Final Report

Implementing Smart Mobility Framework into a Sub-regional Long-Range Transportation Plan

South Bay Cities, Los Angeles County

September 2014

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Section 1
Introduction

INTRODUCTION

This report documents efforts over the past 18 months to integrate into local planning processes the California Department of Transportation's (Caltrans') groundbreaking report, *Smart Mobility 2010: A Call to Action for the New Decade*, which defines a vision for developing a new approach to transportation that is multimodal, sustainable and integrated with land use. The Smart Mobility Framework (SMF) was applied in the sub-regional long-range transportation planning process for the South Bay Cities Council of Governments (COG) sub-region of the Southern California Association of Governments (SCAG) metropolitan planning region. [suggest including Caltrans web link on the Smart Mobility Program] The SMF principles were applied as a broad framework to identify an approach and strategies for considering SMF performance measures when evaluating future multi-modal and sustainable transportation and land use scenarios. The report describes results and recommendations for integrating Smart Mobility concepts as well as broader performance measures (identified during this study) into the long range transportation plan development process and other transportation planning processes for encouraging implementation of "green", sustainable transportation infrastructure.

This study is one of two pilot areas studies covered in a contract with Caltrans to implement the Smart Mobility Framework.. The results of these two pilot area studies will be shared with Caltrans, agency partners, and other stakeholders. The location of Pilot Area 2 is shown in Figure 1.

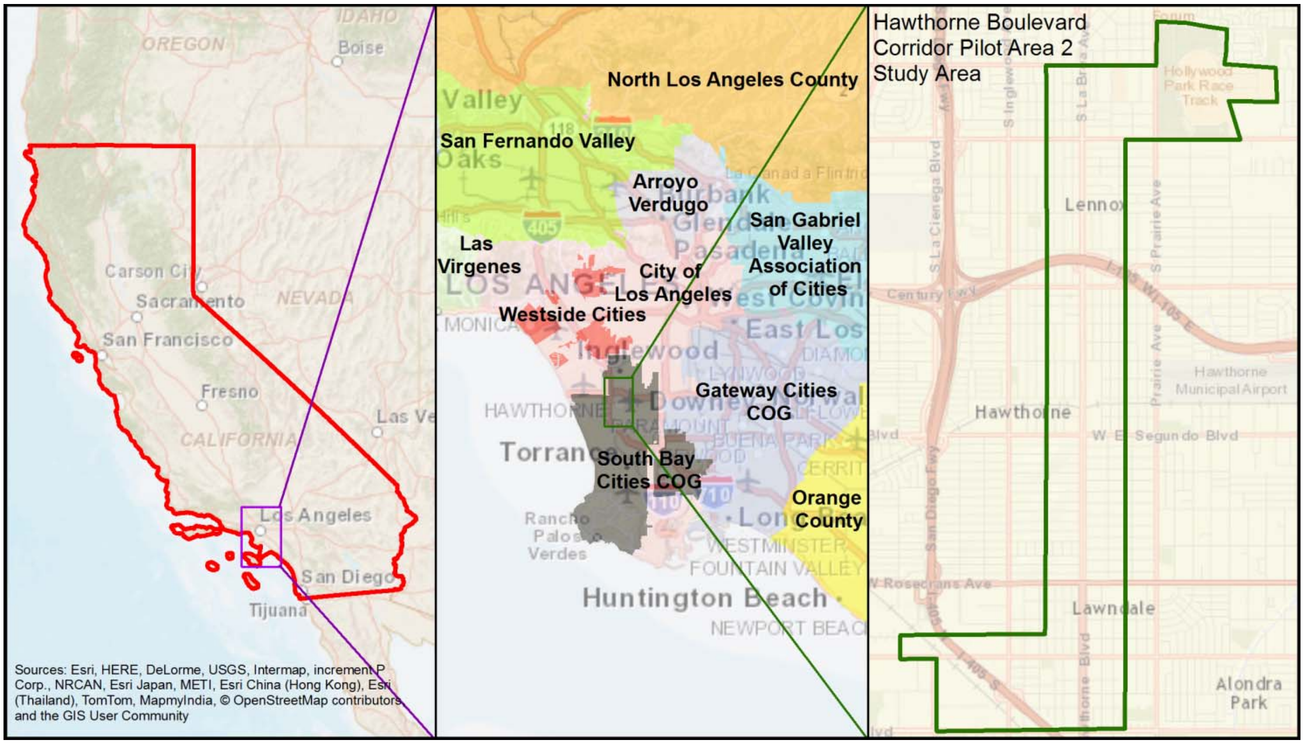
REPORT ORGANIZATION

This report has been organized into the following sections:

- Introduction
- Background
- Study Approach
- Study Results
- Evaluation
- Conclusions and Next Steps

This report has been developed through a contract issued by Caltrans Headquarters Office of Community Planning with support from Caltrans Office of Travel Forecasting and Analysis and Caltrans District 7 Division of Planning. Project management sponsorship was provided by the Los Angeles County Metropolitan Transportation Authority and pilot area support services have been provided by the South Bay Cities Council of Governments.

Figure 1. Pilot Area Location



Section 2
Background

BACKGROUND

In February 2010, Caltrans released *Smart Mobility 2010: A Call to Action for the New Decade*. This document provides a broad planning framework to help guide multi-modal and sustainable transportation planning and development along with providing tools and techniques to assess how well plans, programs, and projects meet 'smart mobility' goals throughout the state.

> *Smart Mobility moves people and freight while enhancing California's economic, environmental, and human resources by emphasizing convenient and safe multi-modal travel, speed suitability, accessibility, management of the circulation network, and efficient use of land.*

The SMF consists of the following principles, place types, and performance measures:

- Six (6) Smart Mobility Principles that express the priorities and values of Smart Mobility
    - Location Efficiency
    - Reliable Mobility
    - Health and Safety
    - Environmental Stewardship
    - Social Equity
    - Robust Economy
- Seven (7) Smart Mobility Place Types designed as tools for planning and programming that implement Smart Mobility:
    - Urban Centers
    - Close-in Compact Communities
    - Compact Communities
    - Suburban Areas
    - Rural and Agricultural Lands
    - Protected Lands
    - Special Use Areas
- Seventeen (17) Smart Mobility Performance Measures that relate to the six (6) Principles (as shown in Table 1)

This effort is part of a larger study being conducted for Caltrans Headquarters Department of Transportation, Community Planning Office to test implementation of the SMF into current transportation planning processes. Specifically, the Pilot Area 1 (PA1) involved integrating SMF principles and performance measures into a second generation Corridor System Management Plan (CSMP) for I-680 corridor within Contra Costa County in Caltrans District 4. The PA1 study is intended to be supplementary and complementary to the CSMP process.

Table 1. Smart Mobility Principles and Performance Measures

Principle	Performance Measure
Location Efficiency	1. Support for Sustainable Growth
	2. Transit Mode Share
	3. Accessibility and Connectivity
Reliable Mobility	4. Multi-Modal Travel Mobility
	5. Multi-Modal Travel Reliability
	6. Multi-Modal Service Quality
Health and Safety	7. Multi-Modal Safety
	8. Design and Speed Suitability
	9. Pedestrian and Bicycle Mode Share
Environmental Stewardship	10. Climate and Energy Conservation
	11. Emissions Reduction
Social Equity	12. Equitable Distribution of Impacts
	13. Equitable Distribution of Access and Mobility
Robust Economy	14. Congestion Effects on Productivity
	15. Efficient Use of System Resources
	16. Network Performance Optimization
	17. Return on Investment

Source: Caltrans. *Smart Mobility 2010: A Call to Action for the New Decade*, Exhibit 10, p. 51.

For Pilot Area 2 (PA2), the goal was to develop a suite of easy-to-use processes and tools to apply Caltrans' SMF toward best practices for sub-regional planning products, project analysis, and ultimately, infrastructure decision making. The product is intended to enable local agency planners to dynamically understand the trade-offs, costs and benefits of various components of the land use and multi-modal transportation project portfolios to optimize a comprehensive set of beneficial economic, environmental, and social equity outcomes; merging the state's SMF with local plans and policies. For Pilot Area 2, SMF was integrated with the Los Angeles County Metropolitan Transportation Authority's

(Metro's) recently adopted Countywide Sustainability Planning Policy (CSPP) principles and priorities as well as the South Bay Cities Council of Governments (SBCCOG) sub-regional priorities as presented in the Sustainable South Bay Strategy. The studies can be accessed online at:

http://media.metro.net/projects_studies/sustainability/images/countywide_sustainability_planning_policy.pdf

http://www.southbaycities.org/projects/land-use/south-bay-sustainable-strategy-integrated-land-use-and-transportation-strategy

Throughout the study process, Project Team meetings were held monthly and included staff from the following agencies:

- Metro
- South Bay Cities COG
- SCAG
- Caltrans District 7
- Caltrans HQ Office of Community Planning

Countywide Sustainability Planning Policy

Metro developed the Countywide Sustainability Planning Policy (CSPP), which builds on the SMF to create a sustainability assessment framework that is unique to land-use, transportation, and demographic conditions in Los Angeles County. The CSPP consultant effort was completed in the summer of 2012, and the policy was adopted by the Metro Board in December 2012. The CSPP defines and maps four place-types, referred to as Accessibility Clusters, by census tract across the county, and provides planning guidance specific to each Cluster to support Metro's project managers in integrating sustainability into program and project development, as well as into Metro's planning functions. It is also a resource for collaborating with regional and local agencies in implementing California's recently adopted climate change laws requiring local policies and projects that will contribute to a more sustainable transportation system. For more information, visit:

http://www.dot.ca.gov/hq/tpp/offices/orip/climate_change/documents/DP-30_Climate_Change.pdf

While the CSPP has its own principles and priorities, unique place types, and performance measures for Los Angeles County, the policy follows a similar framework as the SMF. The CSPP uses 15 performance measures in support of the three broad CSPP principles to evaluate projects. Table 2 lists the metrics used by the CSPP and compares them to the SMF principles.

Performance measures from CSPP are used for monitoring purposes at the regional level rather than for evaluation or prioritization, but some of them could be appropriate for the sub-regional analysis. Additional project-based metrics were developed through consultant efforts related to the CSPP, but are meant to be used to compare and contrast the performance of different project alternatives rather than to compare and prioritize different projects as part of a sub-regional planning effort.

Table 2. Countywide Sustainability Planning Policy Performance Metrics

CSPP Metric	Potential SMF Principles Supported					
	Location Efficiency	Reliable Mobility	Health and Safety	Environmental Stewardship	Social Equity	Robust Economy
Vehicle Miles Traveled	×			×		
Accidents		×	×			
Transportation Fuel Usage	×		×	×		×
Congestion		×		×		×
Emissions			×	×		
Transit Ridership	×	×		×	×	
Transit Travel Time	×	×			×	
Transit Travel Speed		×				×
Walking/Biking Trips	×		×	×		
Respiratory Health			×	×		
Environmental Enhancements				×		
Jobs Adjacent to Transit	×				×	×
Population Adjacent to Transit	×				×	
Transit Service in Strong and Very Strong Accessibility Clusters	×	×				×
Population and Employment in Strong and Very Strong Accessibility Clusters	×	×			×	×

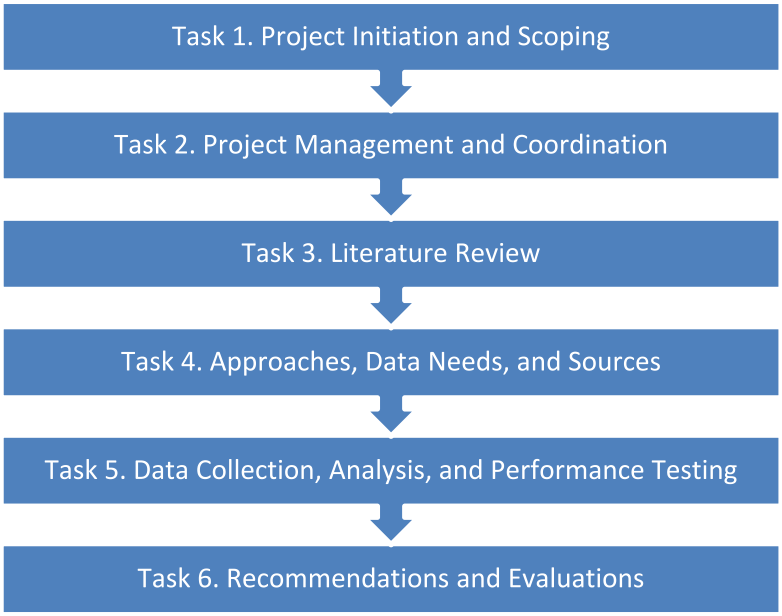
Source: Kittelson & Associates, Inc., 2013.

