TECHNICAL EVALUATION OF THE GREENHOUSE GAS EMISSION REDUCTION QUANTIFICATION FOR THE SAN LUIS OBISPO COUNCIL OF GOVERNMENTS' SB 375 SUSTAINABLE COMMUNITIES STRATEGY

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California Environmental Protection Agency
Air Resources Board

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I. Executive Summary

The Sustainable Communities and Climate Protection Act of 2008 (SB 375) calls for the California Air Resources Board (ARB or Board) to accept or reject the determination of each metropolitan planning organization (MPO), that their Sustainable Communities Strategy (SCS) would, if implemented, achieve the passenger vehicle greenhouse gas (GHG) emission reduction targets for 2020 and 2035, set by the Board in 2010.

For the San Luis Obispo Council of Governments (SLOCOG) region, the Board set passenger vehicle GHG reduction targets at an eight percent per capita decrease in 2020 and an eight percent per capita decrease in 2035. The SLOCOG Board adopted the final Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS), known as *Connecting Communities,* on April 1, 2015. SLOCOG's SCS projects that the region would achieve GHG emissions reductions beyond the established targets, reducing GHG emissions by 9.4 percent per capita in 2020 and 10.9 percent per capita in 2035. SLOCOG transmitted the adopted RTP/SCS and GHG quantification to ARB for review on May 28, 2015.

SLOCOG's RTP/SCS encourages new growth in existing communities and near existing commercial corridors. It builds upon planning concepts that were first introduced with the region's blueprint planning effort, *Community 2050,* adopted in 2008, including the concept of focused growth. The region's 2010 RTP continued to refine that concept with the adoption of smart growth policies. The RTP/SCS establishes Target Development Areas (TDAs) which are existing centers of development within each community, generally served by transit. The RTP/SCS sets forth a plan to invest $2.17 billion for the planning period of 2015-2035, much of it allocated to transit, active transportation and highway improvements. With SCS implementation, SLOCOG projects an increase in the share of multi-family housing in the region's TDAs, close to existing residential and commercial development. The RTP/SCS focuses growth in areas already served by transit. These strategies, together with transportation system management, transportation demand management, and trip reduction programs, are responsible for reducing transportation-related GHG emissions in the region.

This report describes the method ARB staff used to review SLOCOG's GHG quantification as outlined in ARB's July 2011 technical methodology document for SCS evaluation. Specifically, staff reviewed how well the region's travel demand modeling and related analyses provide for the quantification of GHG emission reductions associated with the SCS. This included reviewing data inputs; planning assumptions for future land uses, housing, and transportation policies; and modeling results. This report also describes the results of the technical evaluation which support a Board action to accept SLOCOG's GHG determination.

This staff review concludes that SLOCOG's adopted SCS, if implemented, would achieve the established targets for the SLOCOG region of an eight percent reduction in GHG emissions per capita from 2005 in both 2020 and 2035.

