

RapidPolicy
ASSESSMENT TOOL

FINAL REPORT

DCHC RPAT IMPLEMENTATION

3.11.2016



PREPARED FOR:
FEDERAL HIGHWAY ADMINISTRATION

SUBMITTED BY:
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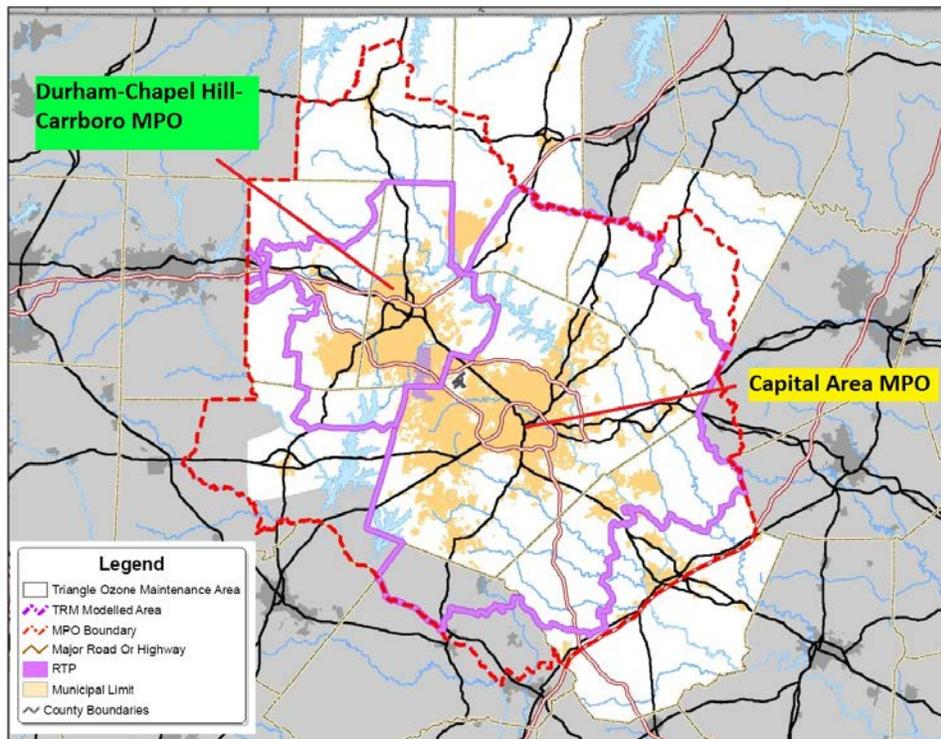


1.0 INTRODUCTION

1.1 | MOTIVATION

The Triangle Region of North Carolina is a large metropolitan region, and current forecasts project both continued outward growth and infill development in selected locations, most notably in the central parts of Raleigh, Durham and Chapel Hill and at community-defined activity centers like the planned mixed-use center within the Research Triangle Park (RTP). The Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO) is the planning agency for the Durham and Chapel Hill portions of the region (Figure 1). The DCHC MPO works jointly to develop their Metropolitan Transportation Plan (MTP) and the Triangle Regional Model (TRM) with neighboring Capital Area Metropolitan Planning Organization (CAMPO) for the Raleigh portion of the region.

FIGURE 1: TRIANGLE REGIONAL MODEL (TRM) AREA



Durham and Chapel Hill are the two largest municipalities within the DCHC MPO, and they combine to form the population, employment, and cultural center of the western side of the Triangle region of North Carolina. In 2011 and 2012, taxpayers in both counties voted by 20-point margins to approve Bus and Rail Investment Plans in both communities, including the initiation of the Durham-Orange Light Rail Transit project, which was accepted by FTA into Project

Development in February of 2014. The City of Durham and Town of Chapel Hill have both made land use decisions that are supportive of Transit-Oriented Development (TOD) along the 17-mile line. The DCHC MPO large jurisdictions have created the Compact Design District, a form-based code district that has already been applied to neighborhoods surrounding the proposed light rail stations. While these early successes in TOD planning demonstrate the DCHC MPO local jurisdictions' commitment to complementing light rail with appropriate land uses, there is relatively less commitment from CAMPO collar counties.

A key challenge for DCHC's and CAMPO's transportation plans is to match the agencies' visions for how the communities should grow with the transportation investments to support this growth. Their close proximity, shared TRM, and often-different approaches to planning pose challenges when developing an MTP. DCHC implemented the Rapid Policy Assessment Tool (RPAT) to help cooperation between the two planning agencies and support dialogs on region wide growth policies.

1.2 | REPORT STRUCTURE

This DCHC RPAT implementation report documents the SHRP 2 C16 Implementation Assistance Program project to implement and evaluate RPAT in the Triangle Region.

- Chapter 2 describes the project's goals and objectives
- Chapter 3 describes the stakeholder outreach, scenario design, data development, and analysis of scenario results conducted over the course of the project
- Chapter 4 describes the technical challenges faced by DCHC during the implementation of RPAT
- Chapter 5 discusses DCHC's recommendations for future improvements to RPAT so that it better supports their planning needs
- Chapter 6 describes DCHC's current plan for including RPAT in its planning workflow
- Chapter 7 provides some conclusions to DCHC's RPAT implementation.

2.0 PROJECT GOALS AND OBJECTIVES

The DCHC MPO, in collaboration with the CAMPO, North Carolina Department of Transportation (NCDOT), RSG, and North Carolina State University (NCSSU), implemented RPAT for the Triangle Region in North Carolina using a User Incentive award from the SHRP 2 C16 Implementation Assistance Program

The project's primary goals were to support the MTP study process, Transportation Improvement Program (TIP) project ranking, regional transportation project assessments, and address policy questions such as the impact of smart growth on travel demand, greenhouse gas emissions, safety, and economic efficiency. The secondary goal was to support the assessment of policies and projects for an MPO that shares a travel demand model area with another MPO and to evaluate RPAT's performance metrics for travel demand, health, and other smart growth strategies for the MTP process. A successful RPAT implementation would address the primary goals of the project by developing a methodology for using RPAT in support of pre-screening transportation and land use scenarios in the MTP process and in assessment of regional transportation policy and projects.

Gaps and deficiencies in the previous MTP process prompted the evaluation of implementing RPAT. In previous MTP studies, applied evaluation methods were not sensitive to policy strategies under consideration by the MPO boards. The methods for evaluating auto-operating cost changes, proposed TOD land use policies, and smart growth development did not yield significantly different results. In the previous MTP process, challenges arose representing and modeling the aging population's impact on travel behavior and land use patterns. Having the quantified benefits from a specific policy change or regional project while accounting for socio-economic variables that are not standard in travel demand models would have helped the previous MTP study. The expectation of implementing RPAT was that the tool would help address these gaps and deficiencies in the next MTP study process.

3.0 PROJECT PROCESS

This chapter of the report describes the process that the project team followed to implement RPAT, including stakeholder outreach, scenario design, data development, and analysis of scenario results conducted over the course of the project.

3.1 | STAKEHOLDERS' INVOLVEMENT

While the implementation of RPAT was led by DCHC MPO staff with support from RSG, the consultants who developed the software during the SHRP 2 C16 project, outreach to and input from stakeholders was an important part of the project.