SBCCOG Sustainable South Bay Strategy

At the sub-regional level, the South Bay Cities developed a land use and transportation strategy that supports sustainable development. The SBCCOG's *Sustainable South Bay Strategy*, which includes innovative transportation projects, such as the neighborhood electric vehicles, combined with land use strategies to concentrate development at nodes within the sub-region. These strategies support sustainable development, but would not generally score very well using traditional performance measurement packages that are often focused on measuring increased system performance for automobiles, which was considered in the selection of performance measures.

WORK PLAN AND SCHEDULE

This effort started with preparing a detailed work plan in coordination with Metro, as the Pilot Area 2 Sponsor. The work plan included a series of tasks as shown in the following:



The detailed work plan is provided in Appendix A.

Section 3
Approach

APPROACH

This chapter presents our approach to applying the Smart Mobility Framework (SMF) performance measures to assess a sub-regional long range transportation plan for the South Bay Cities area. The selected Pilot Area is the area covered by the South Bay Cities Council of Governments (SBCCOG) which is a sub-region in Los Angeles County. This work builds off of Metro's existing performance measures and sustainability policy framework. The SMF principles and performance measures were used to inform and more fully integrate this work on sub-regional long range transportation plans with sub-regional land use plans from the Sustainable South Bay Strategy and the regional Southern California Association of Governments' (SCAG) Sustainable Communities Strategy (SCS) (adopted in 2012). Selected project packages were grouped into portfolios that respectively represented innovative and traditional approaches to transportation system development were crafted. These project packages were used as one half of the equation leading to scenario development while land use considerations formed the other half. These scenarios are therefore referred to as portfolio scenarios in this pilot study.

This effort involved two subtasks:

1. To develop portfolio scenarios in consultation with the South Bay Cities Council of Governments (SBCCOG) that illustrate the benefits of using the SMF at a sub-regional level to identify transportation improvements in combination with land use strategies to attain sustainable community objectives.

2. To identify the appropriate performance measures, data needs, and recommended analysis approach starting with Metro's system-level and project-level performance measures included as part of Metro's Countywide Sustainable Planning Policy (CSPP).

The approach memo (September 10, 2013), which documents this effort and presents a more detailed description of the process to develop the recommended approach, is provided in Appendix B.

For Pilot Area 2 (South Bay Cities), our approach was as follows:

1. Define the land use and transportation scenarios.
2. Identify SMF performance measures and specific metrics to apply based on relevancy and tools.
    a. Review the tools and data available for the analysis and select the tools.
3. Refine the tools and collect the additional data for selected performance measures.
4. Conduct the preliminary analysis.
    a. Revisit performance measures.
5. Compare results of SMF performance measures to traditional performance measures.

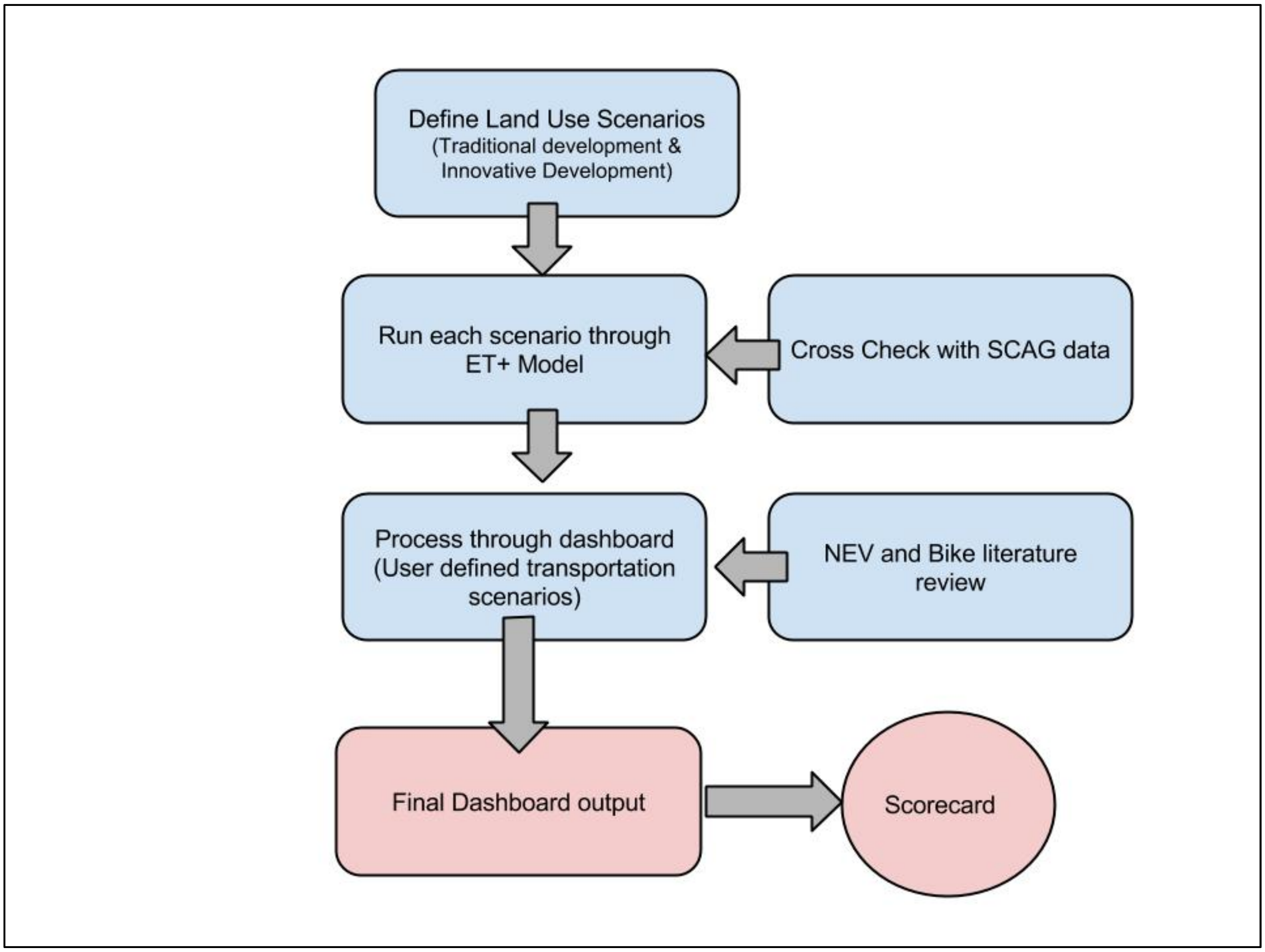


Figure 2. Approach Diagram

Specifically, for the analysis using the Envision Tomorrow (ET+) Model the process involved several steps and allows for an iterative step during the evaluation to modify the scenarios before finalizing and documenting the results.

PORTFOLIO SCENARIOS

Four portfolio scenarios that combine transportation improvements with land use strategies were developed in consultation with the SBCCOG and Metro to illustrate the benefits of the applying SMF performance measures to attain the sustainable community objectives. Given the size of the South Bay Cities sub-region and the neighborhood level of the Sustainable South Bay strategy, two representative areas within the sub-region were initially identified as subjects for the portfolio scenarios. However, after cross checking each potential study area with SCAG regional growth projections one of the study areas was ruled due to inconsistencies between SCAG projections and the goals of this study. The full scale analysis of this study was conducted for the Hawthorne Corridor study area.

The purpose of the portfolio scenarios is to illustrate the benefits of using the SMF at a sub-regional level to identify transportation improvement projects in combination with land use strategies to attain sustainable community objectives as presented in Metro's CSPP. The intent is to assess the effectiveness of a portfolio of scenarios in a sub-regional long range plan that blanket the study area in order to better quantify regional benefits, rather than the assessment of a single project or granular changes.

After discussions with the Project Team during meetings in April and May 2013 and for the purposes of the our analysis, the following five scenarios were developed that compares existing conditions to various levels of changes in future land use and transportation improvements:

- **Scenario One** (Existing) shows the existing conditions in the corridor.
- **Scenario Two** (Business as Usual) assumes only traditional infrastructure and transportation improvements that have already been identified in SBCCOG's Measure R as well as the Congestion Management Fee (CMF) program that are not fully funded with current "traditional" land use patterns.
- **Scenario Three** (SSB land use) focuses only on hypothetical innovative sustainable land use changes in the Sustainable South Bay plan, but with traditional transportation infrastructure improvements, and limited policy change.
- **Scenario Four** (CSPP transportation investments) includes innovative transportation projects (e.g., NEV subsidy, mobility hubs, charging stations, shared lane; multi-lane boulevards), but assumes traditional land use patterns.
- **Scenario Five** (SSB land use and CSPP transportation) evaluates the SBBCOG's innovative project proposals and land use changes in the Sustainable South Bay plan. This is the most progressive of all four future scenarios, providing the groundwork to consider an array of innovative transportation projects (e.g., NEV subsidy, mobility hubs, charging stations, shared bicycle lanes; multi-lane boulevards) in combination with the "neighborhood nodes" concept for the land use configuration.

STUDY AREA

Given the geographic coverage of the South Bay cities and the need to identify a subset of transportation projects and land use changes within the sub-region, the SMF place types and Metro's Accessibility Clusters were used to focus our efforts. Figure 3 shows the Accessibility Clusters concept, as presented in LA MTA's *Metro Countywide Sustainability Planning Policy.* Hawthorne Corridor study area was selected because it presents a high potential to transition to more sustainable transportation planning area.

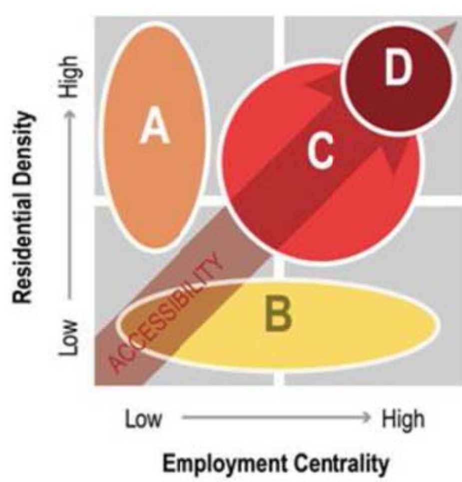


Figure 3. Accessibility Cluster Concept

The Pilot Area Study focuses on the "Hawthorne Corridor":

- Hawthorne Boulevard corridor stretches between West Manchester Avenue to the north and Artesia Boulevard at the south. To the west, the study area is bounded by Aviation Boulevard and Crenshaw Boulevard to the east. The Hawthorne Corridor passes through the cities of Lawndale, Hawthorne, and Inglewood as well as unincorporated Los Angeles County.

This study area has been identified by SBCCOG in *Sustainable South Bay: An Integrated Land Use and Transportation Strategy* as representative of higher density locations that have high potential for redevelopment and land use redistribution.

The map in Figure 4 captures shows the accessibility clusters, which reflect a combination of two factors, residential density and job access or centrality, showing the high degrees of both centrality and population density in the darker pink for the Hawthorne corridor area. These were identified to be key factors in that step that set the stage for future smart growth development. In addition, the Green Line and local bus lines are shown in Figure 4. SCAG 2035 growth projections also indicate an expected increase in future population density in this corridor which would support the more innovated nodal land use concepts evaluated in this study.