II. San Luis Obispo Council of Governments

A. Background

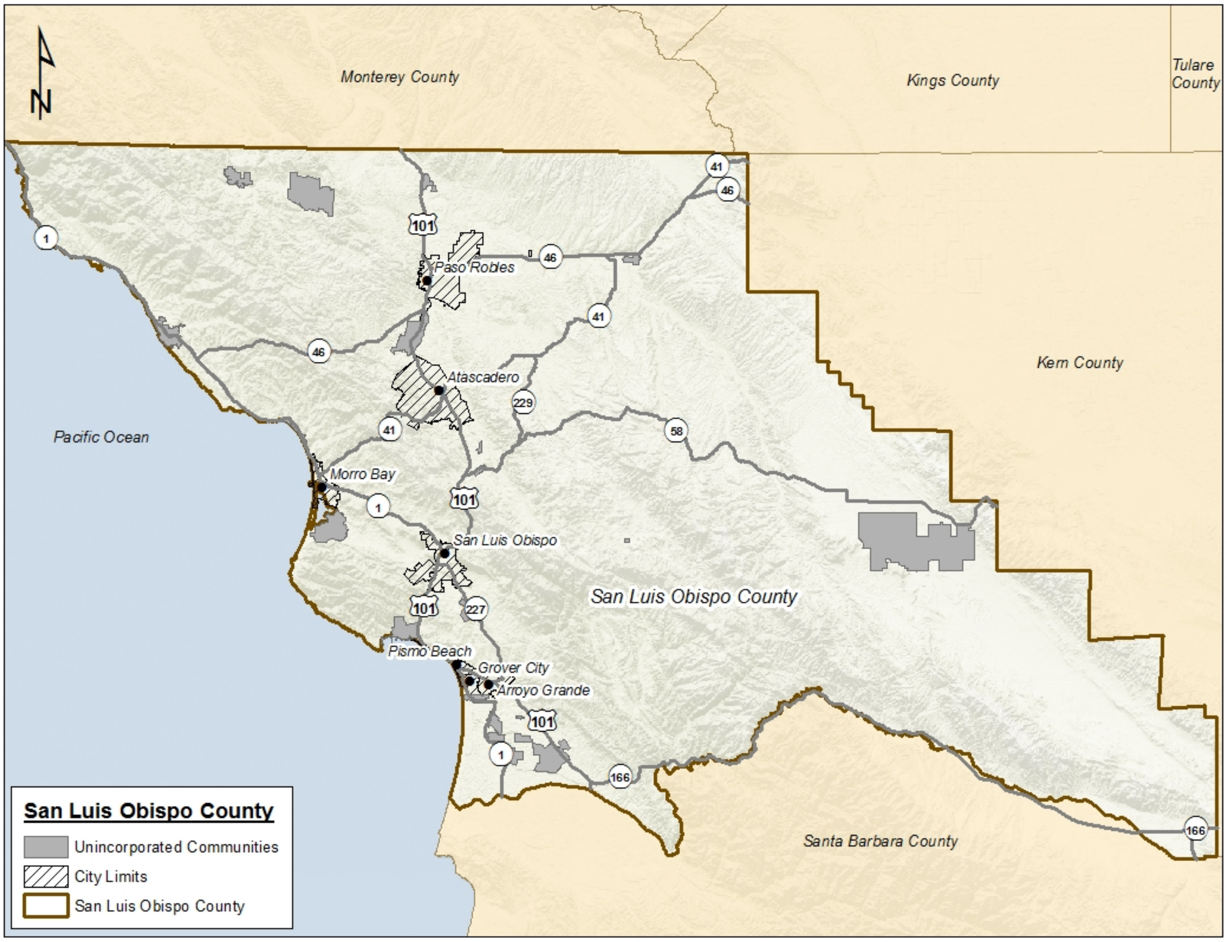
In California, MPOs are responsible for preparing and updating Regional Transportation Plans (RTPs) that include a Sustainable Communities Strategy (SCS), demonstrating a reduction in regional GHG emissions from automobiles and light trucks to meet targets set by ARB.

SLOCOG is the federally designated MPO for San Luis Obispo County (County). The SLOCOG Board of Directors includes 12 delegates; five members from the County Board of Supervisors and one representative from each of the seven cities in the region: Arroyo Grande, Atascadero, Grover Beach, Morro Bay, Paso Robles, Pismo Beach, and San Luis Obispo. Development of SLOCOG's RTP/SCS was conducted through collaboration with member jurisdictions, advisory committees, interested State and federal agencies, and the public. The RTP/SCS provides a set of policies, strategies, and investments to maintain and improve the transportation system to meet the needs of the region for the next 20 years. The RTP/SCS must be updated every four years.

The SLOCOG region encompasses approximately 3,326 square miles along the central California coast. The region's population is largely concentrated in the seven incorporated cities, which accommodate about 56 percent of the total regional population. Unincorporated areas account for the remaining 44 percent. Major urban development in the County primarily occurs along the US 101 corridor, which runs north to south through the region. The largest industries in the region by employment are educational services, health care, social assistance, arts, entertainment, recreation, accommodations and food services. The main transportation facilities in the SLOCOG region include US 101, State Routes 1, 41, 46, as well as various county roads and are depicted in Figure 1 below.

The City of San Luis Obispo in the central part of the County (see Figure 1) is a major employment center, with other concentrations of employment in the north County communities of Paso Robles and Atascadero. Workers commute to employment centers from housing concentrations in the north County, the communities of Morro Bay and Los Osos to the west, and the communities of Pismo Beach, Grover Beach, and Arroyo Grande to the south. Additionally there are some commute trips from the Nipomo Mesa in the far south of the County to employment in northern Santa Barbara County. San Luis Obispo County's location, natural amenities, and temperate weather also make it a popular tourist destination, which results in temporary traffic increases during the peak of the summer tourist season.

Figure 1: SLOCOG Region



Source: SLOCOG 2015a.