The outreach efforts included,

- Presentation and training by DCHC MPO and RSG staff in the project kickoff meeting at Triangle J Council of Government. All of the project partners, including staff members from DCHC MPO, CAMPO, NCDOT and North Carolina State University attended, as well as local planners and Environmental Protection Agency (EPA) staff. This presentation informed stakeholders about appropriate RPAT applications, its suite of performance metrics for evaluation, and the requirements for successful implementation.
- Presentations by the DCHC MPO staff in the NC Association of Rural Planning Organizations (ARPO) meeting and the Association of Metropolitan Planning Organizations (AMPO) conference. These presentations focus on the RPAT introduction and applications.
- Presentation and discussion by the DCHC MPO staff in the DCHC MPO Technical Sub-Committee meeting. Presentation and discussion focused on the RPAT introduction, application and implementation in the DCHC MPO area.
- Project Involvement of students from University of North Carolina at Chapel Hill (UNC). One student in the urban planning master program decided to work on the sensitivity analysis of the RPAT model and use it as the topic for the master's thesis.

3.2 | DATA INVENTORY AND DEVELOPMENT OF MODEL INPUT DATA

RPAT requires population and employment data, tabulations of land use, and transportation system characteristics for a 'base year', or baseline condition. Future year growth patterns, transportation infrastructure investments and other

transportation policy changes can then be evaluated relative to the baseline alternative. Every data point is important and thus RPAT depends on good data to represent a region accurately.

DCHC MPO was primarily responsible for the development of input data, with support and guidance from RSG. Guidance included the review of proposed data sources, review of proposed data processing approaches, and review of developed RPAT inputs. The model calibration and validation revisited this step, reevaluated source material choices, and adjusted input values as necessary.

The data inventory process identified the appropriate data sources, which are enumerated in Table 1, by RPAT model input. The sources included Triangle Regional Model (TRM), TRM Socio-Economic data (TRM SE), CommunityViz Land Use Model, Employment Geocoder data (with refined InfoUSA data), U.S. Decennial Census data (1990, 2000 and 2010), and American Community Survey (ACS) data.

The remainder of this section describes the development of several of the more complex inputs that were built from source data and required significant processing. This includes discussion of the resulting inputs for the three setups that were done: (1) the entire region covered by TRM, including both DCHC MPO and CAMPO jurisdictions; (2) the DCHC MPO region, including the DCHC MPO jurisdiction and its collar counties covered by TRM; and (3) the CAMPO region.

TABLE 1: SCENARIO INPUT DATA SOURCES

	Needed Data	Year	Scenarios	Source
Build Environment	Population by Place type	2010	Base Year	TRM SE + CommunityViz
	Jobs by Place Type	2010	Base Year	TRM SE + CommunityViz
Demand	Auto/Transit Trips per person	2010	Base Year	TRM
	Light Vehicle VMT	2010	Base Year	TRM
	Employment by NAICS	2010	Base Year	Employment Geocoder
	Number of firms by NAICA & Size	2010	Base Year	Employment Geocoder
	Employment Growth Rate	2040	CommP/AIT/MTP	TRM
	Population by Age group	2010	Base Year	Census data
	Future Population by age group	2040	CommP/AIT/MTP	Assumption
	Avg HH Income	2010	Base Year	TRM
	Future HH income	2040	Same for All	Assumption
	Truck VMT by functional classification	2010	Base Year	TRM
Bus VMT by functional classification	2010	Base Year	Calculating by TransCAD	
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 operating 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% & 20%	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 Year	TRM
	Transit Revenues Mile by mode	2010	Base Year	TRM

- ITS = Intelligent Transportation System

BUILT ENVIRONMENT

RPAT defines the built environment as a set of thirteen place types, as shown in Table 2. The thirteen place types are the result of a cross-classification of two dimensions along which the land use in an area is described: area type, which is based on density (in terms of households and jobs per unit area), and development type (which is based on the degree to which land uses are mixed and the level of transit accessibility).

The allocation of land to the four area types (Urban Core, Close In Community, Suburban, and Rural) was determined using the TRM, based on Traffic Analysis Zone (TAZ) land area and the number of households and jobs by TAZ.

The allocation of land to the four development types (Residential, Mixed Use, Transit Oriented Development or Employment) was also determined using the TRM and its TAZ data, defined by applying the following rule:

n = percentage of the TAZ's employment in relation to the total of the population and employment in the TAZ.

- Residential: n less than 33.33%
- Mixed Use: n between 33.33% to 66.67%
- Employment: n greater than 66.67%
- Transit Oriented Development: mixed use surrounding rail station or defined by CommunityViz

TABLE 2: PLACE TYPES FOR HOUSEHOLDS AND FIRMS

Development Type	Area Type			
	Urban Core	Close in Community	Suburban	Rural
Residential	✓	✓	✓	
Employment	✓	✓	✓	
Mixed-Use	✓	✓	✓	
Transit Oriented Development	✓	✓	✓	
Rural/ Greenfield				✓

Following allocation, the 2010 TAZ employment and population totals were summed by the 13 place types, and then scaled to 100% for both employment and population to develop the base year population and jobs input file, “place_type_existing.csv”. The population and employment growth amounts between 2010 and 2040 were then determined for the 13 place types and were scaled to 100% for both employment and population to develop the population and jobs growth input file, “place_type_growth.csv”.

Figure 2 (left chart) shows the distribution of population by area type for the whole region in the 2040 MTP scenario. The majority of the population lives in the suburban area type, which accounts for 55% of the population in 2040, with 35% in close-in communities, 7% in rural areas, and only around 3% in the urban core. Figure 2 also shows the distribution of employment by area type (right chart), which is more centrally located than population, with around 52% in close-in communities, 25% in suburban, and 20% in the urban core.

Figure 3 shows the distribution of population (left chart) and employment (right chart) by development type for the whole region. The majority of the population is in primarily residential development types, with the largest proportion of employment in the employment development type and slightly smaller proportions in mixed use and residential development types.