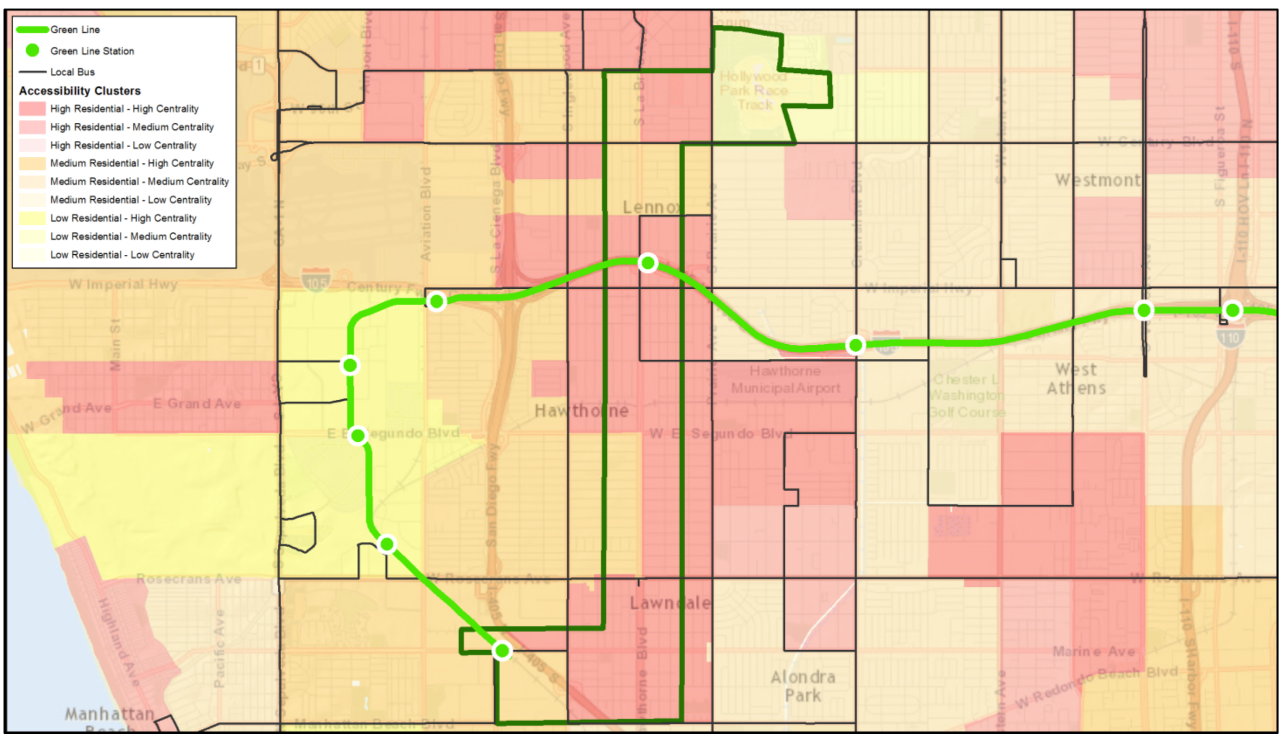


Figure 4. Accessibility Clusters in Hawthorne Study Area

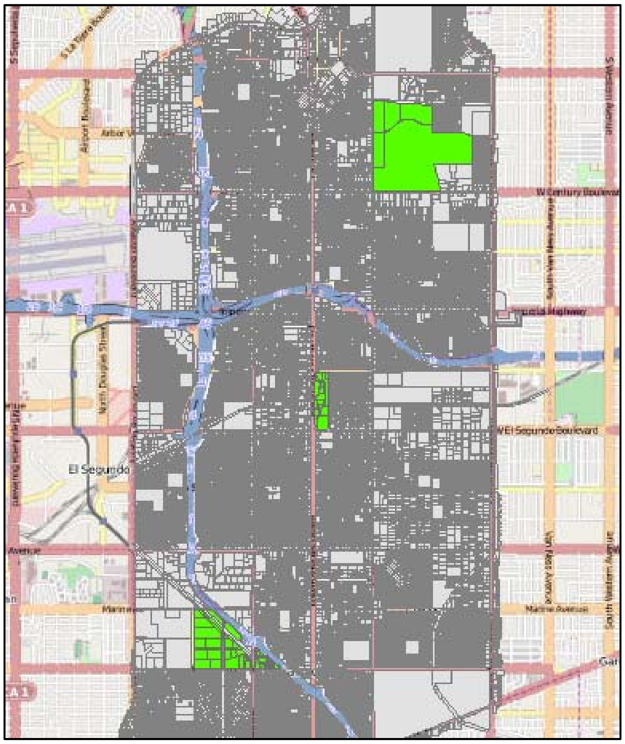


Image A

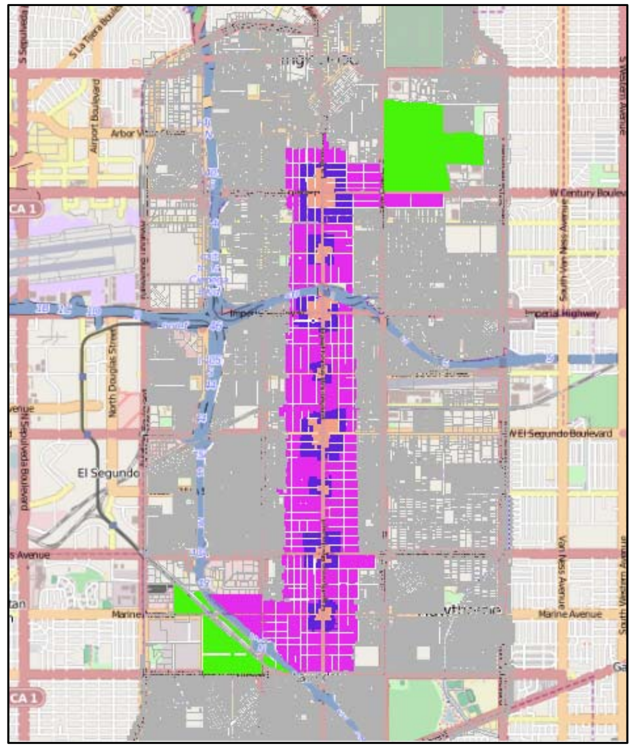


Image B

Figure 5. Hawthorne Corridor Study Area

In Figure 5, Image A shows where the growth would occur under Traditional Land Use assumptions. The areas that were considered for growth in this scenario are shaded green. These are three sites that have been identified for redevelopment by members of the project team from the SBCCOG. The development profiles for these sites (mixture of uses, density and street patterns) are consistent with plans approved for the Hollywood Park site. The mixture is comprised of retail, parking, single family homes, town homes and office space. Examples of traditional land use types are shown in Figure 6.

Figure 6. Examples of Traditional Land Use Types

Figure 5 Image B shows the Innovative Land Use development assumption. The green color is consistent with the development type in Image A, the orange color represents dense commercial and retail nodes, the purple color represents dense residential; multistory apartment complexes and mixed use residential buildings, and the pink represents medium residential: small plot single family houses and townhomes. Examples of innovative land use types are shown in Figure 7.

Figure 7. Examples of Innovative Land Use Types

Table 3 illustrates the types of transportation projects represented under the "Traditional" and "Innovative" transportation scenarios.

Table 3. Transportation Project Types – Traditional vs. Innovative

Traditional Transportation	Innovative Transportation
Roadway capacity improvements Intersection improvements Corridor Systems operations / ITS Bicycle / Pedestrian improvements Transit improvement	Neighborhood Electric Vehicle (NEV) subsidy
	Street network conducive to NEV use, ex: shared lanes, street punch through
	Charging stations
	Mobility hubs
	Increase in Bike infrastructure

PERFORMANCE MEASURES

A set of performance metrics were recommended based on the SMF performance measures and compared to the performance measures used by Metro in the LRTP as well as by SCAG for the RTP/SCS. In selecting the performance metrics, the intent was to identify a subset of the SMF measures that would be most meaningful in demonstrating the sustainability policies at the sub-regional scale. The recommended metrics are listed in Table 4.

Our approach is based on the review of the 17 SMF performance measures and their recommended metrics, as described in Exhibit 11 of the Smart Mobility 2010: Call to Action.[1] Our initial assessment and recommendation are based upon review of the recommended metrics, the relevance of the performance measure to the scale of the sub-regional analysis and the portfolio scenarios, and

[1] Caltrans. *Smart Mobility 2010: A Call to Action for the New Decade*, February 2010.

available tools and data to calculate the performance measures specific to the South Bay Cities. Our recommendations for performance measures for this study are based on the following set of criteria:

- **Relevance** – Do the performance measures reflect the sub-regional scale and the portfolio scenarios? Are the performance measures directly related to the CSPP principles and SBCCOG strategy?
- **Tools and Data** – Are tools and sufficient data available to determine the performance measures now and to forecast them in the future?

A more detailed description of the selection process used to identify performance metrics can be found in the approach memo (see Appendix B).

Table 4 summarizes the approach, including the recommended performance metrics, tools and data sources.

Table 4. Recommended Performance Metrics

	Principles									
	CSPP			SSB						
Performance Metric	Connect	Create Community	Conserve	Reduce pollutants	Reduce Congestion	Reduce Gas Consumption	Improve Safety	**Project Type**	**Tool/Data**	**Data Acquired**
Average Proximity to Employment (30 min by Transit)	×	×						Land Use Change	Travel Demand Model	Y
Average Proximity to Employment (20 min Drive)	×	×						Land Use Change	Travel Demand Model	Y
Average Vehicle Occupancy (AVO)			×	×	×	×		Park-and-ride lots; Neighborhood Vanpool	2001 Regional Household Travel Survey	Y
Modal Travel Time and Cost	×							Various	Travel Demand Model	Y
NEV, Bicycle, Walking Facilities	×		×	×	×	×	×	NEV lanes, NEV subsidies; bike lanes; PEV Readiness Plan; bike/ped improvements	GIS	Y
Percentage of Trips by Transit				×	×	×		Mobility Hub, Neighborhood vanpool, transit improvements	Travel Demand Model	Y
Percentage of Trips by NEV				×	×	×		NEV lanes, NEV Subsidy; PEV Readiness	SBCCOG Research	Y
Percentage of Trips by Bicycling				×	×	×		Bike lanes, safe routes to school	Census/ACS/LA Bike Model	?
Percentage of Trips by Walking		×		×	×	×		Livable Boulevard, safe routes to school	Census/ACS	Y
Quantities of Criteria Pollutants and GhGs			×	×		×		Various	Travel Demand Model, EMFAC	Y
Vehicle Hours of Delay (VHD) or Person Hours of Delay			×	×	×			Intersection Improvements, Railroad Grade Separations, Corridor System Operations/ITS, Hwy on/off-ramps,	CMF Tool, Travel Demand Model	Y

Performance Metric	Principles							Project Type	Tool/Data	Data Acquired
	CSPP			SSB						
	Connect	Create Community	Conserve	Reduce pollutants	Reduce Congestion	Reduce Gas Consumption	Improve Safety			
Vehicle Miles Traveled (VMT) or Person Miles Traveled			×	×		×		Various	ET+, Travel Demand Model	Y
Vehicle Hours Traveled (VHT)			×		×	×	×	Various	ET+, Travel Demand Model	Y
VMT per Capita by Speed Range			×	×		×		Various	Travel Demand Model	Y
Number of Crashes							×	Various	SWITRS, Travel Demand Model, ET +	N
Number of Vulnerable User Crashes							×	Various	SWITRS, Travel Demand Model, ET +	N

Section 4
Analysis Results

ANALYSIS RESULTS

This chapter presents the results of our analysis applying the Smart Mobility Framework (SMF) principles and performance measures to assess four long range land use and transportation scenarios for the South Bay Cities. The analysis was conducting using the Envision Tomorrow Plus (ET+) scenario planning tool. Details of the analysis and the ET+ Tool can be found in Appendix C. The analysis focuses on two different land use scenarios and two different transportation assumptions in a corridor stretching between Inglewood and Hawthorne; "Hawthorne Corridor" as defined below.

DASHBOARD

The dashboard serves a dual purpose, first it provides a snapshot of key metrics measured in the model, second it allows for further interactive analysis to be completed. The dashboard calculator was constructed on top of the ET+ platform to facilitate our comparison of the performance of both traditional and innovative land use and transportation components. An extensive survey of the available research on the influence of NEV and bicycle projects was used in the construction of the dashboard calculator which captures and operationalize the sensitivities between user defined inputs regarding "innovative" transportation projects (NEV, bicycle, bus and walking projects) with outcomes (VMT, GHG emissions). Figure 8 shows the assumptions used to reflect the NEV and Bike projects and programs based on the available research. The full Dashboard is shown in Figure 9.

