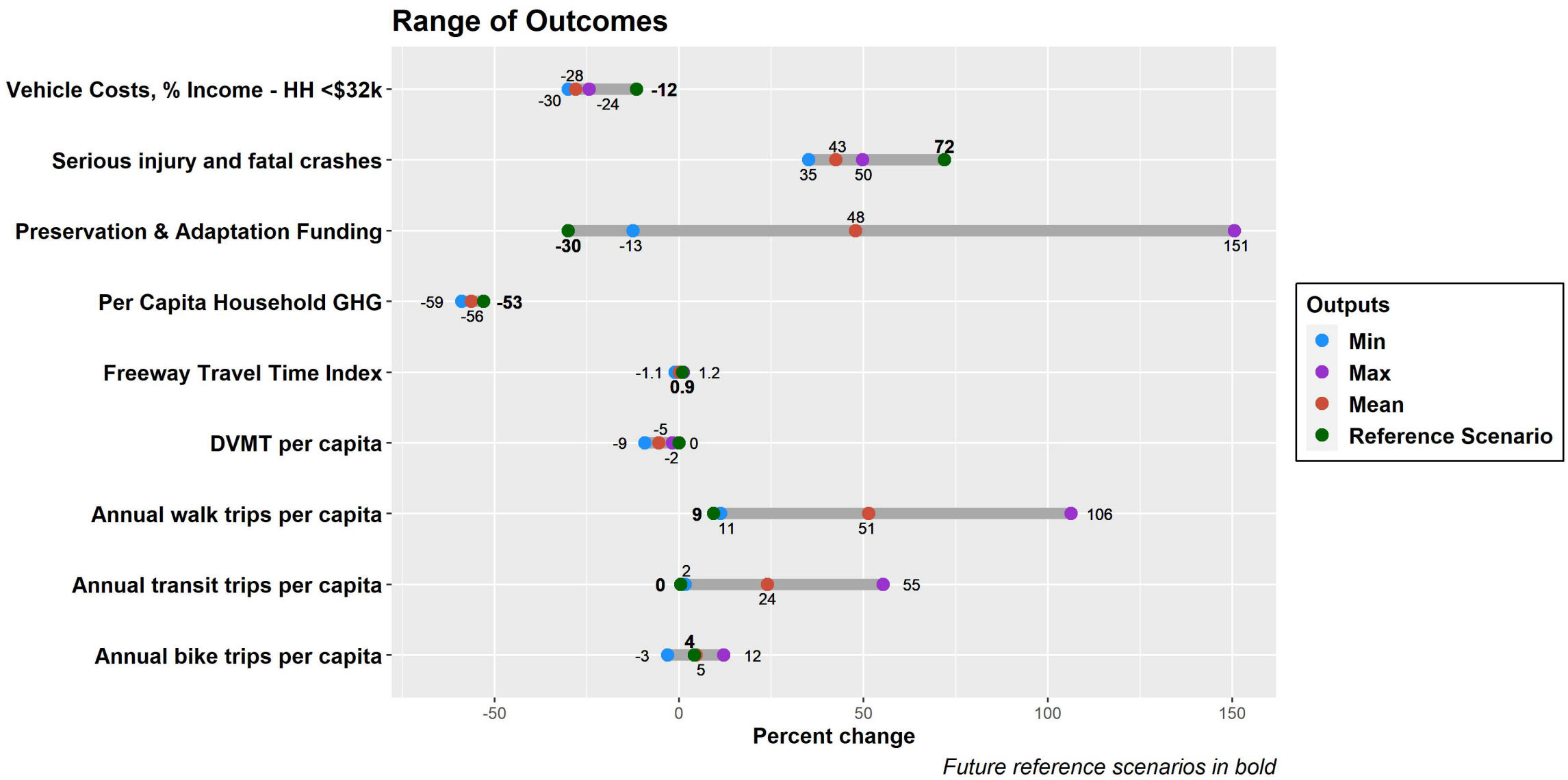
Each Scenario was to determine the optimal investments to maximize the outcomes in the Emphasis Area.

The analysis uses the VE-State model with the TMIP-EMAT (*Exploratory Modeling and Analysis Tool*) interface to explore a wide set of inputs under certain constraints.

Investment Input Ranges

Investment / Policy	Baseline Future Adopted Plan [a]	Low Level Alternative Future (TMIP Level 0) [b]	High Level Alternative Future (TMIP Level 1) [c]
Population Change	+36.5%		
Transit Service (revenue miles)	+25%		+85%
Roadway Capacity (Freeway & Arterial vehicle capacity)	Increase of: 166 freeway lane miles (+4.8%) 189 arterial lane miles (+1.2%)	Increase of: 94 freeway lane miles (+2.7%) 111 arterial lane miles (+0.7%)	Increase of: 211 freeway lane miles (+6.1%) 277 arterial lane miles (+1.7%)
ITS & Operations	1.5x increase between 2015 and 2050		~4x more ITS and Operations investment
Electrification	17% of BEV in 2050 13% increase in EVSE equates to ~85% of single family with EVSE		26% BEV in 2050 ~95% of single-family households with EVSE
Land Use (% in mixed used neighborhoods and changes in density)	No Changes in the Land Use inputs	Baseline given base inputs on land availability, pop, employment	CFEC policies (30% max, except Metro goes to 40% in mixed use neighborhoods)
Active Travel	1.4x growth in active mode trips by 2050		2.5x funding and 4.5x more active trips than low level
Travel Demand Management (TDM)	9% of employees and 5.5% of households in metro regions participate in TDM programs		~21% of employees and households in metro regions participate in TDM programs