FIGURE 2: 2040 REGIONAL POPULATION AND EMPLOYMENT BY AREA TYPE

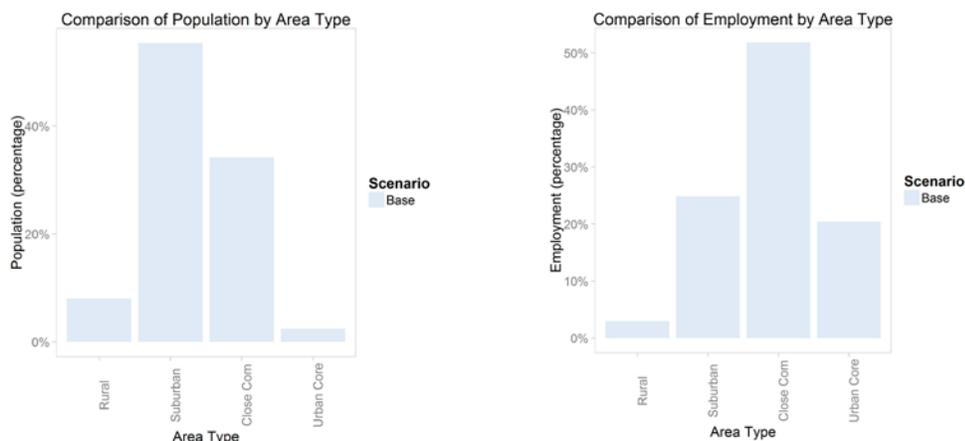


FIGURE 3: 2040 REGIONAL POPULATION AND EMPLOYMENT BY DEVELOPMENT TYPE

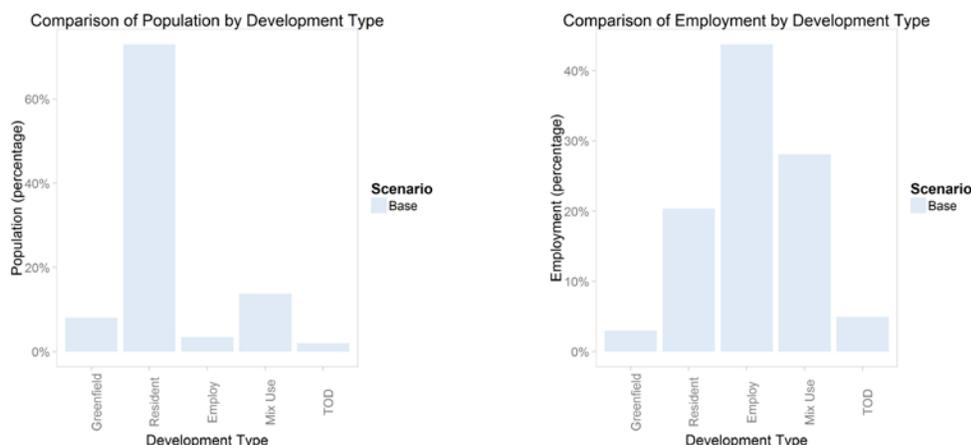


Figure 4 shows a similar chart of the distributions of population (left chart) and employment (right chart) by area type in the 2040 MTP scenario. This time, the distributions are segmented into the two MPO regions, DCHC and CAMPO. The population distributions are relatively similar with slightly more rural and urban core and slight less suburban population in the DCHC region than the CAMPO region. Employment in the DCHC region is concentrated in the urban core, with greater dispersal noted in the CAMPO region.

Figure 5 compares the population (left chart) and employment (right chart) distributions by development type for the DCHC and CAMPO regions. In this case, the allocations of both population and employment are relatively similar, with slightly more development in a combination of mixed use and transit oriented development in DCHC than in the CAMPO region.

FIGURE 4: 2040 POPULATION AND EMPLOYMENT BY MPO AND AREA TYPE

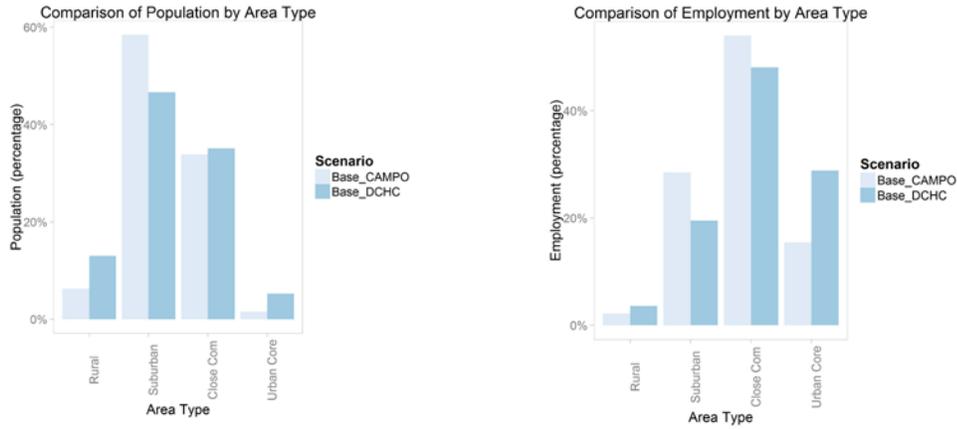
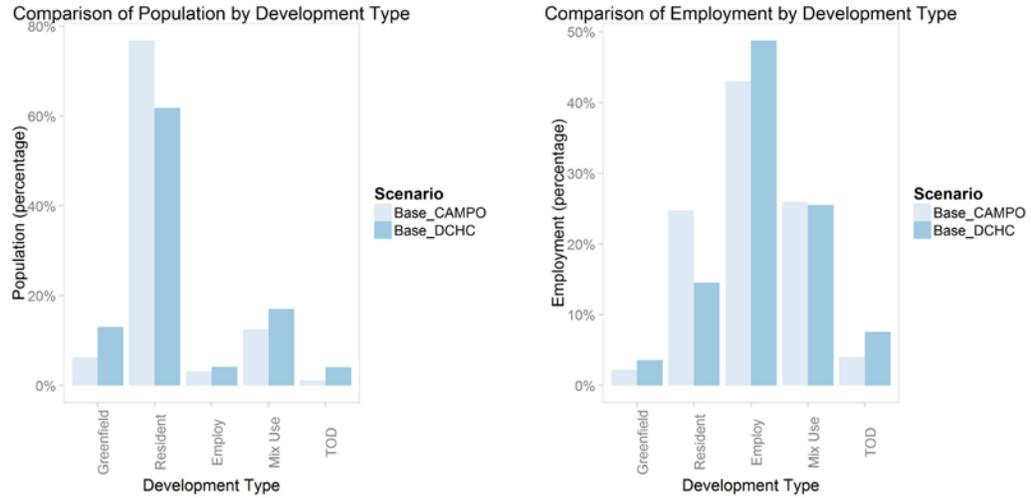


FIGURE 5: 2040 POPULATION AND EMPLOYMENT BY MPO AND DEVELOPMENT TYPE



DEMAND

The Base Daily Vehicle Miles Traveled (VMT) input file (“base_vmt.csv”) includes the total light vehicle daily VMT in the region and the proportion that takes place on freeway and arterial roads. To develop the light vehicle VMT, DCHC MPO staff carefully followed the process described in the RPAT user’s guide that is based on work Atlanta Regional Commission (ARC) did to develop RPAT inputs from the ARC 2010 Plan 2040 Model Summary. DCHC MPO staff obtained the light vehicle VMT from the TRM, extracted the external-to-external trip VMT and summed, in thousands of miles, to comply with the base_vmt.csv file format requirements. To develop the freeway and arterial percentage of light vehicle VMT, DCHC MPO staff summarized VMT by facility type from the loaded highway network in the TRM and then aggregated it to freeway, arterials, and

other roads. The freeway and arterial VMTs were then added and converted to a percentage of the total VMT.

The Truck and Bus Vehicle Miles Traveled input file (“truck_bus_vmt.csv”) includes the split of VMT by bus and truck that takes place on freeways, arterials, and other roads, and includes the proportion of total VMT in the region that is driven by trucks. As with the light vehicle VMT data, the data were developed by DCHC MPO staff using TRM outputs, with some additional processing required using TransCAD to develop the bus VMT input.

