Final Report for SHRP2 C16 RPAT: DVRPC

Regional Overview

The Delaware Valley Regional Planning Commission (DVRPC) has nearly 50 years' experience developing, maintaining, and applying travel demand models. These models are used by DVRPC staff to produce forecasts of future highway and transit travel for our studies. Such studies include long- and short-range plans and programs, highway traffic studies, air quality conformity demonstrations, Federal Transit Administration (FTA) New Starts programs, and member government transportation studies.

DVRPC forecasts future travel using a well-tested travel modeling process. The heart of this process is our Travel Improvement Model (TIM 2.0), which is a best-in-class 4-step travel demand model. A state-of-the-art Activity Based Travel Model (TIM 3.0) is also under development. Both models simulate travel for 11 million people residing in a 25-county area and generating more than 30 million daily trips. While these models are robust and detailed, they are also complex and take approximately 15 hours to complete a model run.

DVRPC had maintained a GIS-based land use forecasting model, UPlan, developed at the University of California-Davis. UPlan used population and employment forecasts along with transportation network characteristics and congestion to identify land that is currently undeveloped or designated developed but vacant. It then explicitly allocated new footprint development to these specific areas that are most likely to be developed. DVRPC had used UPlan to conduct scenario planning exercises, with results published in DVRPC's Making the Land Use Connection: Regional What-if Scenario Analysis (2008).

Furthermore, the results of the UPlan scenario analysis were used to create DVRPC's Choices & Voices online scenario tool. Choices & Voices allows the user to identify preferred future development patterns, additional funding sources, and make investments to improve the region's transportation system. The site is crowdsourced, allowing the user to compare his or her scenario to the average of all other submitted scenarios. Version 1.0 of the site was up for one year, and afterwards DVRPC posted a short summary of all results and comments. These results were one of many inputs to the development of the agency's Connections 2040 long-range plan. Choices & Voices Version 2.0 was launched in October 2013 to account for projects, funding assumptions, and future travel forecasts developed in Connections 2040, and Version 2.1 launched in summer 2014.

Project Goals/Objectives And Scenario Selection

RPAT augmented our use of TIM and UPlan by being able to construct scenarios that shift population and employment growth away from suburban areas and into the urban core, for instance. UPlan was only able to allocate future growth, not re-assign existing population and employment to different place types. DVRPC used RPAT to pre-screen policy scenarios before undertaking extensive travel demand modeling exercises that are time- and resource-intensive. Running our travel demand model and interpreting the results also requires input and labor from our Modeling and Analysis staff. Other staff members and Departments within DVRPC (Long-Range Planning & Economic Coordination and Smart Growth in particular) benefitted from being able to run RPAT and interpret its findings without needing in-depth modeling knowledge. The types of decisions that were influenced by this tool include how and where to grow in Gloucester County, and how the region should grow under the Future Forces scenarios.

DVRPC tested RPAT on two projects:

Future Forces: Originally, DVRPC planned to test RPAT against current planning assumptions incorporated into DVRPC's Choices & Voices online scenario tool, winner of the U.S. DOT Data Innovation Challenge, and to allow for new options. Approval of analyzing Future Forces, rather than testing Choices & Voices, was received during the January 9, 2015 SHRP2 C16 monthly check-in phone call. DVRPC uses scenario planning to better understand arising needs and challenges, and to guide the development and implementation of the region's long-range plan. This effort builds scenarios off of a set of Future Forces of change in Greater Philadelphia. Future Forces may accelerate or reverse current trends, or create new ones that significantly impact demographics, development patterns, use of the regional transportation system, the economy, and/or the environment. DVRPC tested different future population and employment patterns as part of the Future Forces effort. Each Future Force forecasts very different development patterns. These forces will be incorporated into a future update to Choices & Voices. This will allow for some movement of existing population and employment, which the Choices & Voices model does not currently do.

Gloucester County: Gloucester County, NJ contracted with DVRPC's Office of Smart Growth to develop a Unified Land Use and Circulation Master Plan Element. The county's master plan was last comprehensively updated in 1982. This work involves close collaboration with county staff. As Gloucester County is our fastest-growing county, the work is particularly critical for setting the vision for how the county should grow, at the same time reducing sprawl and the consumption of open space, farmland and other natural resource lands. RPAT was used to run various future growth scenarios at the county scale, to evaluate their effects on travel demand. Such scenarios included shifting various percentages of population and employment into Gloucester County's existing developed communities, with a proportional reduction away from their rural areas.

DATA PREPARATION AND CONNECTION WITH DVRPC'S TIM 2.0 MODEL

Prior to modeling the Future Forces, DVRPC worked to validate the model. Two different land use patterns were used, one based on DVRPC's TIM 2.0 travel demand model (TDM), and one based on the Long-Range Plan's municipal designations. Both use similar land use context as RPAT.

The RPAT Place types shown in the next two tables are as follows:

	Urban Core	Close-in-Community	Suburban	Rural
Residential	UC R	CIC R	Sub R	
Commercial	UC E	CIC E	Sub E	
Mixed-Use	UC MU	CIC M	Sub M	
Transit Oriented Development	UC T	CIC T	Sub T	
Rural/Greenfield				Rur

The initial better performer was the TIM 2.0 TDM land use. The TDM has Area Types of 1 - CBD, 2 - CBD-Fringe, 3 - Urban, 4 - Suburban, 5 - Rural, and 6 - Rural open space. Each Transportation Analysis Zone (TAZ) is assigned an Area Type. We used Area Types 1 and 2 for Urban Core, 3 for Close-in-Community, 4 for Suburban, and 5 and 6 for Rural. For the Residential, Commercial, and Mixed-Use designations, we

followed the formulas given in RPAT documentation. The Transit Oriented Development designation was given to any TAZ that contained a passenger rail station.

Based on suggestions from Resource Systems Group (RSG), further testing was done to expand the size of the supply growth rates, daily trips per capita, and base road supply. The results are shown in the following charts.

RPAT Calibration Results

	RPAT Result				
Measure	**Test2 – 10 percent higher supply growth + more trips per capita**	**Test1 – Expanded Base Road Supply (+5%)**	**TDM_Diff (Base Run, round 1 'winner')**	**Test3 Fewer Trips per Capita**	**Travel Model Target**
Average Travel Speeds by Vehicle Type	30.31	30.51	30.25	30.25	**31**
Daily Vehicle Miles Traveled	121,317,165	121,613,283	121,249,152	121,249,152	**131,210,865**
Daily Transit Trips (Δ)	80,581	80,409	80,409	80,236	**78,513**
Vehicle Hours of Travel (Δ)	3,709,854	3,685,165	3,715,446	3,715,446	**4,232,608**
Daily Vehicle Trips (Δ)	2,380,122	2,352,108	2,352,108	2,324,095	**2,076,251**

Source: DVRPC, 2015.

Ranking of RPAT Calibration Results

	Ranking of Closeness to Target			
Measure	**Test2**	**Test1**	**TDM_Diff**	**Test3**
Average Travel Speeds by Vehicle Type	2	1	3	3
Daily Vehicle Miles Traveled	2	1	3	3
Daily Transit Trips (Δ)	3	2	2	1
Vehicle Hours of Travel (Δ)	2	3	1	1
Daily Vehicle Trips (Δ)	3	2	2	1
Average rank	**2.4**	**1.8**	**2.2**	**1.8**

Source: DVRPC, 2015.

DVRPC selected Test1 file, which incorporates a minor adjustment in aggregated road supply inputs.

Not much was done for calibrating the Gloucester County RPAT base scenario because few outputs are available from alternate sources on the county level. We simply mirrored to the best of our ability the standard inputs for RPAT, discussed below, that we used for the regional base data.