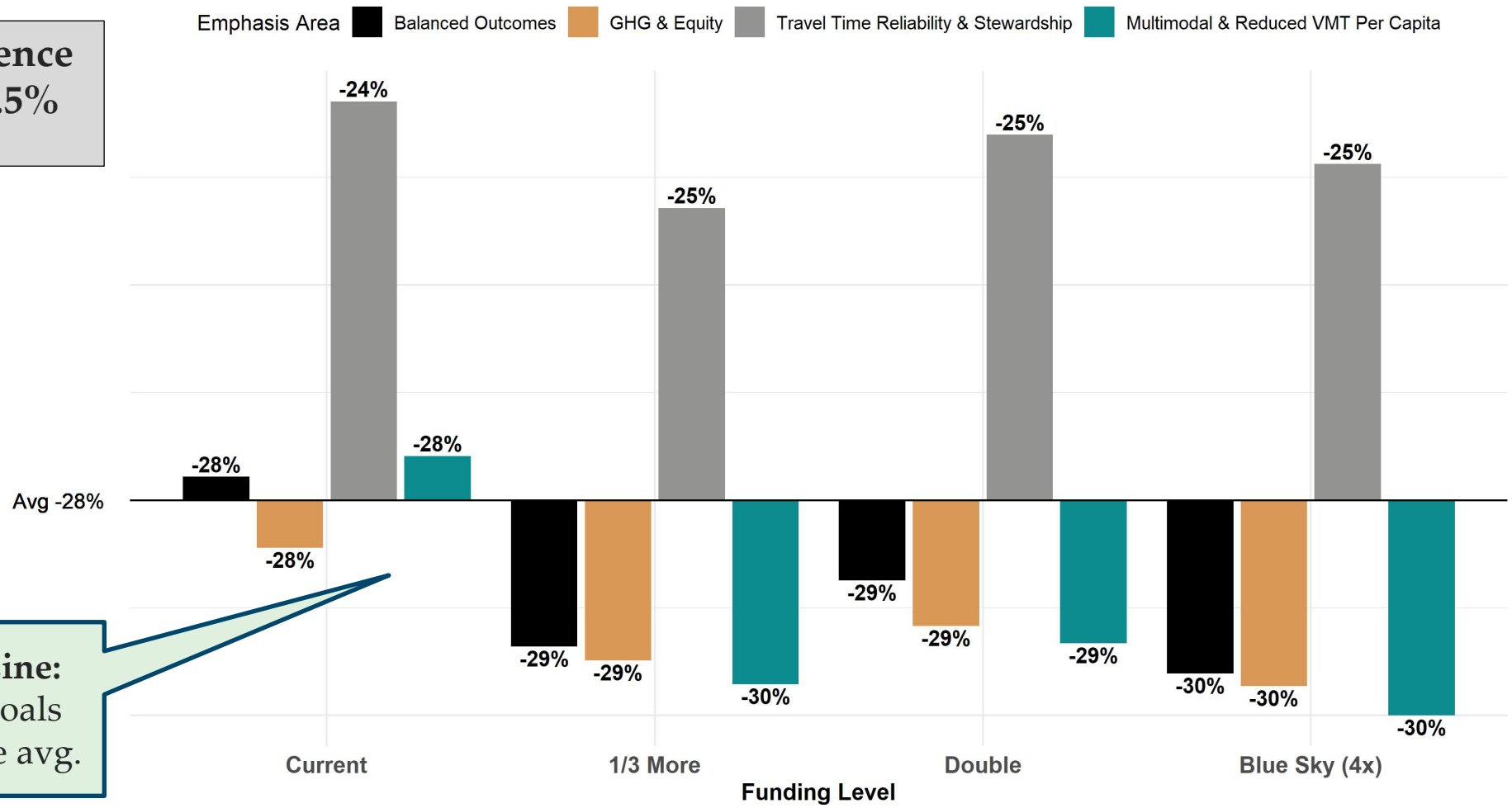
Outcomes Across the 16 Core Scenarios



Future reference scenarios in bold

Outcomes Across the 16 Core Scenarios: Example – Vehicle Ownership and Operating Costs for HH with income <32k per year

Future Reference Scenario: -11.5%



Below the Line: advancing goals more than the avg.

