TravelWorks
Advanced Travel Analysis Tools

Rapid Policy Assessment Tool (RPAT)

Peer Exchange Summary Report

October 19, 2015

Contents

Definitions

AASHTO	American Association of State Highway and Transportation Officials
CAMPO	See Footnote[1]
DCHC	Durham-Chapel Hill-Carrboro Metropolitan Planning Organization
DOT	Department of Transportation
DVRPC	Delaware Valley Regional Planning Commission
EERPAT	Energy and Emissions Reduction Policy Analysis Tool
FHWA	Federal Highway Administration
GHG	Greenhouse Gas
GreenSTEP	Greenhouse gas Strategic Transportation Energy Planning
GUI	Graphical User Interface
I50	Impacts 2050
IAP	Implementation Assistance Program
MPO	Metropolitan Planning Organization
MTP	Metropolitan Transportation Plan
ODOT	Oregon Department of Transportation
RPAT	Rapid Policy Assessment Tool
RSPM	Regional Strategic Planning Model
SHRP2	Second Strategic Highway Research Program
TDM	Transportation Demand Model
TMA	Travel Model Area
TRM	Triangle Regional Model
VMT	Vehicle Miles Travelled

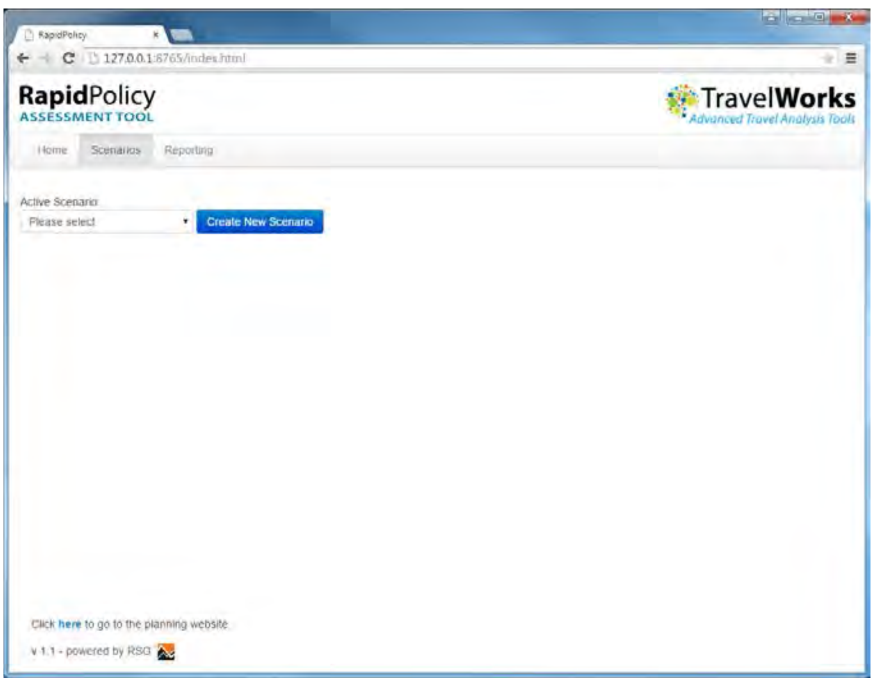
[1] Several MPOs use the acronym CAMPO, including the North Carolina Capital Area Metropolitan Planning Organization and the Corvallis Area Metropolitan Planning Organization.

Overview

Rapid Policy Assessment Tool

The Rapid Policy Assessment Tool (RPAT), formerly known as SmartGAP, is a free and open source software application transportation planning agencies can use to conduct scenario planning to evaluate smart growth and other transportation investment policies. RPAT uses changes in built environment, travel demand, transportation supply, and transportation policies to quantify the effects of planning scenarios on future travel demand. RPAT addresses gaps that exist within common planning process practices by integrating land use strategies and quantitative methods into the investment decision making process.

Figure 1: RPAT Graphical User Interface



RPAT combines a robust set of statistical models with a graphical user interface (GUI) to manage data inputs, run models, and view output, as shown in Figure 1. Input data for RPAT can be produced by using readily-available data sources (such as the U.S. Census Bureau) or data sources that are locally or regionally maintained (such as street centerlines). RPAT is a disaggregate model that simulates the behavior of individual households and firms to determine the effect of policy changes on travel demand. RPAT produces a series of performance metrics for each scenario, including:

- Community impacts
- Travel impacts
- Environmental and energy impacts
- Financial and economic impacts
- Location impacts

These performance metrics can be used to compare scenarios through RPAT's reporting functionality or as standalone quantitative data for the assessment of scenarios at a regional scale.

RPAT was developed as part of the Second Strategic Highway Research Program (SHRP2) C16 project, "Effect of Smart Growth Policies on Travel Demand". SHRP2 C16 provides transportation planning agencies with improved tools and methods for more accurately and comprehensively integrating transportation investment decision-making with land development and growth management. RPAT is one of the SHRP2 research products now being maintained at American Association of State Highway and Transportation Officials (AASHTO's) TravelWorks site (http://planningtools.transportation.org/10/travelworks.html), which hosts a collection of tools to improve modeling and transportation analysis. Releases of the RPAT software are available for download from TravelWorks.

Peer Exchange Meeting

AASHTO sponsored a peer exchange intended to share lessons learned from RPAT implementation in Las Vegas, NV on October 19, 2015. The agencies represented in the peer exchange discussed the wide range of intended uses for RPAT and their varied experiences with implementing the software. The participants in the peer exchange (see Appendix A) discussed aspects of their RPAT implementation, its purposes and intended uses, results from using RPAT, and the problems and limitations encountered during their implementation process.

The session was conducted in three parts:

1. Presentations on implementation topics by the participants including data preparation, outcome and interpretation of results, use of results in policy discussions, and model validation.
2. Presentation of the common framework concept for the family of scenario planning models including RPAT, Federal Highway Administration's (FHWA's) Energy and Emissions Reduction Policy Analysis Tool (EERPAT), and Oregon's Greenhouse Gas Strategic Transportation Energy Planning (GreenSTEP) model.
3. Roundtable discussion on possible enhancements to RPAT.

This document provides a summary of the peer exchange proceedings.

Implementation Assistance Plan Grants

The peer exchange centered on lessons learned by the Implementation Assistance Plan (IAP) grant recipients: Oregon Department of Transportation (ODOT), Delaware Valley Regional

Planning Commission (DVRPC), and Durham-Chapel Hill-Carrboro (DCHC) Metropolitan Planning Organization (MPO). Each of the grant recipients used RPAT in a different way to support planning at their agencies.

Durham-Chapel Hill-Carrboro Metropolitan Planning Organization

DCHC's RPAT implementation was used to pre-screen transportation and land use scenarios in the Metropolitan Transportation Plan (MTP) process. This included addressing policy questions, such as the impact of smart growth on travel demand, greenhouse gas (GHG) emissions, safety and economic efficiency. By using RPAT's scenario testing functionality, the program streamlines the decision-making process. This is beneficial for an MPO like DCHC that works with multiple agencies, including North Carolina Capital Area MPO, North Carolina Department of Transportation (DOT), and GoTriangle (formerly Triangle Transit, the regional transit agency), during the decision-making process. An additional goal for DCHC was that RPAT could help foster cooperation between stakeholders and support a dialog on region wide policies.

Delaware Valley Regional Planning Commission

DVRPC used RPAT in three major work program activities. The first was to test assumptions in their "Choices & Voices" online scenario tool, such as the impacts of transportation operations investments and easily achieved strategies to reduce GHG emissions, such as parking pricing and pay-as-you-drive insurance. The model was also used as part of "The Future Forces What-if Scenarios for Greater Philadelphia", which looked at emerging trends that could drive significant change in the region over the next 30 years. This effort is the first component of DVRPC's upcoming Long-Range Plan update. DVRPC will also use RPAT to test alternative development pattern impacts, and other smart growth strategies as part of a master plan update for Gloucester County, NJ.

Oregon Department of Transportation

Long-range planning for Oregon communities has been enhanced by the development of the GreenSTEP/Regional Scenario Planning (RSPM) model, enabling strategic visioning around policies to reduce GHG emissions and improve system performance in other areas. ODOT has rebranded the most recent version of GreenSTEP to RSPM. GreenSTEP was the basis for developing FHWA's EERPAT, and the SHRP2 C16 RPAT (formerly SmartGAP). RSPM has been enhanced to cover a broader range of policy choices and interactions, and assess indicators beyond GHG, such as household costs. Most recently, the Corvallis Area MPO used RSPM and RPAT to conduct a regional Strategic Assessment that assesses policy scenarios to inform their ongoing planning efforts.

ODOT, in partnership with Corvallis Area MPO and the Oregon Department of Land Conservation and Development, has two goals for the C16 grant: 1) implement RPAT alongside RSPM in Corvallis Area MPO and use both tools to analyze Corvallis Area MPO-led policy scenarios, 2) compare RSPM and RPAT functionality to gain an understanding of how the models may complement one another and how RPAT, particularly the land use analysis capabilities, can be merged into ODOT's RSPM tool. The second objective will be enhanced through additional FHWA funding, which will allow ODOT to run hundreds of RPAT scenarios and visualize the results in a web-based interactive viewer as ODOT previously did with RSPM. Working towards these two goals will enable ODOT to compare the results from the two models to find out how the additional capabilities of RPAT could improve the ongoing Corvallis Area MPO planning work and decision-making, and provide lessons learned that could be applied in other Oregon communities and statewide planning efforts.

Implementation Topics

The peer exchange was organized around four major topics related to RPAT use: 1) data preparation; 2) outcome and interpretation of results; 3) use of results in policy discussions; and 4) model validation. Each of the IAP grant recipients presented on one of the topics. Other peer exchange participants were invited to discuss the topics and share their own experiences. A summary of each topic and the following discussions are presented herein.

Durham-Chapel Hill-Carrboro Data Preparation

RPAT implementation begins with the development of scenario inputs. There are seventeen scenario inputs that together represent the region in aggregate. The scenario input data preparation process is flexible. Each implementation's scenario input development process evolves based on project needs and data availability. The DCHC RPAT implementation achieves its project goals by replicating the results from their regional travel demand model, the Triangle Regional Model (TRM). The Travel Model Area (TMA) for TRM comprises both DCHC and Capital Area MPO, which necessitates the RPAT implementation produce performance metrics not only for the full TMA, but also for the TMA's two component MPOs individually. These competing requirements complicate how DCHC prepares data. Ensuring reconciliation across scenarios and repeatability of data preparation development required formalization of the process.

Two tools facilitate DCHC's data preparation work: 1) a land use allocation toolset and 2) a scenario-splitting toolset. The land use allocation toolset assigns CommunityViz land use data (see Figure 2) to RPAT place types for summary into the appropriate employment and population by place-type bins for RPAT. The second toolset organizes the input data for the full region into a single spreadsheet (see Figure 3). This toolset presents the data as the full region or splits the regional totals to reflect just one of the two MPOs, and produces the formatted scenario inputs in comma separated value format. This second tool helps centralize the data for the development process and helps reconcile scenario inputs between the TMA and the two component MPOs.

Figure 2: CommunityViz Land Use

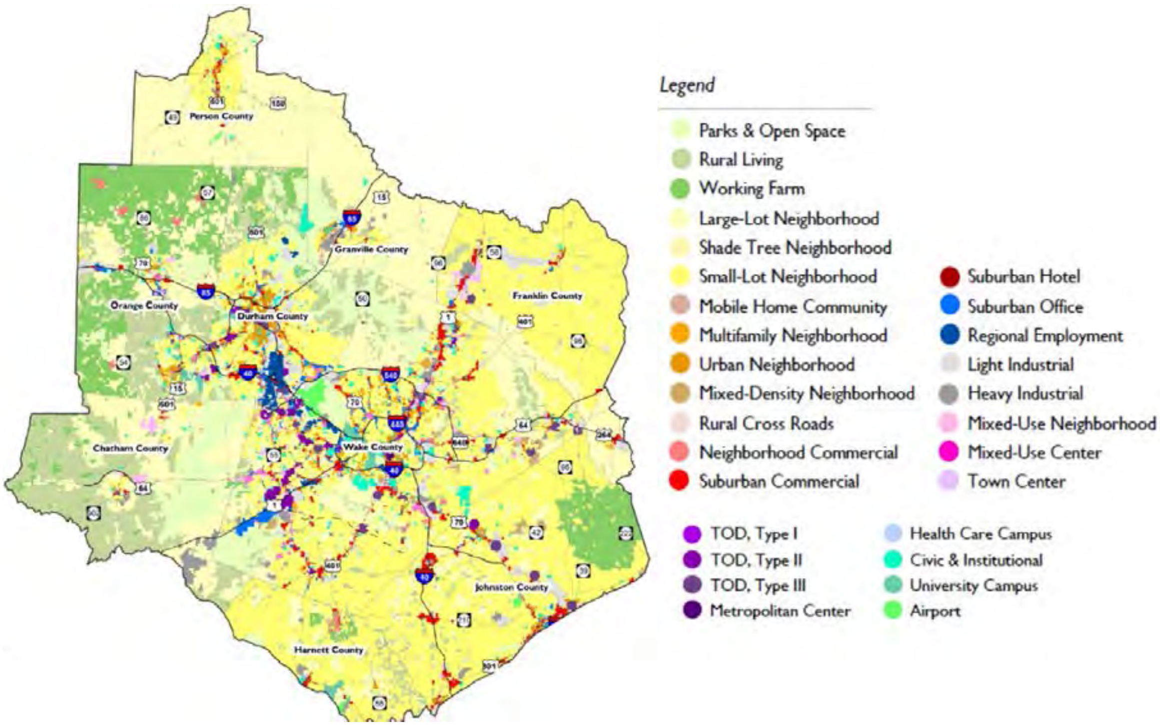
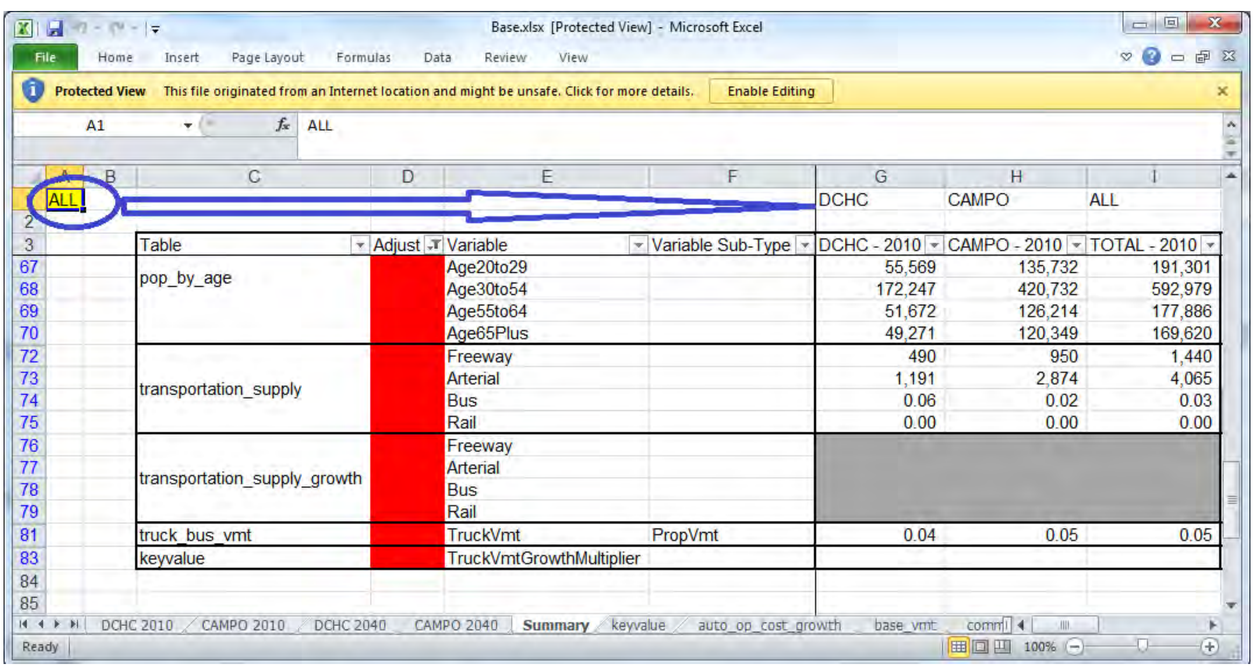


Figure 3: Scenario Organization and Splitting Spreadsheet Tool



	A	C	D	E	F	G	H	I
1	ALL					DCHC	CAMPO	ALL
2								
3		Table	Adjust	Variable	Variable Sub-Type	DCHC - 2010	CAMPO - 2010	TOTAL - 2010
67		pop_by_age		Age20to29		55,569	135,732	191,301
68				Age30to54		172,247	420,732	592,979
69				Age55to64		51,672	126,214	177,886
70				Age65Plus		49,271	120,349	169,620
72		transportation_supply		Freeway		490	950	1,440
73				Arterial		1,191	2,874	4,065
74				Bus		0.06	0.02	0.03
75				Rail		0.00	0.00	0.00
76		transportation_supply_growth		Freeway				
77				Arterial				
78				Bus				
79				Rail				
81		truck_bus_vmt		TruckVmt	PropVmt	0.04	0.05	0.05
83		keyvalue		TruckVmtGrowthMultiplier				
84								
85								

Using the two tools allowed the streamlining and formalization of specific aspects of the data input preparation process. For DCHC, developing these two tools formalized the definition of place types and area types across the region, informed and codified the split of regional totals into sub-region MPO totals, and facilitated the calibration and validation process by minimizing the number of manual adjustments. Facilitating the calibration and validation process facilitated the RPAT replication of transportation demand model (TDM) results, one of DCHC's main project goals.

The DCHC MPO used RPAT data preparation tools to great effect but there are still parts of the process that remain difficult. Three data input preparation items that DCHC found difficult include: using monetary values in year 2000-equivalent dollars, preparing input employment data, and accounting for their new light rail system. Providing input monetary values in year 2000 equivalent dollars is not intuitive and not readily available. Preparing input employment data required a high level of detail that was not available from TRM. Assumptions about ridership and expected rail use required adjusting RPAT parameters.

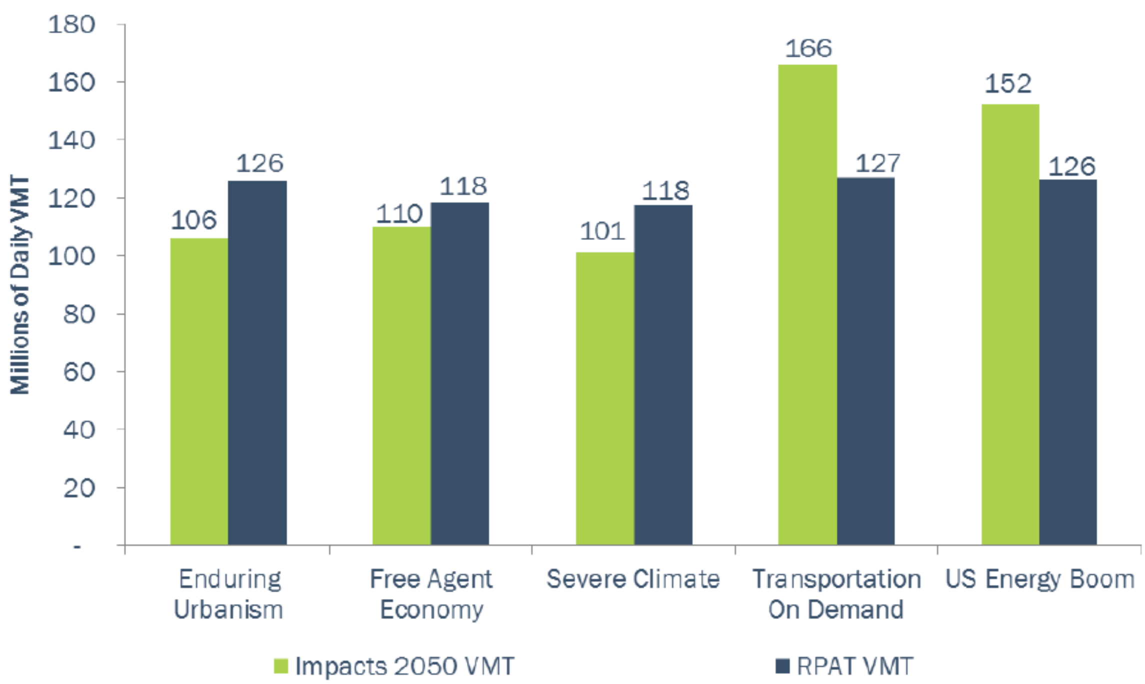
The participants similarly found some RPAT inputs difficult to develop and raised questions regarding the RPAT calibration and validation process. Concerns with data preparation difficulties revolve around three themes: data that is difficult to obtain and assess (such as parking data), data that is difficult to process (such as employment data), and data that can be simplified (such as per capita inputs). The questions regarding calibration and validation stemmed from a desire for more documentation guidance on the process at large, as well as questions what data RPAT should be calibrated. DCHC MPO wanted to calibrate RPAT closely to the TRM model, but not all implementations require calibration processes that are so tightly bound to TDM outputs.

Delaware Valley Regional Planning Commission Outcomes and Interpretation of Results

RPAT produces several performance metrics that cover topics such as vehicle accident and GHG emissions and summarizes output data as tables and charts. The raw, un-summarized disaggregate data is available as .RData files. RPAT users then use and interpret the output performance metrics in different ways, based on the purposes and goals of their implementation. DVRPC used RPAT results in support of two major work program activities with a third program planned. DVRPC's primary goals for using RPAT outcomes are centered on stakeholder outreach.