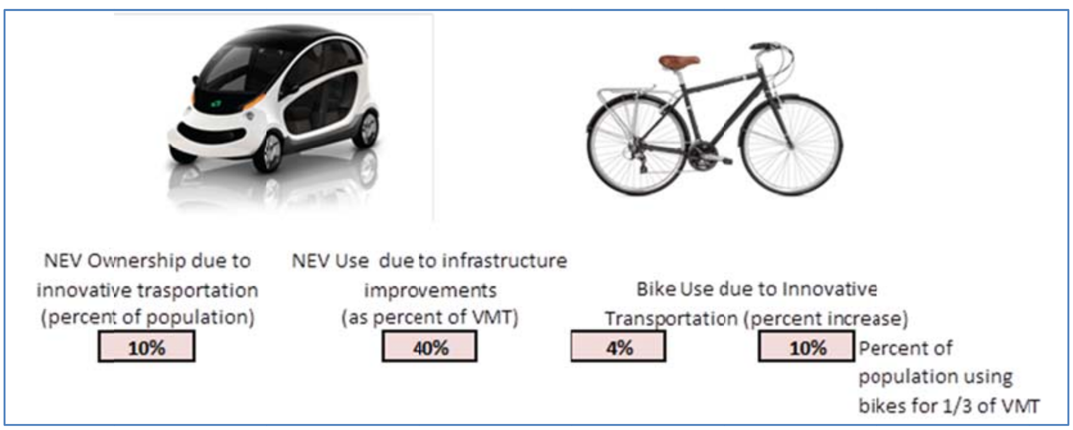


Figure 8. Dashboard Calculator – NEV and Bike Inputs

In scenario planning there are some impacts that can be readily quantified but there are also many hypothetical changes based on behavioral changes. Behavior is influenced by a variety of different factors not just physical infrastructure. Surrounding land use, transportation policy, integration of different networks and cost of transportation are all influencing factors and are fluid and change over time but have a real impact on behavior and travel patterns. This tool serves as a user defined medium to reflect how potential changes in NEV, Bike, Bus and pedestrian activity use will affect other measures such as CO2 and daily VMT per capita. These adjustments serve as a way to capture and quantify hypothetical innovative transportation policy and projects. Examples of potential influencing factors include; NEV subsidy, street network conducive to NEV use and an increase in bike facility per capita, transit hubs, dedicated bus lanes, safe routes to school and sidewalk repairs. Assumptions for the mode share calculations are described in Appendix D.

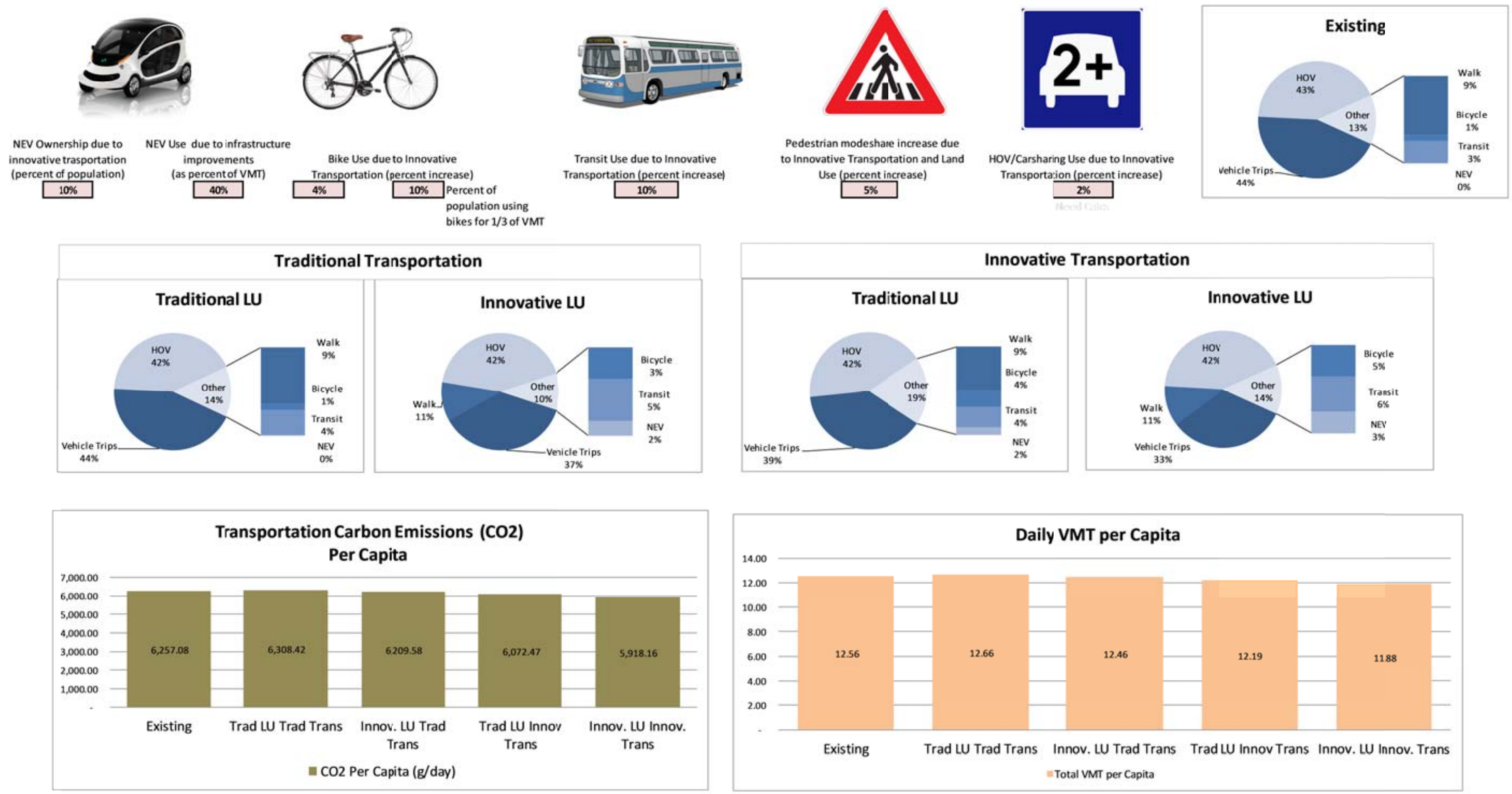


Figure 9. Hawthorne Corridor Dashboard: Comparison of Performance Metrics

As shown in Figure 9, the Hawthorne Corridor Dashboard summarizes and compares the mode share metrics as well as the CO2 Emissions per capita and daily VMT per capita. A closer look at the mode share results in Figure 10 shows that with the adjustments to account for innovative transportation, such as the NEV programs and bike infrastructure improvements, the mode share results in the following:

- Single Occupancy Vehicle Trips
    - Reduced from 44% to 39% with Innovative Transportation
    - Further reduction to 33% with Innovative Transportation and Land Use
- Walking Trips
    - No change from 9% with Innovative Transportation
    - Increase from 9% to 11% with Innovative Transportation and Land Use
- NEV Trips
    - Increase from 0% to 2% with Innovative Transportation
    - Further increase to 3% with Innovative Transportation and Land Use

The Dashboard also includes HOV and transit in the mode share graphics, as placeholders for when additional data and research to support any adjustments is available.

Since the Dashboard Calculator allows the user to define the percent of ownership and use for NEVs and use for bikes, the mode share percentages directly reflect the use by these alternative modes.

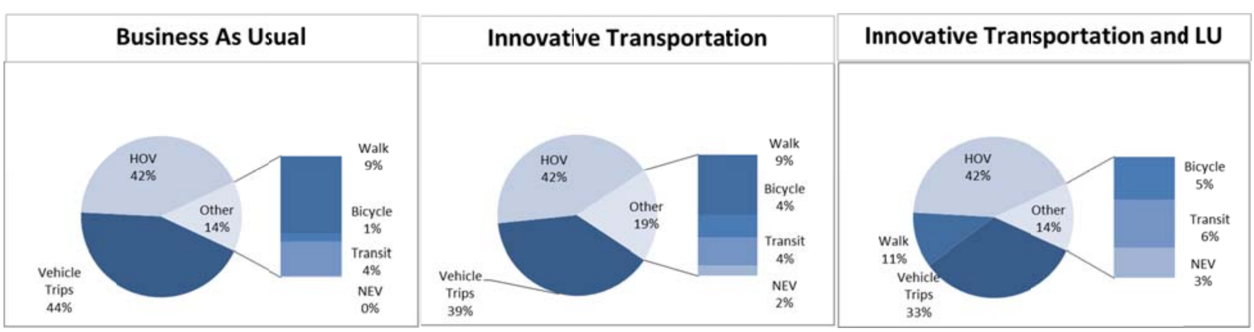


Figure 10. Hawthorne Corridor Dashboard – Mode Share

The Dashboard calculator reports the daily vehicle miles traveled (VMT) per capita for each scenario to reflect the innovative transportation projects. The daily VMT per capita and the percent change relative to the existing conditions are shown in Figure 11. The percent change reflects the effects of innovative land use and transportation with the greater percent reduction with the innovative transportation. The change in land use patterns at the neighborhood nodes results in the greatest VMT reduction. Similarly, GHG emissions per capita decline as the transportation mode shares shift away from single occupant vehicle use and average trip lengths are shortened by the innovative land use scenario.

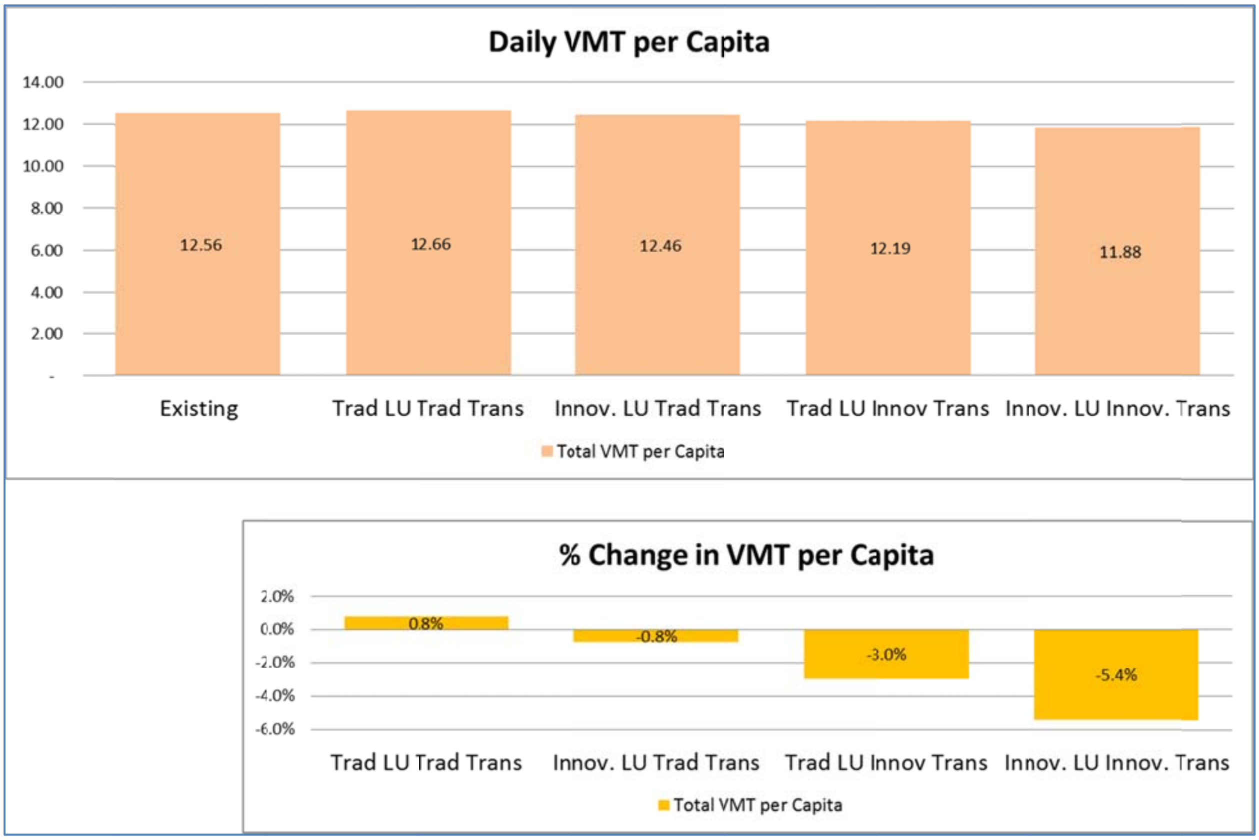


Figure 11. Hawthorne Corridor Dashboard – Daily VMT per Capita

REPORT CARD

The report card (shown in Table 5) serves to holistically illustrate how varying land use and transportation characteristics perform in regards to each measure. As our planning scenarios represent innovative and relatively untested land use and transportation projects (NEV) and profiles, we need to allow theoretical assertions to reside alongside empirical and quantitative measures. Therefore, a report card framework is used to reflect both quantitative and qualitative aspects of the performance of the various scenarios. The report card indicates how various measures may perform under different transportation and land use conditions, as reflected in the SMF/ET+ Model and Calculator outputs. In addition, the Report Card gauges performance in comparison to ideal conditions for each measure:

Existing	**Traditional Land Use**			**Innovative Land Use**		
Quantitative	Quantitative/ Qualitative	*Traditional Transportation*	*Innovative Transportation*	Quantitative/ Qualitative	*Traditional Transportation*	*Innovative Transportation*
		Qualitative	Qualitative		Qualitative	Qualitative

SMF Pilot Area 2 Performance Measures
Study Area 1 - Hawthorne

Measure	Existing: Landuse: B, Transportation: C — Metric	Traditional LU: Directional Change	Traditional LU: Qualitative Assesment — Traditional Transportation	Traditional LU: Qualitative Assesment — Innovative Transportation	Innovative LU: Directional Change	Innovative LU: Qualitative Assesment — Traditional Transportation	Innovative LU: Qualitative Assesment — Innovative Transportation
Average Proximity to Employment (within 30 min drive)	24.1%	↑	C	C	↑↑	B	A
Average Proximity to Employment (within 30 min transit)	2.0%	↓	C	B	↑	B	A
Average Vehicle Occupancy	1.27	=	D	B	↑	C	B
Balanced Modal Travel Cost	$601	=	D	C	↓	C	B
NEV, Bicycle, Walking Facilities	Low	Low	D	B	Low	D	B
Percentage of Trips by Transit	3.3%	↑	C	B	↑↑	B	A
Percentage of Trips by NEV	N/A	N/A	F	D	N/A	C	B
Percentage of Trips by Bicycling	1.0%	=	D	C	↑	B	A
Percentage of Trips by Walking	9.1%	↑	C	B	↑↑	A	A
Quantity of Criteria Pollutants per Capita (g/per)	6,257	↑	C	B	↓	C	B
Vehicle Hours of Delay per Day	1,062.00	↑↑	C	B	↑	C	B
Vehicle Miles Traveled (VMT) per Day	570,873	↑	C	B	↓	B	A
Vehicle Hours Traveled per Day	15,740	↑↑	C	B	↑	A	A
VMT per Capita by Speed Range			C	B		B	A
65+	65%	↑			↓↓		
45-65	3%	↑			↓		
35-45	15%	↑			=		
25-35	13%	↑			↑		
Under 25	4%	↓			↑↑		
Number of Crashes (per/1000)	23	-66%	C	B	-75%	B	A
Number of Vulnerable User Crashes	250	85	C	B	62.5	B	A

Table 5. Report Card for Hawthorne Corridor

In sum, the Report Card reflects metrics from the model while also capturing in a qualitative manner, improvement due to innovative transportation and land use characteristics. The report card provides a framework to measure performance as it relates to ideal conditions as well as giving an indication of the effectiveness of each scenario on various performance measures. The Directional Change provides an indication of the general change in the metric due to the land use changes when compared to existing conditions. A description of the Report Card assumptions for each performance measure is provided in Appendix D.

Directional arrows are an indication of the change that will be garnered from a land use change alone. This reflects that finding from the ET+ model before additional user defined inputs are accounted for. The grades are a qualitative measure of improvement evaluating the combination of the transportation and land use changes. This study attempted to push past the lack of research in emerging areas of sustainable transportation and to incorporate factors that from a theoretical standpoint likely have a direct impact. The grades displayed are also a result of the dynamic nature of the dashboard interface. Particular metrics require the user to perform specific evaluations in order to make a complete determination on the effect that particular innovative transportation projects or policies may have on particular modes.

KEY FINDINGS

The Report Card demonstrates that some of the performance measures are qualitative while others are direct quantifiable outputs from the SCAG model, ET+ Tool, or Dashboard Calculator. In identifying the key performance metrics for this pilot study, the scale of the metrics, which range from local to sub-regional to regional, as shown in Table 6, needs to be considered such that both the regional and local effects of the scenarios on meeting the sustainability goals are captured.

Metric	Source	Measurement Scale
Percent Employment (within 30 min drive)	ET+	Sub-regional/local
Percent Employment (within 30 min transit)	ET+	Sub-regional/local
Average Vehicle Occupancy	SCAG Model	Regional
Balanced Modal Travel Cost	ET+	Local/Sub-regional
NEV, Bicycle, Walking Facilities	Professional Judgment	Local
Percentage of Trips by Transit	SCAG Model/ET+	Local
Percentage of Trips by NEV	SBCCOG	Local/Sub-regional
Percentage of Trips by Bicycling	SCAG Model/ET+/SMC	Local
Percentage of Trips by Walking	SCAG Model/ET+	Local
CO2 emission per Household	ET+	Local/Sub-regional
Vehicle Hours of Delay per Day	SCAG Model	Sub-regional
Vehicle Miles Traveled (VMT) per Day	SCAG Model	Sub-regional
Vehicle Hours Traveled per Day	SCAG Model	Sub-regional
VMT per Capita by Speed Range	SCAG Model	Sub-regional
Number of Crashes (per/1000)	UC Berkeley TIMS, SWITRS/ET+	Local/Sub-regional
Number of Vulnerable User Crashes	UC Berkeley TIMS, SWITRS/ET+	Local/Sub-regional

Table 6. Performance Measures, Source, and Scale

Some of key metrics would include accessibility to employment, mode share by NEV, Bicycling, and Walking, CO2 emissions per household, and VMT to capture regional and local mobility.

Section 5
Evaluation

EVALUATION

The purpose of the pilot area study was to use the SMF principles to more fully integrate sustainability into sub regional transportation and land use planning processes. Specifically, the study objectives were as follows:

- Apply the SMF principles and performance measures to assess future projects for a sub-regional long range transportation plan and compare the outcomes to more conventional transportation performance measures
- Develop a process and tools for analysis of transportation and land use scenarios that reflect Metro's sustainability policies and SBCCOG's sustainability strategies.

This evaluation reflects upon how these two objectives were achieved through this study and presents some of the challenges and lessons learned through the study process.

APPLICATION OF SMART MOBILITY PRINCIPLES AND PERFORMANCE MEASURES

The main objective was to apply SMF principles and concepts as a framework for developing the transportation plan for the South Bay Cities.

Principles. Rather than directly apply SMF principles, this study applied Metro's sustainability principles and Sustainable South Bay principles, which are similar to many of the SMF principles. The SMF principles are a broad framework that is meant to be applied statewide, but allowing for refinement at the regional and local levels to better reflect the local context. The Countywide Sustainability Planning Policy builds on the SMF to create a sustainability framework that is unique to land use, transportation, and demographic conditions in Los Angeles County. The Sustainable South Bay Strategy reflects the unique local context of the South Bay cities.

Place Types. Smart Mobility Place Types were not directly applied for this study. Rather, Metro's Accessibility Clusters were used and the focus was on the Cluster D with high residential density and high job centrality. Metro's "place types" defined as Accessibility Clusters based on residential density and employment centrality were applied. Cluster D within the study area correspond most closely with SMF's Compact Communities place type.

Performance Measures. The performance measure package for this pilot study was developed using the SMF principles. Additionally, since the SMF did not specifically address NEV and fleet electrification, the definition of "multi-modal" was broadened to include NEVs and NEV infrastructure when recommending performance measures to evaluate the sustainability outcomes. The recommended performance measures included 16 quantitative and qualitative measures to demonstrate the different outcomes when comparing the scenarios.

TOOL DEVELOPMENT

The current forecasting and sketch planning tools, including Envision Tomorrow Plus (ET+), Urban Footprint, and Rapid Fire Models, were reviewed. The ET+ tool was selected and enhanced with the Dashboard Calculator to provide an easy-to-use process and tool that evaluates some of the recommended Smart Mobility performance measures in analyzing the scenarios. Combined with the SCAG model data for the more conventional performance measures, the results are summarized in the Report Card.

CHALLENGES AND LESSONS LEARNED

When the work plan was first prepared as part of the RFO process, Metro's Countywide Sustainability Planning Policy was still in development. By the time the detailed work plan was prepared prior to the project kick-off in February 2012, the policy was adopted and was used to develop the objectives for the pilot area study. Some of the challenges and lessons learned through the pilot study are presented below.

Study Area(s)

With the focus on the South Bay Cities as a sub-region, which was too large to cover in its entirety, representative study areas were defined for the analysis. Two study areas were initially defined based on the potential opportunities for neighborhood nodes from the Sustainable South Bay and Accessibility Clusters in the CSPP. The Hawthorne Boulevard Study Area was defined as a linear corridor with an extension to include Hollywood Park, while the Torrance study area included the Green Line station and the Del Amo Mall Expansion. Once the preliminary analysis was completed for the Hawthorne corridor study area, the specific tools and metrics being explored in the pilot study were not able to discern any notable change. The strategies being pursued by the SBCCOG in that study area leaned heavily to technologies and land use distribution changes that have not been researched in sufficient depth to evaluate at the needed precision with the available tools. The Torrance study area was not further studied.

The limitation of having only one study area does not allow comparison of results to other areas within the sub-region. Similarly, it is difficult to infer similarities between this study area and other sub-regions as it is only one data point. The Hawthorne Boulevard Study Area provides a very useful case study of SMF applicability, but the work will need to be expanded in the future before any more universal conclusions are drawn.

Tool Development

From the literature review of best practices and the preliminary investigations conducted for Caltrans Division of Research and Innovation[2], tools to evaluate sustainability are in various stages of development. With SB 375 and AB32, traditional approaches and performance measures are changing, so best practices are being redefined.

Some of the challenges experienced during tool development:

- **Scale.** Various performance measures and tools operate at different spatial resolutions to each other. The approach was to provide a sub-regional analysis allowing the process and tools to be transferrable to other sub-regions. At the sub-regional level, the tool needs to address both regional travel patterns and local neighborhoods and results need to be compared to each other to provide the intended context.
- **Transportation Improvements.** The intent was to assess a 'bundle of improvement projects' rather than specific projects. For the innovative projects, Project Team discussed the level of detail needed by the planning tool for each of the individual project and program. The dashboard tool was developed such that the user could input assumptions about the transportation projects by mode (NEV, Bike, Walk, Transit, and HOV).
- **Platform.** Our evaluation of available sketch planning tools considered ET+ as well as Urban Footprint and other sketch planning models. A criteria for selection should have included the capacity to interface with the sketch planning tool (Urban Footprint) being used by SCAG and other MPOs.
- **Data Collection.** Data collection is costly and time consuming. Existing data sources can provide the necessary input, but need to be available for the entire study area and need to be collected on a cycle that allows the performance measurement program to be repeated at regular intervals. SCAG travel demand model data summarized at the sub-regional scale was used to evaluate the traditional measures as well as provide inputs to the ET+ model.

[2] Caltrans Division of Research and Innovation. *Sustainability Tools and Practices: An Examination of Selected State Departments of Transportation, California Metropolitan Planning Organizations and National Tools*, March 22, 2013 and *Smart Mobility: A Survey of Current Practice and Related Research*, April 25, 2012.

Section 6
Conclusions and Next Steps

CONCLUSIONS AND NEXT STEPS

Long Range Planning Process. The challenge is how to incorporate sustainability into the current LRTP planning processes at a sub-regional scale, including bottom-up from cities and SBCCOG or top-down from SCAG and Metro. The conundrum of the long range planning process needs to be approached as collaboration among all agency partners.

Best Practices / Literature Review. Conventional approaches and performance measures are changing, so best practices continue to be redefined.