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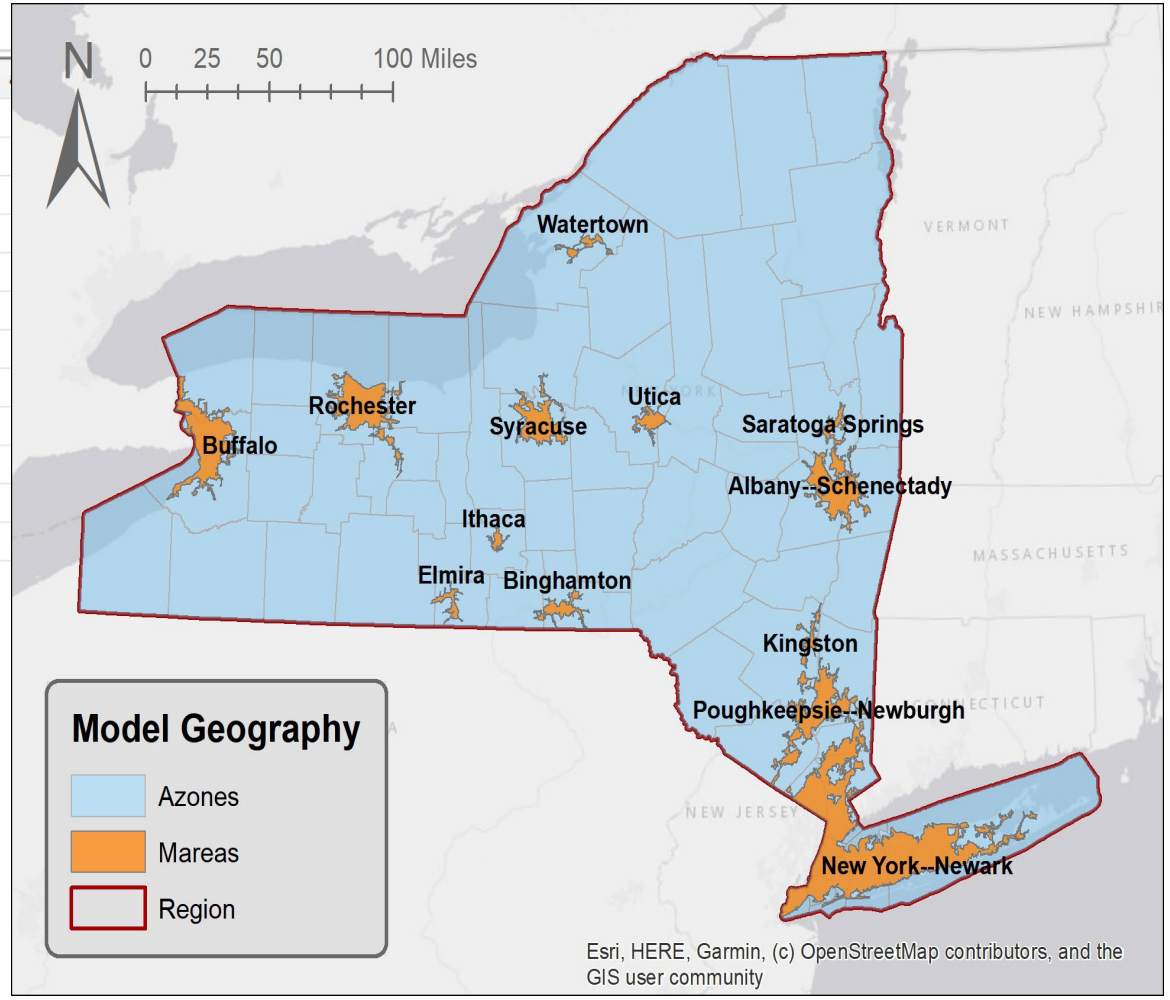
NYSERDA
VE-State Application for the Clean Transportation Roadmap

Example Output at Household Level

	hhid	azone	marea	hhsize	age0to14	age15to19	age20to29
1	Onondaga-51823	Onondaga	Syracuse	7	3	2	1
2	Queens-252834	Queens	NewYork	2	0	0	0
3	Erie-388334	Erie	Buffalo	7	1	2	2
4	Suffolk-20764	Suffolk	NewYork	2	0	0	0
5	Oneida-91084	Oneida	Utica	1	0	1	0
6	Oneida-66946	Oneida	Utica	4	2	0	0
7	Kings-75547	Kings	NewYork	1	0	0	0
8	Kings-441799	Kings	NewYork	2	0	0	0
9	Queens-806580	Queens	NewYork	1	0	0	0
10	Kings-613955	Kings	NewYork	3	0	0	0
11	StLawrence-12878	StLawrence	None	1	0	0	0
12	Orange-69926	Orange	PoughkeepsieNewburgh	2	0	0	0
13	Onondaga-139737	Onondaga	Syracuse	1	0	0	0



- >8 million synthetic households generated that reflect composition of New York State in a given modeled year
- Results can be segmented to identify impacts on specific groups (e.g., LMI household, age categories, etc.)

VE-STATE for NYSERDA

Variables of Interest
Daily VMT
SOV proportion
Diverted trips onto bike and walking
Average trip length
Bike, walk, vehicle trips per day
Avg social/environmental cost per mile
Avg vehicle cost

Segmenting Variables
County
Urban, town, rural
Income
Age
Household size
Number of workers in Household

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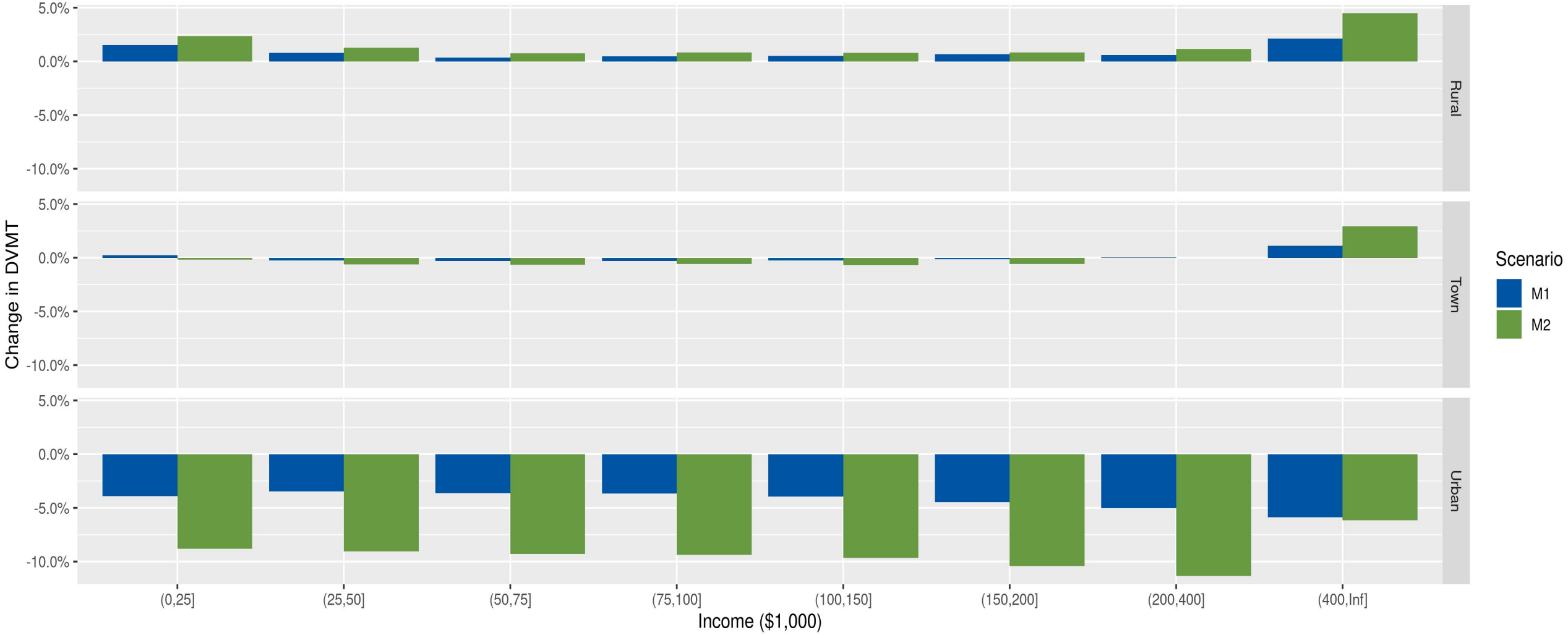
Interim Example Output at Household Level