DVRPC has validated RPAT results against results from a spreadsheet tool "Impacts 2050" (I50) and a University of Pennsylvania GHG emission research. In comparing RPAT and I50 it is clear that I50 is more aggressive in predicting changes (Figure 4). The University of Pennsylvania research yielded similar results to RPAT. In the absence of a thorough understanding of what causes differences between I50 and RPAT, DVRPC has shared results that average findings from I50 and RPAT.

Figure 4: Impacts 2050 and RPAT Comparison



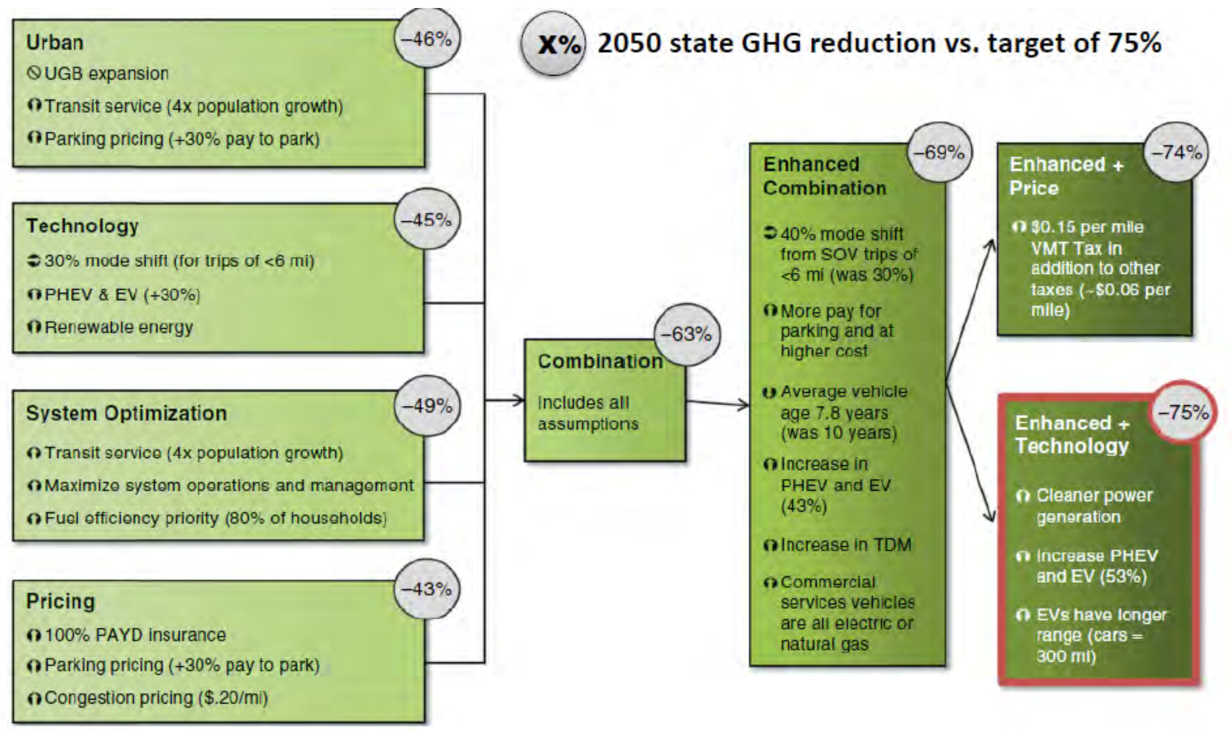
One reason that RPAT may show less variation among scenarios is that RPAT considers the interaction among policies while traditional tools compare policies individually. This means that when traditional tools look at packages of polices, they may double or triple count factors that contribute to some outputs.

DVRPC is not the only agency that is hesitant to share RPAT metrics. While participants generally found RPAT results intuitive, they wanted to see a thoroughly documented validation. Participants generally felt that RPAT results needed to be presented in context with a focus on trends and themes rather than specific results. Furthermore, if policy or infrastructure changes affect only a portion of trips in a region, there will likely be only a small change in region-wide statistics, particularly if the region is large. In this case, it may be helpful to report changes in a subarea.

Oregon Department of Transportation Use of Results in Policy Discussion

The breadth of policies that can be tested with RPAT, coupled with its simple and easily interpretable outputs, makes it a logical tool for discussions with policy makers and stakeholders. ODOT uses RPAT and RSPM (formerly GreenSTEP) to inform policy discussions in working towards statewide Oregon GHG reduction goals. To work towards meeting statewide GHG emission goals, ODOT began by looking at state-level actions (Figure 5). Next, ODOT worked with urban areas to determine the local and regional policies that can contribute to meeting these goals. RPAT and RSPM provided ODOT with the ability to quickly test a wide variety of scenarios, and to understand the implications of each scenario on GHG emissions as well as a range of other factors that may mirror community values. This ability to quickly test scenarios and look at a wide range of outputs has informed productive community discussion centered on a mix of policy and transportation investment alternatives.

Figure 5: Oregon Statewide GHG Planning with RSPM



Corvallis Area MPO is a case study example where RPAT is informing policy discussions based on ODOT strategic planning initiatives. Corvallis is a city of 62,000 people and home to Oregon State University. Corvallis has a centralized job market (Oregon State University) and an expensive housing market. The combination of a centralized job market and expensive housing market contributes to long commutes from surrounding communities. The Corvallis Area MPO Board wanted to better understand the relationship between transportation cost, housing availability and affordability, and community health. Using RPAT, the Corvallis Area MPO developed and tested a set of scenarios to explore these issues. Testing these scenarios with RPAT showed that vehicle miles travelled (VMT) and GHG emissions will continue to increase even with proposed policy changes. This information will help the Corvallis Area MPO to determine if new policy approaches are needed to meet regional goals.

Model Validation

"Validation is the application of the calibrated models and comparison of the results against observed data. Ideally, the observed data are data not used for the model estimation or calibration but, practically, this is not always feasible. Validation data may include additional data collected for the same year as the estimation or calibration of the model or data collected for an alternative year. Validation should also include sensitivity testing."[2]

For RPAT, the validation process is a two-step approach to check output and input data. Output data should be checked against separate-observed data, if possible. Input data should be cross validated with new data. When cross validating population and employment inputs one should think about the origin of the original data: if local data is being used then it should be compared with local data, or if national data is being used then it should be compared to national data. In validating economic inputs it is important that the dollar amounts are normalized to the correct year, which is currently year 2000 dollars. Transportation demand inputs can be validated against a host of data sources, but errors have been noted as well. Direct travel impacts can be compared against national sources or regional TDM but the assumptions baked into either or both of these sources require weighting to contrast with the assumptions in RPAT. Similarly, regional accessibility is best compared to a TDM while sources like the National Highway Traffic Safety Administration report accident data that can be used for validation. Figure 6 presents a validation test conducted by the DCHC MPO, highlighting a significant difference in average speed and vehicle hours of travel, highlighting a misreporting of the TRM vehicle hours of travel.

Calibration efforts are important in focusing the model, but it is more important to understand and explain the output numbers and patterns, rather than attempting to get close to a target. The ability to decipher a coherent story from the outputs, and verifying plausible relationships from key output metrics, is an important part of the calibration process. A close match to targets, whether from the base year or independent source, may not be achievable. That said, final results should be judged for reasonableness and 'explainability', particularly for long-range/horizon year predictions.

[2] Travel Model Validation and Reasonableness Checking Manual, FHWA, September 24, 2010.

Figure 6: Example Test for 2040 Travel Impacts from DCHC MPO

2040 MTP	TRM	RPAT	Difference (%)
Vehicle Trips	7,406,935	7,988,956	7.86
VMT	87,970,656	80,319,835	-8.70
Average Speed - Freeway - Arterial - All Facility	49.9 61.4 45.7 49.9	33.5	-32.87
VHT	2,279,875	1,690,926	-25.83
Transit Trips	227,878	128,787	-43.48

The participants had varying experiences with RPAT validation. One participant said that it might be useful to compare RPAT output to a statewide implementation of EERPAT. It was mentioned that the difficult part of the validation process was understanding the range of acceptability for the validation statistics. Participants agreed that RPAT-specific guidance would be welcomed.

Rapid Policy Assessment Tool Enhancements

The third part of the peer exchange was a two-part conversation about the future of RPAT and possible enhancements of the tool. The discussion started with the components and aspects of RPAT that worked well, transitioning to a conversation of what needed improvement. The conversation concluded with identification of desired adjustments and additions to RPAT.

The conversation of what worked well during the RPAT implementation projects focused on highlighting RPAT's functionality and the tool's utility. RPAT's design as a quantitative scenario planning tool is unique in helping planning agencies answer questions that were once difficult to answer. According to participants, RPAT's functionality and intended use worked well as follows:

- RPAT provides quick, empirical responses to future policy scenarios.
- RPAT provides a range of performance measures.
- RPAT can substitute for a traditional travel demand model or be used as a screening tool prior to using a traditional travel demand model.

Participants said that RPAT is:

- A quick way to test a wide range of scenarios
- Sensitive to policy changes
- A relatively easy to use tool for less technical planners

- Flexible

Participants also discussed additions and changes that they would like to see made to RPAT. These are organized by additions, updates or adjustments, and additional guidance.

Additions to current RPAT tool:

- Residential and commercial building emissions modeling
- Support for modeling infrastructure costs to support new development
- Incorporation of lifecycle costs including operations and maintenance
- Incorporation of proximal relationships between employment and transit
- A robust freight model (which could be adapted from EERPAT)
- Economic indicators
- Cost/benefit results
- Buildings model that constrains development types (which could be adapted from RSPM)
- More robust handling of households including:
  - Housing affordability
  - Household budgeting
  - Outputs by income group

Updates or adjustments to RPAT:

- A wider range of transportation technologies and models (ride sharing, e-bikes, autonomous vehicles)
- Additional policy measures related to intelligent transportation systems and reliability approaches
- Updated dollar values (RPAT currently uses year 2000 as the dollar year)
- Inclusion of public sector employment
- More explicit inputs around non-motorized travel
- Transit ridership models
- Re-estimated models for different geographic regions
- Re-estimated household income models based on current national data (RPAT uses year 2000 data)
- A more robust and interactive scenario visualization interface
- More control over commuter and external travel
- Sensitivity of all performance metrics to transportation supply congestion

- Incorporation of employment type and jobs by industry
- Enhancements to pricing analysis

Additional guidance for RPAT users:

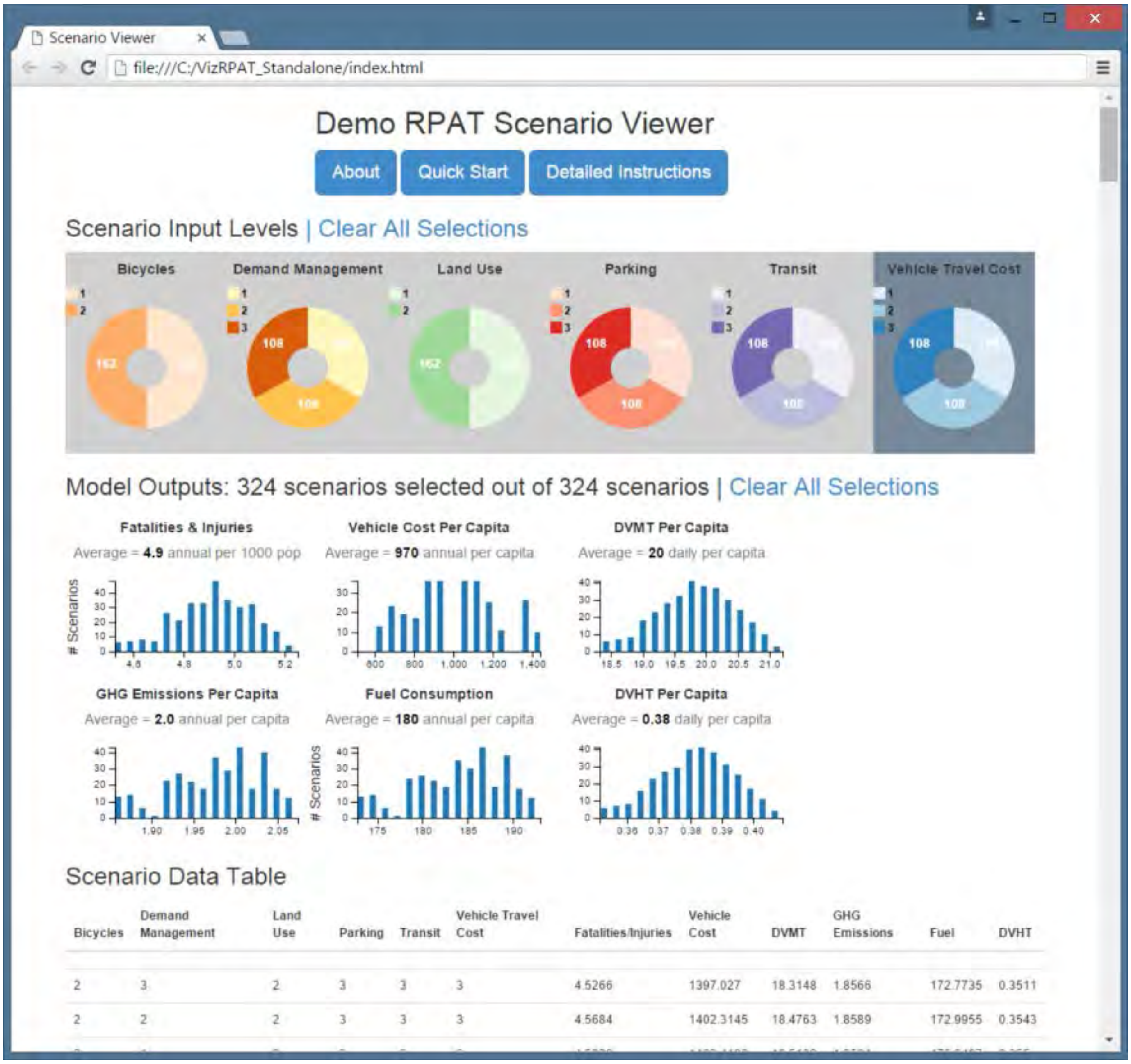
- Information on how far to "push" in different policy areas
- Ranges for acceptable inputs
- More clarification on place types

Users will request new functionality from the RPAT tool and RPAT should continue to incorporate new research and to address new technologies and planning considerations. Similarly, RPAT components should be updated to reflect changes in scenario planning practice. Finally, users requested more guidance about how to use RPAT and interpret results.

Visualization

Strategic planning has a big decision space that can hinder analysis and interpretation of model results. Interactive data visualization is a powerful technique that facilitates the strategic planning and decision making process. By visualizing data interactively decision makers can form connections between variables and outcomes thus shrinking the decision space. Brian Gregor developed the RPAT Scenario Viewer, shown in Figure 7, which is an open source visualization tool that compares RPAT scenarios through an interactive graphic user interface (GUI). Originally developed for RSPM, the Scenario Viewer was modified for RPAT and can run in web browsers that support HTML5 and JavaScript. The Scenario Viewer does not re-run RPAT but instead queries preprocessed results from several hundred RPAT model runs. The Scenario Viewer displays a range of outputs and a range of inputs. Adjusting outcomes shows users the connections between desired outcomes and required inputs, and vice versa, thereby supporting the interpretation of model results in the decision making process. This functionality is not offered with RPAT currently but the participants expressed interest in further development and inclusion of the visualizer within the RPAT GUI.

Figure 7: Demo RPAT Scenario Viewer GUI



Common Framework

ODOT is interested in developing a user community to maintain and improve an Open Source suite of scenario planning tools based on GreenSTEP. At the peer exchange, ODOT presented this concept called the Common Framework to participants to gauge interest in future participation in supporting the Common Framework.

The Common Framework is based on the idea that RPAT, RPSM, and EERPAT were originally built from GreenSTEP code. As each of these models has become more sophisticated, they have developed further from the original GreenSTEP code resulting in the tools being less interoperable. Through the Common Framework, an Open Source community would promote modularity of model component parts, would focus on open data standards to encourage development, and would promote a shared vision for the models.

If the Common Framework is advanced, the models would be consolidated with shared maintenance and governance in 2016 and 2017. The transition would not halt further development, improvement, or maintenance of each individual tool, but would guide the tools towards a common future. For more information about the Common Framework, see Appendix B, which contains a draft of the VisionEval Open Source Project Vision and a draft of the proposed technical approach.

Appendix A: Attendees

Table A1: Attendees

Name	Organization
Thera Black	Thurston Regional Planning Council (TRPC)
Ali Bonakdar	Corvallis Area MPO
Brett Fusco	DVRPC
Brian Gregor	Consultant
Ben Gruswitz	DVRPC
Natarajan Janarthanan	WSDOT
Subrat Mahapatra	Maryland DOT
Felix Nwoko	DCHC MPO
Guy Rousseau	ARC
Tara Weidner	ODOT
Yanping Zhang	DCHC MPO
Eric Pihl	FHWA
Matt Hardy	AASHTO
Bryan Hong	AASHTO
Erich Rentz	RSG
Maren Outwater	RSG
Kristin Hull	CH2M

Appendix B: Peer Exchange Agenda, Presentations, and Materials

TravelWorks
Advanced Travel Analysis Tools

Rapid Policy Assessment Tool Peer Exchange

Westin – Clark County Nevada
(in conjunction with AMPO's Annual Conference)
160 East Flamingo Road, Las Vegas, NV
1-8 p.m. Monday, October 19, 2015

Invitees

Yanping Zhang, Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO)
Felix Nwoko, Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO)
Tara Weidner, Oregon Department of Transportation (ODOT)
Ali Bonakdar, Corvallis Area Metropolitan Planning Organization (CAMPO)
Ben Gruswitz, Delaware Valley Regional Planning Commission (DVRPC)
Thera Black, Thurston Regional Planning Council (TRPC)
Guy Rousseau, Atlanta Regional Commission (ARC)
Natarajan Janarthanan, Washington State DOT (WSDOT)
Subrat Mahapatra, Maryland DOT
Brian Gregor, consultant

Outcome

- Share experiences using RPAT among current and past users/grant recipients
- Identify lessons learned and best practices for future work
- Inform future improvements to RPAT and future implementation activities

Agenda

1-1:15 p.m.	Introductions, welcome, agenda review	Kristin Hull, CH2M
1:15-2 p.m.	Data preparation • Presentation • Discussion	Yanping Zhang and Felix Nwoko, DCHC MPO
2-2:45 p.m.	Outcome and interpretation of results • Presentation	Brett Fusco and Ben Gruswitz, DVRPC

	• Discussion	
2:45-3 p.m.	Break	
3-3:45 p.m.	Use in discussions with policy makers and stakeholders • Presentation • Discussion	Tara Weidner, ODOT and Ali Bonakdar, Corvallis Area MPO
3:45-4:15 p.m.	Tool validation	Maren Outwater, RSG
4:30-5:15 p.m.	General discussion of RPAT tool • What is working well? • What needs improvement	Kristin Hull, CH2M
5:15-5:45 p.m.	Common Framework	Tara Weidner, ODOT
5:45-6:30 p.m.	Break	
6:30-8 p.m.	Dinner and discussion: Where do we go from here?	All

Note: Dinner at 6:30 p.m. will be hosted at the Westin.