SCENARIO TESTS AND VALIDATION OF THE RPAT TOOL

RPAT was used to test a wide variety of impacts, at a regional level and at a county level, including:

REGIONAL SCENARIOS

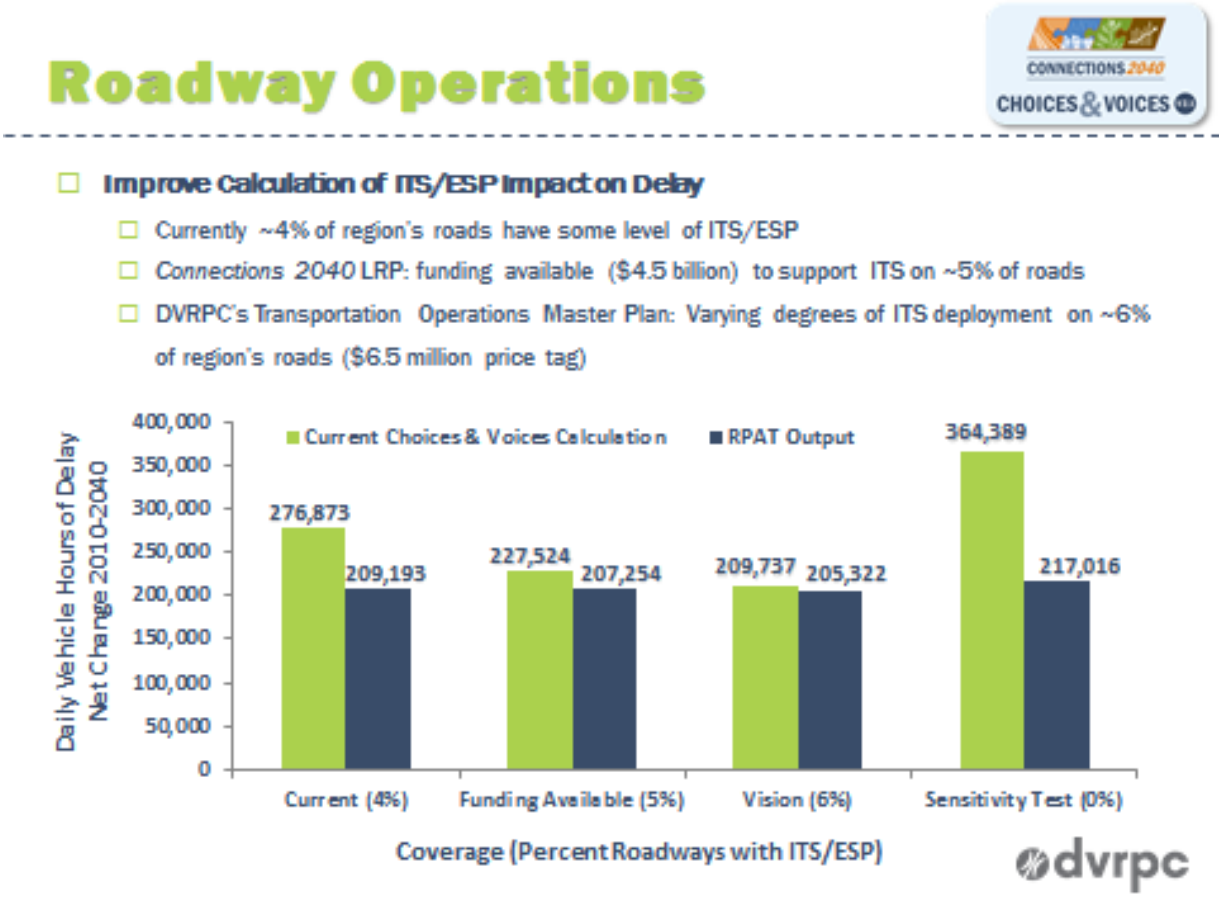
Test for Operational Improvements: Currently investments in transportation operations (ITS, physical road improvements) are estimated to reduce delay per annual dollar amount spent, using Texas Transportation Institute (TTI) estimates. In 2012, TTI estimated that the Philadelphia region (including parts of Delaware and Maryland) spent $186.5 million to reduce delay by about 34,500 hours per day. This comes to about $2.11 per hour of delay reduced. The user identified funding level for transportation operations is then used to estimate annual delay reduction with this relationship. DVRPC's Transportation Operations Master Plan (TOMP) identifies a regional vision for transportation operations, with specific investments identified for key road segments. RPAT was used to identify delay reduction produced for different funding levels (and roads with ITS treatment) and test the estimates produced with the TTI methodology. RPAT was also used to identify how these investments can impact road safety, test for rebound effect (more driving from reduced delay), and identify user cost savings (less fuel consumption). The region currently has 4 percent of its road miles covered with some form of ITS. DVRPC's TOMP would increase this amount by 50 percent, to six percent of all road miles. This plan cannot be fully funded in DVRPC's current Connections 2040, which would allow for only five percent of road miles to have ITS coverage. These three levels of coverage, along with a no ITS (0 lane miles), were tested in RPAT. The hope was to find impacts to VMT (rebound effect), travel speed, and transit ridership, in addition to the current delay impacts estimated in Choices & Voices. As the two charts below show, it appears that only speed and delay impacts are found in RPAT, while there is no change to daily VMT, daily transit trips, or daily vehicle driver trips. RSG postulated that perhaps the ITS treatments in RPAT are limited, and didn't include ESP (emergency service patrol) and other operational improvements included in the TTI Urban Mobility Report data (current C&V source).

Effects of Operational Improvements on Travel

	Percent of Road Network with Operational Improvements			
Outputs	**0%**	**4%**	**5%**	**6%**
Daily VMT	121,164,580	121,164,580	121,164,580	121,164,580
Avg. Lt. Veh. Speed	30.43	30.49	30.51	30.53
Daily VHT	3,447,561	3,398,481	3,398,481	3,436,821
Daily Transit Trips	875,326	875,326	875,326	875,326
Daily Veh. Hrs. of Delay	199,448	192,263	190,483	188,708
Daily Vehicle Driver Trips	17,744,372	17,744,372	17,744,372	17,744,372

Source: DVRPC, 2015

Comparison of Vehicle Hours of Delay under Different Percentages of ITS Roadways Using Choices & Voices and RPAT



Source: DVRPC, 2015.

Test for Parking Pricing in Central Business Districts and Pay-as-you-drive Insurance on Greenhouse Gas Emissions: Recently DVRPC worked with the University of Pennsylvania students to identify ways to reduce regional greenhouse gas emissions. Parking pricing was determined to be one of the most promising and feasible approaches (along with pay-as-you-drive insurance, and other strategies like alternative fuel vehicles, and transit-oriented development). When DVRPC used RPAT to test the effects of parking pricing in central business districts and pay-as-you-drive insurance on greenhouse gas emissions, the model returned results that were similar to those from the student study, *Towards A Low Carbon Philadelphia*. RPAT found that parking pricing in CBDs would result in a 0.1% reduction in greenhouse gas emissions by 2040, while the student study found it would have a 0.27% reduction in greenhouse gas emissions by 2030. RPAT found that pay-as-you-drive insurance would result in a 3% reduction in greenhouse gas emissions by 2040, while the student study found it would have a 0.8% reduction in greenhouse gas emissions by 2030.

Test for Future Population and Employment Patterns under Future Forces: Each Future Force scenario projects very different development patterns. These forces will be incorporated into a future update to Choices & Voices. This will allow for some movement of existing population and employment, which the Choices & Voices model does not currently do. The five future force scenarios were identified

collaboratively by the Greater Philadelphia Futures Group (Futures Group) consisting of regional stakeholder experts. They include: Enduring Urbanism, where population grows around dense regional centers but declines slightly in farther-out suburbs; The Free Agent Economy, where new development centers emerge around universities, which become the creators and incubators of new businesses; Severe Climate, where more infill development and increased density in regional centers occurs; Transportation on Demand, where a mix of suburban and infill development occurs near transit access and regional centers; and The U.S. Energy Boom, where industrial growth reactivates the Delaware River waterfront, and spurs residential growth in areas with easy access to industrial jobs. Among other things, the Futures Group supplied required input data for RPAT in each scenario. Members were surveyed about what values should be given to various inputs and their responses were averaged for the tool.