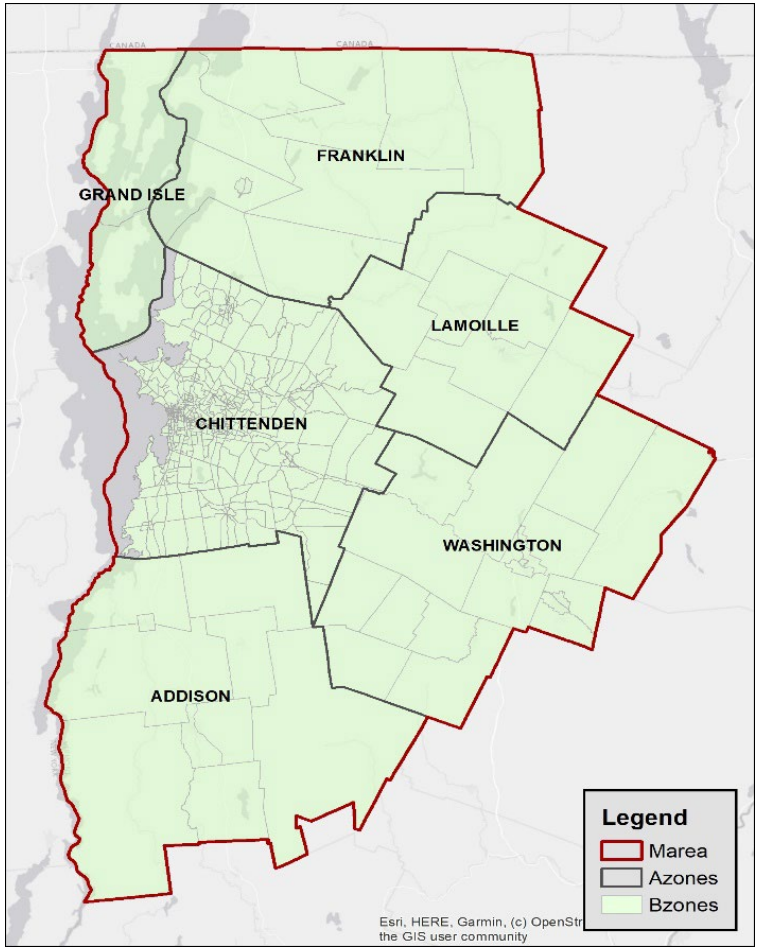


Chittenden County MPO (VT)
VE-RSPM Application for their recent Long-Range Plan and major Interstate Corridor Study

Setting up the strategic model for the CCRPC region using the regional travel demand model

- Developed a “reference” scenario that reflects current conditions and the latest forecasts
- Model inputs are developed for two years: 2015 and 2050
- Key data from the regional travel demand model is being used to develop the RSPM base model
- Zonal structure and land use
- Population and housing
- Employment
- Regional travel demand model also used to calibrate RSPM

Model Zone Structure



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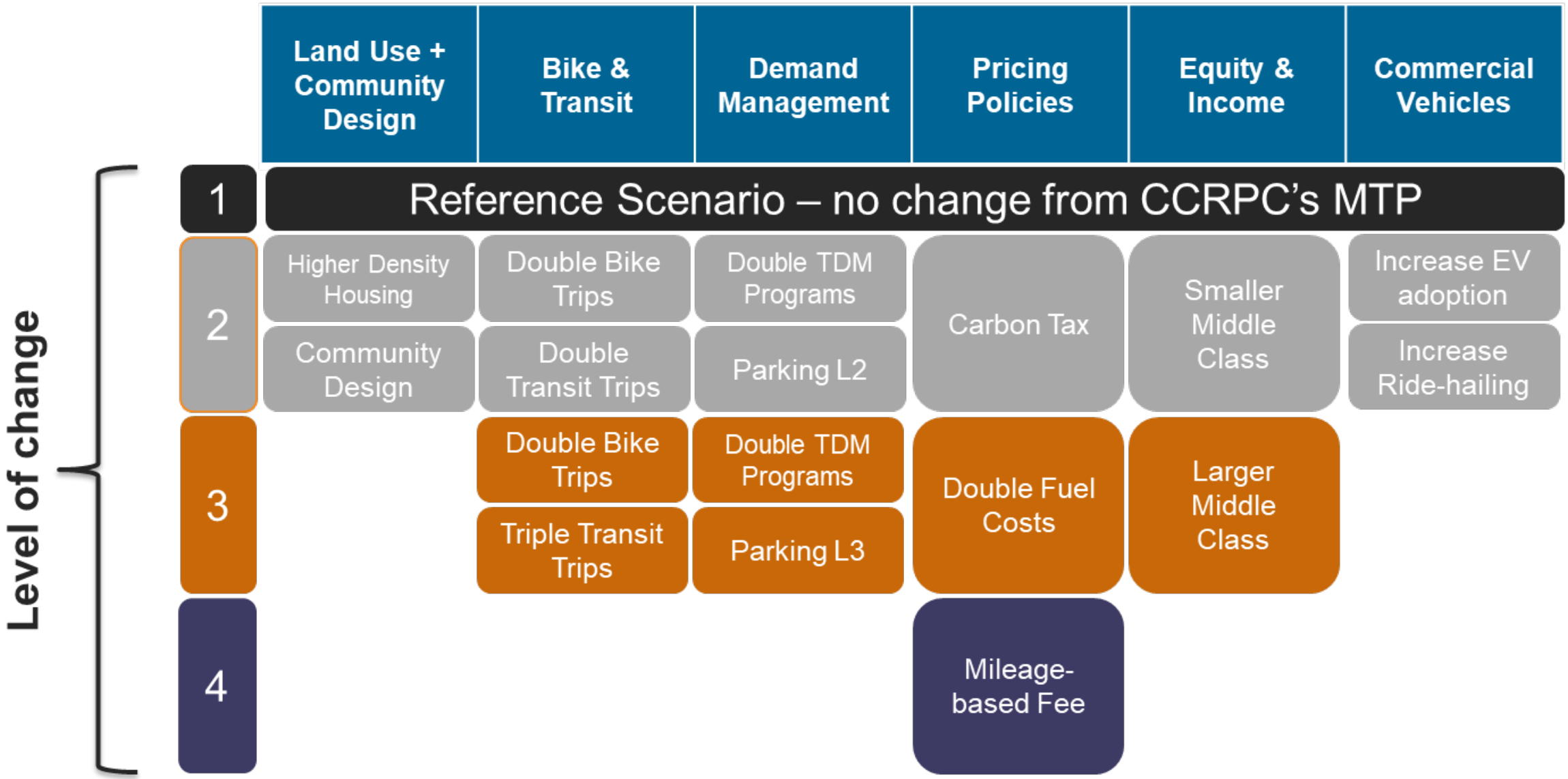
Scenario Testing Structure