To summarize the bus data, DCHC MPO staff used data on transit buses by line joined with the loaded highway network and followed these steps:

1. Used the network’s facility type attribute to create total distance of freeways, arterials and other roads by bus line.
2. Computed bus VMT by freeway, arterial, and other:
 - a. Number of Buses by Peak = 8 hours * 60/peak headway.
 - b. Number of Buses by Off Peak = 10 hours * 60/peak headway.
 - c. Total Bus VMT by Line = Total Line Distance * Total Number of Buses by Line.
 - d. Total Bus VMT is the sum of all Total Bus VMT by Line.
 - e. Total Bus VMT by Freeway = Total Bus VMT * (Freeway Mileage/Total Mileage).
 - f. Total Bus VMT by Arterial = Total Bus VMT * (Arterial Mileage/Total Mileage).
 - g. Total Bus VMT by Other = Total Bus VMT * (Other Mileage/Total Mileage).

Where: peak headway is the number of minutes in the peak period divided by the average number of buses in the peak period.

DCHC staff computed truck VMT by freeway, arterial, and other roads by using the following steps:

1. From TRM’s 2010 loaded highway network, truck VMT by segment = length of the segment * volume of trucks.
2. Summarized all Truck VMT by facility type:
 - a. Truck VMT Freeway % = Truck VMT Freeway/Truck VMT Total.
 - b. Truck VMT Arterial % = Truck VMT Arterial/Truck VMT Total.
 - c. Truck VMT Other % = Truck VMT Other/Truck VMT Total.

3. The overall truck VMT percentage of total VMT was obtained from the TRM, $\text{Truck VMT Percentage} = (\text{Commercial Vehicle VMT} + \text{Medium Truck VMT} + \text{Heavy Truck VMT}) / \text{Total Daily VMT}$.

The Auto and Transit Trips per Capita input file (“trips_per_cap.csv”) contains the average number of auto and transit trips per day per person in the region. DCHC MPO staff developed this input file using population, total vehicle trips, and total transit trips from the TRM, and calculated the two data items as follows:

1. $\text{Auto Transit Trips per Capita} = \text{Total Vehicle Trips} / \text{Population}$.
2. $\text{Transit Trips per Capita} = \text{Total Transit Trips} / \text{Population}$.

3.3 | DEVELOPMENT OF SCENARIOS

DCHC MPO staff developed a set of scenarios to evaluate using RPAT, including several that could be compared with the results of earlier work analytically carried out to develop the region’s MTP. Table 3 shows a matrix of supply and network investments and demand and land use changes that together describe the scenario. The scenarios were developed and later run for all three of the regional RPAT setups (whole region of DCHC + CAMPO, DCHC only, CAMPO only).

The four scenarios that mirror the work on the MTP were combined with several sensitivity tests around the MTP scenario. These sensitivity scenarios first test an additional network policy to invest in ITS, then test an alternative land use scenario by moving an additional portion of growth to a denser location, and finally combine both the supply and land use changes.

TABLE 3: TESTED SCENARIOS - TRIANGLE REGION

		Demand (& Land Use) Scenarios			
		Community Plan (CommP)	All-In-Transit	Metro Transp. Plan (MTP-D)	MTP-D w/ 20% 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*	MTPx20DA
	MTP-S w/ 20% ITS Treatment			MTP w20ITS	MTPx20DAwITS

*Implies a scenario in the metropolitan transportation plan study

Figure 6 and Figure 7 shows the variation in population and employment across scenarios by area type and development type respectively. Notable differences between scenarios in land use allocations occur for the two scenarios that include 20% growth transferred to higher density areas where population in particular grows in the urban core. In addition, the TRN scenario (transit intensive/all-in-transit) leads to the conversion of some locations to transit oriented development and so alters the development type allocation.

FIGURE 6: 2040 SCENARIO POPULATION AND EMPLOYMENT BY AREA TYPE

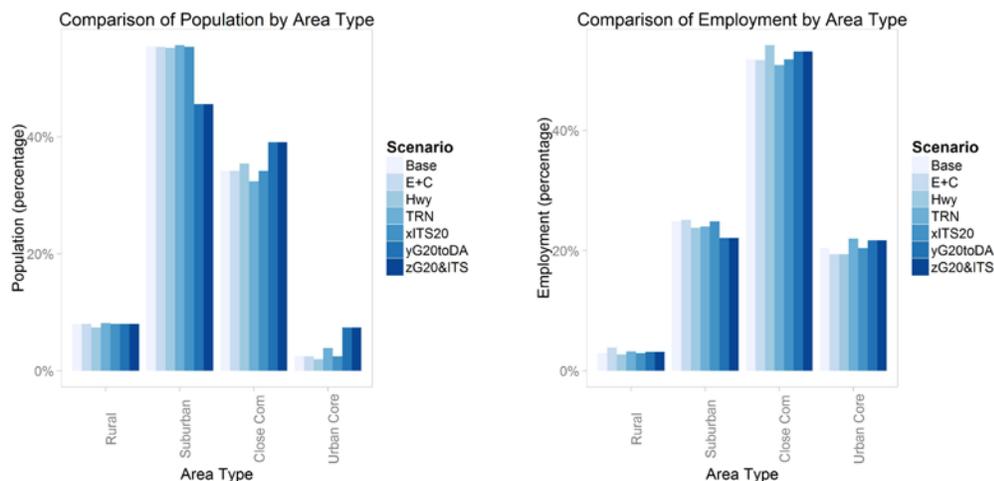
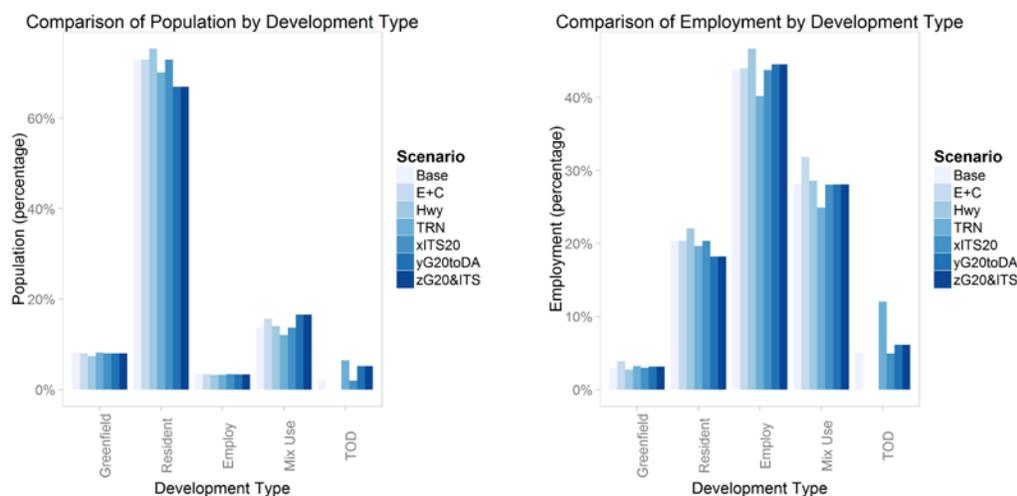


FIGURE 7: 2040 SCENARIO POPULATION AND EMPLOYMENT BY DEVELOPMENT TYPE



3.4 | VALIDATION AND MODEL ADJUSTMENTS

In addition to the various inputs required to construct scenarios, RPAT has several parameter input files. These include, for example, the elasticity assumptions for changes in vehicle miles traveled, walking, and other performance measures, due to changes in place type. All of these parameters are available for the model user to adjust, if required to better validate the model to represent conditions in a specific study region. Following the development of the input files for the region, DCHC MPO and RSG staff reviewed the results from early scenario tests, and identified then implemented required parameter adjustments. These adjustments were made so that the scenario results from RPAT were better validated to conditions observed in Durham and the Triangle

region and to the previous modeling work carried out during the development of the MTP.