Future Forces Population Growth by RPAT Place Type (Place_Type_Growth.csv)

RPAT Place Types	Enduring Urbanism	The Free Agent Economy	Severe Climate	Transportation on Demand	The U.S. Energy Boom
Rur	21.0%	34.4%	37.1%	34.6%	62.7%
Sub R	20.7%	15.8%	19.0%	26.3%	22.6%
Sub E	2.8%	2.8%	2.6%	2.4%	1.4%
Sub M	8.9%	9.1%	7.3%	8.4%	11.1%
Sub T	2.8%	1.6%	3.9%	3.1%	0.8%
CIC R	18.7%	16.2%	11.6%	9.5%	-5.8%
CIC E	2.2%	1.8%	1.8%	1.9%	2.3%
CIC M	4.2%	3.6%	2.9%	3.1%	2.7%
CIC T	4.8%	4.0%	6.1%	4.0%	-0.1%
UC R	3.1%	2.1%	1.2%	1.1%	-0.4%
UC E	3.3%	3.1%	2.3%	2.2%	1.5%
UC MU	4.5%	3.3%	1.9%	1.7%	0.8%
UC T	3.1%	2.2%	2.3%	1.7%	0.4%

Source: DVRPC, 2015.

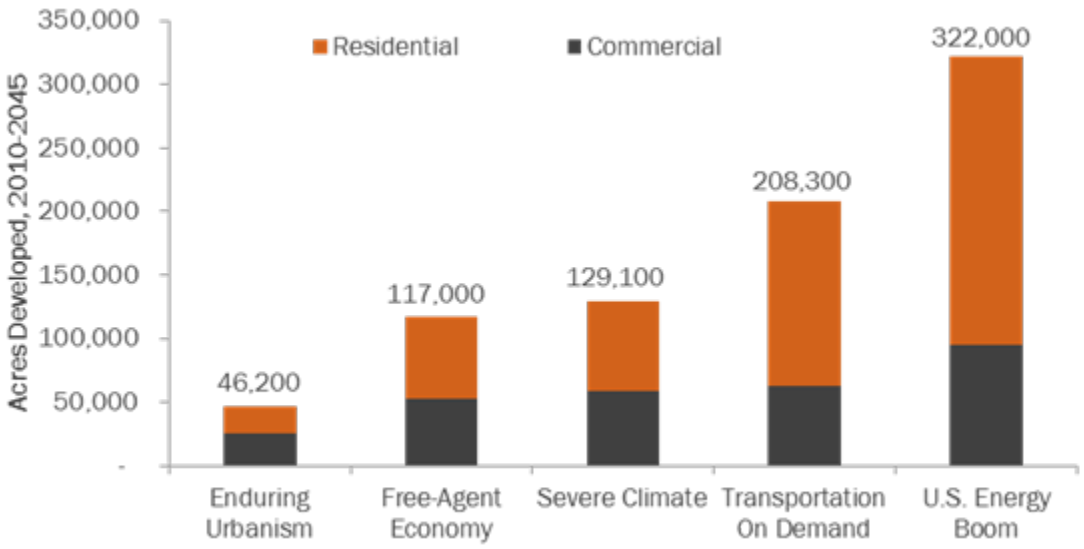
Future Forces Employment Growth by RPAT Place Type (Place_Type_Growth.csv)

RPAT Place Type	Enduring Urbanism	The Free Agent Economy	Severe Climate	Transportation on Demand	The U.S. Energy Boom
Rur	32.0%	36.2%	37.6%	35.2%	45.8%
Sub R	21.5%	18.0%	20.6%	26.8%	23.3%
Sub E	3.2%	5.6%	5.3%	2.3%	0.9%
Sub M	12.1%	9.9%	7.2%	9.6%	15.2%
Sub T	2.1%	1.6%	3.9%	3.1%	1.7%
CIC R	12.0%	12.4%	9.2%	8.1%	1.0%
CIC E	2.0%	2.9%	3.9%	3.7%	6.6%
CIC M	2.9%	2.5%	1.2%	1.8%	1.4%
CIC T	3.2%	3.3%	5.5%	3.9%	1.9%
UC R	1.9%	1.1%	0.4%	0.5%	-0.8%
UC E	2.2%	5.8%	7.5%	7.2%	8.5%
UC MU	2.7%	-1.1%	-4.3%	-3.8%	-6.1%
UC T	2.1%	1.8%	2.0%	1.6%	0.6%

Source: DVRPC, 2015.

Projected acres of new footprint development further illustrate the different land use patterns.

Projected Acres of New Footprint Development of the Five Future Force Scenarios



Source: DVRPC, 2015.

Test for Numerous Travel Impacts Using the Future Forces: Each Future Force Scenario is envisioned as having different travel impacts on the region, based on the following additional descriptors and assumptions (see chart):

Enduring Urbanism: Millennials and empty nesters moving back to walkable urban and suburban centers are the start of a long-term trend, as future generations show an even stronger desire for city living and walking, biking, and transit.

The Free Agent Economy: Individuals must create their own economic opportunities and contribute more toward their healthcare and retirement, as labor efficiency and the rising cost of full-time employees cause large companies to continue to reduce their workforces.

Severe Climate*:* Increasing atmospheric carbon levels, due to continued global use of fossil fuels, lead to the worst-case outcomes of climate change. The region must prepare for hotter and wetter weather, more frequent and intense storms, and rising sea levels.

Transportation on Demand: Smartphones, apps, and real-time information help people get around using a multimodal network of car sharing, taxis, ride sharing, transit, biking, bike sharing, walking, and new modes such as on demand micro transit bus service and ride sourcing, where a vehicle is e-hailed for a point-to-point trip.

The U.S. Energy Boom: The region's economy grows with domestic natural gas extraction and distribution and renewed manufacturing. An abundance of domestically produced energy keeps the cost of energy low and helps the nation become more energy independent.

Assumptions Used to Build Future Force What-if Scenarios

Factor	Enduring Urbanism	The Free Agent Economy	Severe Climate	Transportation on Demand	The U.S. Energy Boom
2045 Population (millions)[1]	6.58 [+17%]	6.44 [+15%]	6.45 [+15%]	6.51 [+16%]	6.48 [+15%]
Demographic Trends	Young adults (20–34 years old) continue to flock to the region; and there are fewer persons per household	Population is more transitory, as people move in search of economic opportunity	Region receives some in-migration from other regions that are more severely impacted by climate change	New medical technologies extend lifespans	Population and jobs increase due to the energy hub and economic growth
2045 Employment (millions)[1]	3.33 [+13%]	3.29 [+12%]	3.28 [+11%]	3.30 [+12%]	3.33 [+13%]
2045 Income per Capita[1, 2]	$39,000 [+44%]	$36,100 [+33%]	$35,000 [+29]	$37,400 [+38%]	$39,500 [+46]
Development Patterns	Population grows around dense regional centers, but declines slightly in further out suburbs	Universities become the creators and incubators of new businesses and focus of new development centers	More infill development and increased density in regional centers	Mix of suburban and infill development that occurs near transit access and regional centers	Industrial growth reactivates the Delaware River waterfront, and spurs residential growth in areas with easy access to industrial jobs
Travel Demand Shifts	Increase in walking, biking, and transit trips	Fewer 9-to-5 work schedules, which harms transit agencies ability to effectively deliver service	Less trade reduces amount of goods movement	New transportation services, such as ride sourcing, and micro transit, become major travel providers	Overall increase in freight moved by pipeline, train, and waterways
Transportation Infrastructure	Significant push to pedestrianize Main Streets, while adding protected bike infrastructure to most non-highway roads	Strong desire for low cost options, pushing a move toward Complete Streets, which safely accommodate all users	Extreme weather shortens transportation infrastructure lifespans and increases maintenance costs	New technologies lower costs and extend lifespans of transportation infrastructure	Low energy prices reduce the cost of building and maintaining transportation infrastructure
2045 Gasoline Cost/Gallon[1, 2]	$3.60 [+26%]	$3.70 [+29%]	$4.60 [+61%]	$3.80 [+33%]	$3.10 [+8%]
2045 Average Vehicle Fuel Efficiency[1]	46 mpg [+109%]	44 mpg [+100%]	50 mpg [+127%]	60 mpg [+173%]	41 mpg [+86%]
Inflation Rate, 2010-	3.75%	2.25%	4.5%	1.5%	3.0%