RapidPolicy
ASSESSMENT TOOL

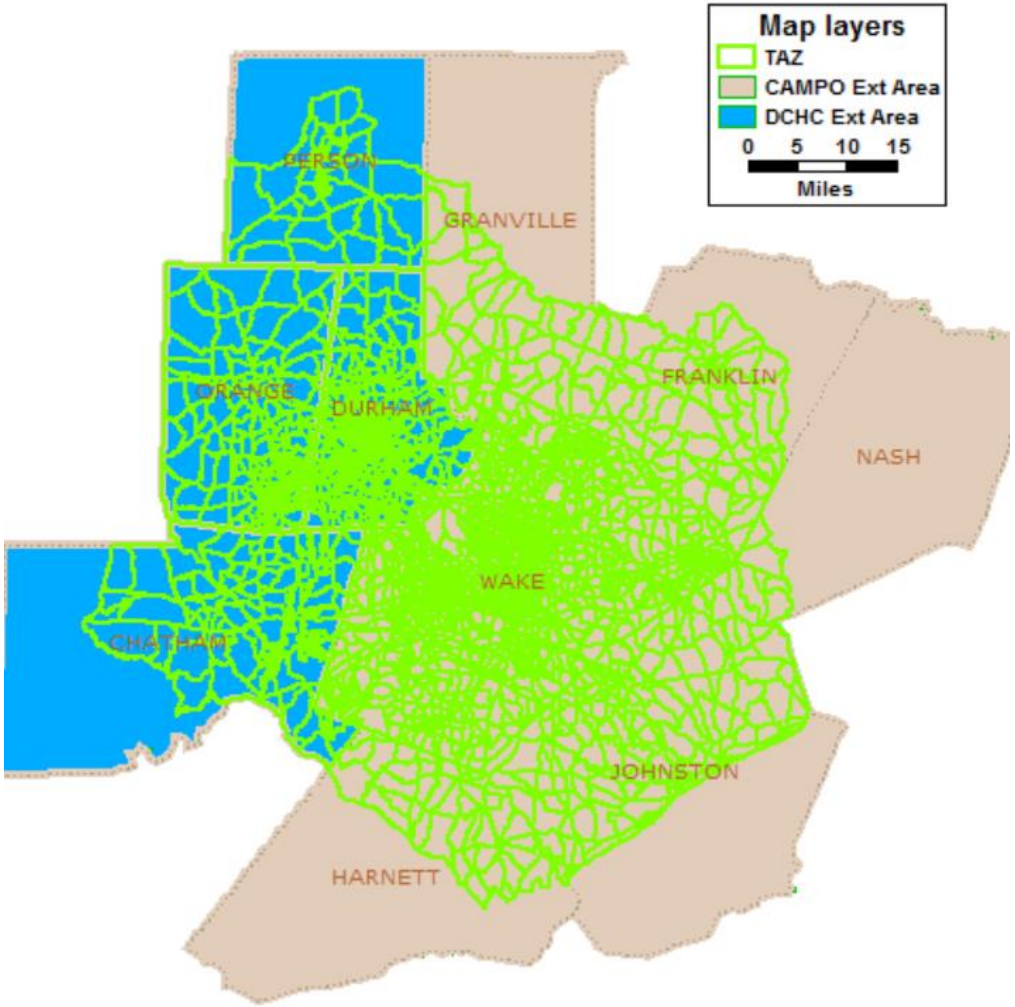
RPAT Application and Input Preparation for Triangle Region

Yanping Zhang
Felix Nwoko

Triangle Region North Carolina

1) Durham-Chapel Hill-Carrboro MPO (DCHC MPO)

2) Capital Area MPO (CAMPO)



SHRP 2 C16 Project Overview

DCHC MPO, CAMPO, NCDOT & ITRE/NCSU work together on adopting RPAT:

- Validating the RPAT to replicate the results of Triangle Region Model (TRM)
- Supporting the pre-screening of transportation and land use scenarios in the Metropolitan Transportation Plan (MTP) process.
- Addressing policy questions, such as the impact of smart growth on travel demand, greenhouse gas emission, safety and economic efficiency

Tested Scenarios - Triangle Region

- *Scenarios of the MTP Study

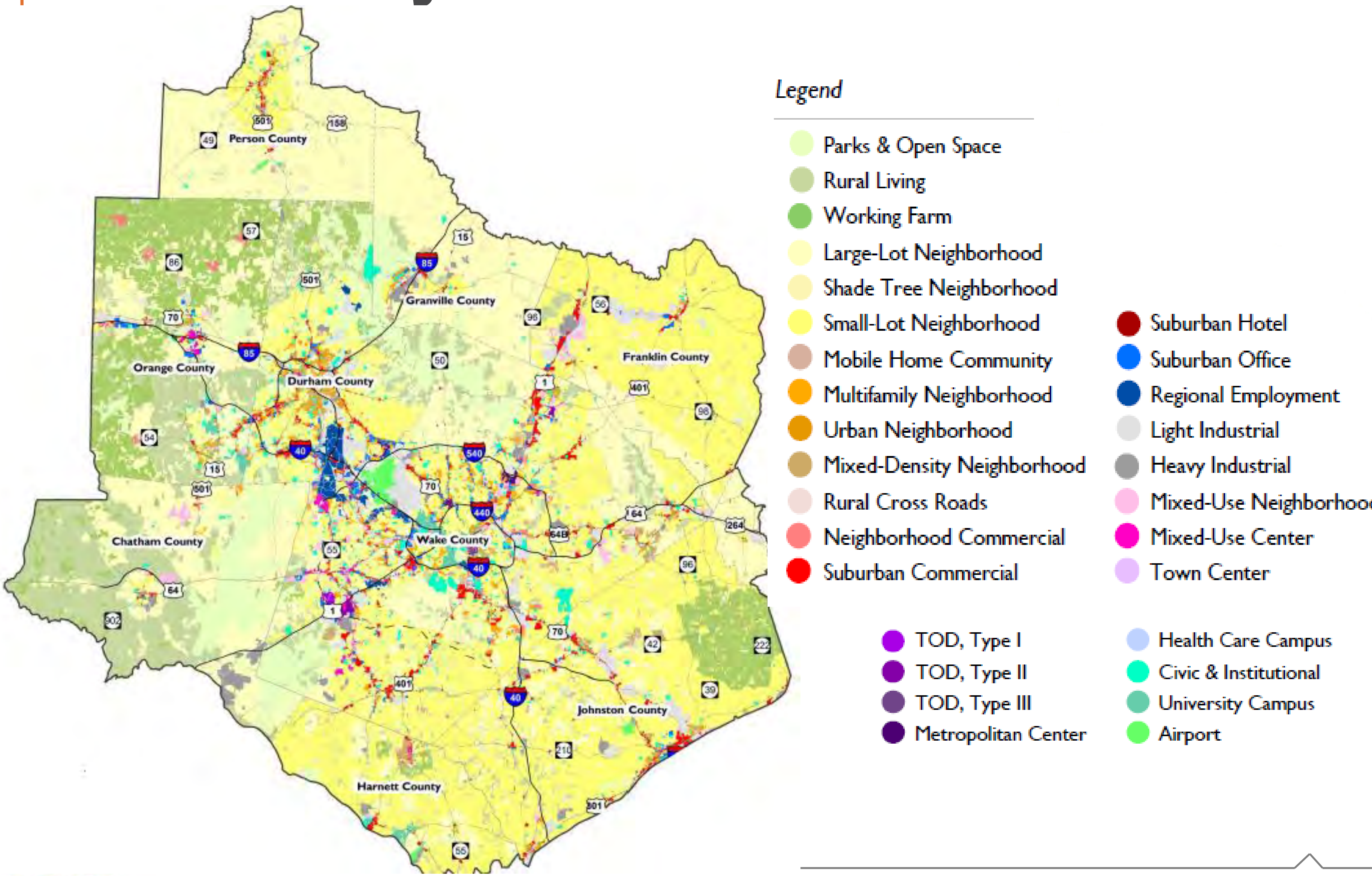
		Demand (& Landuse) Scenarios			
		Community Plan (CommP)	All-In-Transit	Metro Transp Plan (MTP-D)	MTP-D w/ 15% Growth Shift to Dense Area
Supply (& Network) Scenarios	Existing Plus Committed			E+C*	
	Transit Intensive		TRN*		
	Highway Intensive	Hwy*			
	Metro Transp Plan (MTP-S)			MTP*	MTPx15DA
	MTP-S w/ ITS				MTPx15DAwITS

Tested Scenarios:

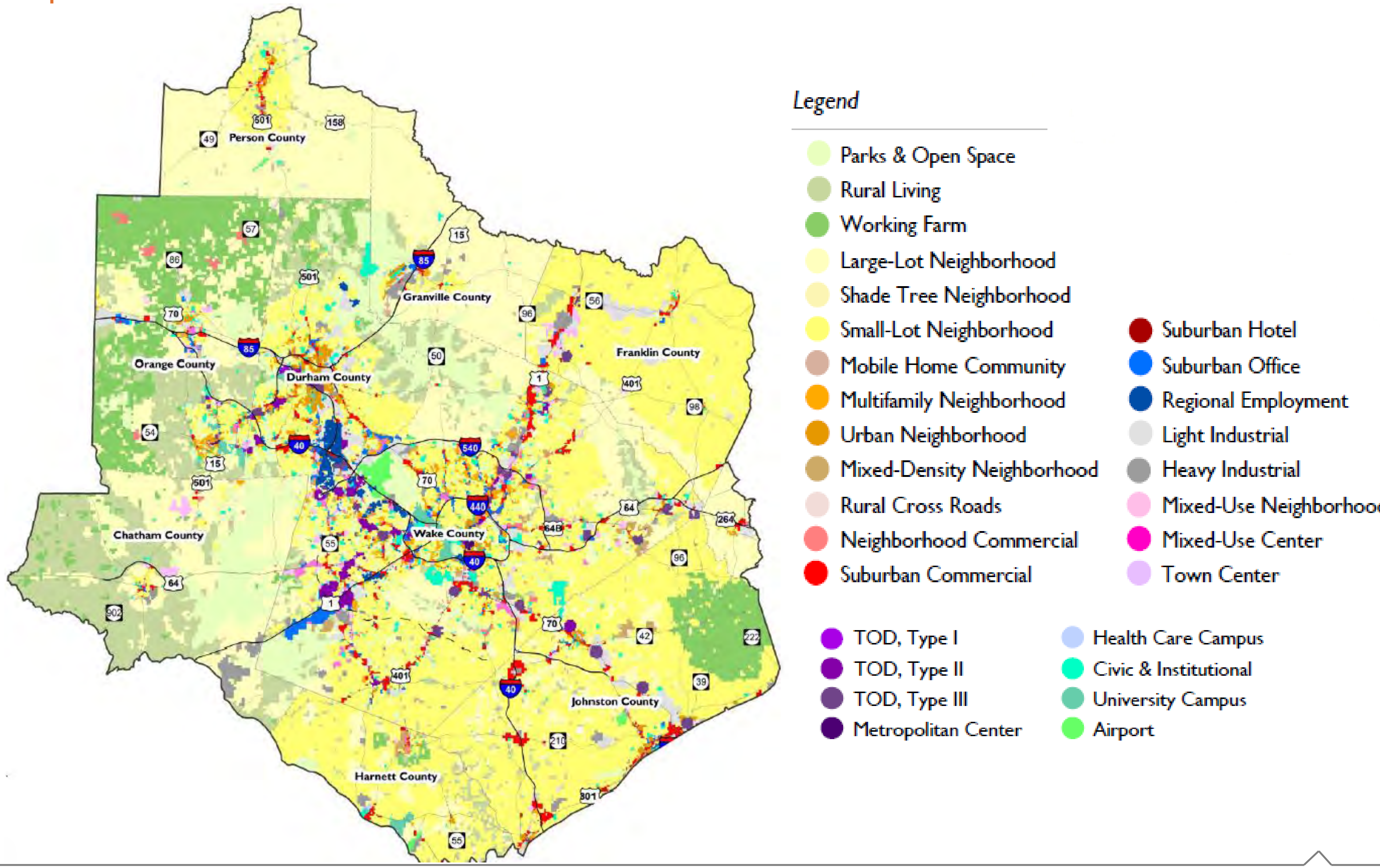
6 Scenarios Tested

1. 2040 MTP - Baseline
2. E+C: 18% Reduction of Roadway Construction
3. Hwy: 9.8% Increase of Roadway Construction
4. TRN: 276% Rail Mile Increase, 12% Bus mile Reduction and 9.4% Reduction of roadway construction
5. Shift 15% Growth to Dense Areas
6. Shift 15% Growth to Dense Areas with 15% lane mile ITS treatment

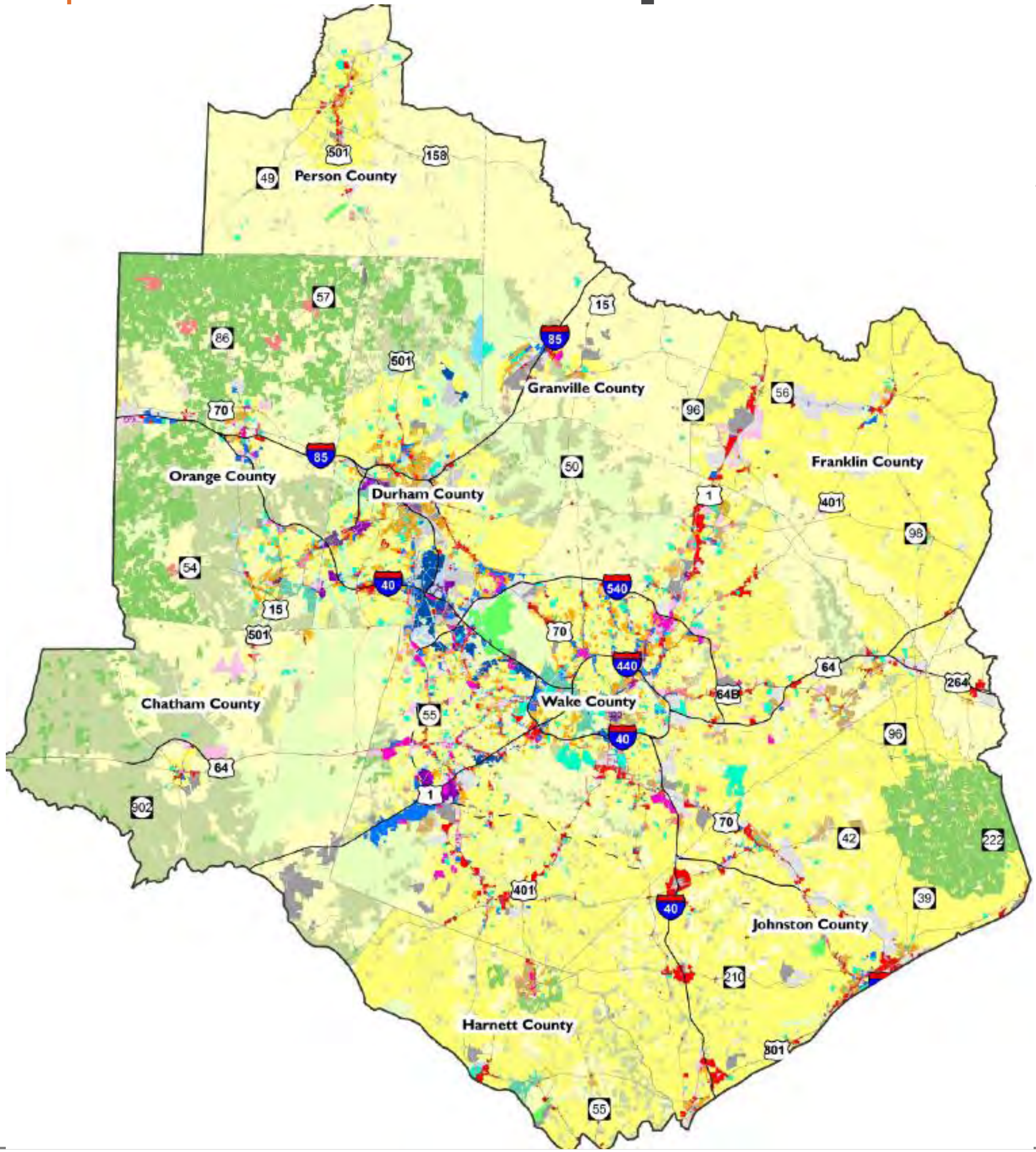
Community Plan Scenario



All-In-Transit Plan Scenario



Metro Transportation Plan Scenario

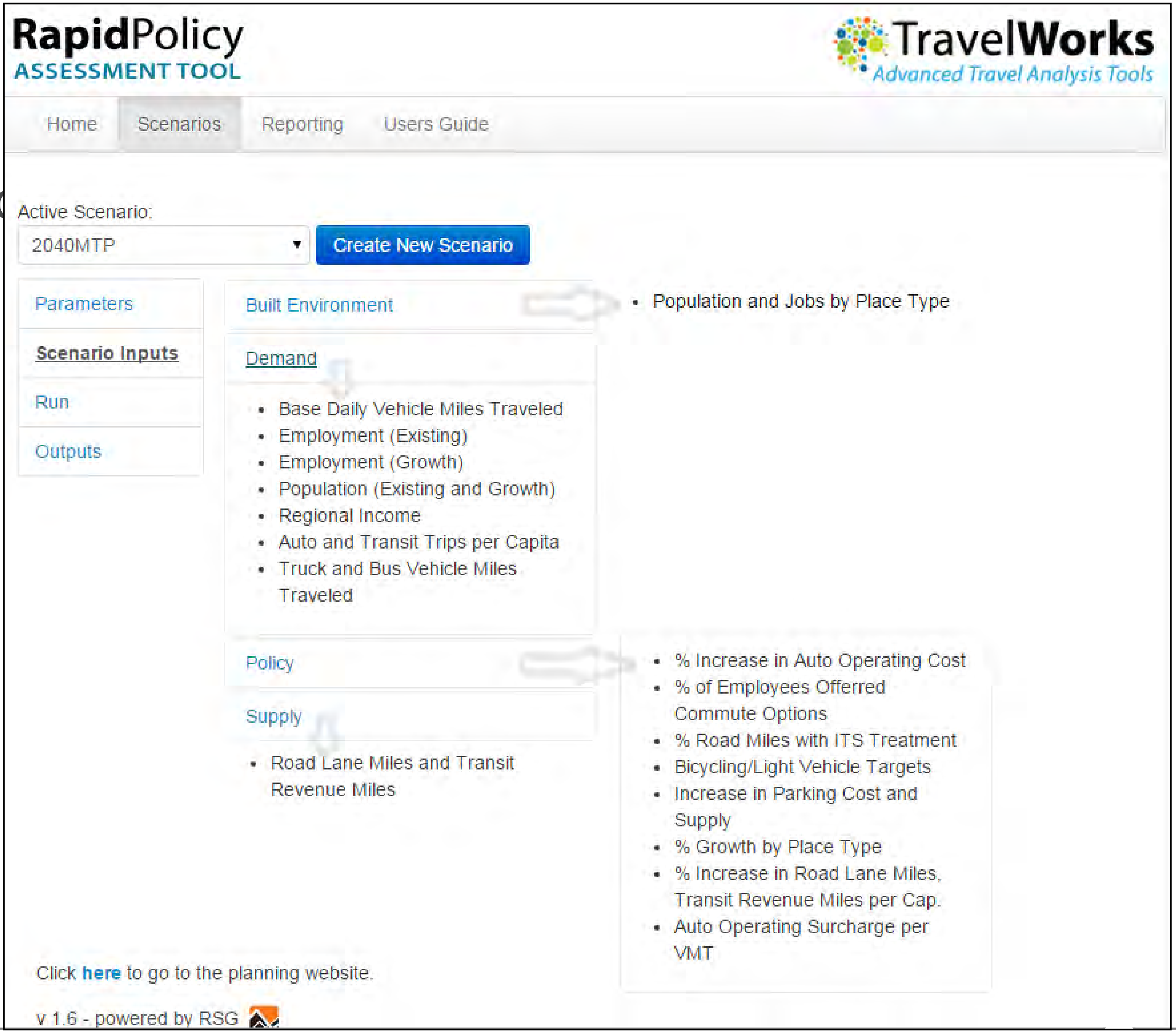


Legend

- Parks & Open Space
- Rural Living
- Working Farm
- Large-Lot Neighborhood
- Shade Tree Neighborhood
- Small-Lot Neighborhood
- Mobile Home Community
- Multifamily Neighborhood
- Urban Neighborhood
- Mixed-Density Neighborhood
- Rural Cross Roads
- Neighborhood Commercial
- Suburban Commercial
- Suburban Hotel
- Suburban Office
- Regional Employment
- Light Industrial
- Heavy Industrial
- Mixed-Use Neighborhood
- Mixed-Use Center
- Town Center
- TOD, Type I
- TOD, Type II
- TOD, Type III
- Metropolitan Center
- Health Care Campus
- Civic & Institutional
- University Campus
- Airport

Input

- Built Envir
- Demand
- Policy
- Supply



Input Data Sources

	Needed Data	Year	Scenarios	Source
Build Environment	Population by Place type	2010	Base Yr	TRM SE + CommunityViz
	Job by Place Type	2010	Base Yr	TRM SE + CommunityViz
Demand	Auto/Transit Trips per person	2010	Base Yr	TRM
	Light Vehicle VMT	2010	Base Yr	TRM
	Employment by NAICS	2010	Base Yr	Employment Geocoder
	Number of firms by NAICA & Size	2010	Base Yr	Employment Geocoder
	Employment Growth Rate	2040	CommP/AIT/MTP	TRM
	Population by Age group	2010	Base Yr	Census data
	Future Population by age group	2040	CommP/AIT/MTP	Assumption
	Avg HH Income	2010	Base Yr	TRM
	Future HH income	2040	Same for All	Assumption
	Truck VMT by functional classification	2010	Base Yr	TRM
	Bus VMT by functional classification	2010	Base Yr	Calculating by TransCAD

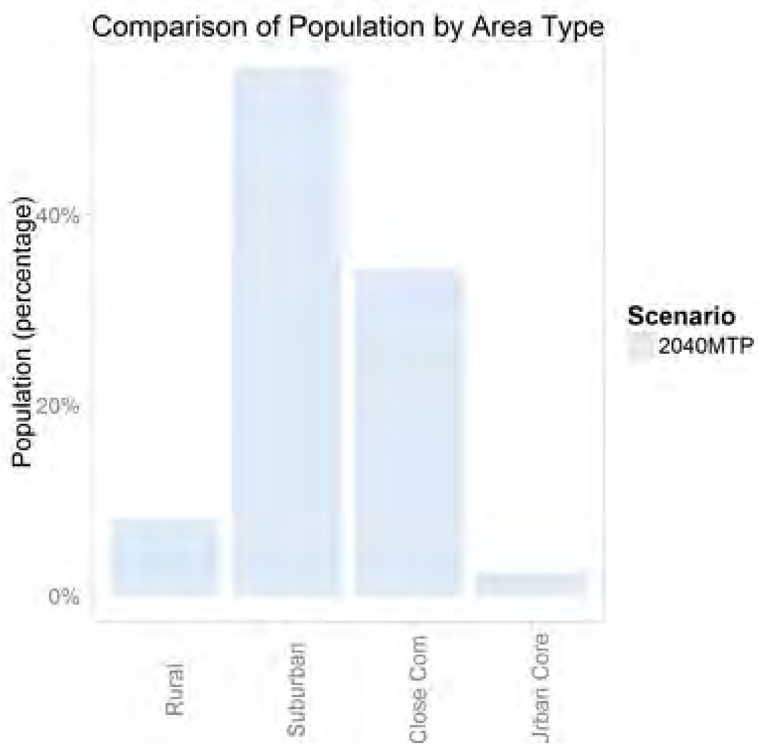
Input Data Sources (Cont'd)