Table 5 presents the validation results for the region and each of the two MPO regions for the base MTP scenario, while Table 5 presents the validation results for the whole region for each of the four comparable scenarios.

At the whole region level, RPAT and the TRM were within 5% for the metrics of VMT, vehicle hours traveled (VHT), transit trips and vehicle trips. When the region was split into two MPO regions, there were large differences between RPAT and the TRM, particularly for VHT, where RPAT was higher than the TRM for the DCHC MPO region and lower for the CAMPO region.

TABLE 4: VALIDATION RESULT OF 2040 MTP SCENARIO BY AREA LEVEL

Regional Level	Vehicle Miles Traveled	Vehicle Hours Traveled	Total Transit Trips	Total Vehicle Trips
RPAT	66,367,265	1,623,893	223,402	8,894,594
TRM	63,920,021	1,707,586	227,878	8,919,982
Difference (%)	3.83%	-4.90%	-1.96%	-0.28%
DCHC MPO Area	Vehicle Miles Traveled	Vehicle Hours Traveled	Total Transit Trips	Total Vehicle Trips
RPAT	17,371,467	486,718	125,922	2,387,135
TRM	18,070,414	440,688	124,489	2,518,296
Difference (%)	-3.87%	10.45%	1.15%	-5.21%
CAMPO Area	Vehicle Miles Traveled	Vehicle Hours Traveled	Total Transit Trips	Total Vehicle Trips
RPAT	49,219,135	1,143,438	105,879	6,528,177
TRM	46,309,134	1,266,898	103,389	6,401,686
Difference (%)	6.28%	-9.75%	2.41%	1.98%

There are some notable differences between the results achieved with RPAT than those from the TRM for the other scenarios (Table 5). While in general RPAT matched closely to the TRM in terms of transit and vehicle trips, it varied more widely for VMT and in particular VHT. The VHT results from the TRM suggest that the TRM is much more sensitive to transportation supply and congestion than RPAT. For example, in the E+C scenario, the TRM shows a significant decrease in VMT and a large increase in VHT, which RPAT does not reflect.

TABLE 5: REGIONAL VALIDATION RESULTS

2040 MTP (Base)	Vehicle Miles Traveled	Vehicle Hours Traveled	Total Transit Trips	Total Vehicle Trips
RPAT	66,367,265	1,623,893	223,402	8,894,594
TRM	63,920,021	1,707,586	227,878	8,919,982
Difference (%)	3.83%	-4.90%	-1.96%	-0.28%
2040 E+C	Vehicle Miles Traveled	Vehicle Hours Traveled	Total Transit Trips	Total Vehicle Trips
RPAT	66,985,193	1,666,770	143,054	8,907,138
TRM	61,984,039	2,101,251	136,768	8,918,546
Difference (%)	8.07%	-20.68%	4.60%	-0.13%
2040 TRN	Vehicle Miles Traveled	Vehicle Hours Traveled	Total Transit Trips	Total Vehicle Trips
RPAT	66,873,046	1,614,344	266,899	9,028,196
TRM	64,754,815	1,895,815	254,899	9,169,445
Difference (%)	3.27%	-14.85%	4.71%	-1.54%
2040 Hwy	Vehicle Miles Traveled	Vehicle Hours Traveled	Total Transit Trips	Total Vehicle Trips
RPAT	67,530,571	1,657,132	134,108	8,928,961
TRM	67,002,560	1,833,933	141,816	9,122,719
Difference (%)	0.79%	-9.64%	-5.44%	-2.12%

3.5 | GENERATION AND EVALUATION OF PERFORMANCE MEASURES

RPAT produces a range of performance measures by default, which provide a range of useful indicators about the impacts and benefits of each scenario. This section of the report summarizes the outputs for various performance measures, comparing the impacts of the different scenarios.

Figure 8 compares VMT per capita across the scenarios. In general, focusing growth in denser areas and improving transit decrease VMT, while focusing growth in less dense areas and improving the highway system increase VMT. The MTP scenario is more effective than the other two investment alternatives at managing VMT, while the land use alternative scenarios that add on to the MTP scenario by focusing growth in urban core areas within the region are particularly effective at reducing VMT relative to the MTP scenario.

FIGURE 8: COMPARISON OF DAILY VEHICLE MILES TRAVELED PER CAPITA BY SCENARIO

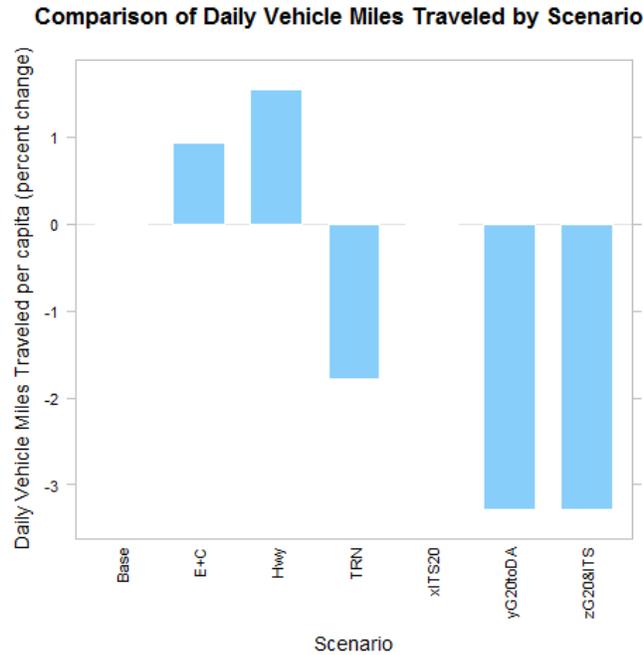


Figure 9 shows a comparison of changes in VHT per capita by scenario. In this case, adding no additional highway capacity that leads to congestion can increase travel time overall, while adding more additional highway capacity in the highway intensive scenario that leads to longer distance travel with additional travel time overall as well. Operational strategies such as ITS to reduce congestion impacts are particularly effective at reducing VHT as travel speeds at peaks hours are increased.