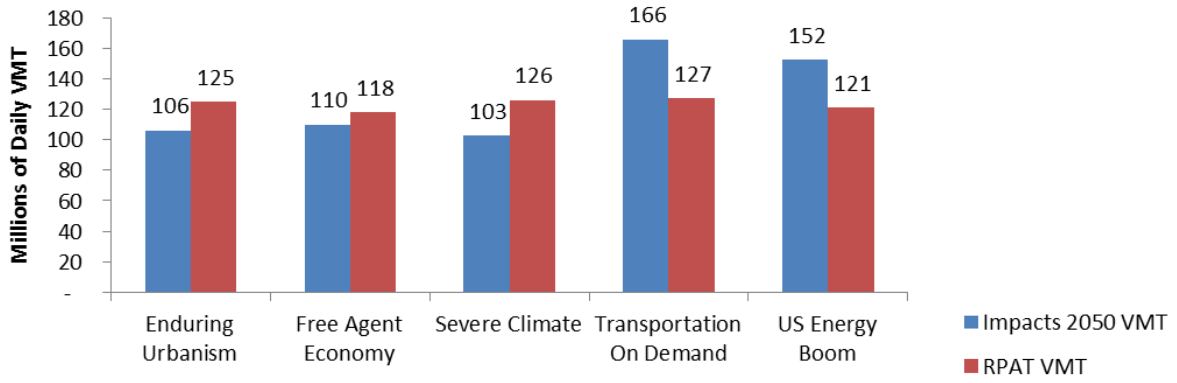
2045					
Miscellaneous	Demand increases for new types of housing, such as micro apartments; urban schools slowly close the quality gap, reducing the push of families to the suburbs	Demand grows for co-working space; 3-D printing brings more local manufacturing back to the region	The need to rebuild and make infrastructure more resilient limits investments that can encourage economic growth	A significant increase in zero-car households	Fossil fuels remain the dominant energy source

[1] Numbers in parentheses are comparisons to a 2010 baseline, when regional population was 5.62 million, employment was 2.95 million, income per capita was approximately $27,100, fuel cost was $2.86 per gallon, and vehicles averaged 22 mpg.
[2] In 2010 dollars.
Source: DVRPC, 2015.

The Future Forces were analyzed and modeled as what-if scenarios out to the year 2045. This highlights how the region may change over the next 30 years, potential shifts in transportation demand, and identifies specific opportunities that may arise, and challenges the region is likely to face. The report identifies actions needed to better position the region to respond to these Future Forces. Contingent actions and skills are specific to each Force, and leading indicators can be used to determine if it is occurring in the region. Universal actions are beneficial regardless of which Forces arise.

Modeling was done with Impacts 2050, a socio-economic systems dynamic model, and RPAT. Impacts 2050 identified future age pyramids based on births, deaths, in-migration, and out-migration to the region. It also has an embedded sketch travel demand model, which is intended to account for changing travel behaviors, an assumption that travel-demand models rarely consider. The objective was to model very different transportation futures. The following chart shows regional daily VMT estimates for each Future Force from Impacts 2050 and RPAT.

Regional Daily VMT Estimates for Future Forces Scenarios Using Impacts 2050 vs. RPAT



Source: DVRPC, 2015.

Similar discrepancies were found for transit ridership. DVRPC proposes to average the two models' outputs in the Future Forces report.

DVRPC estimated future crash rates to account for connected vehicles (in all Forces, -50 percent for all crashes based on CV technologies being able to address 80 percent for all unimpaired crashes). For the transportation on demand scenario with autonomous vehicles, a 30 percent vehicle fleet was assumed, and the Eno Center's *Preparing a Nation for Autonomous Vehicles* report was used to estimate a further 15 percent crash reduction. Autonomous vehicles were also estimated to increase the region's road capacity by 6 percent (again based on the Eno report).

Summary of What-if Scenario Indicators in 2045

Factor	2010	Enduring Urbanism	The Free Agent Economy	Severe Climate	Transpor-tation on Demand	The U.S. Energy Boom
New Footprint Residential and Commercial Acres Developed, 2010–2045	-	46,200	117,000	129,100	208,300	322,000
Percent of Population in Centers	23%	25%	24%	23%	23%	20%
Percent of Employment in Centers	22%	23%	23%	23%	22%	21%
Percent Zero-Car Households	15%	26%	15%	15%	38%	13%
Annual VMT per Capita	**6,940**	**6,440**	**6,470**	**6,190**	**8,220**	**7,840**
Daily Linked Transit Trips (millions)	**0.8**	**1.4**	**1.2**	**1.2**	**1.3**	**0.9**
Daily Walking and Biking Trips (millions)	1.5	3.8	2.3	2.3	2.3	1.7
Daily In-vehicle Minutes (driver & passenger) per Capita	**48**	**53**	**53**	**51**	**84**	**62**
Average Daily Speed (mph)	**30**	**31**	**31**	**32**	**31**	**30**
Annual Recurring Vehicle Hours of Delay per Capita	**22**	**22**	**20**	**21**	**31**	**30**
Annual Fatal Crashes	**326**	**186**	**194**	**176**	**196**	**225**
On-road (Tailpipe Only) & Residential Energy Green-house Gas Emissions (Annual $MTCO_2E$ per Capita)	**6.8**	**4.8**	**5.0**	**4.8**	**4.9**	**5.6**
Annual Household Residential Energy and Transportation Costs*	$12,080	$15,640	$10,360	$19,340	$16,530	$11,830
Transportation Costs as a % of Income	15%	15%	10%	20%	16%	11%