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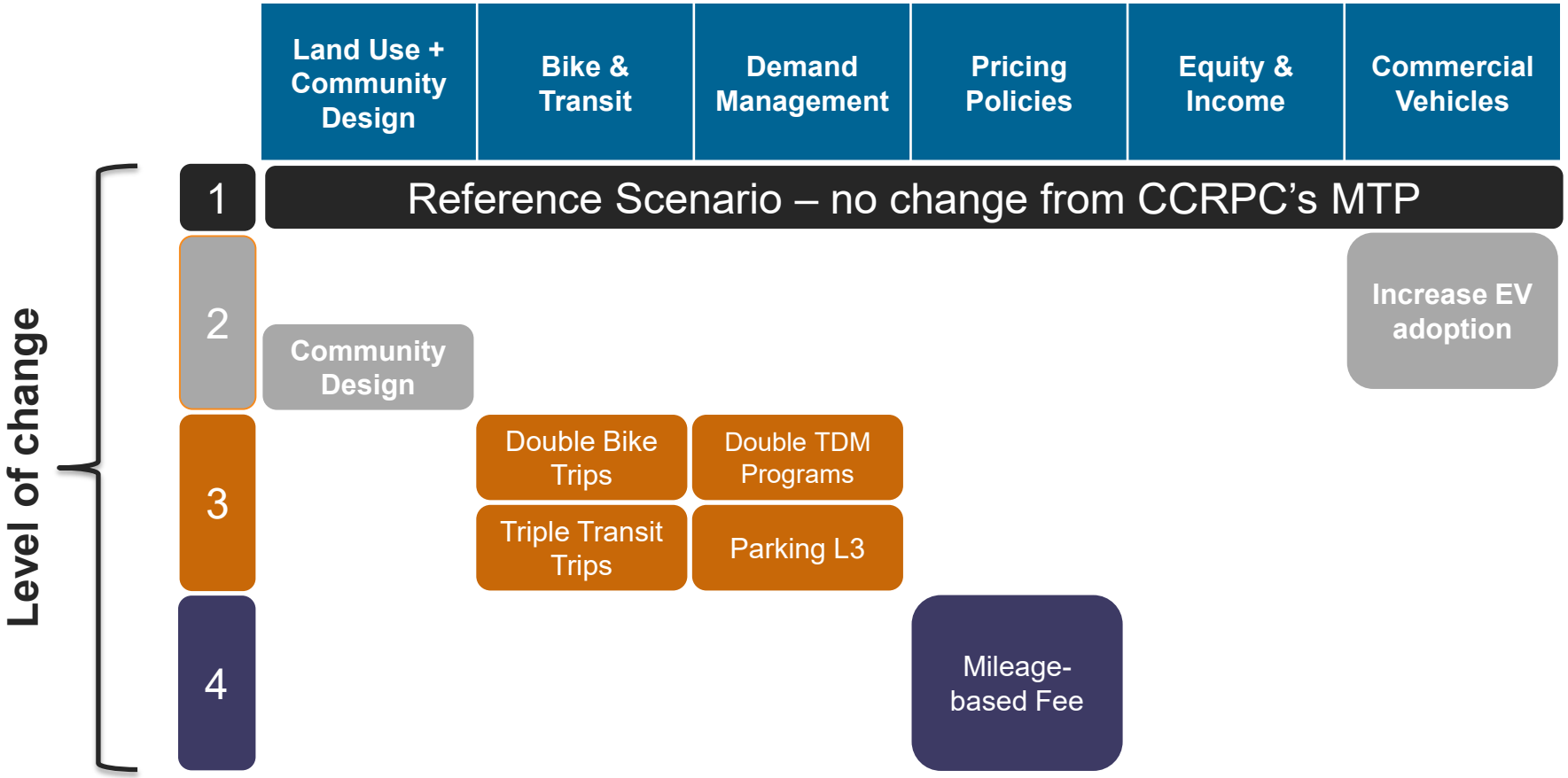
Preferred Low Household VMT Scenario