FIGURE 9: COMPARISON OF VEHICLE HOURS OF TRAVEL PER CAPITA BY SCENARIO

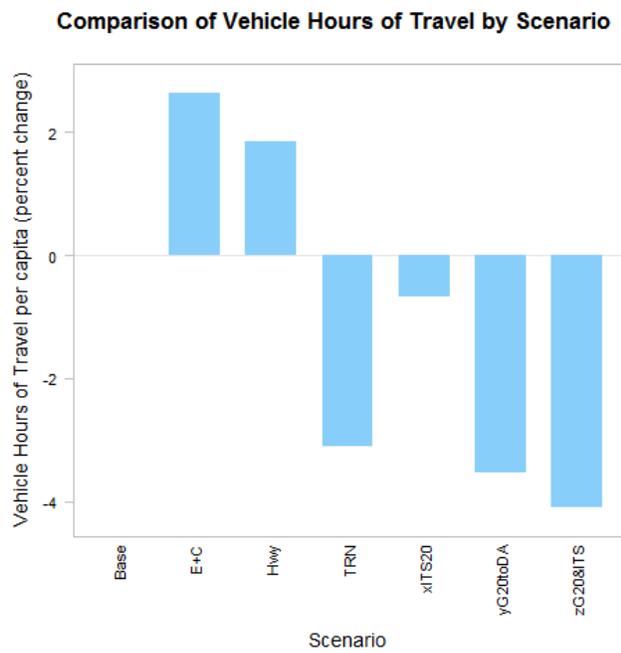


Figure 10 and Figure 11 compare the number of vehicle and transit trips per capita by scenario. The changes in vehicle trips are not entirely intuitive, with more trips in the transit investment scenario, but it is also coupled with more transit trips. The land use scenarios where more population growth occurs in the urban core lead to the expected outcomes of fewer vehicle trips and more transit trips as more of the new activity in the region takes place in walkable and transit friendly locations.

FIGURE 10: COMPARISON OF DAILY VEHICLE TRIPS PER CAPITA BY SCENARIO

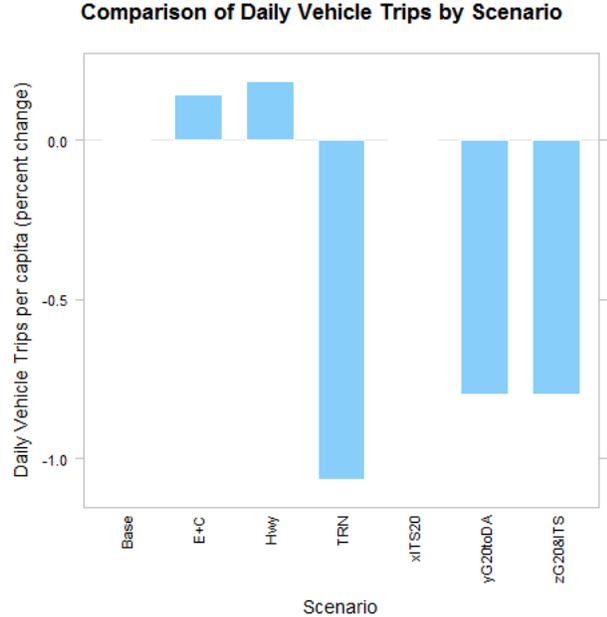


FIGURE 11: COMPARISON OF DAILY TRANSIT TRIPS PER CAPITA BY SCENARIO

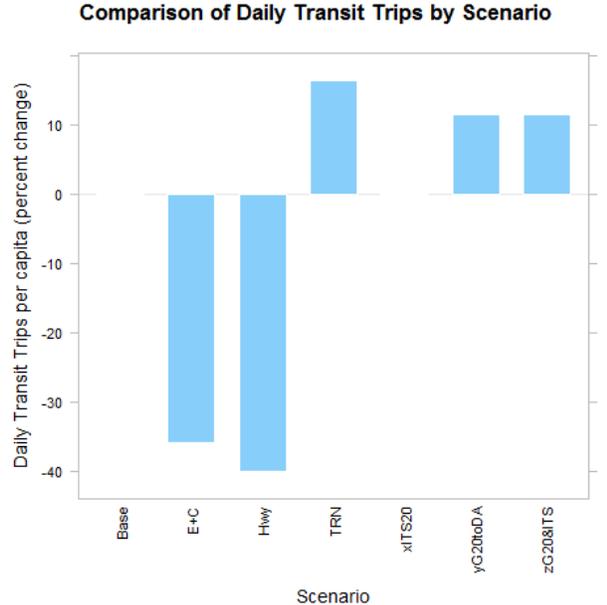
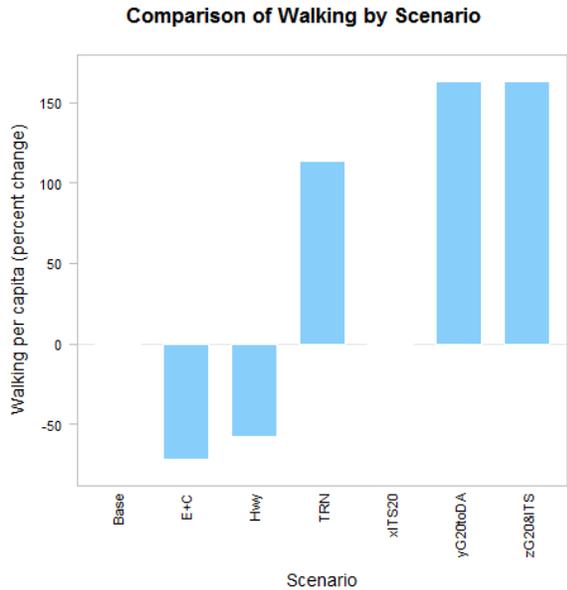


Figure 12 shows how the amount of walking per capita is impacted across the scenarios. In this case, the amount of walking amongst new residents of the region is significantly higher when they locate in denser and more transit friendly locations.

FIGURE 12: COMPARISON OF WALKING PER CAPITA BY SCENARIO



In addition to the travel metrics discussed above, RPAT can derive cost related measures such as highway infrastructure costs.

Figure 13 shows how the costs vary from very low for the E+C scenario to very high in the highway intensive scenario.

FIGURE 13: COMPARISON OF HIGHWAY INFRASTRUCTURE COST BY SCENARIO

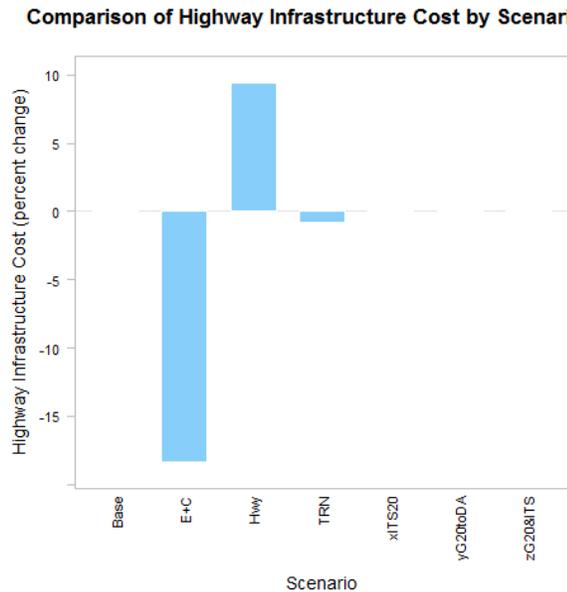


Figure 14 shows a performance measure derived from the amount of travel, the number of road traffic accidents per capita. Since RPAT's accidents metric is proportional to VMT, the change in the number of accidents tracks the change in VMT. The land use alternative scenarios that lead to a reduction in VMT as more activity takes place in the urban core also lead to a reduction in the number of accidents. Figure 15 shows percentage changes in the Greenhouse Gas (GHG) emission per capita by scenario. The land use alternative scenarios lead to a reduction in the GHG emission as more non-vehicular activities takes place in the urban core.