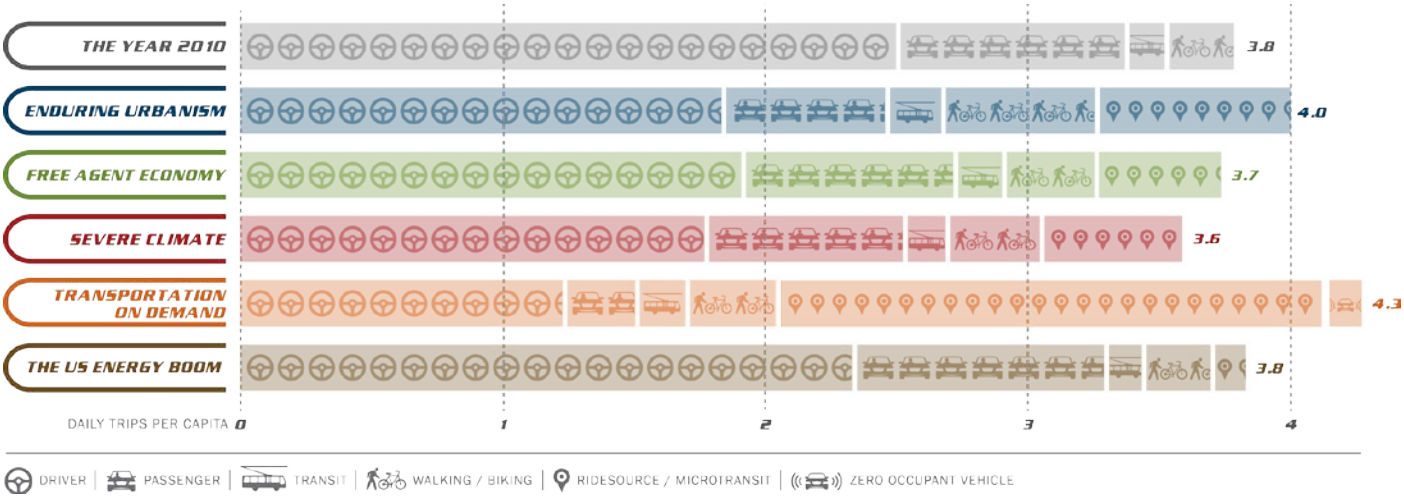
Bold indicates values fully or partially derived from RPAT.
*In 2015 dollars.
Source: DVRPC, 2015.

We were expecting to get a much greater variance in VMT per capita, based off the very different vehicle operating costs we provided, but it really didn't tip the scales. We even tried to trick RPAT by supplying different base year VMT per capita starting points for each scenario, and still got rather flat results. Something similar happens with Transit Trips. We tried to distribute the base year transit trips

by the Impacts 2050 tool's 2045 transit trip distribution and still got rather flat results, though the bars did move in the same direction as the inputs.

RPAT results for daily trips per capita and mode share in 2045 for each of the scenarios are shown in the following chart.

Daily Trips per Capita and Mode Share in 2045 Under Future Forces



Source: DVRPC, 2015.

GLOUCESTER COUNTY, NJ SCENARIOS

RPAT was used to run various future growth scenarios at the county scale, to evaluate their effects on travel demand. We tested a total of eight scenarios in support of the Gloucester County, NJ master planning process, as described below.

Run Base Scenario: We tested the base Gloucester County, NJ model, which uses our DVRPC 2040 forecast by TAZ to create place types, to see what the outputs would be for 2040.

Outputs	
Direct Travel Impacts	**Base**
Daily VMT (millions of miles)	9,324,459
Ave. Lt. Veh. Speed (mph)	31.2
Daily VHT (hours)	274,421
Daily Transit Trips	8,723
Daily Veh. Hrs Delay (hours)	59,077
Daily Veh. Driver Trips	257,171
Community Impacts	
Fatal Accidents	30
Injury Accidents	2,688
Property Accidents	4,416
Job Access: Income $0-20k (% change)	-9.0%
Job Access: Income $20-40k (% change)	-9.1%
Job Access: Income $40-60k (% change)	-9.2%
Job Access: Income $60-80k (% change)	-9.3%
Job Access: Income $80-100k (% change)	-9.4%
Job Access: Income $100k+ (% change)	-9.5%
Walking (% change)	-21.2%
Location Impacts	
Regional Access (% change)	-6.7%
Env./Energy Impacts	
GHG Emissions (Annual $MTCO_2$ per capita)	1,782
Fuel Consumption (gasoline equivalent gallons)	194,811
Financial/Econ. Impacts	
Ann. Traveler Cost ($ millions)	196,113,452
Hwy Infra. Costs ($ per lane mile)	1,543
Transit Infra. Costs ($ millions)	2,260,632
Transit Operating Costs ($ millions)	10,825,563

Source: DVRPC, 2015.

Test for Impacts of Less Growth in Rural Areas and More Growth in Close-In Communities in Gloucester County: We tested the base Gloucester County, NJ model against a fictitious scenario where the share of growth slated for rural areas in the base was swapped with the highest density type, Close-in-Communities (Mixed). We found the results reasonable as they were in line with our regional tests of RPAT. By developing in close-in communities rather than rural areas in this scenario, by 2040 Gloucester County would increase transit trips, regional accessibility, and average speeds while also benefitting from reducing daily vehicle hours of delay, daily vehicle driver trips, daily VMT, daily VHT, accidents, fuel consumption and greenhouse gas emissions.

Effects of Inverted Allocation of Gloucester County, NJ Growth between Rural and Close-in-Communities (Mixed)

Inputs

	GloCo_Base		Inverted Allocation	
PlaceType	PopGrowth	EmpGrowth	PopGrowth	EmpGrowth
Rur	49.8%	36.7%	0.7%	2.6%
Sub R	38.0%	26.5%	38.0%	26.5%
Sub E	0.2%	12.2%	0.2%	12.2%
Sub M	9.4%	20.5%	9.4%	20.5%
Sub T	0.0%	0.0%	0.0%	0.0%
CIC R	1.9%	1.2%	1.9%	1.2%
CIC E	0.0%	0.3%	0.0%	0.3%
CIC M	0.7%	2.6%	49.8%	36.7%
CIC T	0.0%	0.0%	0.0%	0.0%
UC R	0.0%	0.0%	0.0%	0.0%
UC E	0.0%	0.0%	0.0%	0.0%
UC MU	0.0%	0.0%	0.0%	0.0%
UC T	0.0%	0.0%	0.0%	0.0%

Outputs	Base	InvertAlloc
Direct Travel Impacts		
Daily VMT (millions of miles)	9,324,459	8,988,295
Ave. Lt. Veh. Speed (mph)	31.2	31.6
Daily VHT (hours)	274,421	261,389
Daily Transit Trips	8,723	10,667
Daily Veh. Hrs Delay (hours)	59,077	53,314
Daily Veh. Driver Trips	257,171	244,747
Community Impacts		
Fatal Accidents	30	29
Injury Accidents	2,688	2,591
Property Accidents	4,416	4,257
Job Access: Income $0-20k (% change)	-9.0%	-5.2%
Job Access: Income $20-40k (% change)	-9.1%	-6.2%
Job Access: Income $40-60k (% change)	-9.2%	-7.0%
Job Access: Income $60-80k (% change)	-9.3%	-7.5%
Job Access: Income $80-100k (% change)	-9.4%	-7.9%
Job Access: Income $100k+ (% change)	-9.5%	-8.4%
Walking (% change)	-21.2%	-0.7%
Location Impacts		
Regional Access (% change)	-6.7%	-0.4%
Env./Energy Impacts		
GHG Emissions (Annual $MTCO_2$ per capita)	1,782	1,780
Fuel Consumption (gasoline equivalent gallons)	194,811	194,528
Financial/Econ. Impacts		
Ann. Traveler Cost ($ millions)	196,113,452	195,826,216
Hwy Infra. Costs ($ per lane mile)	1,543	1,543
Transit Infra. Costs ($ millions)	2,260,632	2,764,320
Transit Operating Costs ($ millions)	10,825,563	13,237,590

Source: DVRPC, 2015.

Test for High and Low Growth Scenarios in Gloucester County: We tested future growth in Gloucester County out to 2040 with allocation by place type to the base scenario, for both a low population growth of 10% and a low employment growth of 20%, as compared to the base scenario of 30% population growth and 26% employment growth. With lower growth, there were expected impacts in less daily VMT, daily VHT, daily vehicle hours of delay, daily vehicle driver trips, and daily transit trips. Average light vehicle speed improved. Low growth found fewer accidents and improvements in regional accessibility, greenhouse gas emissions and fuel consumption, as well as lower financial and economic impacts.

We also tested a high growth scenario by increasing population growth to 40% and employment growth to 50%. This scenario resulted in the expected impacts and increases in VMT, VHT, transit trips, delay,

overall tripmaking, accidents, greenhouse gas emissions, fuel consumption, infrastructure and traveler costs, and worsening of regional accessibility and walking percentages.