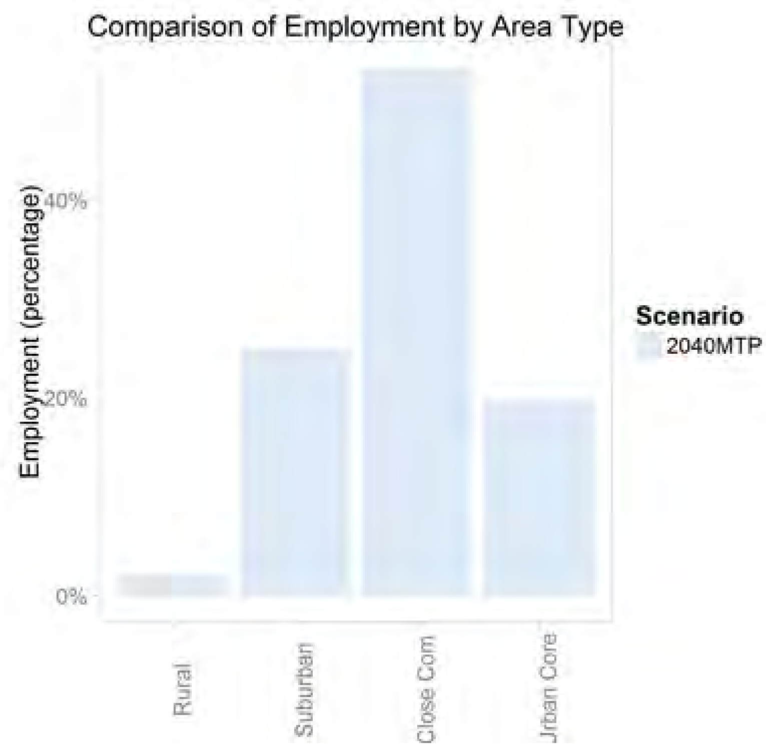
	Needed Data	Year	Scenarios	Source
Policy	% Population growth by place type	2040	CommP/AIT/MTP	TRM + CommunityViz
	% Employment growth by place type	2040	CommP/AIT/MTP	TRM + CommunityViz
	% Increased in Auto opearting cost	2040	Same for All	Assumption
	% Increase in Road Lane Miles by FC	2040	Hwy/AIT/MTP	TRM
	% Increase in Transit Revenue Miles per Cap	2040	Hwy/AIT/MTP	TRM
	% Employees offered Commute Opt	2040	Same for All	Assumption
	% Road miles w/ ITS Treatment	2040	0% & 15%	Assumption
	Auto Operating Surcharge per VMT	2040	Same for All	Assumption
	Bike/Light Vehicle Targets	2040	Same for All	Assumption
	Increase in Parking cost and supply	2040	Same for All	Assumption
Supply	Road Ln Miles by functional classification	2010	Base Yr	TRM
	Transit Revenues Mile by mode	2010	Base Yr	TRM

Input Data Summary

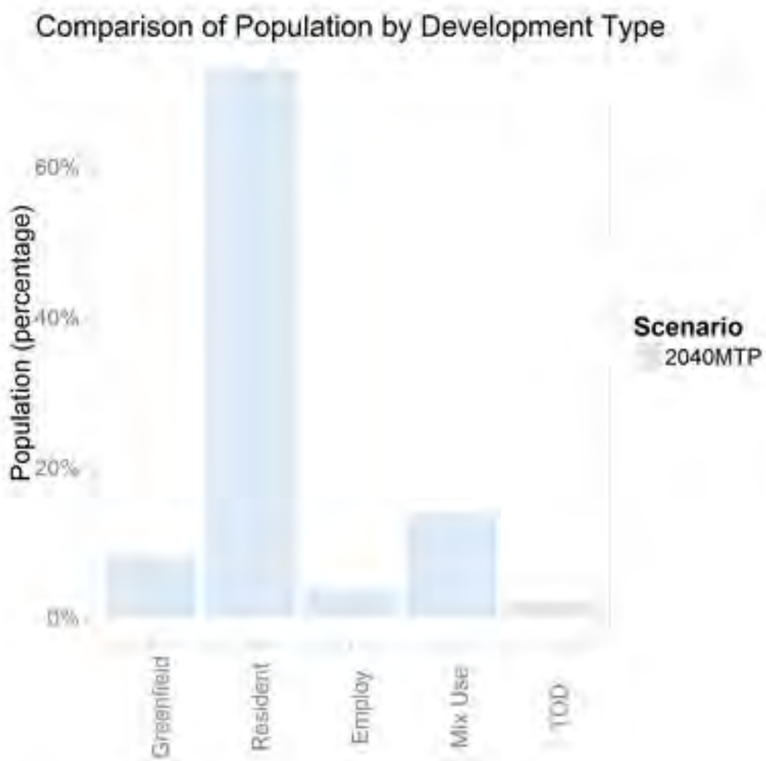
Scenario Number Scenario Name	1 2040 MTP	2 E+C	3 Hwy	4 TRN	5 MTPx15DA	6 MTPx15DA wITS
Assumption - Highway	Base	-18%	9.80%	-9.40%	no change	no change
Assumption - Transit	Base	-45%	-45%	216%	no change	no change

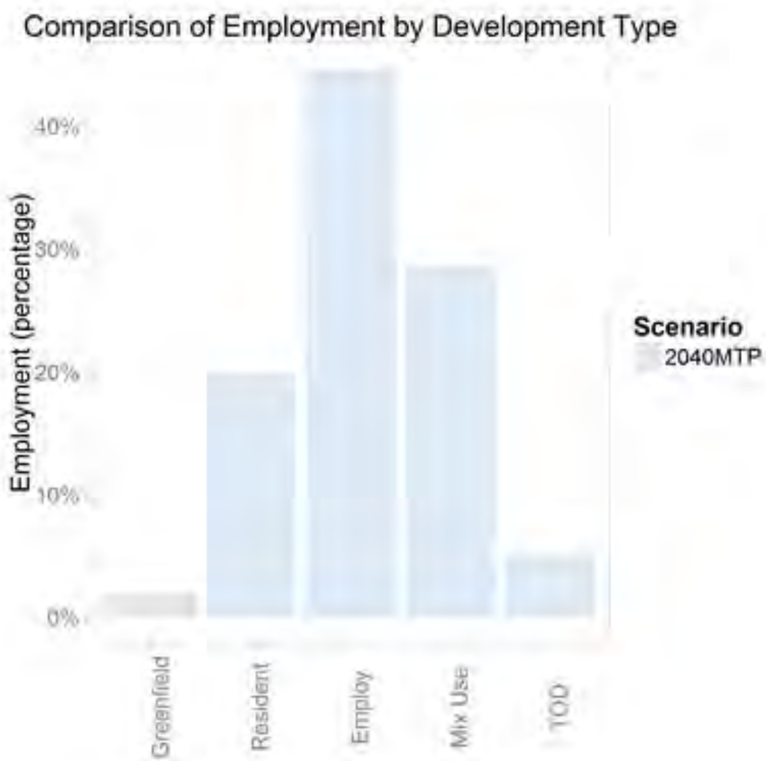
2040 MTP Pop. & Emp. By Area Type





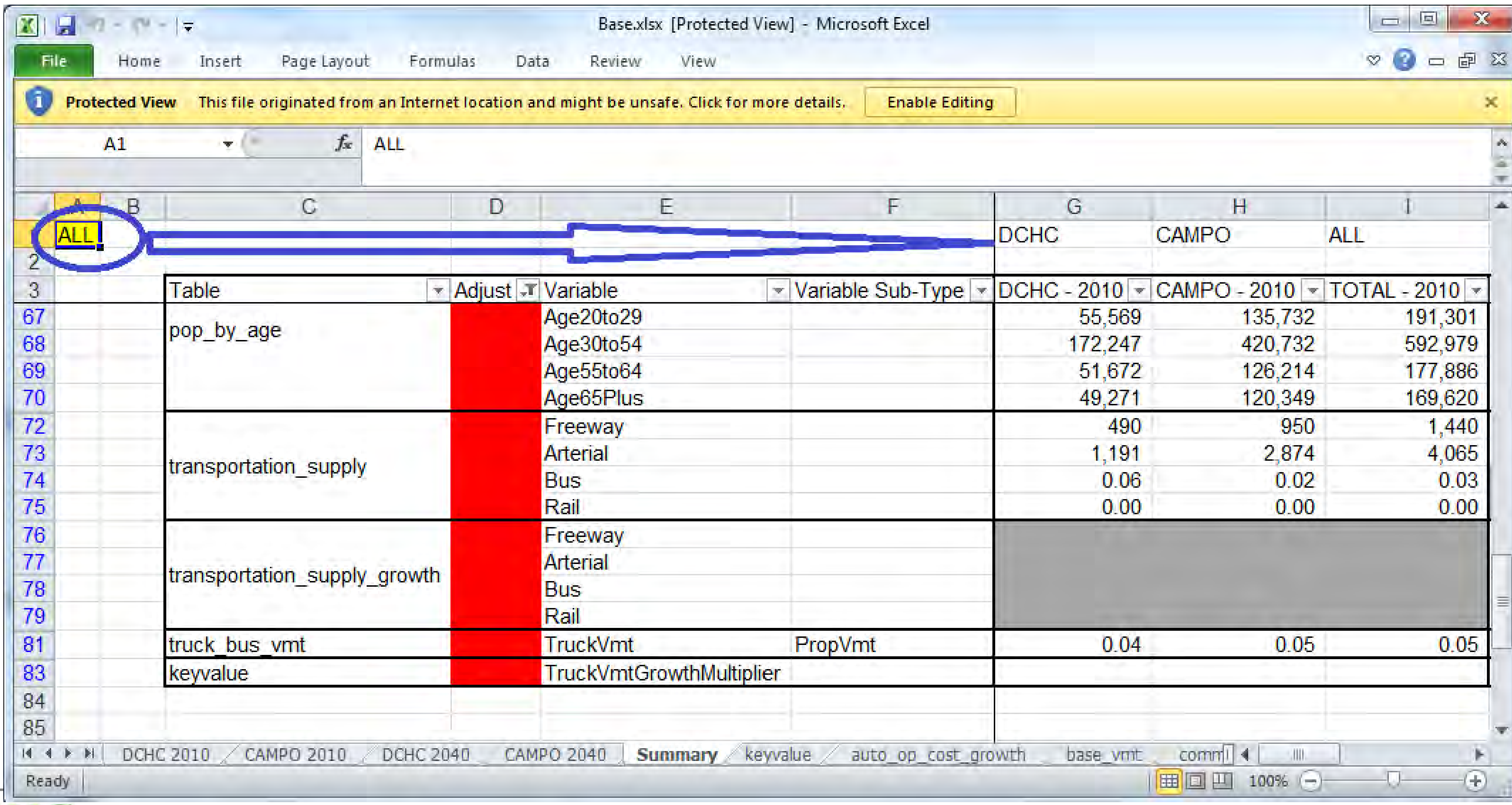
2040 Pop. & Emp. by Development Type





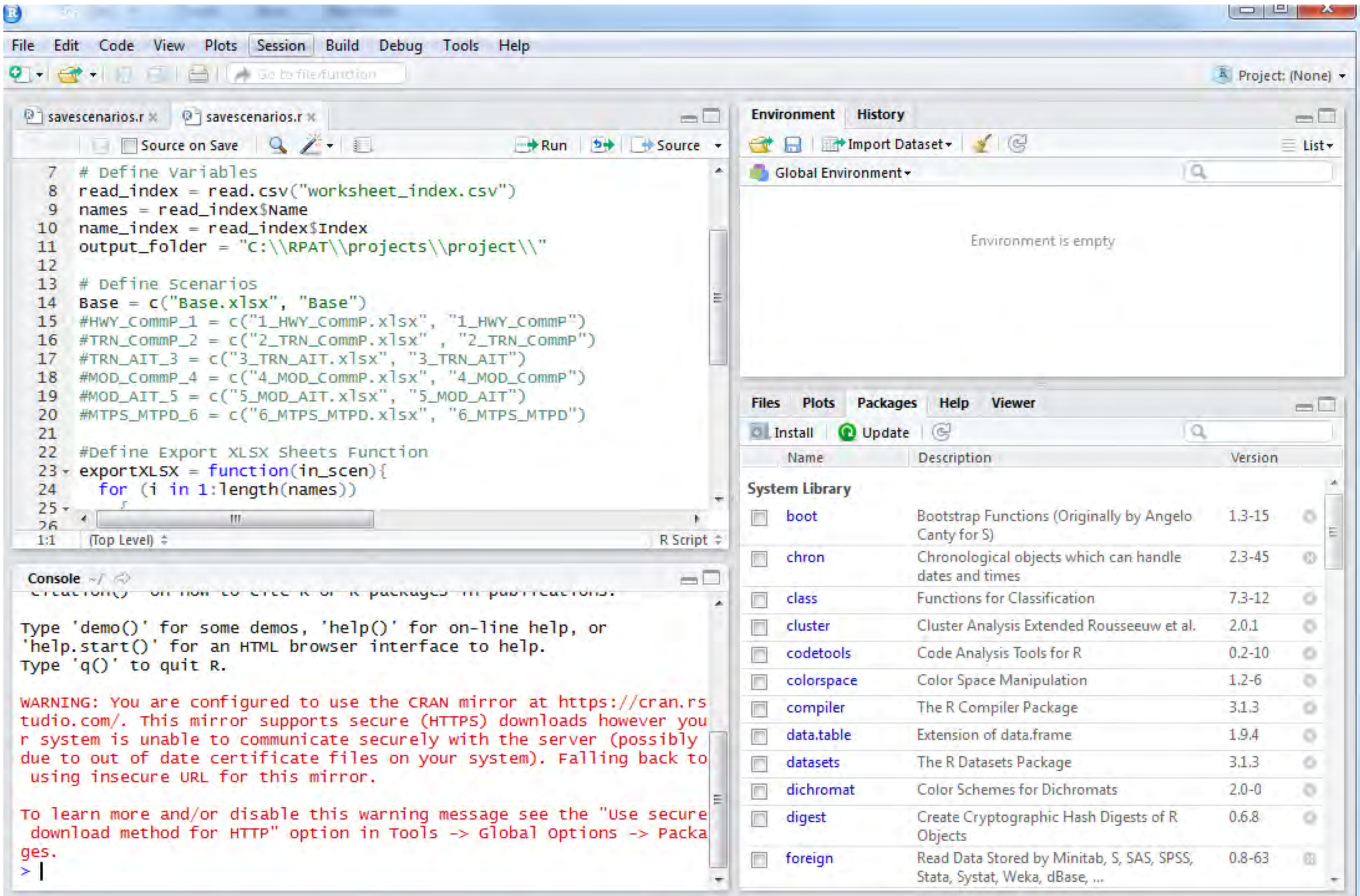
Tool to Build the Input by Sub-region(1)

- Keep All Inputs in one MS Excel File
- R-Script convert the excel data to RPAT input files
- <u>Developed By RSG</u>



	A	B	C	D	E	F	G	H	I
1	ALL						DCHC	CAMPO	ALL
2									
3			Table	Adjust	Variable	Variable Sub-Type	DCHC - 2010	CAMPO - 2010	TOTAL - 2010
67			pop_by_age		Age20to29		55,569	135,732	191,301
68					Age30to54		172,247	420,732	592,979
69					Age55to64		51,672	126,214	177,886
70					Age65Plus		49,271	120,349	169,620
72			transportation_supply		Freeway		490	950	1,440
73					Arterial		1,191	2,874	4,065
74					Bus		0.06	0.02	0.03
75					Rail		0.00	0.00	0.00
76			transportation_supply_growth		Freeway				
77					Arterial				
78					Bus				
79					Rail				
81			truck_bus_vmt		TruckVmt	PropVmt	0.04	0.05	0.05
83			keyvalue		TruckVmtGrowthMultiplier				
84									
85									

Tool to Build the Input by Sub-region(2)



Remarks

- Using the 2000 Dollar Value
- Base Year VMT and Vehicle trips exclude the External-to-External (EE) VMT and trips
- Existing Employment is based on the MPO Employment Analyst Data
- Transportation supply, Road Lane mile and Transit revenue mile, is assumed to grow in line with population increase
- Transit Trip Rate was refined to as a variable, which is response to the transit supply change
- Development types were determined for each TAZ using the percentage of the TAZ's employment in relation to the total of the population and employment in the TAZ.

DVRPC SHRP2-C16 Outcomes and Interpretation

Rapid Policy Assessment Tool Peer Exchange
October 19, 2015

Ben Gruswitz, AICP
Senior Transportation Planner

Outline

- Update for CrowdSourcing Scenario Planning Tool : Choices & Voices v3.0
  - Future Forces
    - new feature for tool
    - main effort for the update
  - Improvements to existing calculations & other added features
- Master Plan: Gloucester County, NJ
- Conclusion

Choices & Voices

Web Application

- tool to accompany our long range plan - “Connections”
  - Created for “Connections 2040”
  - Update for “Connections 2045”
- future development patterns
- transportation funding and investments
- instant feedback
- crowdsourcing

www.dvrpc.org/choicesandvoices

dvrpc

CONNECTIONS 2040 CHOICES & VOICES V2.1

CREATE YOUR VISION FOR GREATER PHILADELPHIA

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Transportation Projects

You have **$59.0 billion** ⓘ to invest in transportation projects from now to 2040. You can use this to maintain the system, make operational improvements, or build new highway or transit projects.

System Preservation

How well do you want to maintain roads and bridges?

Failure to properly maintain roads and bridges reduces safety, increases vehicle operating costs ⓘ, increases travel delay, and vehicle emissions.

$36.5

$ 36.5 billion - Maintain current conditions

Click here to maintain current funding levels, current conditions worsen

Click here to maintain current conditions

Click here to acheive and maintain a state-of-good-repair

At what level would you like to maintain transit infrastructure, including rail infrastructure, transit vehicles, and transit stations? ⓘ

Failure to properly maintain transit infrastructure reduces the safety and reliability of the system as well as the comfort level of the user, all of which lead to lower ridership levels.

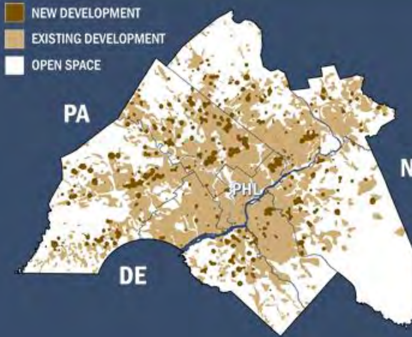
$21.9

$ 21.9 billion - Maintain current conditions

Click here to maintain current funding levels, current conditions worsen

Click here to maintain current conditions

Click here to achieve and maintain a state-of-good repair



...Your Vision for the Future

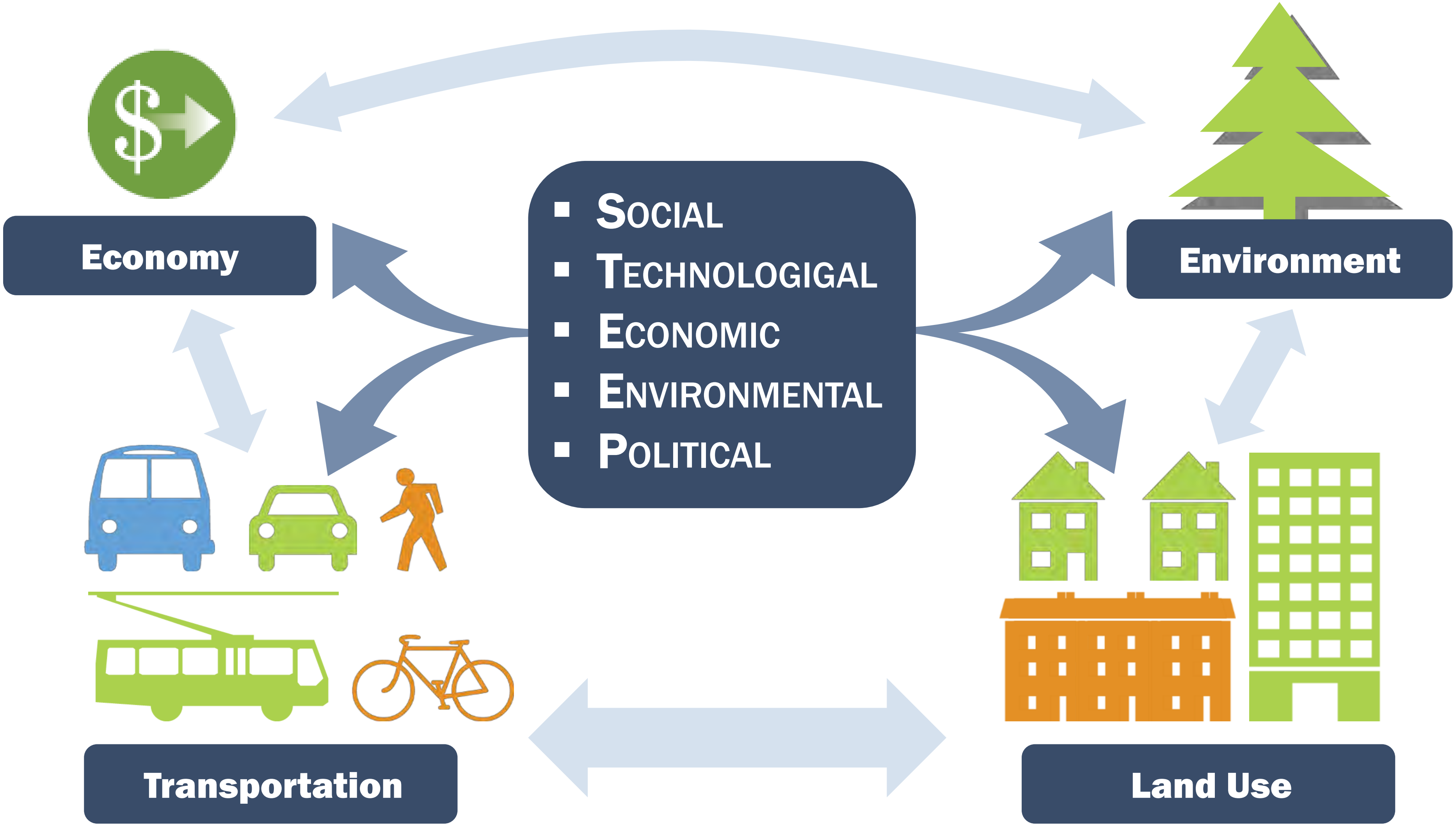
TODAY → 2040

Budget Remaining: $0.6 billion

↑	9%	1,185,900	Acres Developed
↑	4%	7,660	Vehicle Miles Driven
↑	2%	102	Biking & Walking Trips
↓	-7%	60	Transit Trips
↑	6%	$14,440	Transportation & Energy Costs
↑	72%	37.5	Hours of Congestion
↓	-2%	7.5	Greenhouse Gas Emissions
↑	7%	7.6	Road Fatalities