- Increase teleworking by 50%
- MTP land use density (90% of Households in existing developed areas)
- Double trips made by bike
- Triple transit services and improve frequencies
- Double participation in TDM programs and increase cost of parking
- Mileage-based fee (~5 cents/mile)

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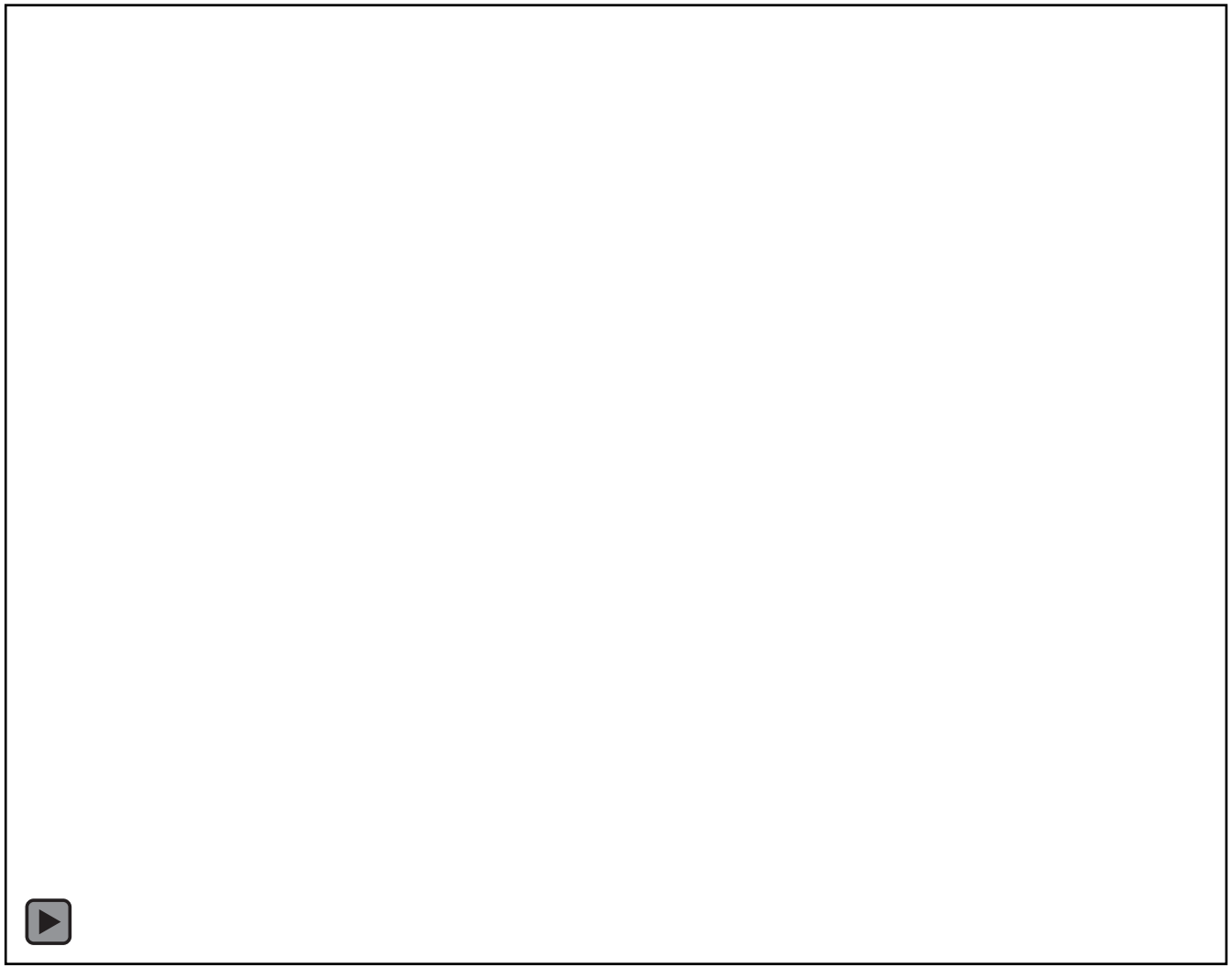
Interactive scenario viewer can be used to evaluate results using performance metrics