The base, low growth and high growth all found significant declines in walking percentages, due to development out into rural and suburban areas.

Effects of High and Low Growth in Gloucester County, NJ

Inputs	**Base**	**LoGrowth**	**HiGrowth**
Pop Growth	30%	10%	40%
Emp Growth	26%	20%	50%
Outputs			
Direct Travel Impacts			
Daily VMT (millions of miles)	9,324,459	7,753,975	10,249,963
Ave. Lt. Veh. Speed (mph)	31.2	29.4	31.9
Daily VHT (hours)	274,421	279,462	272,759
Daily Transit Trips	8,723	3,982	11,655
Daily Veh. Hrs Delay (hours)	59,077	72,435	53,765
Daily Veh. Driver Trips	257,171	117,242	376,636
Community Impacts			
Fatal Accidents	30	25	33
Injury Accidents	2,688	2,235	2,955
Property Accidents	4,416	3,672	4,854
Job Access: Income $0-20k (% change)	-9.0%	-9.6%	-10.0%
Job Access: Income $20-40k (% change)	-9.1%	-9.6%	-10.0%
Job Access: Income $40-60k (% change)	-9.2%	-9.7%	-10.0%
Job Access: Income $60-80k (% change)	-9.3%	-9.7%	-10.0%
Job Access: Income $80-100k (% change)	-9.4%	-9.8%	-10.0%
Job Access: Income $100k+ (% change)	-9.5%	-9.8%	-10.0%
Walking (% change)	-21.2%	-21.1%	-27.7%
Location Impacts			
Regional Access (% change)	-6.7%	-6.6%	-8.5%
Env./Energy Impacts			
GHG Emissions (Annual $MTCO_2$ per capita)	1,782	1,524	1,908
Fuel Consumption (gasoline equivalent gallons)	194,811	166,526	208,577
Financial/Econ. Impacts			
Ann. Traveler Cost ($ millions)	196,113,452	167,595,741	209,976,216
Hwy Infra. Costs ($ per lane mile)	1,543	521	2,029
Transit Infra. Costs ($ millions)	2,260,632	1,032,047	3,020,379
Transit Operating Costs ($ millions)	10,825,563	4,942,196	14,463,786

Source: DVRPC, 2015

Test for High and Low Growth Scenarios in Gloucester County But Allocating to Different Place Types Than the Base: We tested future growth in Gloucester County out to 2040 with allocation by place type to other scenarios besides the base, namely testing low growth but allocated to "status quo" 2010 place types (distributing growth by the 2010 distribution of place types). In the low growth status quo compared to the low growth base scenario, transit trips increased slightly, and fewer overall trips were taken, though there were negligible impacts on accidents or job access. Walking improved, as did regional accessibility, though greenhouse gas emissions increased slightly. There were also slightly higher costs for transit operating and infrastructure costs, with little effect on highway costs.

We also tested high growth but allocated 10% of population and employment growth to Urban Mixed Use (Urb_MU) and distributed the remainder according to Base 2040 growth patterns. In the high growth urban mix scenario compared to the high growth base scenario, VMT and VHT were reduced, while transit trips increased. By allocating more growth to urban mixed use areas, accidents were reduced, job and overall regional accessibility were improved, and transit costs increased. There was negligible effect on greenhouse gas emissions or fuel consumption.

Effects of High and Low Growth in Gloucester County, NJ but Allocated to Different Place Types

Inputs	**Base**	**LoGrowth**		**HiGrowth**	
Pop Growth	30%	10%		40%	
Emp Growth	26%	20%		50%	
Outputs	**Base**	**LoGrowth**	**LoStatusQuo**	**HiGrowth**	**Hi_UrbMix**
Direct Travel Impacts					
Daily VMT (millions of miles)	9,324,459	7,753,975	7,721,291	10,249,963	10,020,844
Ave. Lt. Veh. Speed (mph)	31.2	29.4	29.4	31.9	32.0
Daily VHT (hours)	274,421	279,462	277,683	272,759	270,519
Daily Transit Trips	8,723	3,982	4,189	11,655	13,390
Daily Veh. Hrs Delay (hours)	59,077	72,435	71,563	53,765	52,806
Daily Veh. Driver Trips	257,171	117,242	115,874	376,636	365,950
Community Impacts					
Fatal Accidents	30	25	25	33	32
Injury Accidents	2,688	2,235	2,226	2,955	2,889
Property Accidents	4,416	3,672	3,657	4,854	4,746
Job Access: Income $0-20k (% change)	-9.0%	-9.6%	-9.4%	-10.0%	-8.2%
Job Access: Income $20-40k (% change)	-9.1%	-9.6%	-9.4%	-10.0%	-8.3%
Job Access: Income $40-60k (% change)	-9.2%	-9.7%	-9.5%	-10.0%	-8.5%
Job Access: Income $60-80k (% change)	-9.3%	-9.7%	-9.7%	-10.0%	-8.7%
Job Access: Income $80-100k (% change)	-9.4%	-9.8%	-9.7%	-10.0%	-8.9%
Job Access: Income $100k+ (% change)	-9.5%	-9.8%	-9.7%	-10.0%	-9.1%
Walking (% change)	-21.2%	-21.1%	-16.2%	-27.7%	-15.1%
Location Impacts					
Regional Access (% change)	-6.7%	-6.6%	-5.5%	-8.5%	-5.0%
Env./Energy Impacts					
GHG Emissions (Annual $MTCO_2$ per capita)	1,782	1,524	1,525	1,908	1,907
Fuel Consumption (gasoline equivalent gallons)	194,811	166,526	166,633	208,577	208,431
Financial/Econ. Impacts					
Ann. Traveler Cost ($ millions)	196,113,452	167,595,741	167,713,016	209,976,216	209,845,682
Hwy Infra. Costs ($ per lane mile)	1,543	521	521	2,029	2,029
Transit Infra. Costs ($ millions)	2,260,632	1,032,047	1,085,660	3,020,379	3,470,061
Transit Operating Costs ($ millions)	10,825,563	4,942,196	5,198,936	14,463,786	16,617,191

Source: DVRPC, 2015.

Test for Percentage Increases in Lane Miles with ITS and Increases in Roadway Supply in Gloucester County: We also tested for 10% ITS coverage of road miles versus the 5% in the base scenario for 2040. While there was no change in VMT, accidents, transit or driver tripmaking, accessibility, greenhouse gas emissions, or infrastructure costs, there were reductions in VHT, delay, annual traveler cost, and a slight reduction in fuel consumption.

We also tested for a 10% increase in freeway and arterial growth (CapBump) as opposed to approximately 1% growth in the base for 2040. We found there was a significant increase in VMT and vehicle speeds. We would have expected increased number of daily vehicle driver trips because, but this value stayed the same. Accidents increased, while accessibility remained the same. Greenhouse gas emissions and fuel consumption increased, as well as traveler cost and highway costs. There was no change to transit trip making, which we assumed would occur, or costs.