How To Use ⓘ

Future Forces



Future Forces

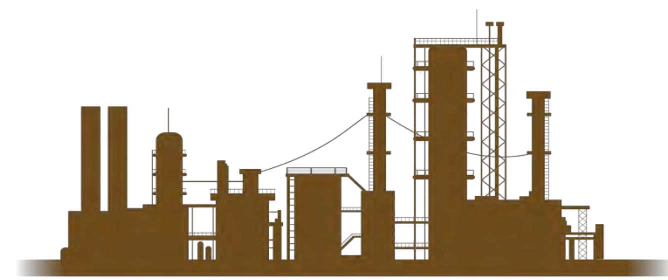
GREATER PHILADELPHIA FUTURE FORCES

Enduring Urbanism

Free Agent Economy

Severe Climate

Transportation on Demand



The US Energy Boom

Futures Group Forecasts

GREATER PHILADELPHIA FUTURE FORCES

	2045 Pop (MM)	2045 Emp (MM)	2045 Income / Cap*	2045 Gas Cost/gal.*
Enduring Urbanism	6.58	3.33	$ 39,000	$ 3.60
The Free-Agent Economy	6.44	3.29	$ 36,100	$ 3.70
Severe Climate	6.45	3.28	$ 35,000	$ 4.60
Transportation on Demand	6.51	3.30	$ 37,400	$ 3.80
The U.S. Energy Boom	6.48	3.33	$ 39,500	$ 3.10

* In 2015 dollars. 2013 income per capita ~$27,100

Impacts 2050 (I50)

- Age-pyramids
  - Birth rates
  - Death rates
  - Migration rates
  - Marriage rates
  - Divorce rates
- Development patterns
- Sketch-level travel demand model
  - VMT & vehicle trips
  - Passenger trips
  - Transit ridership
  - Walking & biking trips

Vehicle Miles Traveled Per Capita

GREATER PHILADELPHIA FUTURE FORCES

	Inputs		Outputs
	2045 Vehicle Operating Costs	2010 VMT	2045 VMT
Enduring Urbanism	$ 1.13	5,900	6,990
The Free-Agent Economy	$ 0.68	6,240	6,700
Severe Climate	$ 1.53	5,810	6,650
Transportation on Demand	$ 0.49	9,300	7,130
The U.S. Energy Boom	$ 0.85	8,570	7,090
Actual DVRPC Estimate	*$ 1.16*	*6,930*	*7,600* *

** Actual estimate for the year 2040.*

dvrpc

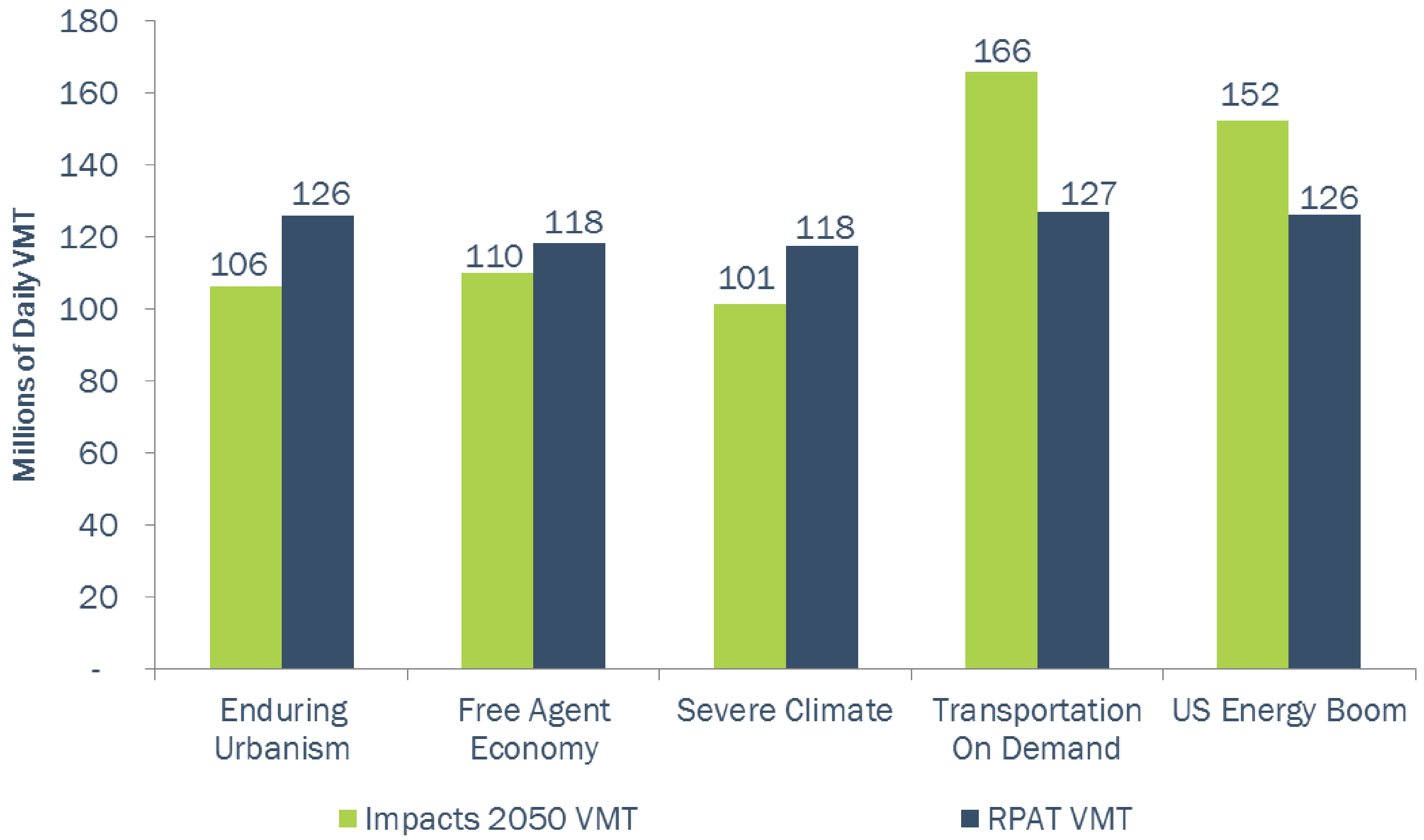
Daily Linked Transit Trips

GREATER PHILADELPHIA FUTURE FORCES

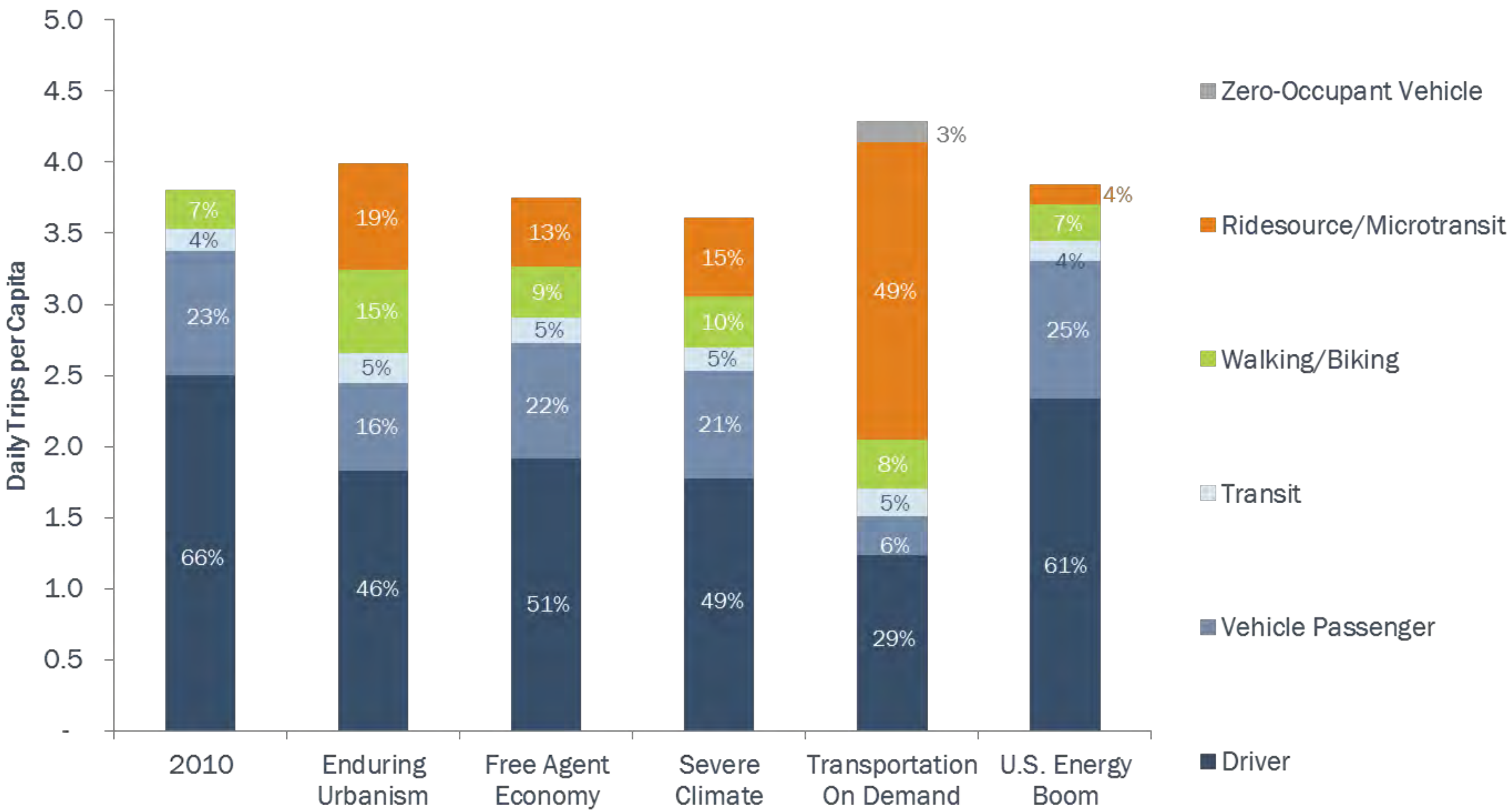
(In Millions)	2010 (I50 Input)	2045 (RPAT Output)	
Enduring Urbanism	1.75	1.04	
The Free-Agent Economy	1.42	0.95	
Severe Climate	1.11	0.91	
Transportation on Demand	1.56	0.96	
The U.S. Energy Boom	0.93	0.89	
Actual DVRPC Estimate	*0.79*	*0.87*	*

dvrpc

Impacts 2050 and RPAT Comparison

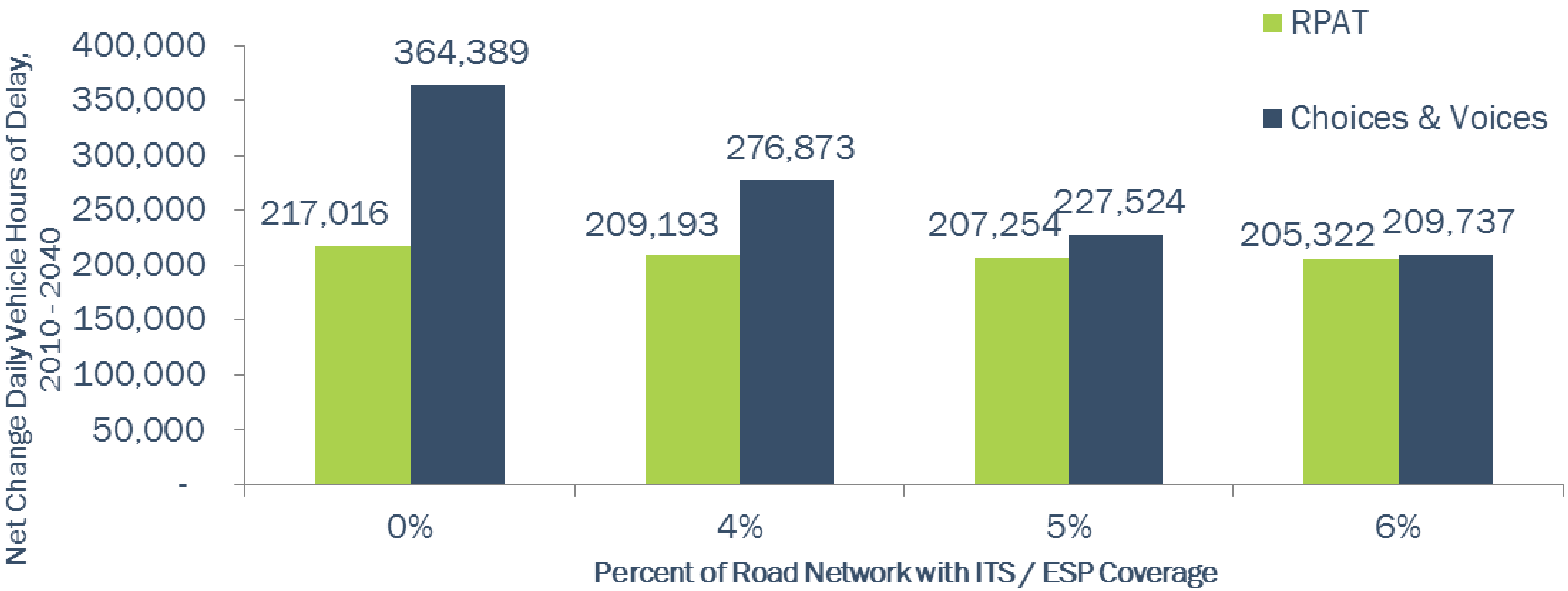


Daily Trip Modeshare

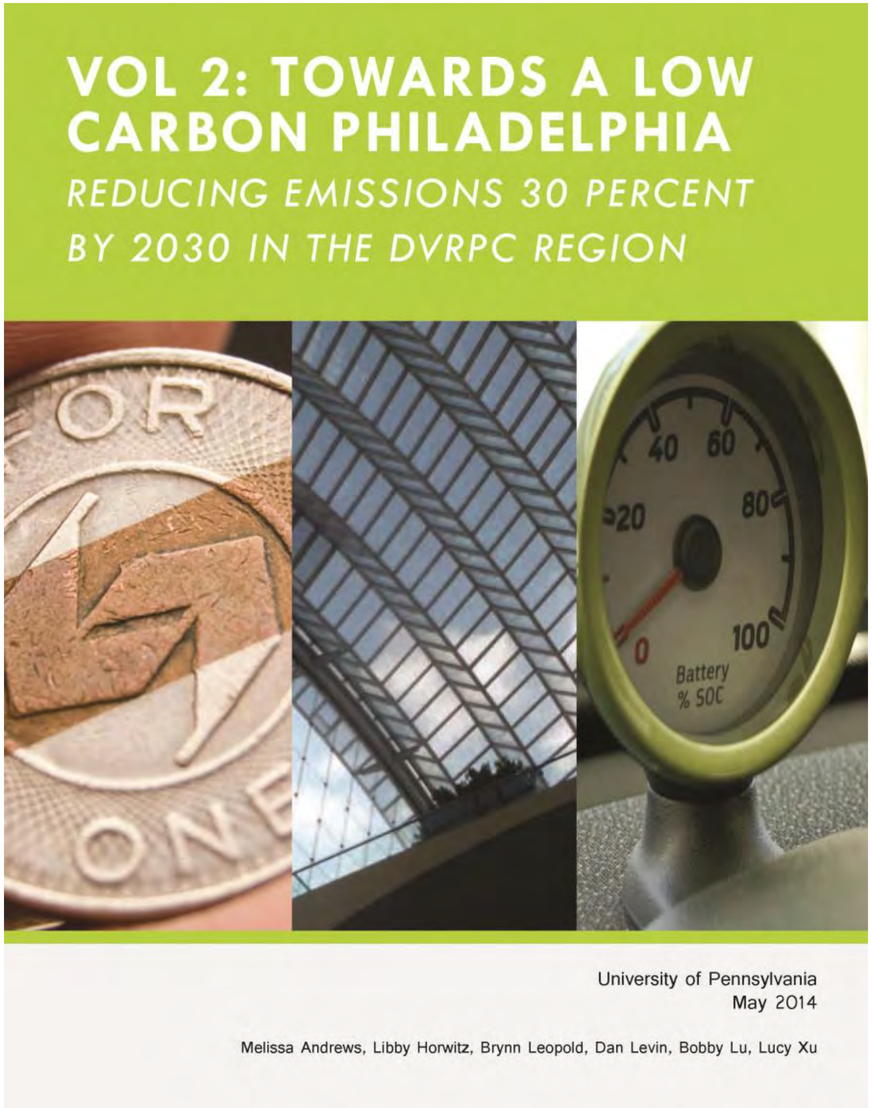


Roadway Operations

- DVRPC's Transportation Operations Master Plan
  - Currently ~4% of region's roads have some level of ITS / ESP
  - Vision: Varying degrees of ITS deployment on ~6% of region's roads
  - *Connections 2040* LRP: funding available to support ITS on ~5% of roads



Reducing Greenhouse Gas Emissions


VOL 2: TOWARDS A LOW CARBON PHILADELPHIA
REDUCING EMISSIONS 30 PERCENT BY 2030 IN THE DVRPC REGION

University of Pennsylvania
May 2014

Melissa Andrews, Libby Horwitz, Brynn Leopold, Dan Levin, Bobby Lu, Lucy Xu

Low Hanging Regional Actions

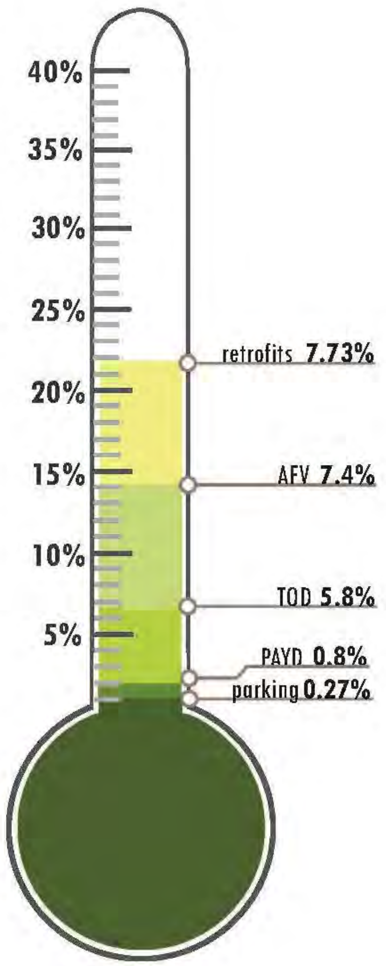
- ☐ Building Retrofits
- ☐ Alternative Fuel Vehicles
- ☐ Transit-Oriented Development
- ☐ Pay-As-You Drive Insurance*
- ☐ Parking Strategies
    - ☐ Parking Cash Out
    - ☐ Real-Time Info
    - ☐ Increase CBD Fees*
    - ☐ Payment in-lieu of Parking

*Tested use of RPAT

Greenhouse Gas Reductions

CONNECTIONS 2040 CHOICES & VOICES V2.1

Toward a Low-Carbon Philadelphia



RPAT

- PAYD Insurance : -3.0%
  - 0.7 cents/mile
- Parking Pricing: -0.1%

Roadway Design Example

- Transportation Investments should ...