FIGURE 14: COMPARISON OF TRAFFIC ACCIDENTS PER CAPITA BY SCENARIO

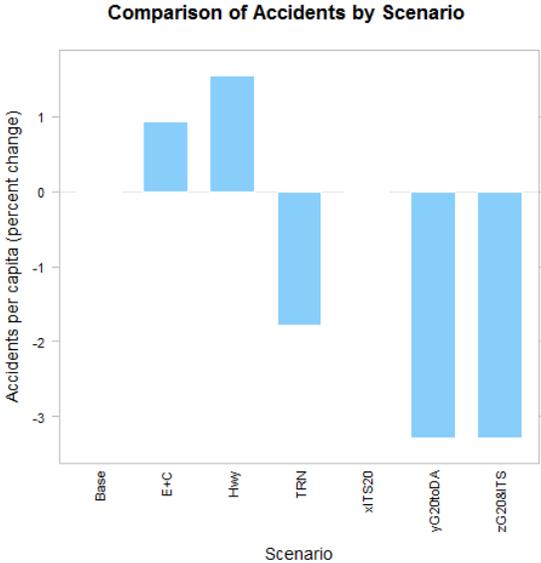


FIGURE 15: COMPARISON OF GREENHOUSE GAS EMISSION PER CAPITA BY SCENARIO

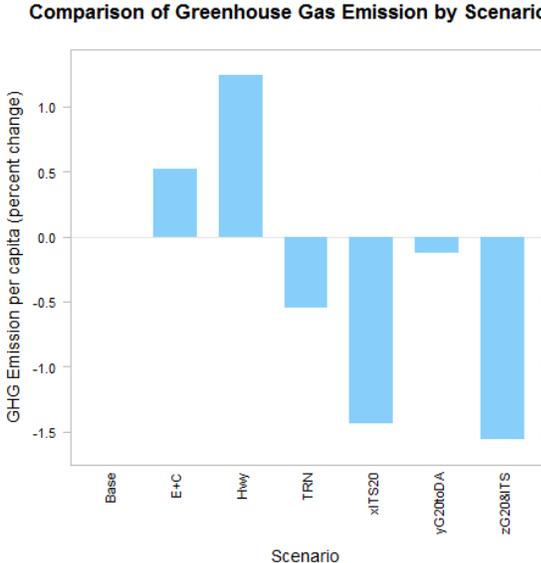


Figure 16 compares percentage changes in the VMT per capita by scenario and MPO region defined in Section 3.2. Figure 17 displays percentage changes in the VHT per capita by scenario and MPO. Figure 18 shows percentage changes in the GHG emission per capita by scenario and MPO. In general, the trends of these three percentage changes of each MPO are similar to those at the regional level, which were shown in Figure 8, Figure 9 and Figure 15.

FIGURE 16: COMPARISON OF DAILY VEHICLE MILES TRAVELED PER CAPITA BY SCENARIO

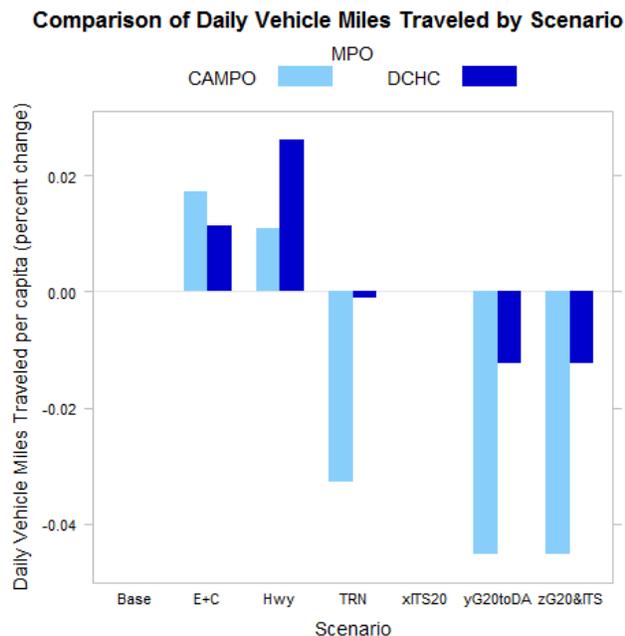


FIGURE 17: COMPARISON OF VEHICLE HOURS OF TRAVEL PER CAPITA BY SCENARIO

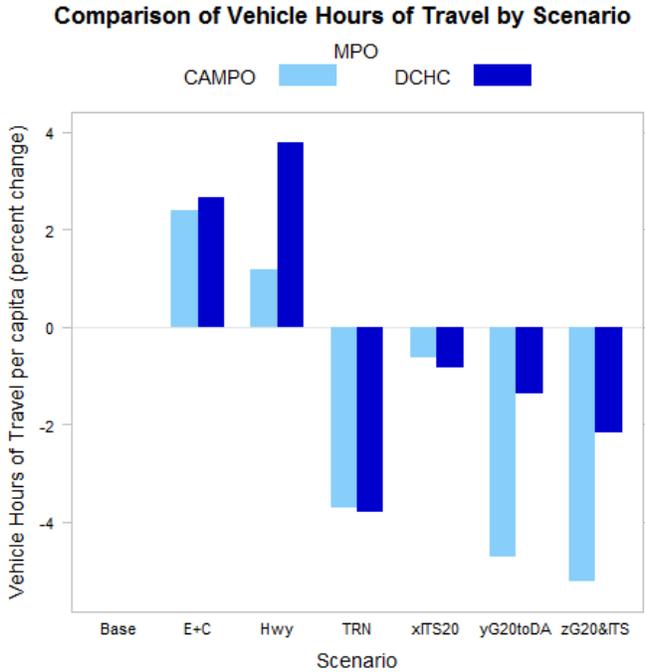
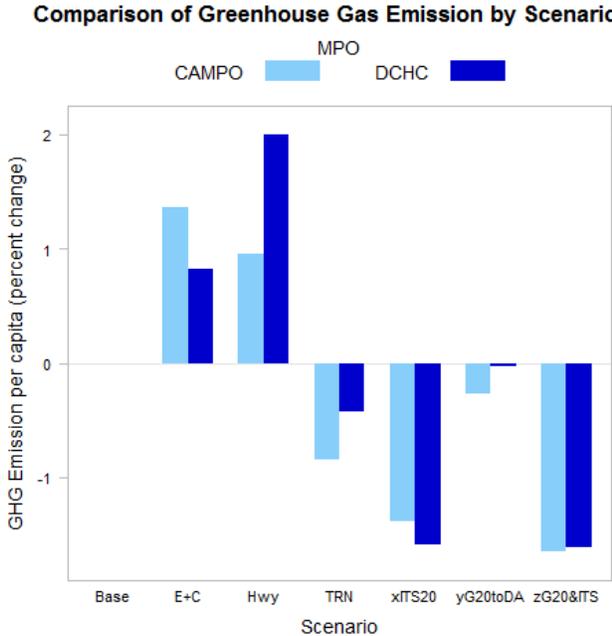


FIGURE 18: COMPARISON OF GREENHOUSE GAS EMISSION PER CAPITA BY SCENARIO



4.0 DISCUSSION OF TECHNICAL ISSUES FACED DURING THE PROJECT

This chapter of the report describes the technical challenges faced by DCHC MPO staff during the implementation of RPAT, including installation issues, difficulties generating inputs, and finally challenges faced representing certain types of scenarios in RPAT.