Effects of Increases in Lane Miles with ITS and Increases in Roadway Supply in Gloucester County, NJ

Outputs	Base	ITS10	CapBump
Direct Travel Impacts			
Daily VMT (millions of miles)	9,324,459	9,324,459	11,065,241
Ave. Lt. Veh. Speed (mph)	31.2	31.5	41.9
Daily VHT (hours)	274,421	271,806	240,224
Daily Transit Trips	8,723	8,723	8,723
Daily Veh. Hrs Delay (hours)	59,077	56,463	-12,339
Daily Veh. Driver Trips	257,171	257,171	257,171
Community Impacts			
Fatal Accidents	30	30	36
Injury Accidents	2,688	2,688	3,190
Property Accidents	4,416	4,416	5,240
Job Access: Income $0-20k (% change)	-9.0%	-9.0%	-9.0%
Job Access: Income $20-40k (% change)	-9.1%	-9.1%	-9.1%
Job Access: Income $40-60k (% change)	-9.2%	-9.2%	-9.2%
Job Access: Income $60-80k (% change)	-9.3%	-9.3%	-9.3%
Job Access: Income $80-100k (% change)	-9.4%	-9.4%	-9.4%
Job Access: Income $100k+ (% change)	-9.5%	-9.5%	-9.5%
Walking (% change)	-21.2%	-21.2%	-21.2%
Location Impacts			
Regional Access (% change)	-6.7%	-6.7%	-6.7%
Env./Energy Impacts			
GHG Emissions (Annual $MTCO_2$ per capita)	1,782	1,782	2,065
Fuel Consumption (gasoline equivalent gallons)	194,811	194,772	225,667
Financial/Econ. Impacts			
Ann. Traveler Cost ($ millions)	196,113,452	196,074,994	227,286,373
Hwy Infra. Costs ($ per lane mile)	1,543	1,543	14,809
Transit Infra. Costs ($ millions)	2,260,632	2,260,632	2,260,632
Transit Operating Costs ($ millions)	10,825,563	10,825,563	10,825,563

Source: DVRPC, 2015.

We had also hoped to analyze the countywide effects of percentage increases in transit supply, since there is a proposed light rail system currently in the environmental review process, but since RPAT uses 'percent change' and not 'absolute change', having a base of zero does not allow for an analysis of the new rail line's transit trips.

The following is a summary chart of the eight Gloucester County Scenarios.

Scenario Descriptions	
Base	Gloucester County based off DVRPC Adopted forecast allocated to TAZs
InvertAlloc	Inverting the allocation of pop and employment growth such that the Base's high Rural (Rur) growth would be swapped with its low Close-in-Community Mixed (CIC_M) growth
LoGrowth	Low growth scenario for county, keeping the growth allocation of Base 2040 growth
LoStatusQuo	Low growth scenario for county, distributing growth by the 2010 distribution of Place Types
HiGrowth	High growth scenario for county, keeping the growth allocation of Base 2040 growth
Hi_UrbMix	High growth scenario for county, allocating 10% of pop and emp growth to Urban Mixed Use (Urb_MU) and distributing the remainder according to Base 2040 growth patterns
ITS10	Base scenario with 10% ITS coverage in 2040 instead of 5%
CapBump	Base scenario with 10% increase in freeway and arterial growth as opposed to ~1%

Gloucester County Outputs

Outputs	Base	InvertAlloc	LoGrowth	LoStatusQuo	HiGrowth	Hi_UrbMix	ITS10	CapBump
Direct Travel Impacts								
Daily VMT (millions of miles)	9.3	9.0	7.8	7.7	10.2	10.0	9.3	11.1
Ave. Lt. Veh. Speed (mph)	31.2	31.6	29.4	29.4	31.9	32.0	31.5	41.9
Daily VHT (hours)	274,421	261,389	279,462	277,683	272,759	270,519	271,806	240,224
Daily Transit Trips	8,723	10,667	3,982	4,189	11,655	13,390	8,723	8,723
Daily Veh. Hrs Delay (hours)	59,077	53,314	72,435	71,563	53,765	52,806	56,463	-12,339
Daily Veh. Driver Trips	257,171	244,747	117,242	115,874	376,636	365,950	257,171	257,171
Community Impacts								
Fatal Accidents	30	29	25	25	33	32	30	36
Injury Accidents	2,688	2,591	2,235	2,226	2,955	2,889	2,688	3,190
Property Accidents	4,416	4,257	3,672	3,657	4,854	4,746	4,416	5,240
Job Access: Income $0-20k (% change)	-9.0%	-5.2%	-9.6%	-9.4%	-10.0%	-8.2%	-9.0%	-9.0%
Job Access: Income $20-40k (% change)	-9.1%	-6.2%	-9.6%	-9.4%	-10.0%	-8.3%	-9.1%	-9.1%
Job Access: Income $40-60k (% change)	-9.2%	-7.0%	-9.7%	-9.5%	-10.0%	-8.5%	-9.2%	-9.2%
Job Access: Income $60-80k (% change)	-9.3%	-7.5%	-9.7%	-9.7%	-10.0%	-8.7%	-9.3%	-9.3%
Job Access: Income $80-100k (% change)	-9.4%	-7.9%	-9.8%	-9.7%	-10.0%	-8.9%	-9.4%	-9.4%
Job Access: Income $100k+ (% change)	-9.5%	-8.4%	-9.8%	-9.7%	-10.0%	-9.1%	-9.5%	-9.5%
Walking (% change)	-21.2%	-0.7%	-21.1%	-16.2%	-27.7%	-15.1%	-21.2%	-21.2%
Location Impacts								
Regional Access (% change)	-6.7%	-0.4%	-6.6%	-5.5%	-8.5%	-5.0%	-6.7%	-6.7%
Env./Energy Impacts								
GHG Emissions (Annual $MTCO_2$ per capita)	1,782	1,780	1,524	1,525	1,908	1,907	1,782	2,065
Fuel Consumption (gasoline equivalent gallons)	194,811	194,528	166,526	166,633	208,577	208,431	194,772	225,667
Financial/Econ.								

Impacts								
Ann. Traveler Cost ($ millions)	196.1	195.8	167.6	167.7	210.0	209.8	196.0	227.3
Hwy Infra. Costs ($ per lane mile)	1,543	1,543	521	521	2,029	2,029	1,543	14,809
Transit Infra. Costs ($ millions)	2.3	2.7	1.0	1.1	3.0	3.5	2.3	2.3
Transit Operating Costs ($ millions)	10.8	13.2	4.9	5.2	14.5	16.6	10.8	10.8

Source: DVRPC, 2015

PERFORMANCE MEASURES AND EVALUATION

Innovation:

New understanding gained or capability available: There are several areas where RPAT can answer questions not addressed with our TIM 2.0 Travel Demand Model. These include: the ability to construct scenarios that shift population and employment growth (e.g., directing population and employment growth away from suburban areas and into the urban core), and the ability to use a greater array of inputs and outputs than the TIM 2.0 model (e.g., being able to test pay-as-you drive insurance and increased parking fees on greenhouse gas emissions). UPlan was only able to allocate future growth, not re-assign existing population and employment to different place types.

FHWA requested a comparison of RPAT to DVRPC's travel demand model, which was provided on July 31. DVRPC found in multiple scenarios that RPAT finds within 10% of our travel demand model results, which is good, with the exception of VHT (DVRPC model shows much higher 2040 VHT than RPAT). FHWA consulted with RSG who found that RPAT reports *total* VHT and not *change* in VHT. DVRPC was comparing RPAT output VHT to the Delta/change VHT from our Travel Model. Based on this VHT discussion, DVRPC may have found an error in our Travel Demand Model output reporting script, where it is inadvertently doubling VHT.

Implementation and Deployment:

Discussion of skills and abilities gained by agency or partner staff; or new work processes, data resources, analysis capabilities now in use by the agency or partner organizations:

RPAT allowed DVRPC to test operational improvements for the region as a whole, and to test five Future Forces scenarios, as detailed earlier in this report. These Future Forces scenarios will be added to the Choices and Voices Tool. DVRPC also was able to test RPAT against our TIM 2.0 model, as well as the Impacts 2050 model.

Since RPAT takes less time to run than our model, it can be used in the future to run various policy scenarios, though it still requires the use of a dedicated computer for the run time that cannot be used for other tasks simultaneously. The run times however are much shorter (averaging 33 minutes for a regional run and 2 minutes for the Gloucester County runs!) rather than the overnight runs of DVRPC's TIM 2.0 TDM model. Note, these fast run times are based on using a Dell Optiplex 990 with an Intel® Core™ i7-2600 CPU @ 3.40 GHz Processor, 8 GB of RAM, and 64-bit Operating System.