Prioritize vehicles

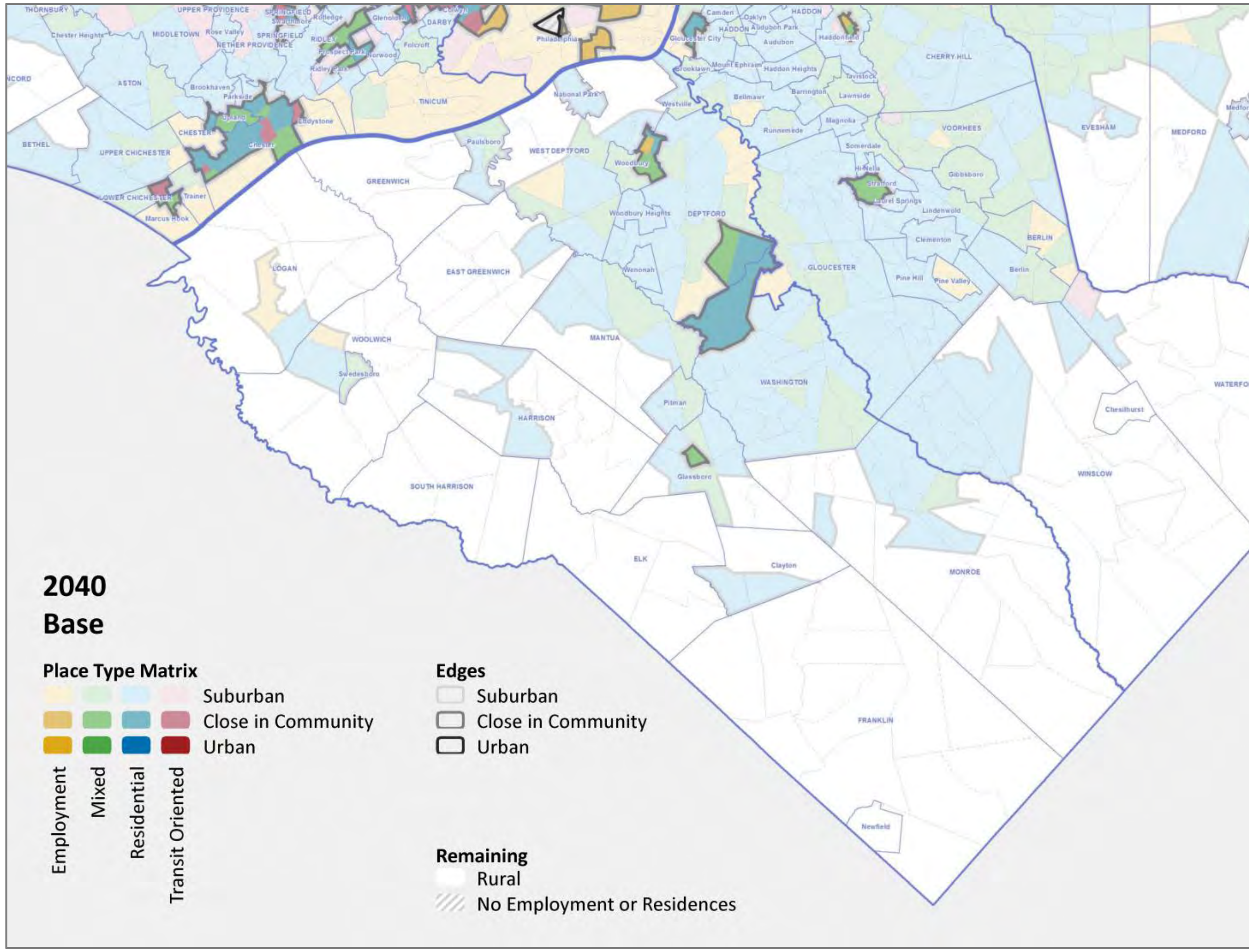
Balance modes

Prioritize bikes & peds

- What would be the outcomes?

Master Plan

- Gloucester County's GC2040 Plan
  - Preliminary stages
  - May focus on Place Type changes



RPAT Conclusions

TravelWorks
Advanced Travel Analysis Tools

- Translating RPAT outputs was difficult due to mix of totals and deltas
- Able to account for shifting travel behavior, new modes?
- May not be a good fit for testing future scenarios
- May not be able to show a signal through the noise in large, slow growth regions
- Cannot rely solely on models and modeling
  - Barraba's Law – important decisions should never be based solely on the results of a quantitative model.

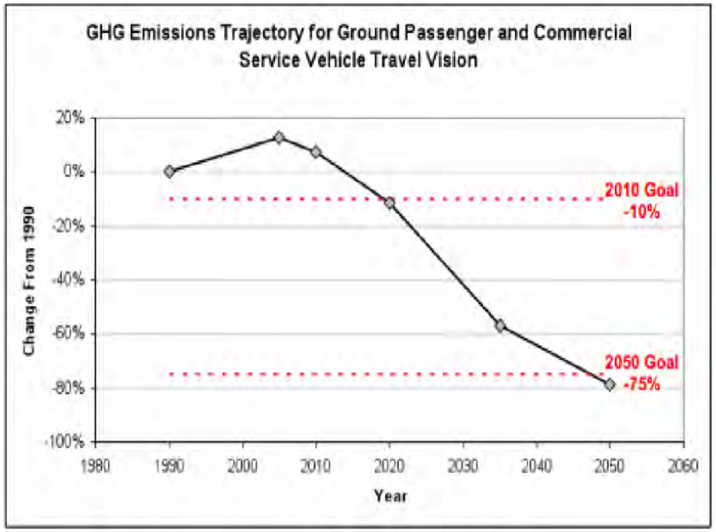
RPAT/RSPM use in discussions with policy makers and stakeholders

Tara Weidner
Oregon DOT

Oregon Department of Transportation

Oregon GHG Planning with RSPM

- **Oregon State GHG Goals** (2007)
  - Stop emissions growth by 2010
  - Reduce emissions by 10% by 2020
  - Reduce emissions by 75% by 2050



- **Metropolitan GHG Reduction Targets** (2009/2010)
  - Covers 6 metropolitan areas for 2035
  - Covers light duty vehicles (cars and trucks)
  - Scenario Planning – required in 2 largest MPOs

- **Oregon Sustainable Transportation Initiative (OSTI)** (2009/2010)
  - Interagency program (ODOT & DLCD/Land Use)
  - Statewide Transportation Strategy (STS)
  - Development of new planning tools
    - GHG Reduction Toolkit
    - Regional Strategic Planning Model (RSPM)
  - MPO Strategic Assessments

State GHG Planning with RSPM

Oregon GHG requirements called for a new "Strategic" Planning Tool ….GreenSTEP/RSPM

- ❑**Goal-oriented**. Complement other tools.
- ❑**Quick Runtimes**. Many scenarios to test uncertainties and tradeoffs.
- ❑**Breadth over Depth**.
- ❑**Simple**. Time available for using outputs.
- ❑**Visual/interactive**. Exploration by policy makers/public.

State GHG Planning with RSPM

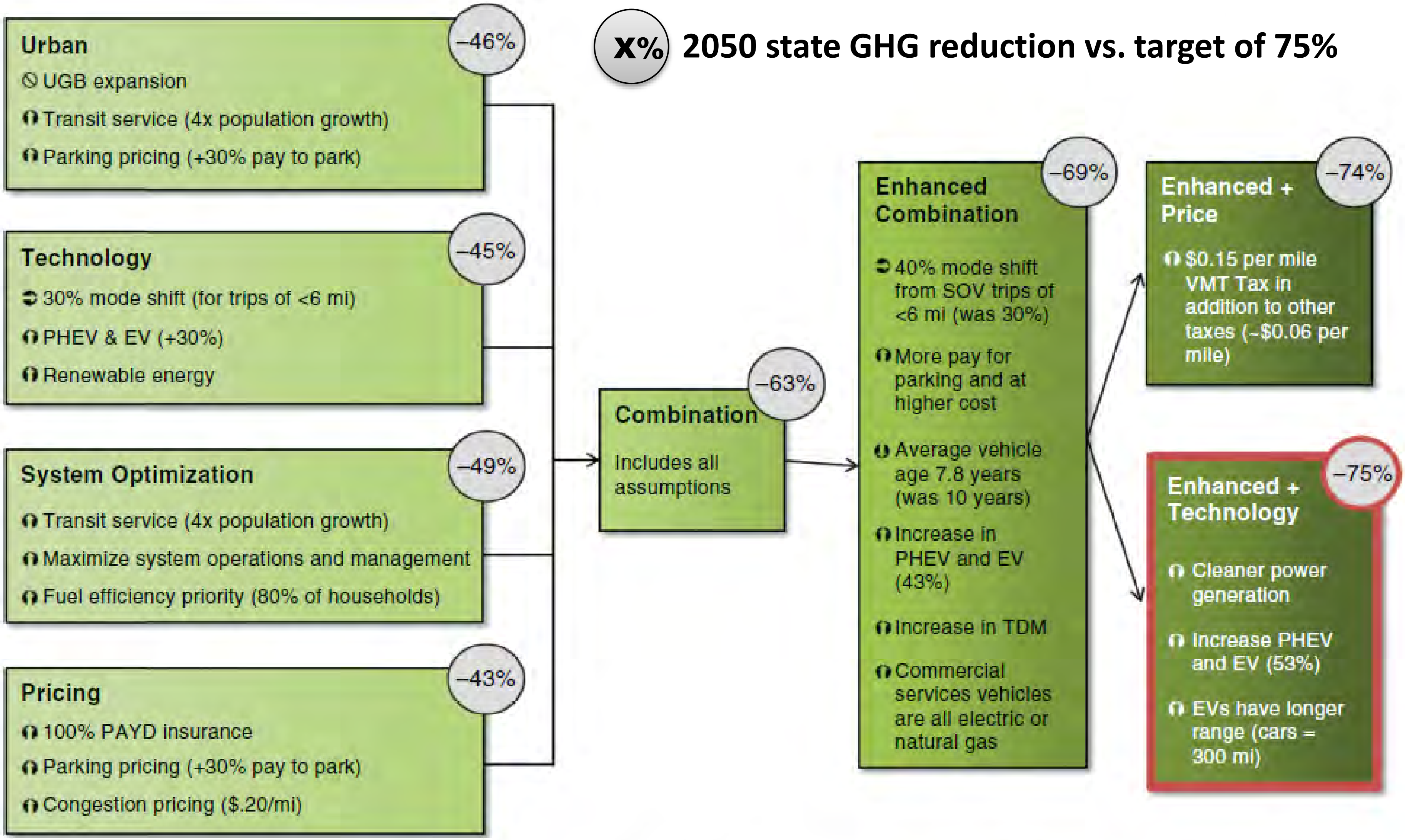


FIGURE 1 Evolution of STS scenarios for on-ground passengers (SOV = single-occupant vehicle, TDM = transportation demand management, UGB = urban growth boundary).

MPO GHG Planning with RSPM

2035 GHG targets for Oregon metropolitan areas

per capita light vehicle GHG emissions reduction

Metropolitan area	Adopted target[1]
Portland Metro[2]	20%
Salem-Keizer	17%
Corvallis	21%
Eugene-Springfield[3]	20%
Bend	18%
Rogue Valley	19%

[1] Adopted by the Land Conservation and Development Commission in May 2011

[2] Required scenario planning and adoption

[3] Required scenario planning

Calculated via interagency effort using GreenSTEP

<u>MPO Scenario Planning Process</u>

Proposed approach: Regional Transportation Plan meets GHG target

- Assess adopted plans
- Evaluate more ambitious strategies
- Adopt a preferred scenario
- Monitor progress

As implemented:

Requirements vary by MPO size

For smaller MPOs, voluntary process

Broadening to more "targets" (e.g., health, equity, etc.) results in…

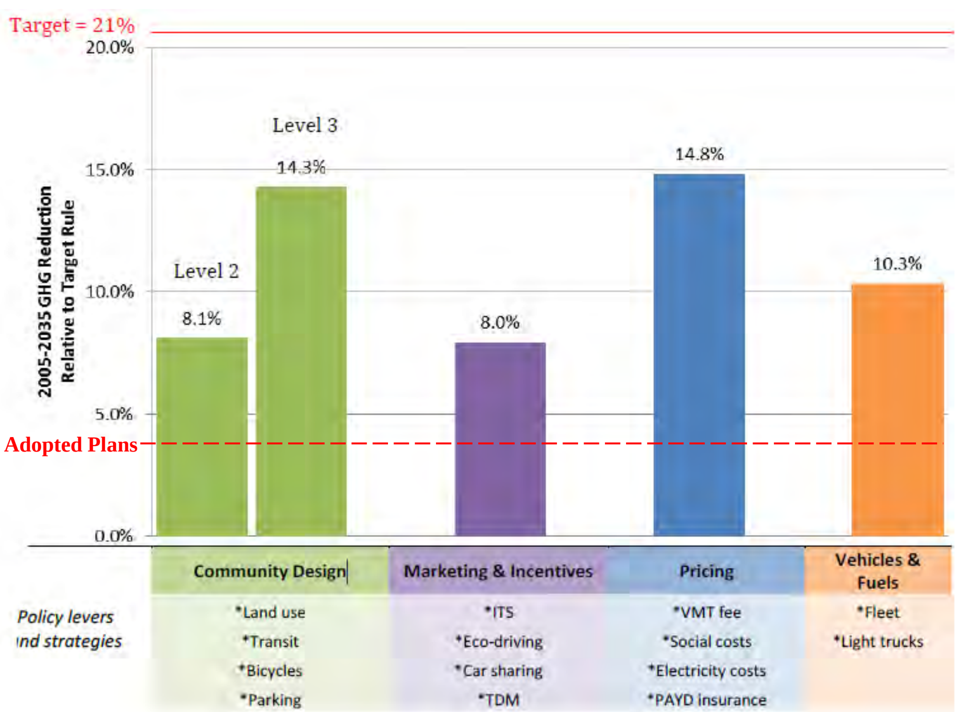
Performance-Based Planning

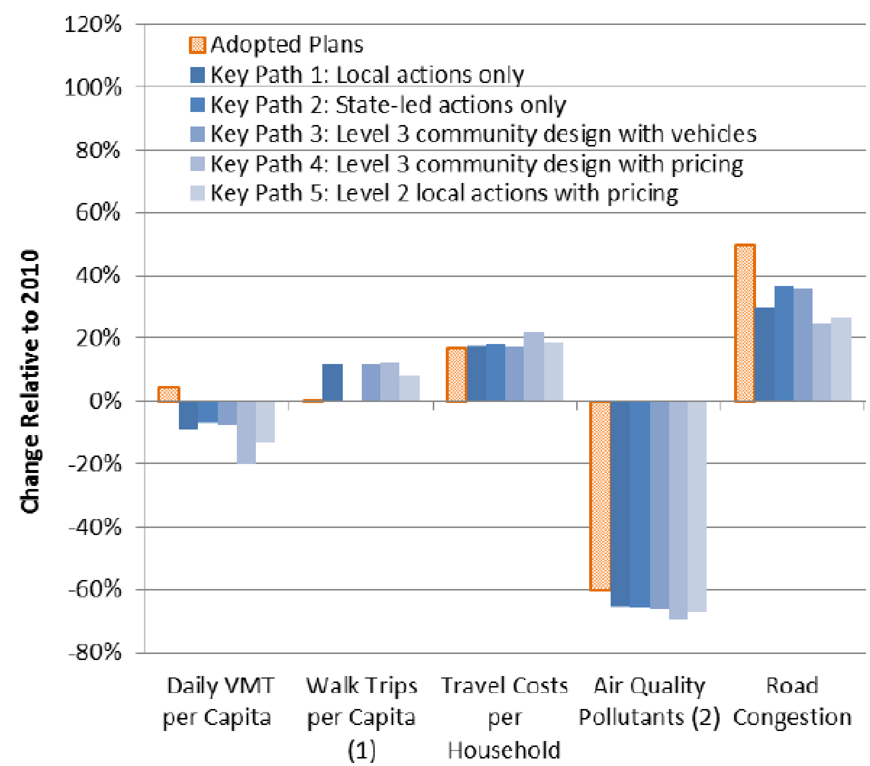
MPO GHG Planning with RSPM

RSPM Inputs:

Regional Context	Local Actions: Community Design	Local Actions: Marketing & Incentives	Collaborative Actions: Vehicles & Fuels	Collaborative Actions: Pricing
• Demographics • Income Growth • Fuel Price	• Future Housing (Single- & Multi-Family) • Parking Fees • Transit Service • Biking	• TDM (home & work-based) • Car Sharing • Education on Driving Efficiency • Intelligent Transportation Systems	• Vehicle Fuel Economy (mpg) • Fuels • Commercial Fleets	• Pay-As-You-Drive Insurance • Gas Taxes • Road User Fee

Corvallis Area MPO Results:

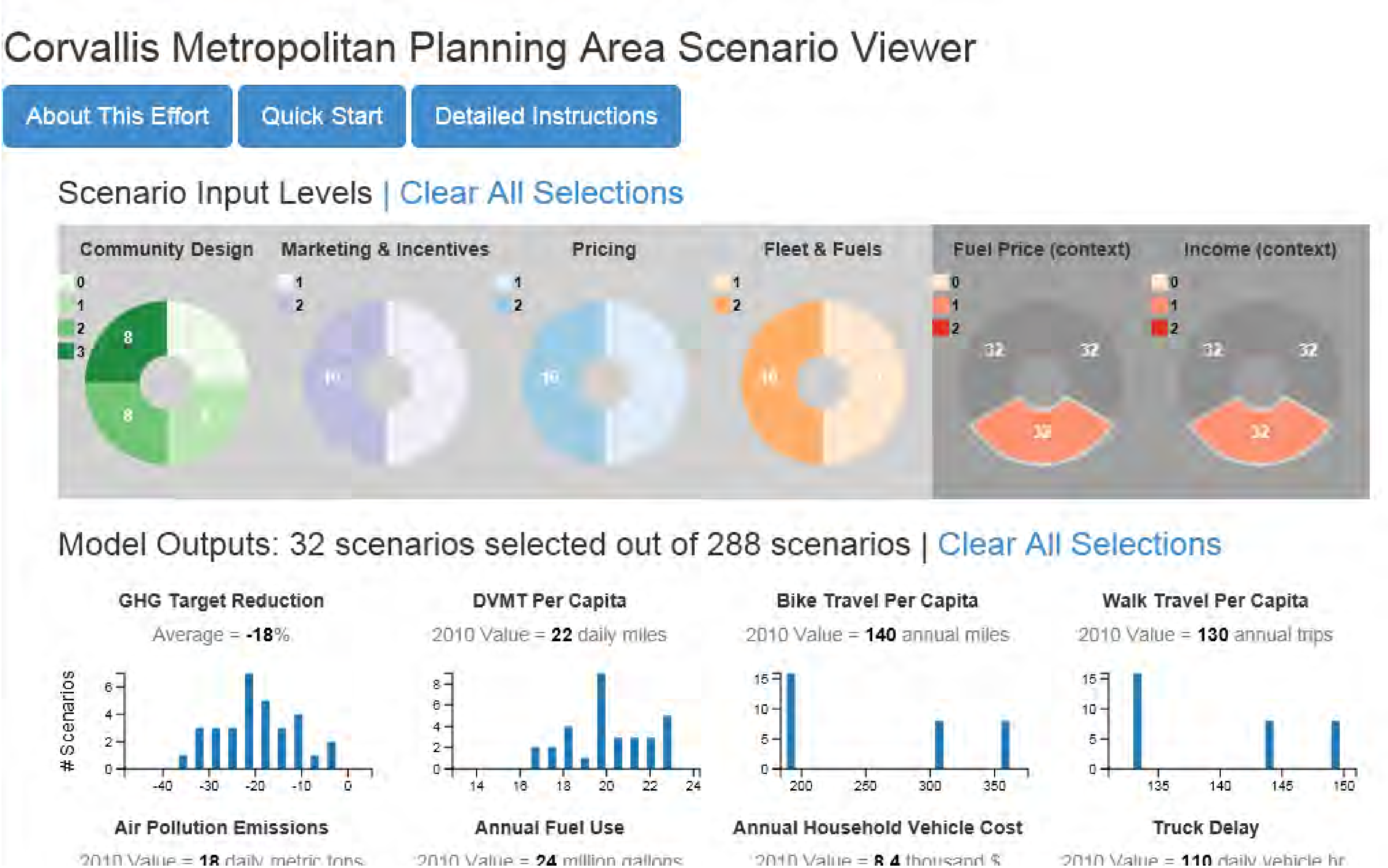




Relative Impacts of Policies by Outcome Measure
(from CAMPO Strategic Assessment, July 2014)

Note: Policies (bars) within each outcome (column) have been scaled to 100%, reflecting relative impact for a single outcome. Policy bars should not be compared across outcomes (e.g., land use is not necessarily more effective in reducing travel costs than in reducing GHG emissions).