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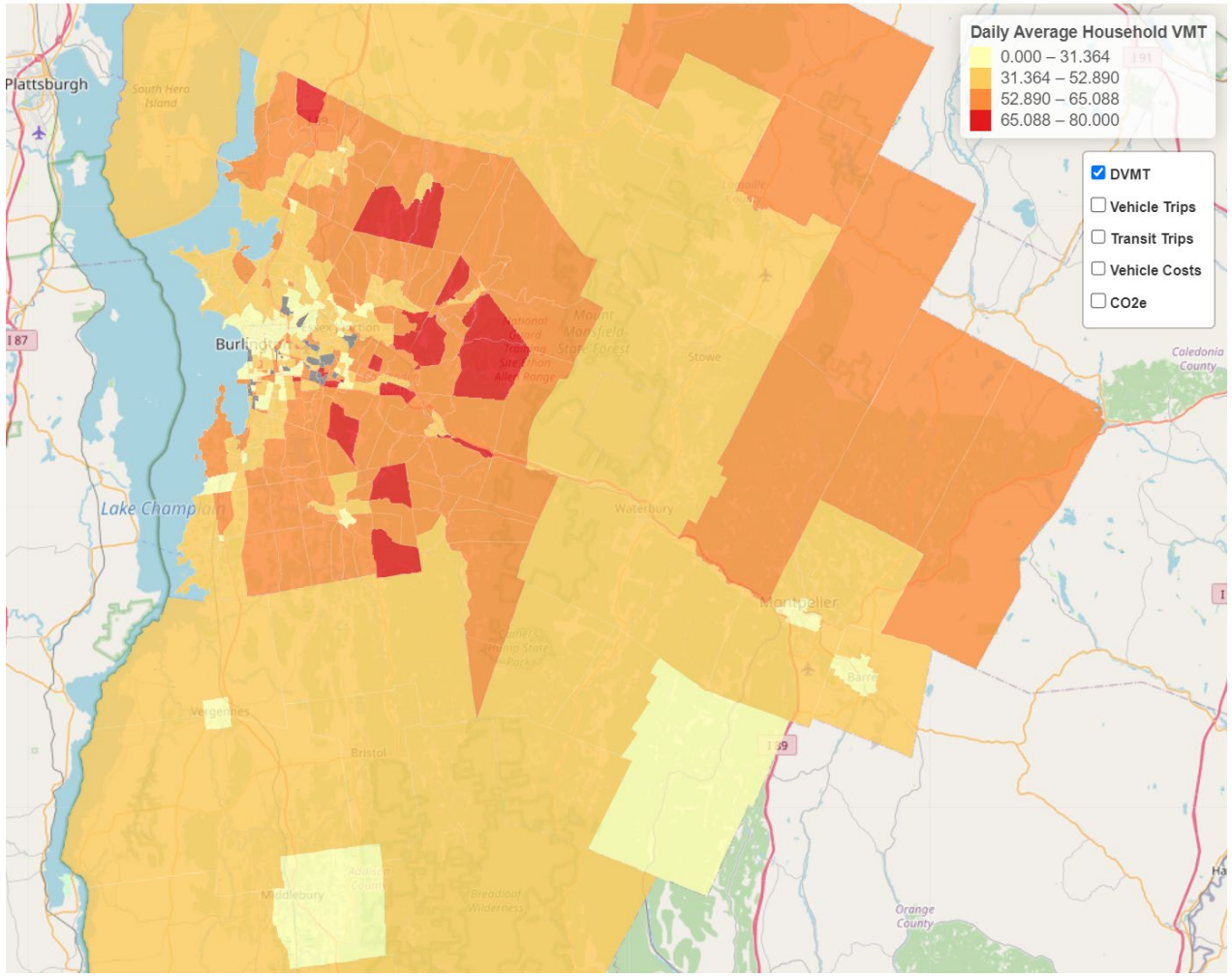
Using rShiny to load and compare Spatial data across select scenarios



Zone by Zone summary of the various outputs from the Strategic Model.

Visualizes the spatial differences between scenarios

Approach: built linkage between TAZ shapefile and the strategic model zone structure. Created queries in rShiny. (Work underway to have dashboards in PowerBI, Tableau, and Python as well)

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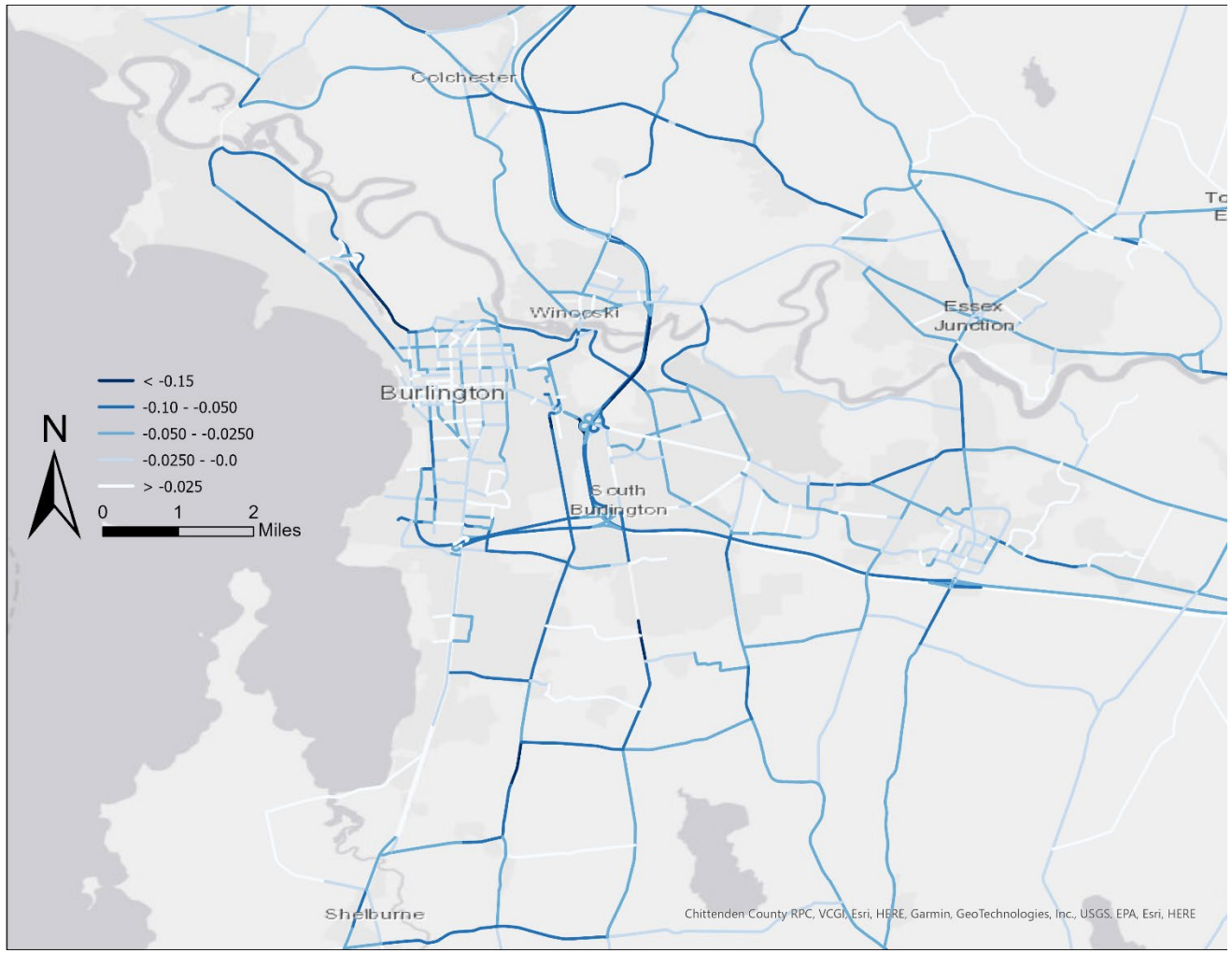
Last Step included Adjusting Trip Based Model



Revised vehicle ownership and vehicle trip generation rates for households within TAZs.