Coordination among SBCCOG, Metro, SCAG, and Caltrans D-7. The Project Team includes representatives from several local agencies engaged in transportation planning. Convening this group on a regular basis outside of this study would provide opportunities to address some of the institutional barriers and shared sustainability goals of these agencies at the various levels, particularly those involving overlapping and potentially conflicting performance goals such as target mode splits and land use density patterns.

Within the agencies, like SBCCOG, the study recognizes the varying agendas, specifically, between the Infrastructure Working Group (IWG) with its Public Works Directors and Livable Communities Working Group (LCWG) with planners.

Smart Mobility Principles and Concepts. Smart Mobility 2010 provides a framework that is not intended to be prescriptive allowing for varied approaches to transportation planning as tools and data become available. Because it is a flexible framework, the SMF is adaptable toboth the positive and negative changes in transportation and mobility (specifically, due to technological advances such as NEV's, Google driverless cars, more efficient vehicles, etc.). As conditions continue to change, the priorities of the SMF may need to be revisited over time.

Tool limitations and adaptations. Scenario planning tools have limitations for analyzing performance of innovative transportation projects and programs, like the NEV program, bike lanes, and Safe Routes to School programs. Adapting the tool requires data and research for the tool to be sensitive to new types of projects that address system needs in different ways.

Dashboard Calculator. The Dashboard Calculator provides the platform for future tool development to quantify sustainability. The tool would require more data and validation before the results could be easily incorporated into SCAG planning for future investment decision-making. In addition to the innovative project types, there has not been enough experience evaluating bundles of projects to validate the tool. Ultimately, some of the inputs that are currently needed to make the dashboard function such as specific mode shares need to become an output for the dashboard to be truly informative in the way it was intended.

NEXT STEPS

Current scenario planning tools had limitations for analyzing performance of innovative transportation projects, like the NEV program, bike lanes, and Safe Routes to School program, so the Dashboard Calculator was developed as part of this effort. However, limited data and research was available to support adapting the tool to be sensitive to innovative transportation projects at the sub-regional measurement scale.

Future Development of Tool(s). Future applications include developing a validate-able tool for prioritizing projects with quantifiable metrics. This would require additional research and more data collection. Pilot studies implementing specific new project types and pre- and post-implementation data collection would provide additional data points for validating the tool.

Focus on Specific Performance Metrics. Some of key metrics would include mode share by NEV, Bicycling, and Walking, CO2 emissions per household, and VMT that capture regional and local mobility.

For example, Figure 12 shows how vehicular CO2 emissions vary depending on the speed of the vehicle. This information is essential to this study, specifically in the consideration of future neighborhood electric vehicle (NEV) use. NEVs typically are operated at slower speeds and for shorter trips than the average automobile trip. (SBCCOG, Zero Emission Local Use Vehicles: The Neglected Sustainable Transportation Mode, 2013.) This is significant because, on average, vehicles traveling at speeds under 25 mph emit twice the emissions that a vehicle traveling at speeds over 25 mph would emit. This indicates that NEV use will provide an additional reduction to emissions as would other modes that replace low speed trips. It is important to note that this additional reduction in CO2 emissions is not currently reflected in the model. It is postulated that NEV, bike, pedestrian and zero emission bus trips would net twice the CO2 reduction. The model is structure to measure primary mode choice only so without further modification, it is difficult to quantify the added reduction for zero emission modes. Specifically, more research is needed to differentiate the effect of replacing a car trip with another zero emission mode.

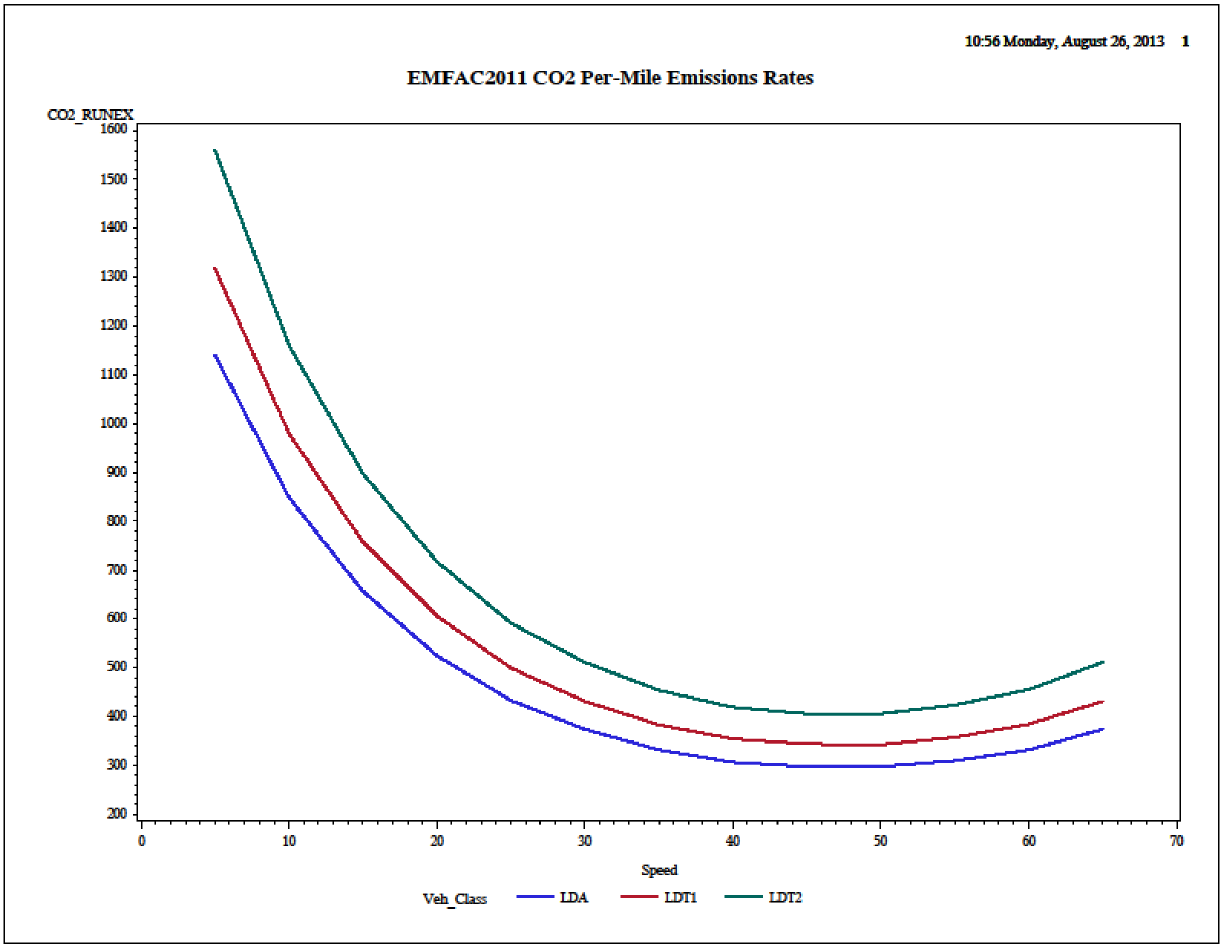


Figure 12. CO2 Per Mile Emission for three vehicle classes at different speeds (Leonard Seitz)

South Bay Strategic Growth Council Grant

The South Bay received a Strategic Growth Council Grant to conduct further studies and develop the tools and framework. Metro, the SBCCOG, San Diego State University (SDSU) and the Los Angeles Regional Collaborative for Climate Action and Sustainability (LARC), a program of UCLA, have formed a partnership, to develop tools to implement the SSBS. The new tools consist of a Sub-Regional Implementation Toolkit to provide technical assistance for local level adoption of GHG reduction strategies and a Mobility Matrix for the South Bay, which includes evaluation and screening criteria for identifying priority projects.

Outreach and Briefings

Overall Study Outreach Approach. The overall outreach for the study starting at Caltrans HQ will be conducted once both pilot studies are completed. Specifically, the schedule has the Draft Report and presentations in September and October and the Final Report and presentations in November and December.

PA2 Outreach. The PA2 Project Team has discussed possible presentations to include:

- Metro's Adhoc Sustainability Committee on July 16
- SBCCOG's Livable Communities Working Group in September (possibly) and invite Infrastructure Working Group and EECAP to attend.

Section 7
References

REFERENCES

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7. U.S. Environmental Protection Agency. Guide to Sustainable Transportation Performance Measures. August 2011. http://www.epa.gov/dced/transpo_performance.htm

APPENDICES

APPENDIX A. DETAILED WORK PLAN – PILOT AREA 2

APPENDIX B. APPROACH MEMO

APPENDIX C. ENVISION TOMORROW PLUS (ET+) DOCUMENTATION

Envision Tomorrow Plus (ET+) is a unique scenario planning tool. This tool interfaces between ArcGIS and Excel to evaluate how changes at the parcel level affect a number of different regional measures. ET+ provides a real-time evaluation of relevant indicators to measure a scenario's performance. Indicators include both VMT and carbon emissions analysis.

ET+ is an open-access scenario planning tool, which allows users to download the software for use within the ArcMap/Excel interface. Both the ArcMap files and Excel spreadsheets can be modified. In this way, ET+ is versatile and expandable, which is a key reason for choosing this particular software package for this project. ET+ requires an initial batch of data to be input that tunes the sensitivity of the model to the particular region that is being studied. The unique inputs for ET+ are customizable allowing exact development type and mixtures to be defined. This allowed for the creation of the two unique land use scenarios that were evaluated in this study. Once the model processed initial results based on land use changes, further modifications were made possible through the supplemental dashboard tool. The dashboard tool allows for user defined modification to the overall results incorporating different transportation assumptions.

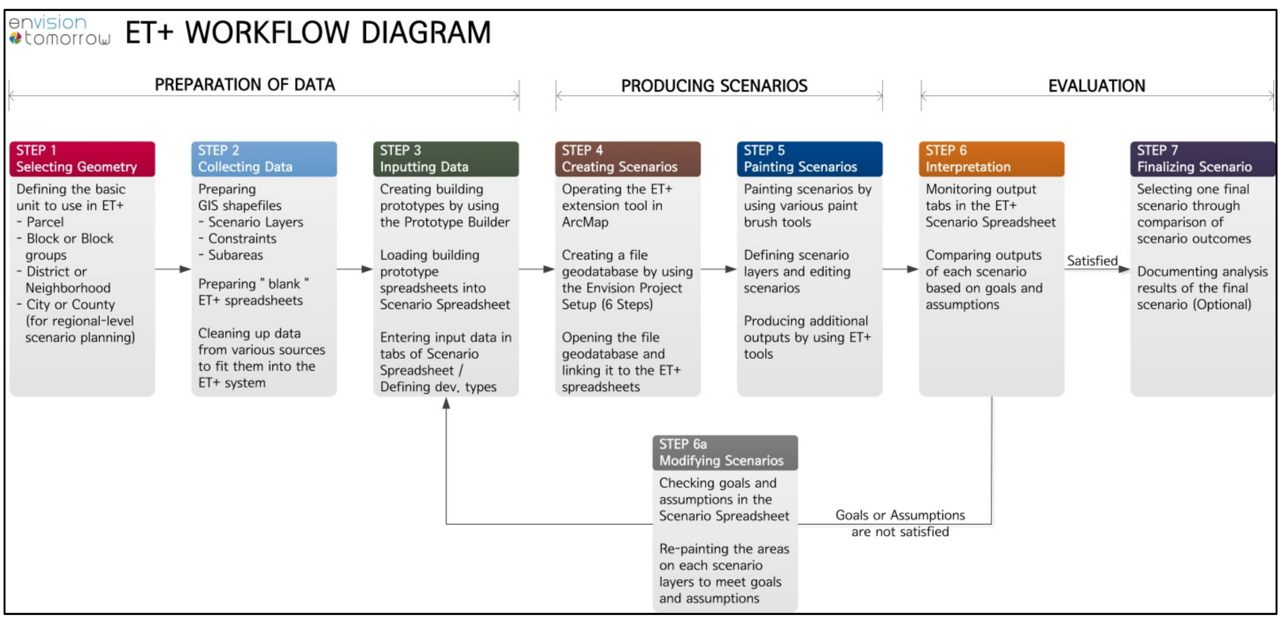

Exhibit C-1. ET+ Workflow Diagram

ET+ provides a real-time evaluation of relevant indicators to measure a scenario's performance. ET+ includes a total of 61 indicators relating to land use, transportation, housing, economy, and environment.