Sensitivity Test Viewer (CAMPO)

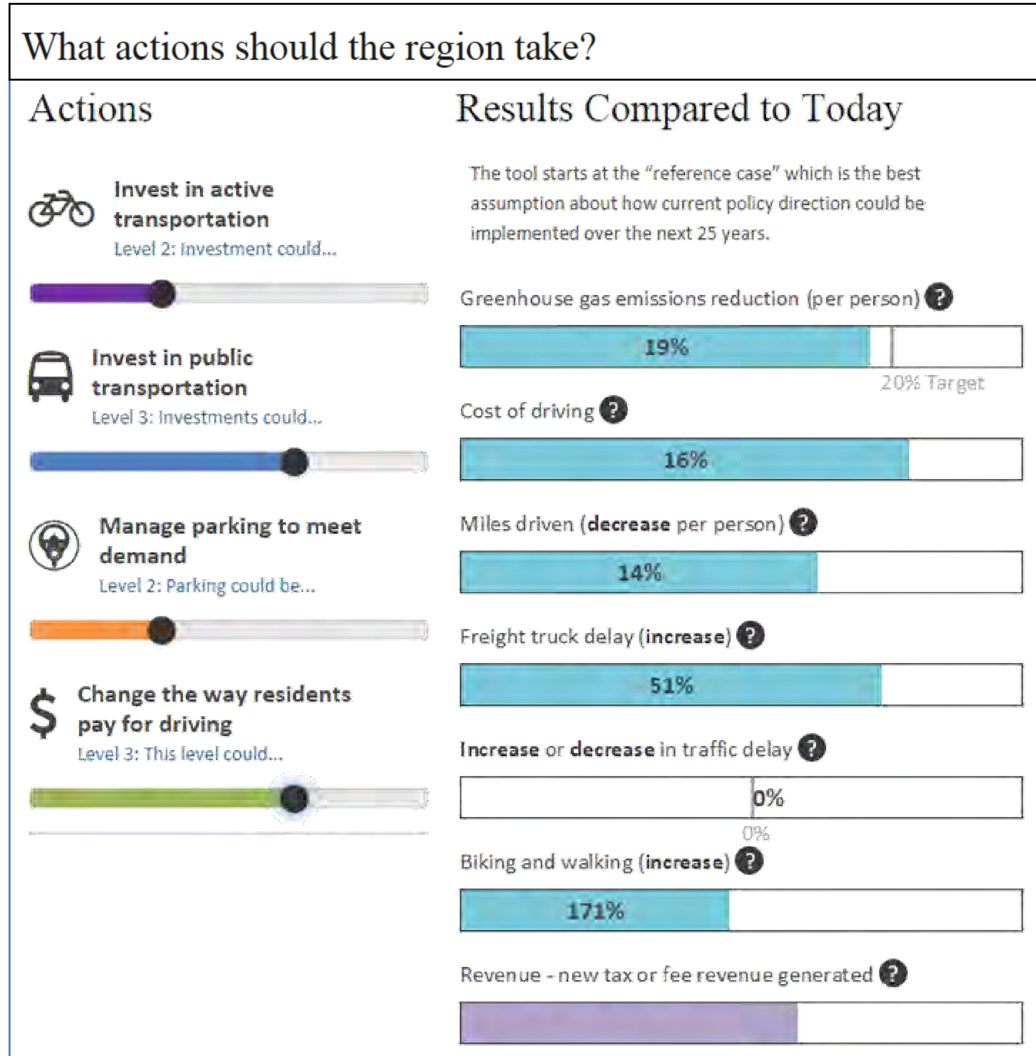


http://www.oregon.gov/ODOT/TD/TP/Pages/scenarioviewer.html

Community Involvement (CLMPO)

Central Lane Scenario Planning

- Stakeholder workshops
- Future Builder online tool
- Telephone survey
- Targeted equity outreach



Source: Central Lane MPO Scenario Planning Process, 2015.
http://www.clscenarioplanning.org/future-builder/

Why RPAT? – Tool Comparison

Element	RPAT	RSPM
Geography	One study area zone	Study Area – **Divisions – Districts** (census tract size)
Year/Units	N/A (mix of absolute and "new" impacts)	**Inputs vary by year** (e.g., gas tax, adoption curve for mid-years)
Employment	**Employment** (NAICS 6-digit) + # of firms by size	N/A
University GQ	N/A	**University GQ** inputs separate from Household population
Trips	Explicit Trip Rate Input, **Auto+Transit Trip outputs**	N/A
Costs	• Veh Per Mile (Op, fuel, gas tax, VMT fee) • Veh fixed costs • **Transit Fares** • Infrastructure (cap+Op) - Fwy/Arterial, **Bus/Rail**	• Veh Per Mile (Op, fuel/**elec**, gas tax, VMT fee, **carbon tax, congestion fee**) • Veh fixed costs (Insurance, Registration, Financing) • Infrastructure (cap+Op) - Fwy/ Arterial
Work-based TDM/ Commute Options	**4 TDM programs, sensitive to LU Place Type** (Rideshare, Vanpool, Transit Subsidies, Telework)	Participating TDM HHs achieve 5% DVMT reduction.
Home-Based Individualized Mktg Pgms	N/A	Participating **IMP** HHs achieve 7% DVMT reduction.
ITS	Ramp Metering	2 Fwy, 2 Arterial ITS programs considered (Ramp Metering, **Incident Mgmt, Signals, Access Mgmt**)
Health/Safety	**Crash** Incidents (fatality, injury, property)	N/A; have used ITHIM post-processor for health impacts: • **Safety (crash injuries/fatalities)** • **Air Quality burden of disease benefits** • **Active Transit burden of disease benefits**
Fleet/Fuel	• LDV Auto fleet (exogenous MPG input) • LDV Fuel (including carbon intensity)	• LDV Auto fleet characteristics + turn over rates (**endogenous MPG**) • LDV Fuel (including carbon intensity) • **LDV Electricity (+ carbon intensity)**
LDV Commercial Service	N/A	**Comm Svc considered explicitly** enable policies for public/private fleets.
Congestion	Older congestion model	**Updated congestion model**, accommodates more ITS policies.
Calibration/Housing model	N/A	**Housing model** allocates HHs to DUs; calibrated to District HH Per Capita Income. Allows demographics (size, income) to match housing type.
Other policies	N/A	• **CarShare Programs** • **EcoDriving Programs** • **Household Vehicle Optimization** of multi-vehicle fuel economy

Why RPAT?

Interest in merging these RPAT elements into RSPM….

- **Additional Policies:**
  - Land Use place types
  - Enhanced TDM (telework, rideshare, transit subsidy)
- **Additional Outputs:**
  - Crash
  - Infrastructure costs (funding)
  - Transit trips
- **Other attributes with potential:**
  - employment, e.g., use in work-based parking, intercity travel, etc.?
  - Transit fares

TravelWorks
Advanced Travel Analysis Tools

Rapid Policy Assessment Tool Peer Exchange

Maren Outwater and Erich Rentz

October 2015

Definition

RapidPolicy ASSESSMENT TOOL

Validation is the application of the calibrated models and comparison of the results against observed data. Ideally, the observed data are data not used for the model estimation or calibration but, practically, this is not always feasible. Validation data may include additional data collected for the same year as the estimation or calibration of the model or data collected for an alternative year. Validation should also include sensitivity testing.

Source: *Travel Model Validation and Reasonableness Checking Manual*, FHWA, September 24, 2010.

SHRP2 SOLUTIONS

Validation for RPAT

RapidPolicy ASSESSMENT TOOL

- **Input Data**
  - Check aggregated input data against separate observed data for base year
  - Check aggregated input data against separate forecast data for future year
- **Outputs**
  - Check outputs against separate observed data for base year
  - Check outputs against separate forecast data for future year
  - Check output trends against expected results

- Checking against a separate source may not always be feasible but is still desirable.
- Checking inputs may seem unnecessary, but can identify mistakes.

Population and Employment Inputs

RapidPolicy ASSESSMENT TOOL

- **Population and Employment by Place Type**
  - Check totals by area type
  - Check totals by development type
- **Existing Employment**
  - County Business Pattern (CBP) data by firm size
  - Local employment data source
- **Employment Growth**
  - Bureau of Labor Statistics
  - State employment projections
- **Existing Population and Growth**
  - Census population by age group
  - Local population data source
  - Regional or State population projections

- Check total annual growth projections
- Check aggregate totals of employment and population

Economic Inputs

RapidPolicy ASSESSMENT TOOL

- **Average Regional Household Income (Year 2000)**
  - Bureau of Economic Analysis (BEA)
  - Regional or State estimates adjusted to Year 2000

TABLE 3: CPI ADJUSTMENTS TABLE

YEAR	CPI, 1980=100	ADJUST TO 2000
1980	100.000	0.581
1985	107.600	0.625
1990	130.700	0.759
1995	152.400	0.885
2000	172.200	1.000
2005	195.300	1.134
2010	218.056	1.266
2014	236.736	1.375

Transport Demand Inputs

RapidPolicy ASSESSMENT TOOL

- **Auto and Transit Trips per Capita**
  - National Household Travel Survey (NHTS) for auto trips
  - National Transit Database (NTB) for transit trips
  - Regional travel survey
  - Regional travel demand model
- **Base Daily Light Vehicle Miles Traveled (VMT) and Proportion of VMT on Freeways and Arterials**
  - Highway Performance Monitoring System (HPMS)
  - Federal Highway Cost Allocation Study (FHCA)
  - Regional travel demand model
  - Regional count databases

- **Truck and Bus VMT and Proportion of VMT on Freeways and Arterials**
  - HPMS
  - FHCA
  - Regional travel demand model
  - Transit authority data

Transport Supply Inputs

RapidPolicy ASSESSMENT TOOL

- **Road Lane Miles**
  - FHWA Highway Statistics data
  - Regional or State sources
- **Transit Revenue Miles**
  - National Transit Database (NTD)
  - Regional or State sources

Direct Travel Impacts

RapidPolicy ASSESSMENT TOOL

- **Daily Vehicle Miles Traveled**
  - Highway Performance Monitoring System (HPMS)
- **Daily Vehicle Trips**
  - Regional travel demand model
  - National Highway Travel Survey (NHTS)
- **Vehicle Hours of Travel, Delay**
  - TTI Urban Mobility Scorecard
  - Bureau of Transportation Statistics (BTS)
- **Average Travel Speeds by Vehicle Type**
  - National Performance Management Research Data Set (NPMRDS)
- **Daily Transit Trips**
  - National Transit Database (NTD)
  - Regional travel demand model

- There are some private sector sources that produce speed and delay estimates.
- Some national sources should be reviewed and cleaned before use.

Environment and Energy Impacts

RapidPolicy
ASSESSMENT TOOL

- **Fuel Consumption**
  - U.S. Energy Information Administration
- **Greenhouse Gas Emissions**
  - U.S. Environmental Protection Agency

Forecasts will not necessarily match any future scenario in RPAT, but can be used as a reasonableness check.

Financial and Economic Impacts

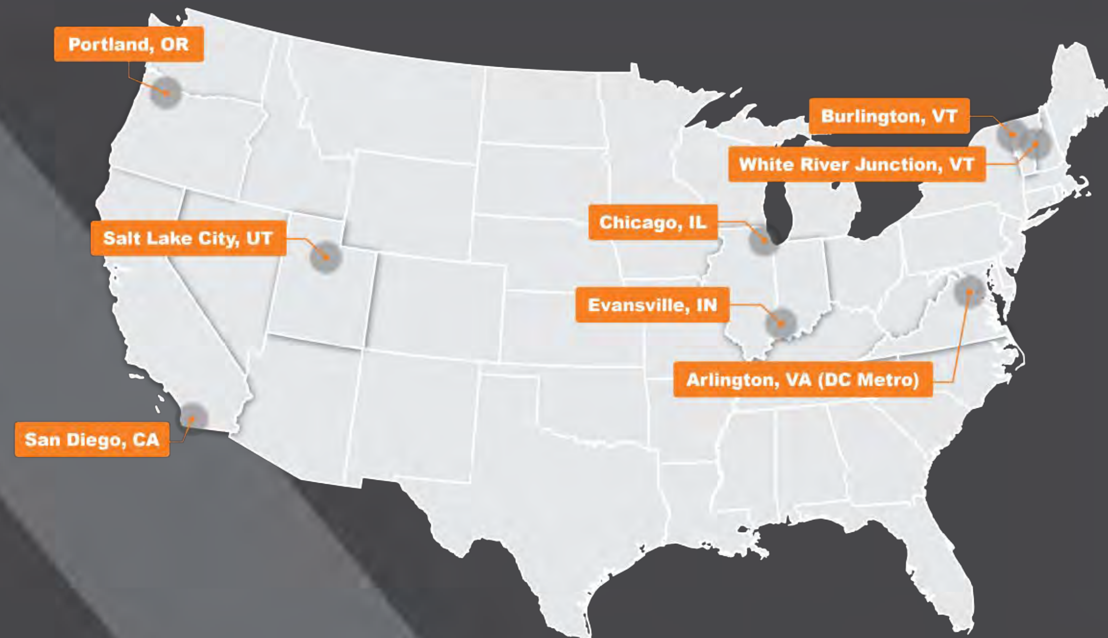
RapidPolicy ASSESSMENT TOOL

- **Regional Highway Infrastructure Costs**
  - State and regional sources
- **Regional Transit Infrastructure and Operating Costs**
  - Transit authority sources
- **Annual Traveler Cost**
  - Gas cost can be estimated based on VMT and average gas price per mile
  - Fuel tax, parking cost and VMT tax are the result of policies being tested

Location and Community Impacts

RapidPolicy ASSESSMENT TOOL

- **Regional Accessibility**
  - Regional travel demand model
- **Job Accessibility by Income Group**
  - Regional travel demand model
- **Accident Rates and Value**
  - National Highway Traffic Safety Administration (NHTSA)
- **Change in Walking Percentage**
  - TCRP Report 95 for Transit Oriented Development
  - NCHRP Report 770 for Walk and Bike Trips



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Example Test for 2040 Travel Impacts

RapidPolicy ASSESSMENT TOOL

- **Compare 2040 Travel Speeds, VMT, Transit Trips, VHT and Vehicle Trips**
  - Long Range Plan scenario
  - Travel Demand Model scenario
- **To 2040 Travel Model Targets**

Example from Delaware Valley Regional Planning Commission

	RPAT Result				Travel Model Target
Measure	LRP_Diff	LRP_Tot	TDM_Diff	TDM_Tot	
Average Travel Speeds by Vehicle Type	30.31	30.35	30.25	30.27	31
Daily Vehicle Miles Traveled	119,769,581	118,769,590	121,249,152	120,808,780	131,210,865
Daily Transit Trips (Δ)	85,836	94,251	80,409	84,065	78,513
Vehicle Hours of Travel (Δ?)	3,664,985	3,631,854	3,715,446	3,701,344	1,300,068
Daily Vehicle Trips (Δ)	2,314,494	2,256,854	2,352,108	2,325,273	2,076,251

Example Test for 2040 Speeds

RapidPolicy ASSESSMENT TOOL

- **Compare 2040 Average Travel Speeds by Vehicle Type**
  - Long Range Plan scenario
  - Travel Demand Model scenario
- **To 2040 Conformity Target**

Example from Delaware Valley Regional Planning Commission

Average Travel Speeds by Vehicle Type(AveSpeed.MaTy.csv)

	LRP_Diff	LRP_Tot	TDM_Diff	TDM_Tot	Conformity Target
LtVeh	30.31	30.35	30.25	30.27	2040
Truck	32.17	32.22	32.10	32.12	31
Bus	25.74	25.76	25.71	25.72	

Example Test for 2040 Travel Impacts

RapidPolicy ASSESSMENT TOOL

- **Compare 2040 Travel Speeds, VMT, Transit Trips, VHT and Vehicle Trips**
  - Travel Demand Model scenario
- **To 2040 Travel Model Target**

Example from Durham Chapel Hill Carrboro Metropolitan Planning Agency

2040 MTP	TRM	RPAT	Difference (%)
Vehicle Trips	7,406,935	7,988,956	7.86%
VMT	87,970,656	80,319,835	-8.70%
Average Speed	49.9	33.5	-32.87%
- Freeway	61.4		
- Arterial	45.7		
- All Facility	49.9		
VHT	2,279,875	1,690,926	-25.83%
Transit Trips	227,878	128,787	-43.48%

A New Framework for the GreenSTEP Family of Models
VisionEval Open Source Project Vision

Oct 2015DRAFT ODOT (T.Weidner, A. Pietz, and B. Dunn), and FHWA (J. Raw, N. Fortey, and E. Pihl)

PREAMBLE: Strategic Planning/Open Source/Open Data Benefits

Strategic planning is a means to help governments select policies and actions to address pressing long-term issues fraught with uncertainty. Regions are faced with a number of matters of concern related to the development of sustainable transportation systems (e.g., energy, air quality, water, agricultural lands, public health, and economic development), as well as uncertainties about the future. Strategic planning tools allow exploration of many scenarios to assess policy/investment tradeoffs about complex systems enabling us to "think better" about intended and unintended consequences of our actions.

Open source projects provide for collaboration, investment efficiency and quality control benefits, while their transparent **public access to data** supports a recent emphasis of government at both the federal and local levels.[1] Agencies[2] note the key benefit of open source projects are that public funds are not spent doing something more than once, as other interested teams can improve or contribute back on projects rather than starting from scratch. Other noted advantages include: flexibility with consultants because the tool is not proprietary with clearly defined intellectual property rights, reuse provides incentives for the development team to follow best practices (e.g., thorough documentation and portability), and the codebase and the collaborative process can serve as a reference and help to expose the project's lessons learned to the larger community.

MISSION STATEMENT:

Create a collaborative Open Source Tool that houses an award-winning family of strategic models, as a public resource useful for performance-based planning and other uses (e.g., teaching) under an evolving understanding of future uncertainties in order to make **INFORMED DECISIONS** to reach **DESIRED COMMUNITY OUTCOMES** under limited resources. Much like the R language repository of modular components, the **TOOL** would be freely available, flexible, and easy for users and contributors across the globe to understand, use, assemble, and extend in a plug-and-play fashion. The project would be maintained and governed by a **COMMUNITY** of agency sponsors, active users and developers who are able to pool funds to extend these performance-based strategic planning models. The value of the tool would engender long term support for **CONTINUITY**, upgrades and outreach.

- Create something useful to inform decisions:
  - transportation performance-based planning tool
  - flexible framework allows adding features to enable value and use beyond transportation
  - strategic tool for visioning complements more detailed modeling tools used in implementation
  - Interactive web-based scenario viewer allows public to explore policy/investment tradeoffs
- Continued code development in response to application-driven needs (e.g., ease of use or enhanced value to decision-making process)

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[1] The Obama Administration "Transparency and Open Government" memorandum, asked agencies to "establish a system of transparency, public participation, and collaboration." (January 2009). The city of San Francisco's Executive Directive 09-06 on Open Data, states: "This Directive will enhance open government, transparency, and accountability by improving access to City data that adheres to privacy and security policies. Data which often resides in technology systems…is structured and can be used by other computer applications for analysis or new uses such as mapping." (Newsom 2009).

[2] "Creating CountDracula: an Open SourceCounts Management Tool," 2014 TRB Annual conference, SFCTA.

- Make it painless to use/contribute
- Accept outside contributions
- Make the assumptions and tool code transparent to contributors and users
- Sustain continued maintenance of code and community
- Develop in a phased approach, with sufficient flexibility keeping the end goal in mind.

Common Tool Platform:

Imagine a tool platform with these features and capabilities…

- A common platform where tools are built from components that can be swapped in and out
- Provided specifications and services enable independent model researchers and developers from around the world to create components that work with each other
- The repository is freely accessible over the internet where developers can share their work and modelers can download components to build the models they need
- Model components that are not only documented, input checks are built in, as are model estimation code and data enabling estimations to be reproduced, checked and modified.
- Components include built in automation to estimate custom parameters for a region.

What success looks like:

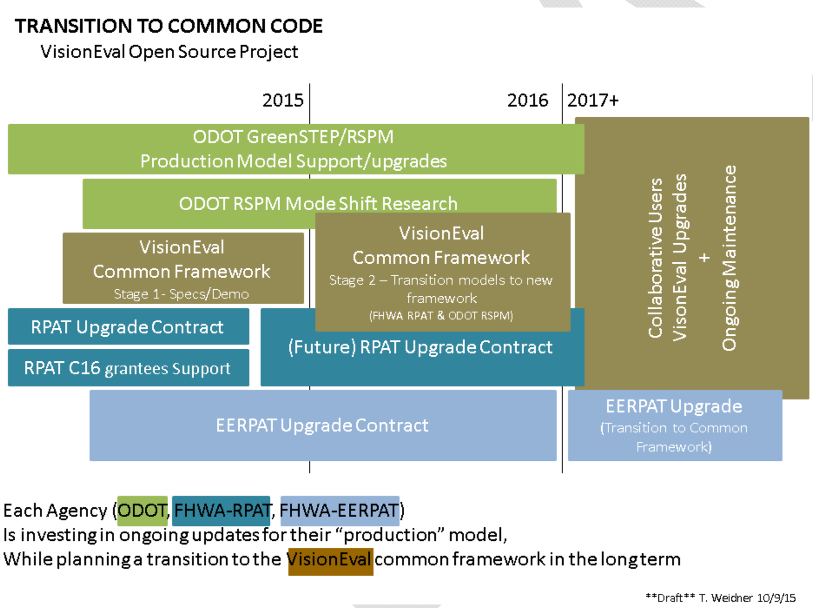
- **INFORM DECISIONS** – Tool integrates seamlessly into the decision-making process influencing transportation investments and policy tradeoffs and decisions, as well as quantitatively informing other policy discussions.
  Measure of Success: Website hits, federal support of base tool, applications of tool/interactive scenario viewer in planning process (once or systematic)
  Keys to Success: Visualization of results; ease of use in communicating outputs; approachability and understandability for informing public and stakeholders.
- **TOOL** – Common framework tool (loosely coupled modules which interact through a common datastore) that is open source licensed, hosted on GitHub, with a process for accepting contributing code including standardized tests and requirements. The code is stable, easy to use for both tool builders and users, and extensible to long term needs. Code is well documented for developers, assemblers, and users including user's guide and code examples.
  Measure of Success: Website hits, use in published projects, use in classrooms, level of questions received
  Keys to Success: modular, open source, scalable, continue successful practices (agile, listen to users, etc.)
- **COMMUNITY** –Users that have policy Qs/needs and resources to implement, as well as developer pool with familiarity with the tool enough to build new code, and others with less familiarity to use/assemble existing code and develop inputs. Training programs/workshops/on-line.
  Measure of Success: Participants
  Keys to Success: Build development/use capacity within multiple consultants. Compel use through ease of use and/or value to policy process.
- **CONTINUITY** – The tool and community is supported by sponsoring agencies able to pool resources and find independent funding to maintain the basic project needs. This includes governance forums, as well as scheduled releases and tool maintenance, as well as sponsored research to refresh the tool for emerging modes and measures.
  Measure of Success: Data sources (estimation data) and units (year of dollars) are current (within 5 years)
  Keys to Success: Tool Maintenance Plan; Divers policy maker/developer/academia community support

Value to Community

- **Policy Maker** (consumer) – Through evaluation of many scenarios and tradeoffs, enhance the abilities of planners, advocates, the public, and decision makers to reason about complex systems and consider many possible courses of action; ability to test risk/resilience of plans under future uncertainties; cost-effective pooled fund tool upgrades; consultant flexibility/incentives of open source process; credible, maintained tool; collaborative code maintenance/updates; community of active users; Case studies
- **Analysts** (applier) – Use outcomes to support policy. Use what's already done and using in different way. Users Guide detail on building and interpreting inputs/outputs and understanding sensitivities.
- **Developer/Researcher** (developer) – Simple tool with Synthetic household detail allows many policies to be tested/added (lightweight, short runtimes, estimation datasets included in packages). Easily extend code to use for own purposes (modular, scalable, accessible data); maintained and documented code (Clear standards and guidelines); community of developers.
- **Educators** – Relatively simple tool with synthetic household detail and policy case study examples can be instructive on technical and policy level, and be used to evaluate simple user scenarios.