4.1 | INSTALLATION

Installation is improved significantly in this release of RPAT with the bundling of RPAT and R into a single executable installer. However, installing software in general can be difficult in an agency environment and having to transition to a new version of the software part way through the project added another step to the process.

The new executable installer version of RPAT was used by DCHC MPO staff immediately upon its release, and they did face a bug related to R installation on certain Windows operating systems under some security configurations. This underlines the difficulty of creating easy (automated) installation packages that install open source software and models built on top of that software and having them work across the large number of combinations of operating system and configuration.

4.2 | INPUTS

One notable challenge faced when developing inputs for RPAT is understanding clearly what the input table content should be. For example, some input data are absolute values, while some are expressed as growth value and it is not always straightforward to identify the correct type from the user's guide or the naming conventions used in the input files.

While having all of the inputs files in a CSV file format means that they are readily accessible, this did lead to some issues for DCHC staff as they prepared the data. For example, the employment table generated in an Excel spreadsheet had some formatting issues when converted to the CSV file. In general, collecting data from spreadsheets and other sources and formatting the data into the input files was found to be the most manually intensive and error prone aspect of setting up RPAT.

DCHC MPO staff also faced difficulty selecting the correct household income forecasts to use. While the TRM model does include data on future household income amongst its socioeconomic data, the income growth was very low and led to estimates of future VMT in RPAT that diverged significantly from the TRM. Using an alternative and higher income forecast source led to higher VMT growth

in RPAT but did reinforce the potential sensitivity of results to relatively difficult to forecasts inputs.

4.3 | MODEL

DCHC MPO staff found a high degree of difficulty in representing a transit system investment scenario. RPAT’s transit trip prediction is not responsive to a relative increase or decrease of transit supply to population growth, but is instead responsive to changes in land use allocation (more population and employment growth in urban core areas leads to more transit growth).

To overcome this, the DCHC MPO staff refined the allocation of land use to place types to reflect a transit system investment. For example, the land use of TAZs around stations was changed to TODs from other development types and the sensitivity of the model to those land use changes was also increased from default values to more rapidly increase transit trips as land use was converted to TOD. In addition, the DCHC MPO staff developed a formula to generate the variable transit trip rate based on the transit supply. This formula/approach is very useful not only for the region, which has no existing rail service but has planned rail service in the future, but also for the scenario, which has relatively large change of transit supply, i.e. large increase or decrease of transit revenue miles per capita. The formula to adjust the transit ridership growth is built on the MTP scenario results of the triangle region MTP, and given below,

$$TRG = TRG0 * (1 + \frac{R1}{R0})$$

$$R1 = R1_{bus} + R1_{rail}$$

$$R1_{bus} = 0.045 * Ln(RMG_{bus})$$

$$R1_{rail} = R0 * (0.68 + 0.4 * Log_{10}(\frac{8 * RM_{rail}}{RM_{bus0}}) / POPG)$$

Where TRG is the final/adjusted growth of transit ridership

TRG0 is the original growth of transit ridership from RPAT

R0 is the regional average of transit trips per capita in the base year

R1 is the adjustment on transit trips per capita

R1_{bus} is the adjustment on bus trips per capita

R1_{rail} is the adjustment on rail trips per capita

RMG_{bus} is the percent increase in bus revenue miles per capita

RM_{rail} is the rail revenue miles in the future year

RM_{bus0} is the bus revenue miles in the base year

POPG is the population growth rate.

By default, the transit supply is assumed to grow in line with population increase; therefore, a value of 1 of RMG_{bus} indicates growth in proportion with population growth. A value less than 1 indicates that there will be less bus revenue miles per person, in the future. A value large than 1 indicates faster freeway expansion than population growth.

There are two ways to apply the formula; the direct way is applying the first equation to the transit ridership growth result from RPAT, and the indirect way is using $(R0+R1)$ to replace $R0$ in the RPAT input. The indirect way has the final ridership growth in RPAT so that it is very convenient to compare this result among all existed scenarios. The indirect way is suggested to be used, but it should be kept in mind that the regional average of transit trips per capita in the base year is not input anymore and the replacement is $(R0+R1)$.

DCHC MPO staff provided FHWA with recommendations for future improvements to RPAT so that it can better support their planning needs. The improvements include updates to existing components, new functionality to fill gaps in the policies that can be evaluated using RPAT, and requests for more guidance on the acceptable use of RPAT.

5.0 ROLE OF RPAT IN THE AGENCIES PLANNING WORKFLOW

This chapter comments on DCHC's current plan for including RPAT in its planning workflow. DCHC envisages that the primary use of RPAT is to support the MTP study process. This encompasses several steps, including, but not limited to,

- Supporting the pre-screening of transportation and land use scenarios in the MTP. DCHC MPO staff found it easy to run additional scenarios once the model was set up and calibrated. This allowed DCHC MPO to use RPAT as a pre-screening tool to run many variations of transportation investments and land use scenarios. Replicating that many scenarios in the TRM would be time and cost prohibitive, and non-quantitative pre-screening methods might be flawed.
- Providing the performance measures for the MTP goals and targets, such as greenhouse gas emissions, economic efficiency and safety. RPAT includes a series of performance measures that are post processed from the travel demand outputs of RPAT at the end of each scenario run. Many of these would be more time consuming to calculate using the TRM and other tools in combination.
- Addressing some policy questions that cannot be addressed by the TRM, such as fuel price impacts, travel demand management strategy, and Intelligent Transportation system (ITS). RPAT was designed to incorporate a relatively broad range of policy sensitivities beyond the usual highway or transit system changes that might be evaluated most readily with the TRM.

In addition to supporting the MTP study process, DCHC MPO staff expects that a secondary use of RPAT is to support the assessment of policies and projects for other agency planning needs, such as TIP project ranking, regional transportation project assessments, and Comprehensive Transportation Plan (CTP) studies.

6.0 CONCLUSIONS

DCHC MPO staff were able to successfully develop a calibrated RPAT model for the joint DCHC and CAMPO region and demonstrated that along most dimensions they were able to adequately replicate previous analyses performed using the TRM for the region's MTP.

The additional scenarios run during the scenario testing portion of this implementation project demonstrated that RPAT is a quick response tool for policy tests that captures growth impacts from a different angle than the traditional travel demand model. It is also sensitive to policies that a travel demand model is generally insensitive to such as economic factors, urban form changes, fuel price variations, and travel demand management policies. Finally, DCHC MPO staff found that it provides additional performance measures that are useful in comparing the impacts of different scenarios.

DCHC MPO staff collated a list of improvements, informed by their own experience using RPAT and what they have heard in peer workshops and during other discussions over the course of the implementation project, which are included in this report. With these additional features, RPAT would form a helpful step in the agency's workflow during the preparation of future MTPs and during other planning studies.