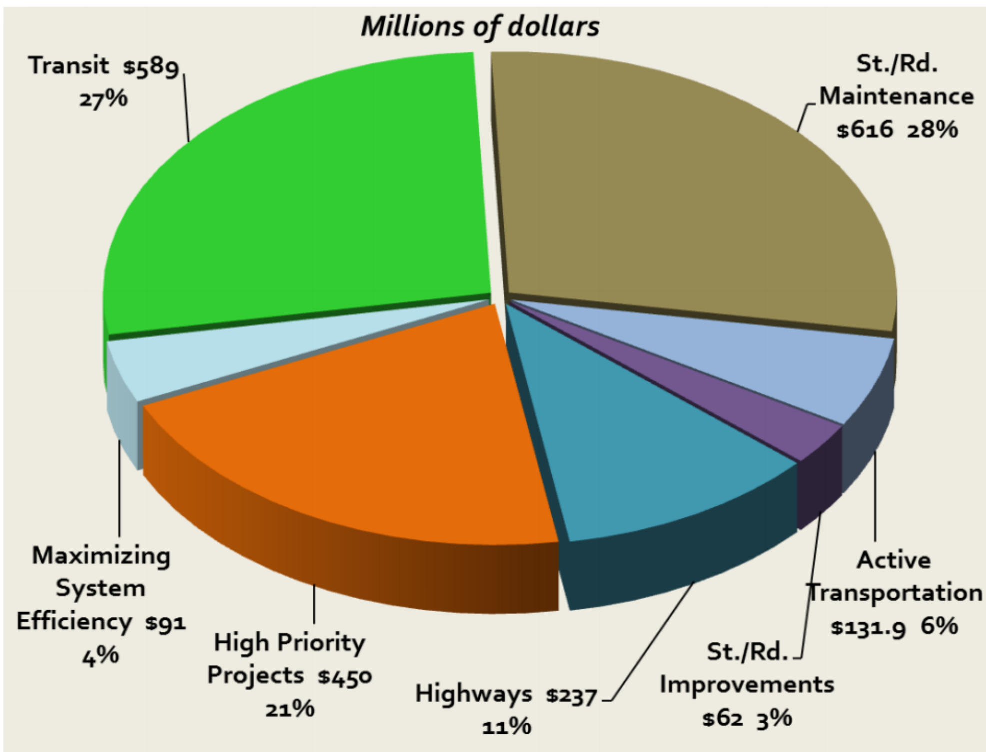
In addition, California Polytechnic State University at San Luis Obispo (Cal Poly)–located just outside the City of San Luis Obispo–has an annual enrollment of about 20,000 students, an on-campus population of about 6,500 students, and employs about 3,000 people in central San Luis Obispo County. The University affects both commuting travel patterns and the supply of housing in the central part of the County.

B. Transportation Planning in the Region

SLOCOG developed its RTP/SCS in close coordination with its member cities, the County, transit operators, Caltrans, the San Luis Obispo Air Pollution Control District, and a wide array of community stakeholders. The RTP integrates the general plans of its member agencies and the transportation investments needed to support the planned growth. The RTP sets forth policy and transportation funding priorities over the next 20 years.

The SLOCOG RTP/SCS includes a constrained transportation scenario with total available funding of $2.17 billion for the planning period 2015-2035. The plan invests over $700 million in transit and active transportation and another $700 million in highway and high-priority projects. The high-priority projects include safety improvements to the State Route 46/41 corridor in the eastern part of the County. Of the remaining amount, $620 million is allocated for roadway maintenance and $91 million to maximizing system efficiency. The RTP/SCS invests a total of 33 percent of the budget in public transit and active transportation. Figure 2 summarizes RTP expenditures by project type.

Figure 2: SLOCOG 2014 RTP/SCS Expenditures by Project Type



Source: SLOCOG 2014.

Funding for transportation projects in the SLOCOG region comes from federal, State, and local sources, including federal transportation funding legislation, fuel taxes, license fees, developer-paid impact fees, and public transit fare revenue. The region has not implemented a self-help taxation measure, which many other regions have implemented to help raise additional transportation revenue. Projecting available transportation funding can be challenging. For example, improvements in fleet fuel economy have resulted in declining fuel sales and a reduction in fuel tax collection. Given this uncertainty, the transportation budget was projected based on revenue sources known to the best of SLOCOG's ability, and was used to develop the financially constrained transportation project list.

III. SLOCOG SCS Planning Process and Development

A. Blueprint Planning and RTP/SCS

Regional Blueprints are collaborative planning processes that engage residents of a region to articulate a vision for the long-term future of their region. The regional vision is developed from residents' values and priorities, and informed by advanced geographic information systems (GIS) modeling and visualization tools that demonstrate the impacts of growth and planning decisions. The blueprint planning process leads to the development of alternative growth scenarios for the region. A preferred growth scenario is selected through a public process that can guide land use and transportation decisions and priorities.

In 2007, SLOCOG began the process to develop a blueprint plan for the region. After extensive outreach to the public, workshops, and working with its member jurisdictions, SLOCOG adopted the long-range blueprint planning document, *Community 2050,* in 2008. The SLOCOG 2010 RTP built upon the blueprint concepts in Community 2050 and included a preliminary SCS, or Pre-SCS.

The *Community 2050* Blueprint and the subsequent Pre-SCS in the 2010 RTP identified TDAs in the County where new compact, mixed use development is encouraged, generally in the vicinity of transit services. TDAs are consistent with local general plans, and are generally located close to and within existing employment centers and residential areas. The 2014 RTP/SCS reflects the strategies developed in the 2010 RTP, including a focus on growth in TDAs.