Timeline and Resources

The baseline tool common framework is intended to be accomplished in a 2-phase joint FHWA-ODOT effort, to first specify and test the framework, and a second to transfer at least one ODOT and FHWA existing tool to the framework. This is funded, and anticipated to occur by 2017 (see figure below). Continued use and maintenance Agency support hinge on the value of the project as express by users.



Next steps

- **Codebase:** Common framework phase I+II projects, ODOT Research on mode shift , documentation
- **Community-Technical:** Developers forum starting with Common framework phase I+II projects
- **Community-Policy**: Policy Makers Forum starting with Oct 2015 RPAT Peer Exchange, proposed Performance-Based Planning peer exchange (SLOC), proposed ITM conference workshop
- **Continuity:** "Readiness" review of Open Source Project by outside experts to inform one time and ongoing investment in money and resources to achieve vision (funding TBD).

References

- "VisionEval: A New Framework for the GreenSTEP Family of Models, Technical Overview and Approach," Gregor, & Weidner (October 2015)
- GitHub: https://github.com/gregorbj/RSPM
- Federal RPAT & EERPAT Models
    - EERPAT: https://www.planning.dot.gov/fhwa_tool/
    - RPAT: https://planningtools.transportation.org/10/travelworks.html
- Oregon DOT GreenSTEP & RSPM Models and applications
    - Statewide Transportation Strategy (GHG): http://www.oregon.gov/ODOT/TD/OSTI/Pages/STS.aspx
    - Scenario Planning: http://www.oregon.gov/ODOT/TD/OSTI/Pages/scenario_planning.aspx
    - CAMPO Strategic Assessment & CLMPO Future Builder interactive scenario viewers: http://www.oregon.gov/ODOT/TD/TP/Pages/scenarioviewer.html http://www.clscenarioplanning.org/future-builder/

Application/Case Studies

(how influenced decisions, what was involved technically)

- C16 RPAT pilot (proof of concept) + newer grantee
- EERPAT pilots
- Oregon Transportation Options Plan - RSPM quantified statewide impacts if plan was implemented in all MPOs (see text box)
- Oregon Legislature – GHG evaluation of proposed Transportation package
- Eugene-Oregon Climate Recovery Ordinance 20540

Deployment Accomplishments

- (proposed) May 2016 ITM Conference, session and/or C16 workshop
- (proposed) 2015/2016 SLOC-funded Performance-Based Planning Peer Exchange
- Nov 2015 RSAI Conference, Portland (Gregor common framework presentation)
- Oct 2015 AMPO Conference, RPAT Peer Exchange, RPAT Training
- July 2015 CAMPO Strategic Assessment (RSPM) received FHWA 'Environmental Excellence Award'
- July 2015 RPAT Training
- Apr 2015 APA Conference (Weidner presentation)
- 2015 NC state AMPO meeting (RDU presentation)
- Oregon DOT Statewide Transportation Strategy won AASHTO award
- 2010 GreenSTEP model won AASHTO 'Presidents Award for Planning'

ODOT's GreenSTEP model demonstrates the benefits of transportation options investments

GreenSTEP was developed by the Oregon Department of Transportation (ODOT) to estimate and forecast the effects of various policies and other influences on the amount of vehicle travel, the types of vehicles and fuels used, energy consumption, and resulting GHG emissions. The model estimates vehicle ownership, vehicle travel, fuel consumption, and GHG emissions at the individual household level. One factor or input into the model is the participation of households in transportation demand management/TO programs. Other factors include land use and transportation system characteristics, vehicle ownership, household daily vehicle miles traveled, etc.[12]

The GreenSTEP model was run to evaluate the general outcomes/benefits of increasing transportation options programs and associated community design variables across the state. The analysis hinges off the GreenSTEP setup and inputs assumed in the ODOT Statewide Transportation Strategy (STS) report;[13] pivoting off the STS-Reference scenario, and assuming levels in the OTC accepted STS-Recommended or Vision scenario.

Results

The effect of ambitious implementation of transportation options programs across all Oregon metropolitan areas in year 2035 was evaluated. This included home and work based TDM programs, car-sharing, and parking cash-out programs. Other related policies were increased marginally to reflect TO program effects (transit service, bicycle promotion, parking coverage, and parking fees). Benefits of transportation options include benefits to individual households and the overall transportation system. This general assessment shows:

→ 7 percent reduction in daily vehicle miles traveled per capita

→ 7 percent reduction in GHG emissions

→ 3 percent reduction in number of vehicles per household

→ 2 percent reduction in annual household travel costs

→ 10 percent reduction in annual vehicle travel delay per capita

→ 3 percent reduction in daily heavy truck delay

Note: Additional information is being pursued to monetize some of the TO benefits from the GreenSTEP model, including cost savings from reduced truck delay.
Source: GreenSTEP model results based on setup for the Oregon Statewide Transportation Strategy (2011)

VisionEval: A New Framework for the GreenSTEP Family of Models Technical Overview and Approach

Brian Gregor, Oregon Systems Analytics LLC
Tara Weidner, Oregon Department of Transportation
10/9/15

This white paper outlines the vision, approach, and timeline for developing a new framework for the GreenSTEP family of models, VisionEval. It is intended to provide an understanding of key objectives and end products, as well as the path to get there.

Project Purpose and Vision

ODOT developed the GreenSTEP model for statewide use, and a rebranded metropolitan version of the model as the Regional Strategic Planning Model (RSPM). The GreenSTEP/RSPM models have proven to be successful in providing modeling support for several high profile state and metropolitan area planning applications. These **successes** include:

- Development of a legislatively mandated statewide strategy for reducing greenhouse gas emissions from the transportation sector;
- Development of the legislatively mandated analysis of the potential for reducing greenhouse gas emissions from light-duty vehicles in metropolitan areas;
- Development of scenario plans for metropolitan areas; and
- Analysis of the potential effects of advanced vehicles on gas tax revenues.

In addition, the GreenSTEP model has been adapted for use by other states in the form of the Federal Highway Administration's (FHWA) Emissions Reduction Policy Analysis Tool (EERPAT), and portions of the model became the underlying basis of the SHRP2 C16 Rapid Policy Assessment Tool (RPAT, formerly SmartGAP).

The GreenSTEP/RSPM models are disaggregate strategic planning models, and have introduced a number of innovative concepts to transportation modeling, winning a national award from the American Association of State Highway Transportation Officials (AASHTO) in 2010. The term "disaggregate strategic planning model" represents several distinguishing features of these models. They are disaggregate in the sense that they model aspects (i.e. characteristics and behaviors) of individual households. They are strategic planning models because they are used to support long-range strategic planning processes such as visioning, policy development, and scenario planning where many alternatives and potential conditions need to be modeled to address a range of possibilities and uncertainties. In strategic planning models, some detail is sacrificed to enable a much larger number of alternatives and aspects to be modeled.

The success of the tool has resulted in four slightly different models, sufficiently different so that model upgrades are not easily shared. The goal of this effort is to put the models in a common modularized framework. In addition to increasing collaboration, the new framework addresses several limitations that have become apparent through the use of these models. Some of these **limitations** include:

- The structure of data storage and retrieval scales poorly with large populations and large numbers of household attributes. This shows up in the need for large computer memories when modeling large populations and in increasing time performance penalties as more household attributes are added.
- The models are not modular enough to enable new capabilities to be added in a plug-and-play fashion. This makes the code more difficult to extend and maintain than it needs to be, and limits the ability of other developers to contribute to improving the models.
- The structure of the data storage also increases the difficulty of producing performance measures from model outputs. The models produces a wealth of information for calculating performance measures, but a substantial amount of scripting is required in order to retrieve that information and calculate measures.

This project will create a new model framework for implementing disaggregate strategic planning models including the GreenSTEP/RSPM models. The **design goals** for the new model framework will be:

1. Modular: A model will specify in a simple declarative script the model modules to be used. Modules will be packaged in standard R language packages.
2. Open: Clear standards and guidelines will enable developers anywhere to create modules and/or combine modules into new or improved models.
3. Scalable: Models will be able to be built for regions of varying population sizes, from small town to large metropolitan area or state.
4. Accessible: Data will be managed in a persistent store to mediate between modules and enable performance measures to be produced using simple commands.
5. Quick: Short runtimes are key to allowing a large number of model runs to strategically assess a wide variety of synergistic policy actions under future uncertainties.
6. Simple UI: A well-structured user interface to facilitate a limited set of inputs and flexible output processing is essential. A Graphical User Interface may help, depending upon the user community.

General Approach to Development

Even though the GreenSTEP/RSPM models are innovative, they were developed on tight timelines and with a strong customer orientation. This was made possible by following agile modeling practices and by developing and implementing the models in the R language and environment for statistical computing and graphics. These **agile modeling practices** will be incorporated into the development of the new framework including:

- Lightweight design up front.
- Iterative development, by doing just enough to meet needs and then revising and refactoring as needed.
- Modular development with testing throughout the development of each module.
- Paying attention to customer needs, understanding what information works in their policy forums, and anticipating their needs.

The R language played a key role by enabling a continuous development process from data exploration, to model estimation, to model implementation, to model testing, to model integration, and finally to model application.

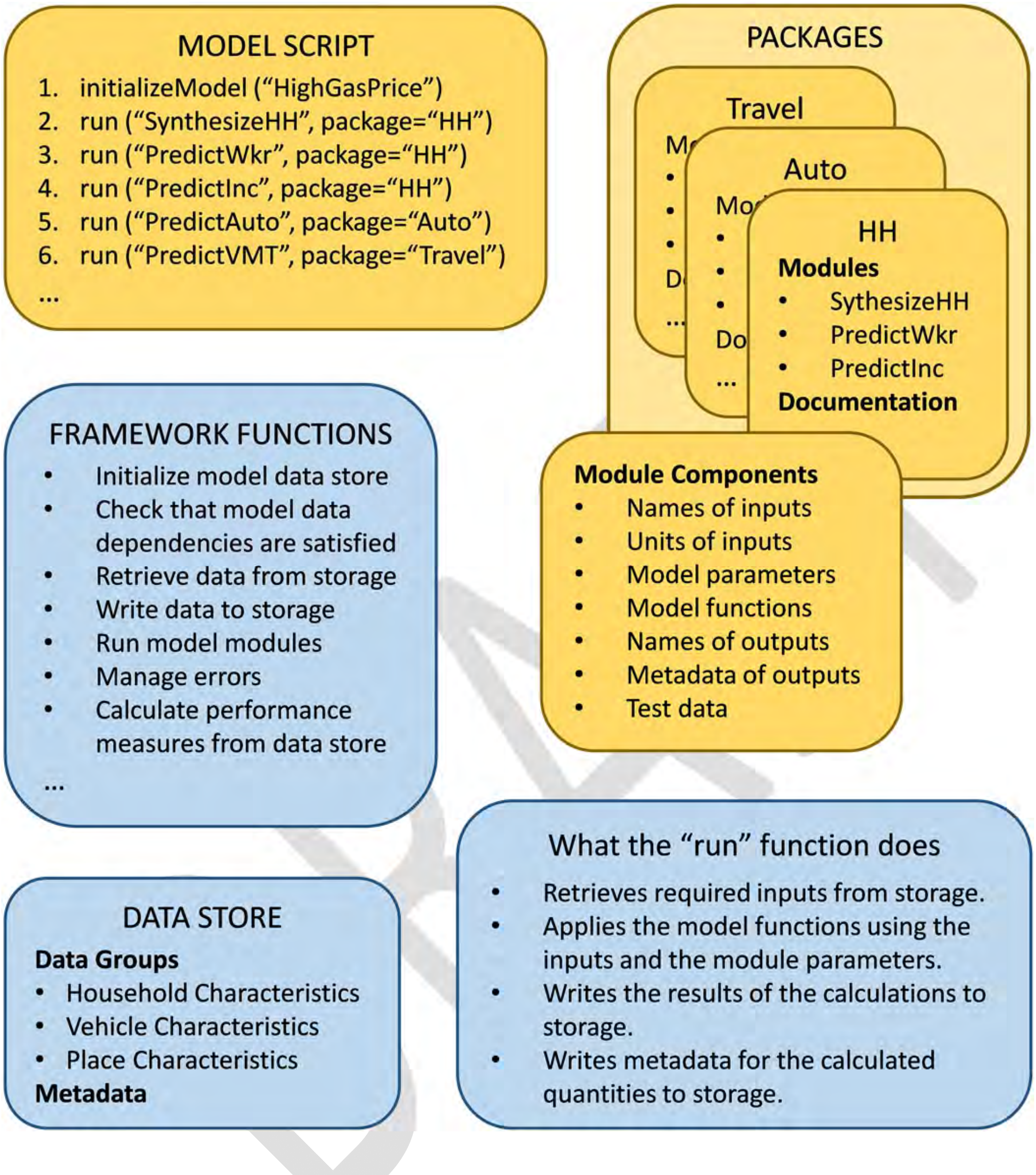
The development of the new framework will follow these successful **practices**.

- The organizing concepts for the framework are based on extensive use of the GreenSTEP/RSPM models and customer requests.
- Development will proceed iteratively from a light-weight design. Components will be developed and tested in iterations to create core functionality and then to extend the functionality as needed.
- At periodic intervals the components will be integrated and tested together.
- Revisions to the individual components will be made as necessary to assure successful integration.
- Documentation and development of specifications will proceed in tandem.
- Organizational requirements will be kept as simple as possible for prospective module developers.

Framework Overview

The new framework is named **VisionEval**. This framework will enable many types of strategic planning models to be assembled for regions of many different sizes, from small metropolitan areas to multi-state regions. The GreenSTEP model will be one type of model built within the VisionEval framework. An overview of the envisioned framework is presented here to provide a context for understanding the work scope. Figure 1 illustrates the primary elements of the framework.

Figure 1. Overview of VisionEval Common Framework



A model operating in the framework is composed of **two groups of components**.

- **Model Components** (shown in orange) - These includes components created by module developers and assemblers. These components are not strictly part of the framework, rather they are created in compliance with framework standards. The standards assure that module components can use the framework services and can be assembled into working models. There are two types of model components, packages and model scripts.

- **Packages –** These are compilations of one or more model modules. A model module contains all of the information needed to implement a model which calculates some attribute (e.g. household income). The information components of a module are shown in Figure 1. Any number of modules can be included in a package. The package includes documentation for the included modules, R scripts and data that were used for estimating the modules, examples for using the modules, and test data.

- **Model Scripts** - A model script creates a model by calling on the services of a number of model modules. A model script is a simple text file which calls on framework services to initialize a model and then specifies a sequence of calls to modules, by module name and package name.

- **Framework Services** (shown in blue) - These include all of the services provided by the framework. These run in the background and require no attention by module developers and assemblers.

  - **Data Store** - This is a file which contains all the data that is used by and created by a model. The data is organized into groups of attributes such as household attributes, vehicle attributes, and place attributes. The file will be addressable so that the data written to or read from the file is only what is needed. The data store will also contain the metadata including units for all data elements. The HDF5 file format will be used for the datastore.

  - **Framework Functions** - The heart of the framework is a set of functions which provide essential services for creating and managing the data store, checking models to make sure that all the needed data is available or will be created in the proper order for the model to run correctly, reading and writing to the data store, running modules, and calculating performance measures from the data store.

  - **Run Script** - Describes the basic services that the framework provides when it executes a module.

Three types of users are anticipated to use this framework:

- **Module developers** create model modules that are distributed in standard R packages. For example, Figure 1 illustrates 3 packages named “HH”, “Auto”, and “Travel”. A package may contain several modules. The figure shows 3 modules in the HH package: SynthesizeHH, PredictWkr, and PredictInc. Each module contains all of the information needed for it to be executed in the framework. This is illustrated in the “Module Components” box.

- **Model assemblers** create a model by writing an R script which specifies the order in which modules will be executed. The script may execute modules in a sequential manner or may include more complicated looping constructs.

- **Model appliers** prepare inputs for an assembled model, run the model, and extract model outputs typically to support planning decisions or research objectives.

Development Approach

The development of the framework and conversion of existing models to the new framework will occur in two phases. In the first phase the framework functionality, specifications, application programming interface and prototype modules will be developed. A second phase will complete the conversion of ODOT (GreenSTEP and RSPM) and FHWA (EERPAT and RPAT) models into the new framework.

Phase I of the new framework conversion effort will create and test all of the framework specifications and services. It will also demonstrate the specifications by creating several prototype modules that are bundled as R packages. In addition, common procedures used in the various model functions will be identified and generalized framework functions for carrying out these procedures will be developed in order to reduce code redundancy and to facilitate the development of new modules. This task will also unify how the state and metropolitan versions of the models treat geographic units. Although the state model imputes many geographic characteristics and the metropolitan RSPM treats them explicitly, the same data store structure will be used for both. Finally this task will show how simple model run scripts are written to assemble modules into running models. Phase I tasks include:

1. **Project kickoff and review of overview and approach** - Convene a technical review group of model developers, academics, technical users, and agency sponsors. Review and finalize the framework approach.

2. **Set-up development work environment** - Set up collaborative open source development work environment, shared repository on GitHub, scripting standards, model estimation package documentation/standards, package development environment, and initial documentation for creating module packages.

3. **Develop Data Store and Functionality for Interaction** - Develop specifications for the design of a data store using HDF5 file format. This file format is used by the new open matrix standard for travel models. In addition, R language support for HDF5 is available. Subtasks include developing specifications for the data store, interaction tests, interaction functions, prototypes, and documentation. This task will proceed in tandem with the fourth task (develop module structure). The work on both tasks will proceed in iterations where each successive iteration increases functionality and detail. Each iteration will involve improving specifications, documentation, code, and testing.

4. **Develop Module Structure and Functions to Run a Module** - Define what is required of a module to work within the common framework, including supporting structure and functions. In general, a model module must contain all of the information needed by the framework functions to retrieve needed inputs from the data store, execute the module, and save the results to the data store. In addition, given this information the framework must perform validation of a model script, checking

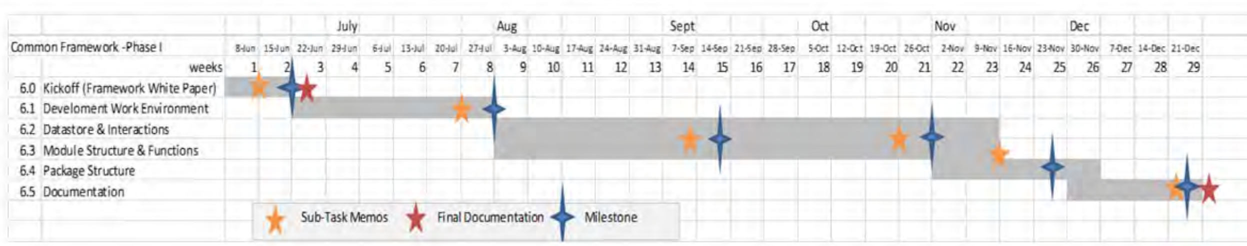
whether all of the inputs needed by each module are available when needed by the module. Subtasks include developing module specifications, describing functionality within modules and for interacting with modules, developing module tests, developing two prototype modules, and developing framework functions for interacting with modules. Work on this task will proceed in tandem with work on the third task.

5. **Develop Specifications, Procedures, and Tools for Developing Packages for Model Modules** - Specifications, procedures and tools will be developed to guide users in the development of model modules. Subtasks include developing specifications for model packages and tests for package sufficiency, developing a model package template and functions for testing package sufficiency, developing and testing a prototype package using the prototype modules developed in the fourth task, and writing instructions for developing packages.

6. **Final Documentation** - Final documentation will be developed which describes the final framework, provides instructions for model assemblers and developers, reports prototype results, lessons learned and time expended, provides recommendations on converting existing strategic planning models to the framework, describes outstanding issues, and offers implementation cautions.

Phase I is underway building demonstration code as well as specifications and standards, and is intended to be accomplished over approximately 5 - 6 months. The timing of tasks and important milestones is shown in the following figure.

Figure 2. Phase I Development Timeline



Phase II is anticipated to involve the conversion of the latest versions of ODOT's GreenSTEP and RSPM as well as the federal RPAT model to the VisionEval framework. The new framework-based versions will be tested with inputs that are the same as existing model runs to assure that they produce the same outputs as those model runs. Key tasks will be to convert the latest version of GreenSTEP and the metropolitan RSPM, and to package the new models into a set of R packages. Conversion of the Federal EERPAT tool is intended to be implemented in a separate phase. The full benefits of this common framework are realized when all four tools are converted. A timeline and workscope for Phase II will be developed at a later date.