Indicators		Summary_New	Summary_Total
Baseline Info. (7)	Population	●	●
	Net New Population		●
	Displaced Population		●
	School Aged Children		●
	Average Household Size	●	●
	People per Net Acre	●	●
	Housing Units per Net Acre	●	●
Growth (2)	Developed Acres (with %)	●	●
	Infill Development	●	
Land Use (5)	Land Area Mix	●	●
	Land Mix Score(Entropy)	●	●
	Building sqft Mix	●	
	Building sqft Score (Entropy)	●	
	Average Floor Area Ratio (FAR)	●	
Transportation (15)	Walk and Transit Friendliness (0-1 scale)	●	●
	Parking Spaces	●	
	Parking Spaces per 1,000 sq. ft. of Development	●	
	Parking Lot Coverage	●	
	Parking Cost as Percent of Building Value	●	
	New Road Land Miles	●	
	New Road Cost	●	
	Walk Trips		●

	Transit Trips		●
	Vehicle Trips		●

Indicators		Summary_New	Summary_Total
Transportation (15)	Internal Trips		●
	External Trips		●
	Vehicle Miles Traveled (VMT)		●
	Mixed Use District Travel – VMT per Capita		●
	ULI Shared Parking Savings		●
Economy (14)	Employment Mix	●	●
	Employment by Type	●	●
	Net New Jobs		●
	Displaced Jobs		●
	Job-Housing Balance	●	●
	Jobs per Net Acre	●	●
	Household Income Needed to Afford the Average Home Cost in Each Scenario	●	
	Average Wage in Each Scenario	●	
	Subsidy	●	
	Financial	●	
	Subsidy per Unit	●	
	Property Tax Revenue per Acre	●	●
	Sale Tax Revenue per Acre	●	●
	Monthly Household Costs (H+T+E)		●

Housing (11)	Housing by Type	●	●
	Housing Mix	●	●
	Net New Housing Units		●
	Redeveloped Housing Units		●
	Owner/Renter Mix	●	
	Average Rent	●	
	Average Rental Unit Size	●	
	Average Home Price	●	
	Average Owner Unit Size	●	
	Housing Distribution by Income	●	
	Housing by Building Type	●	
Environ. (7)	Impervious Cover of New Development (%)	●	
	Energy Use per Household	●	●
	Carbon Dioxide (CO_2) Emission per Household	●	●
	Landscaping Water Use per Household	●	●
	Internal Water Use per Household	●	●
	Waste Water per Household	●	●
	Solid Waste per Household	●	●
TOTAL (61 Indicators)		**45 Indicators**	**38 Indicators**

(*) Note: Indicators colored in blue are ones that are used in both the 'Summary_New' and the 'Summary_Total' tabs.

ET+ Tool Analysis

ET+ consists of two primary tools: the Prototype Builder and the Scenario Builder. For the purposes of our analysis, the Scenario Builder was used to create the land use scenarios and evaluate each scenario using a set of user-defined benchmarks or indicators.

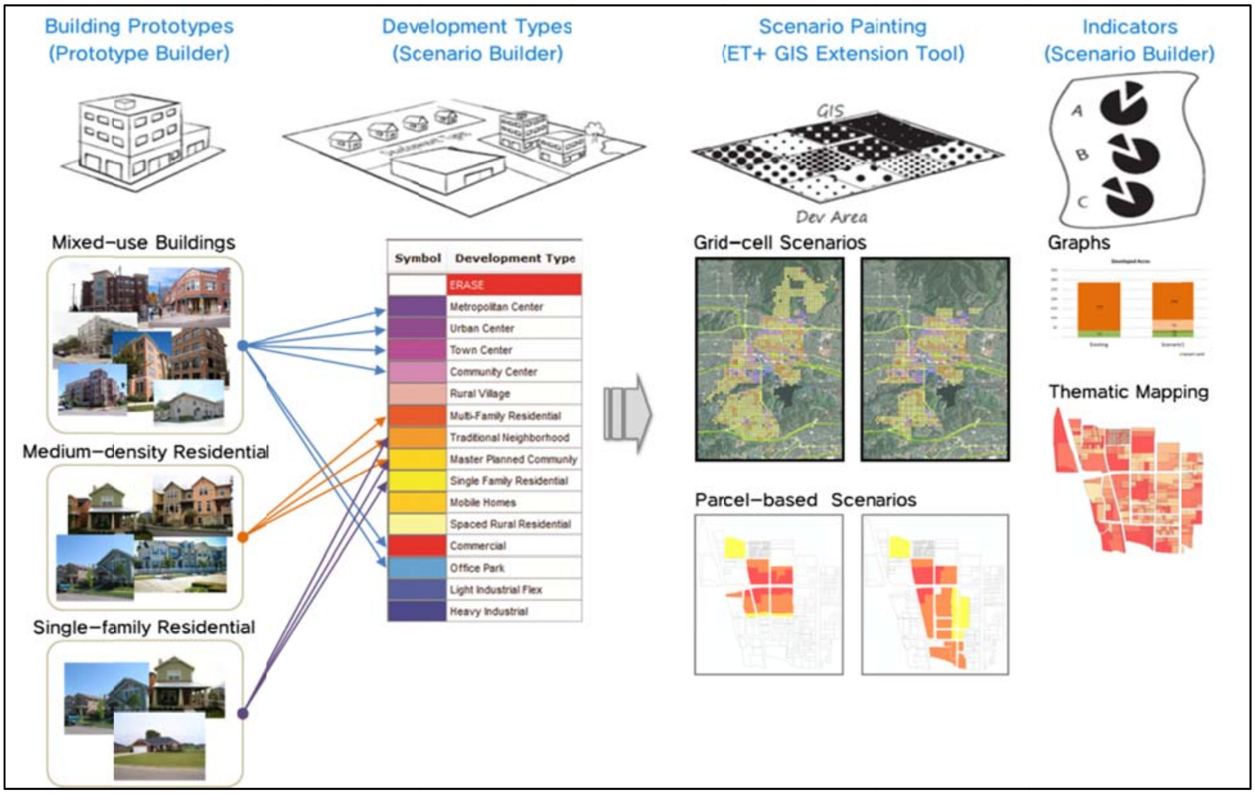

Exhibit C-2. ET+ Model Tools

To create the land use scenarios, data is entered into the ET+ spreadsheets, examples of which are shown in Exhibit C-3 and Exhibit C-4. The basic premise consists of quantifying and capturing various qualities of the existing land use, then replacing chosen parcels with a new set of information that reflects the specified type of development in that scenario. This information is aggregated into the summary total that is then fed into the model. The model examines a total of 61 different indicators grouped into 7 categories: Baseline Information, Growth, Transportation, Land Use, Economy, Housing and Environment. The models utilize these indicators to then calculate the net effects from the existing scenario to the proposed development scenario. This is a two part process; the first step of the model run quantifies changes in land use, housing and demographics, while the second set focuses on the net effects on transportation. This same process is repeated in the second half of the model run in order to examine the net effect that land use changes have on transportation.

The following provide various snap shots of the input and output sheets of the model. Exhibit C-3 and Exhibit C-4 function as the foundation of the different development types. These sheets represent proposed land use change scenarios and translates those into a set of number to feed into the model.

Exhibit C-5 captures the overall characteristic of the region. This information is built into the model from the R&D phase.

2. Enter Development Type Names (Clear Streets)	Block Size					Street Characteristics							
	Block Width 1 (ft)	Block Width 2 (ft)	Buildable Block Area (Sq Ft)	Total block Area (to center line) (Sq Ft)	Total Block Area (Acres)	Number of Drive Lanes	Drive Lane Width	On-street Parking Width	Bike Lane Width	Sidewalk Width	Total Landscaping Width	Total Street Width	Cul-de-sac as percent of all intersections
Hotel 5	350	350	122,500	188,356	4.3	4	10	5	4	12	2	84	0%
Lifestyle Retail Suburban Main Street	350	350	122,500	188,356	4.3	4	10	5	4	12	2	84	0%
Office 5	350	350	122,500	188,356	4.3	4	10	5	4	12	2	84	0%
Mixed-Use Office 5	350	350	122,500	188,356	4.3	4	10	5	4	12	2	84	0%
Mixed-Use Office 15	350	350	122,500	188,356	4.3	4	10	5	4	12	2	84	0%
Conventional Lot Single Family - 6,00	350	350	122,500	188,356	4.3	4	10	5	4	12	2	84	0%
Small Lot Single Family - 4,000 sq ft	350	350	122,500	188,356	4.3	4	10	5	4	12	2	84	0%
Townhomes Medium	350	350	122,500	188,356	4.3	4	10	5	4	12	2	84	0%
Garden Apartment	350	350	122,500	188,356	4.3	4	10	5	4	12	2	84	0%
Apartment 3	350	350	122,500	188,356	4.3	4	10	5	4	12	2	84	0%
Apartment 5 - Wrapped Parking	350	350	122,500	188,356	4.3	4	10	5	4	12	2	84	0%
Apartment 5	350	350	122,500	188,356	4.3	4	10	5	4	12	2	84	0%
Condo 5	350	350	122,500	188,356	4.3	4	10	5	4	12	2	84	0%
Mixed-Use Residential Renter 5	350	350	122,500	188,356	4.3	4	10	5	4	12	2	84	0%
Hollywood Park	350	350	122,500	188,356	4.3	4	10	5	4	12	2	84	0%
Commercial and Retail	350	350	122,500	188,356	4.3	4	10	5	4	12	2	84	0%

Exhibit C-3. ET+ Spreadsheet: Define Development Types

Load Buildings / Clear Buildings	1. Load your Prototype buildings		Housing Type			Residential Rent		Residential Sales Price		
#	Building Name	Dwelling Units / Acre	Type of Housing	Percent Renter	Percent Owner	Rent ($/SqFt)	Avg Rent ($/Mo.)	Sales Price ($/SqFt)	Avg Sales Price ($)	Avg Monthly Mortgage Payment ($)
6	Mixed-Use Office 15	-		0%	0%	$ -	$ -	$ -	$ -	$ -
7	Conventional Lot Single Family - 6,00	5	SF	0%	100%	$ -	$ -	$ 270	$ 567,000	$ 3,399
8	Small Lot Single Family - 4,000 sq ft	12	SF	0%	100%	$ -	$ -	$ 275	$ 495,000	$ 2,968
9	Townhomes Medium	13	TH	0%	100%	$ -	$ -	$ 260	$ 390,000	$ 2,338
10	Garden Apartment	22	MF	100%	0%	$ 1.80	$ 1,980	$ -	$ -	$ -
11	Apartment 3	36	MF	100%	0%	$ 1.65	$ 1,403	$ -	$ -	$ -
12	Apartment 5 - Wrapped Parking	66	MF	100%	0%	$ 1.90	$ 1,900	$ -	$ -	$ -
13	Apartment 5	46	MF	100%	0%	$ 1.90	$ 1,520	$ -	$ -	$ -
14	Condo 5	62	MF	0%	100%		$ -	$ 300	$ 300,000	$ 1,799
15	Mixed-Use Residential Renter 5	57	MF	100%	0%	$ 1.75	$ 1,750	$ -	$ -	$ -
16	Hollywood Park	-			0%		$ -		$ -	$ -

Exhibit C-4. ET+ Spreadsheet: Building Prototypes

HH Travel App Inputs	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Select Project County (or nearest location)	Los Angeles County, California			
Land Use Characteristics				
Employees in Region	650,000	650,000	650,000	650,000
Employees in Study Area	92,864	97,080	92,864	97,080
LN Employees in Study Area	11.44	11.48	11.44	11.48
Employment Density	6,146	6,425	6,146	6,425
% Change in Employment Density	0%	5%	0%	5%
New Employees in Study Area	625	7,552	625	7,552
Population in Study Area	126,497	133,126	126,497	133,126
JobPop	0.43	0.43	0.43	0.43
LN JobPop	-0.85	-0.84	-0.85	-0.84
Area (acres)	9,670	9,670	9,670	9,670
Area (square miles)	15.11	15.11	15.11	15.11
LN Area (square miles)	2.72	2.72	2.72	2.72
Activity Density	14,519	15,237	14,519	15,237
LN Activity Density	9.58	9.63	9.58	9.63
Developed Land Area Mix (Sq Ft)				
Residential Land Area Amount (sq ft)	649,013	7,195,702	649,013	7,195,702
Commercial Land Area (sq ft)	115,217	1,221,783	115,217	1,221,783
Public/Institutional Land Area (sq ft)	156,571	1,985,398	156,571	1,985,398
Total Land Area (sq ft)	920,801	10,402,883	920,801	10,402,883
Land Use Mix (Entropy)	0.50	0.51	0.50	0.51
LN Land Use Mix (Entropy)	-0.69	-0.67	-0.69	-0.67
Residential Unit Mix				
Single Family Residential (du)	22,081	22,236	22,081	22,236
Townhouse Residential (du)	214	938	214	938
Multi-Family Residential (du)	11,138	14,784	11,138	14,784
Mobile Home Residential (du)	0	0	0	0
Total Residential Amount (du)	33,434	37,958	33,434	37,958

Import Scenarios | Clear Input Cells

Exhibit C-5. ET+ Land Use Inputs Scenario Spreadsheet

Exhibits C-6 and C-7 show examples of the outputs on the scenario spreadsheet. These portray the type of information that the model is capable of summarizing for different scenarios.