Re-ran trip generation, distribution, mode, and assignment to explore network effects.

METRIC	2050 BASE	MODEL A	MODEL A PERCENT CHANGE FROM THE BASE
Total VMT	5,197,692	4,336,475	-17%
Total VHT	147,243	117,968	-20%
VMT/Person	32.4	27.0	-17%
VHT/Person	0.9	0.7	-24%
VMT/Person Trip	5.77	4.50	-22%
VHT/Person Trip	0.23	0.12	-47%
Total Person Trips	963,724	963,724	0%

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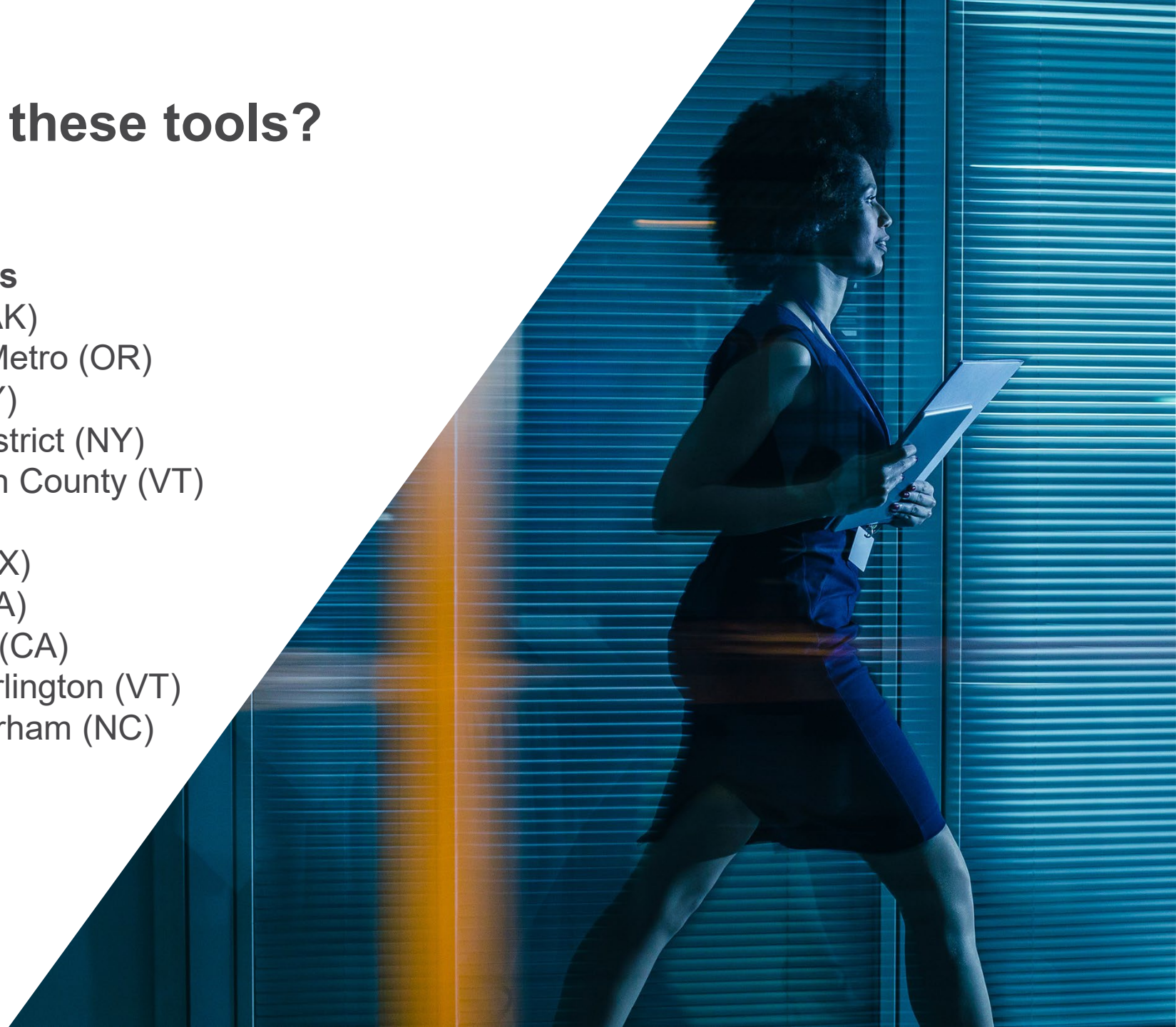
Who has been using these tools?

FHWA & Volpe

DOTs:
- Vermont*
- Maryland*
- Utah*
- Colorado*
- Washington
- New Mexico*
- Oregon
- New York
- Massachusetts
- Virginia

MPOs/Cities
- AMATS (AK)
- Portland Metro (OR)
- Ithaca (NY)
- Capital District (NY)
- Chittenden County (VT)
- ARC (GA)
- H-GAC (TX)
- MAPC (MA)
- SANDAG (CA)
- City of Burlington (VT)
- City of Durham (NC)



*EERPAT (related Strategic Model for States)

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Thank you

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