DVRPC intends to use RPAT in calendar year 2016 to run some region-wide scenarios on sustainable transportation options and their potential impacts on travel. These results will be used in an update to the Choices & Voices model.

Agency and project partners participate in all required calls/meetings: Two to three DVRPC staff members participated in all monthly calls from September 2014 to December 2015.

Project deliverables are submitted to Volpe/FHWA on time and on schedule: Five quarterly progress reports plus the final report were submitted by DVRPC on time.

Agency develops recommendations for refinements to the RPAT tool: DVRPC has found several errors in the data documentation and shared these with FHWA and RSG. DVRPC has also provided several recommendations on how to improve the labeling of outputs for greater clarity and ease of use. In the tested RPAT version, it is hard to tell whether some outputs are reporting the delta between the future value and present value or if it is the future value. Rather than having to calculate the desired outputs ourselves, it would be more informative if RPAT showed the base value, change, and future value. RSG concurs and plans to change the model outputs in the next version of RPAT.

DVRPC summarized another basic set-up issue in using different approaches for the change in population and employment for the 2040 forecast. Does one use the total 2040 projections and apply a percent allocation for distributing the population based on place types, or does one subtract the 2010 values from the 2040 forecast and assign just the percent change based on the projected growth? The documentation is not clear on which of these approaches (net change in population vs. total population) is correct. It is subject to interpretation.

DVRPC recommends that the headings for the existing distribution of population and employment by place type (place_type_existing.csv) which currently say "PopGrowth" and "EmpGrowth should be changed to be more accurate, to Pop*Existing*" and "Emp*Existing*". Adjusting the headers is on the list of changes that RSG will be making for the next release of RPAT.

DVRPC also had a problem with travel elasticity with respect to income (finding that there was no change in travel demand as you varied income levels). This was communicated to the team, and we understand RSG has or will be fixing this in the next version of RPAT.

Another issue with running RPAT is that R will use up as much memory as you can give it. In our experience users with older computers could not use their PC for other tasks while running RPAT but with newer computers it simply slowed performance. While RPAT offers benefits that it can complete runs much more quickly than traditional travel demand models, this issue should be noted.

For using RPAT to test different scenarios for the Gloucester County (NJ) Master Plan, we experimented with Place Types, using our TAZs to allocate employment or residential growth in specific areas. There was not much change in the county Place Types from the existing 2010 and Board-adopted 2040 forecast.

Also for Gloucester County, RPAT is less able to add additional transit miles to an area since RPAT uses 'percent change' and not 'absolute change.' Therefore, having a base of zero does not allow for an analysis of the new rail line's transit trips, but one could theoretically analyze changes in land use patterns if manipulated to do so. We recommend refinement so that areas without rail can test the introduction of rail.

Agency supplies lessons learned from participating as a RPAT User Incentive Recipient: Lessons learned include:

- Training on RPAT prior to disseminating the software would have been very helpful for DVRPC staff to get up to speed quickly and be able to ask questions and get instant feedback. The training in October that Ben Gruswitz attended at the AMPO Conference was well-received. Further investigation into the research that created RPAT, as well as dissecting the tool's programming in R could have yielded some insights into how the tool works with some reassurances that its calculations were based off best practices. A potential addition or development for RPAT would be to test different roadway design types (those that prioritize vehicles, those that balance modes, those that prioritize bicycles and pedestrians) and their impacts. Translating RPAT outputs was difficult due to the mix of totals and deltas. DVRPC found that the Impacts 2050 tool pairs well with RPAT and gives additional and alternate outputs.

Communications and Outreach:

***Project data and information is shared with the academic and practitioner communities*:**
DVRPC staff presented this project to our Board of Directors on October 23, 2014.

DVRPC staff discussed RPAT with Gloucester County Planning Commission staff on Dec. 17, 2014, regarding its use in their master planning process.

DVRPC staff discussed RPAT at Future Forces meetings on Dec. 10, 2014 and Sept. 22, 2015, regarding how to use RPAT to refine the Choices and Voices scenario tool. The Futures Group response to the modeling results was that Severe Climate was too suburban oriented. Seeing direct climate change impacts would yield a stronger local/regional response, particularly through a denser, more urban development pattern. This scenario was then completely remodeled in Impacts 2050 and RPAT to reflect the Futures Group comments.

DVRPC staff reached out to discuss RPAT with our neighboring MPO, the South Jersey Transportation Planning Organization, specifically Dave Heller, Team Leader for Regional and Systems Planning, and Andrew Tracy, Transportation Planner, to discuss the tool and its capabilities for their future scenario planning efforts on July 27, 2015.

DVRPC staff presented at the Peer Exchange in October 19-20, 2015, held in conjunction with the Association of Metropolitan Organizations annual meeting in Las Vegas.

DVRPC staff participated in a call with RPAT practitioners on Dec. 11, 2015 to discuss the Impacts 2050 model and RPAT. Practitioners included RSG, Oregon Department of Transportation, Maryland State Highway Administration, and DVRPC.

DVRPC staff is willing to participate in the 2016 TRB workshop and 2016 Tools of the Trade Conference to discuss RPAT and other strategic planning tools. DVRPC staff is also willing to sit on an advisory committee developing VisionEval, a proposed open source, open data platform that would integrate multiple strategic planning tools.

USEFULNESS OF DATA AND THE RPAT TOOL

RPAT is indeed a robust model designed to do a lot with simple inputs, but it wasn't designed to answer some of the questions we were asking in the Future Forces scenarios and updates we were seeking for Choices & Voices calculations. To accommodate some emerging trends in smart growth and scenario planning, it might be good to consider adding new and emerging modes like ride share, ride source,

micro-transit, connected vehicles, automated vehicles, smart/digital roads, etc. Also street design options could have complete streets or shared space choices, narrower lane widths, traffic calming measures, or at least control over speed limits. Congestion pricing would also be useful.

One of the main conclusions we drew from testing RPAT was that the tool is not very sensitive to inputs that may vary quite a bit from each other. For the Future Forces scenarios, we were expecting a much greater variance in VMT per capita, based off the very different vehicle operating costs we provided, as well as a greater variance in transit trips, but not much change was seen. The bars did at least move in the same direction as the inputs, just not at the magnitude expected. Thus, we are unsure whether RPAT is legitimately conservative or not as sensitive as it should be? Other regions and RSG did not have a definitive opinion either way. For Choices & Voices and Future Forces, RPAT was not that good of a fit because it showed little sensitivity to future scenarios' significant changes from current trends. It was also hard to account for shifting travel behaviors and new modes. Overall RPAT may not be very responsive in slow growth regions such as DVRPC's.

CONCLUSION

RPAT overall is a useful tool for rapid policy assessment, and there is a lot of potential with RPAT given further development. RPAT would be particularly useful if paired with other strategic planning tools, such as Impacts 2050, which DVRPC found gives additional and alternate outputs. Other tools, such as GreenSTEP, The Energy and Emissions Reduction Policy Analysis Tool (EERPAT), Regional Strategic Planning Model (RSPM), and Integrated Transport and Health Impact Modeling Tool (ITHIM), are proposed to be packaged together as VisionEval. This open source, open data platform would be a very robust tool, and DVRPC is committed to assisting as part of the advisory committee on this effort.

Deployment of RPAT should involve upfront training, an understanding of the effort it takes to upload and calibrate the input data, and confirmation that an agency has the necessary computer hardware availability to run the RPAT software. We are confident that RPAT can be a good fit for smaller MPOs that lack a robust travel demand model or as an additional tool for larger MPOs with existing models.