			Traditional Transportation				Innovative Transportation			
	Business As Usual		Traditional Land Use		Innovative Land Use		Traditional LU/ Innov. Trans		Innov. LU/Innov. Trans	
Commercial Parking	-	0%	-	0%	-	0%	-	0%	-	0%
Total	361,911,569		343,880,652		372,314,452		362,832,370		372,314,452	
Land Mix Score (Entropy)		0.30		0.80		0.79		0.80		0.79

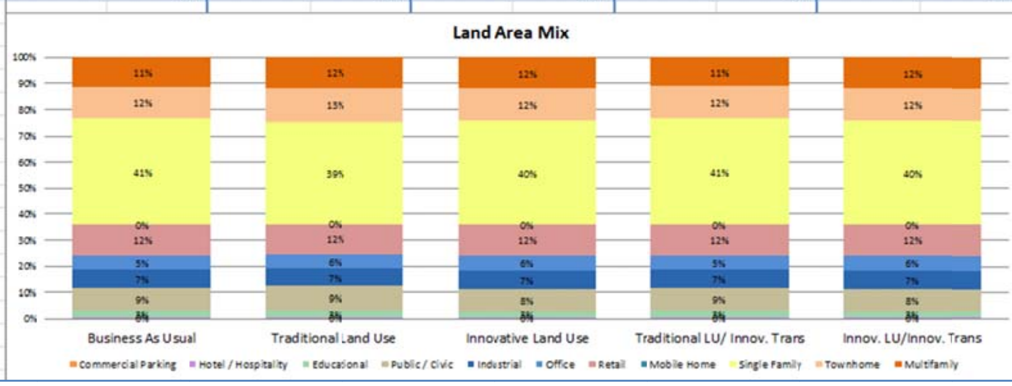

Exhibit C-6. Comparison of Land Use Mix by Scenario

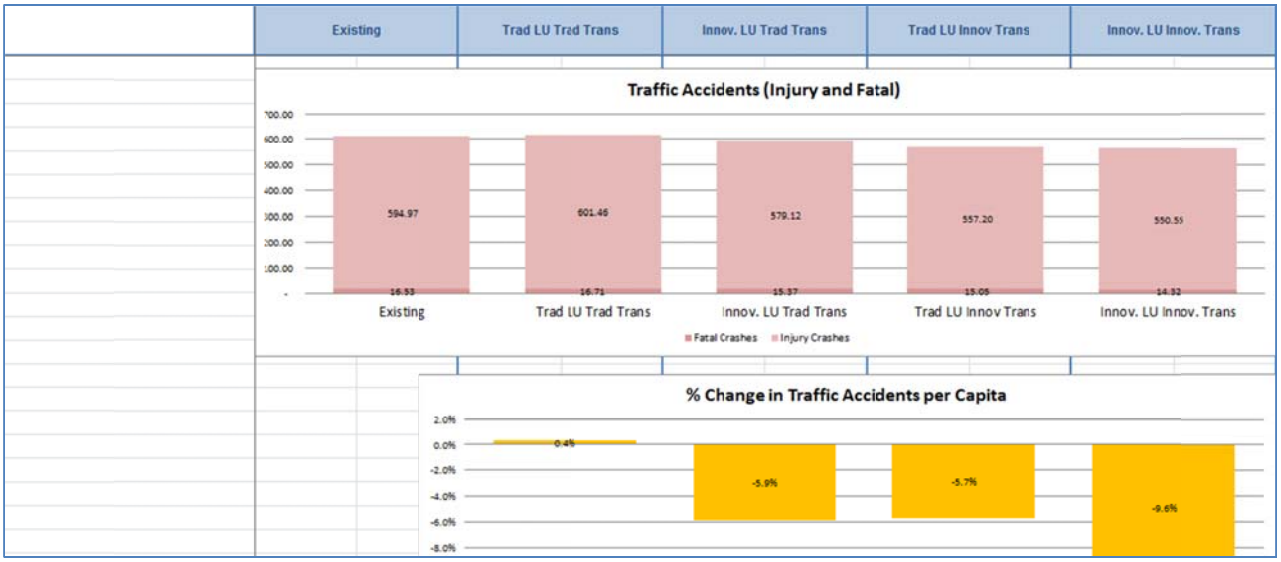

Exhibit C-7. ET+ Indicator: Comparison of Traffic Accidents by Scenario

APPENDIX D. DASHBOARD CALCULATOR / SCORECARD ASSUMPTIONS

Dashboard Calculator

Dashboard Instructions and Assumptions

Dashboard Calculator Instructions:

The dashboard calculator is designed to facilitate the comparison of different potential results due to innovative transportation measures. This comparison is performed on top of both innovative and traditional land use scenarios. User are able to select a percent increase in different alternative modes of transportation at a scale to reflect the level of innovative transportation measure taken.

Dashboard Calculator Assumptions:

This project deals in a developing area of planning research. While theoretically we can assume the direction a policy might have on an outcome variable (NEVs will help lower GHG), there is a degree of uncertainty about the magnitude, which leads us to rely on both qualitative and quantitative measures.

The dashboard reflects quantitative data with the ability for user defined modifications. These modifications are poised to capture potential impacts of four modes of transportation: NEV, Bicycle, Transit and Pedestrian. While the model provides a base line measure for mode share that includes these four modes, there are many potential influencing variables that are, at this time, hard to fully capture. In order to better capture the ambiguity in future travel patterns the dash board has this added post-processing tool.

NEV:
The following displays the assumptions for the NEV post processing calculation:

	Existing	Traditional LU Traditional Transportation	Traditional LU Innovative Transportation	Innovative LU Traditional Transportation	Innovative LU Innovative Transportation
NEV Ownership	1%	1%	User Defined 1-25%	5%	User Defined 1-25%
NEV Use (as percent of VMT)	19%	19%	19%	User Defined 19%-45%	User Defined 19%-45%

Baseline modes share is assumed to be 1%, baseline percent of vehicle miles travels (VMT) replaced by NEV is 19%* (SBCCOG. Zero Emission Local Use Vehicles: The Neglected Sustainable Transportation Mode, 2013.) Based on research we hypothesized that land use has a greater effect on the NEV use while innovative transportation measures and policies has a greater effect on ownership. For traditional land use and transportation we assumed baseline numbers except for the innovative land use/traditional transportation column we assumes a 5% ownership rate as opposed to the baseline of 1%.

Bicycle:

There was less conclusive research available for bicycle use so we provided a broad range for the user to select. The user is identifying the percent of the population that would switch from a car to a bicycle for 1/3 of their VMT. The user selects from a range of 1-25%. This number would reflect an average of both ends of the spectrum: those switching to bicycle for their daily commute and those switching to a bicycle solely for errands or other minor trips. The calculations for the different combinations of innovative/traditional land use and transportation are shown below. We added an additional 50% increase as a scaling factor when there are both innovative land use and innovative transportation factors at play.

	Existing	Traditional LU Traditional Transportation	Traditional LU Innovative Transportation	Innovative LU Traditional Transportation	Innovative LU Innovative Transportation
Bicycle use increase (Percent of population	Model Output	Model Output	User defined (1/3 of 1-25%)	User defined (1/3 of 1-25%)	User defined (1/3 of 1-25% + 50% increase)

Transit:

The ET+ model captures change in transit mode share specifically due to land use, but there are factors beyond what is captured in the model that could influence people to switch from vehicular travel to transit. These factors captures under the umbrella term “innovative transportation” could include transit hubs, dedicated bus lanes, and operational efficiencies (signal prioritization). This portion of the dashboard allows the user to capture these speculative changes. The user selects the percent increase in transit mode share from a range of 1-25%.

	Existing	Traditional LU Traditional Transportation	Traditional LU Innovative Transportation	Innovative LU Traditional Transportation	Innovative LU Innovative Transportation
Transit use increase (Percent of population	Model Output	Model Output	User defined, additional (1-25% of population)	Model Output	User defined, additional (1-25% of population)

Pedestrian:

The model captures change in pedestrian mode share due to land use, but there other contributing factors outside of the model that could influence behavioral change. Safe routes to school projects and programs, road diets, and sidewalk improvements are all factors beyond the model that could influence people to switch from vehicular travel to walking. This portion of the dashboard allows the user to capture these speculative changes. The user selects the percent increase in walking from a range of 1-

25%. We added an additional 50% increase as a scaling factor when there are both innovative land use and innovative transportation factors at play.

	Existing	Traditional LU Traditional Transportation	Traditional LU Innovative Transportation	Innovative LU Traditional Transportation	Innovative LU Innovative Transportation
Pedestrian increase (Percent of population	Model Output	Model Output	User defined, additional (1-25% of population)	User defined, additional (1-25% of population)	User defined, additional (1-25% of population + 50%)

HOV:

There are factors beyond what is captured in the model that could influence people to switch from a single occupancy vehicle to carpooling. These factors captures under the umbrella term “innovative transportation” could additional HOV lanes, carpooling incentive programs, shits due to traffic among others. This portion of the dashboard allows the user to capture these speculative changes. The user selects the percent increase in transit mode share from a range of 1-25%.

	Existing	Traditional LU Traditional Transportation	Traditional LU Innovative Transportation	Innovative LU Traditional Transportation	Innovative LU Innovative Transportation
HOV increase (Percent of population	SCAG Data	SCAG data adjusted	User defined, additional (1-25% of population)	SCAG data adjusted	User defined, additional (1-25% of population + 50%)

Scorecard Assumptions

The scorecard and grade are part of a qualitative, general framework that are meant to help facilitate discussions around various if/then scenarios. These are subjective, user defined. These are allowing for scalability and magnitude effects of if/then scenarios.

Grades are representative of different actions. They are not reflective of hard measures, but are reflective of user-defined qualitative scales of change.

Scorecard Assumptions and Sources:

Average Proximity to Employment (within 30 min drive)

ET+: Percent of regional jobs available within a 30 min drive

Average Proximity to Employment (within 30 min transit)

ET+: Percent of regional jobs available within a 30 min transit ride

Average Vehicle Occupancy

SCAG: average vehicle occupancy

Balanced Modal Travel Cost

ET+: Cost per household

NEV, Bicycle, Walking Facilities

Qualitative Measure based on comparative observation

Percentage of Trips by Transit

SCAG Model/ET+ Calculations: Percentage of total daily trips by transit

Percentage of Trips by NEV

Not sufficient data

Percentage of Trips by Bicycling

SCAG Model/ET+ Calculations: Percentage of total daily trips by bicycle

Percentage of Trips by Walking

SCAG Model/ET+ Calculations: Percentage of total daily trips that are made by a pedestrian

Quantity of Criteria Pollutants

ET+ Scenario Spreadsheet : CO2 Emissions per household (Tons/Year)

Vehicle Hours of Delay per day

SCAG: Hours delay per person day

Vehicle Miles Traveled (VMT) per person

SCAG: Vehicle Miles traveled per person in study area

Vehicle Hours Traveled per PD

SCAG: Vehicle hours traveled per person in study area

VMT per Capita by Speed Range

SCAG: Vehicle miles traveled for selected speed ranges

Number of Crashes (per/1000)

UC Berkeley Transportation Injury Mapping data, SWITRS database; ET+

Number of Vulnerable User Crashes

UC Berkeley Transportation Injury Mapping data, SWITRS database; ET+