B. Development and Adoption of the Regional Growth Forecast

SLOCOG contracted with AECOM to develop the 2040 Regional Growth Forecast (2040 RGF). The 2040 RGF updates the previous RGF completed by AECOM in 2009 by adding household projections, extending population and employment projections to 2040, and recalibrating the base household population and total housing units using the data from the 2010 census. A more detailed discussion about the region's population, housing, and employment projections is provided later in this report.

1. Adoption of the 2040 Regional Growth Forecast

The 2040 RGF included low-, medium-, and high-growth scenarios. In July 2011, SLOCOG staff recommended to the Board of Directors that the medium growth scenario for population and employment be approved for use in RTP/SCS development. On August 3, 2011 the SLOCOG Board accepted staff's recommendation and staff began developing regional modeling inputs with the 2040 RGF.

During preparation of the population, housing, and employment inputs for the regional land use allocation tool in late 2013 and early 2014, SLOCOG staff became aware that the growth projected in the adopted medium-growth population scenario of the 2040 RGF was not occurring. Additionally, the observed growth in building permits was not occurring at a pace consistent with the medium-growth scenario adopted in the 2040 RGF. SLOCOG staff believes that the slower-than-anticipated population growth, water availability concerns, and the resulting limitations on new development are responsible for the reduced growth and will persist for a number of years. In April 2014, SLOCOG staff recommended that the Board adopt the low-growth population scenario for use in RTP/SCS development to better match the observed growth and SLOCOG's expectations going forward. Because of the uncertainty in predicting future economic trends, SLOCOG staff recommended that the medium employment growth scenario continue to be used in SCS development. On April 2, 2014 the SLOCOG Board of Directors accepted staff's recommendations to assume low population growth and moderate employment growth in the preferred scenario.

2. Consistency with the Regional Housing Needs Assessment

SB 375 requires the coordination of housing planning with regional transportation planning through the RTP/SCS. The State of California, through the Department of Housing and Community Development (HCD), issued an eight-year Regional Housing Needs Determination to SLOCOG. HCD calculates the amount of housing needed within four income distribution categories based on demographic projection information from the California Department of Finance. According to the housing projections in the RTP/SCS, SLOCOG projects more than the minimum amount of housing to meet the eight-year need within the region as determined by HCD.

C. Development and Selection of the Preferred Scenario

SLOCOG staff developed one future scenario for 2020 and three scenarios for 2035. Only one scenario was developed for 2020 because building activity has been slow since the start of the economic recovery, and the projected development for 2020 is better-understood than for 2035.

The 2035 scenarios assume varying levels of multi-family residential development. Additionally, each 2035 scenario intensifies job growth in urban areas to varying degrees. Each scenario was evaluated using the regional land use allocation tool (CommunityViz). Table 1 below summarizes the future scenarios developed by SLOCOG staff.

Table 1: SLOCOG Future Scenario Characteristics.		
Scenario	**Percent Jobs in New Development**	**Percent New Multi-Family Residential Development***
2020	93	44
2035 Current Trends	85	26
2035 Preferred Growth	90	37
2035 High Intensity	95	45

* Excluding Cal Poly University-associated housing.
Source: SLOCOG 2014.

The regional land use allocation tool identifies the general location of land uses, residential densities and building intensities within the region consistent with current general plans and zoning densities. TDAs are identified within each community and are generally commercial areas and surrounding multi-family residential areas. The TDAs were developed by SLOCOG staff with considerable input from local jurisdiction planning staff and are consistent with local general plans. Because in most cases existing transit service is aligned along corridors within TDAs, intensified development and job growth focused in TDAs will have better access to transit.

Scenario 1, Current Trends continues past growth patterns into the future and is the business-as-usual option. Results from the regional land use allocation and emissions modeling indicate that Scenario 1 is not aggressive enough and barely meets the 2035 GHG per capita reduction target of 8 percent, and was therefore rejected. Scenario 3, the "High Intensity" growth scenario allocates 45 percent of new multi-family housing and 95 percent of new jobs to urbanized areas. SLOCOG staff believes it is unlikely that the region could reach the goal of 45 percent multi-family new housing by 2035 given the observed growth pattern and likely continuation of water restrictions on new growth. This coupled with emissions modeling that indicated Scenario 3 yielded only 0.2 percent additional GHG reductions compared to the preferred scenario, led SLOCOG staff to conclude that Scenario 3, although aggressive was likely not achievable. Scenario 2 allocates 37 percent of new housing and 90 percent of new jobs in urbanized areas and is consistent with SLOCOG's investment strategy. SLOCOG staff judged Scenario 2 as being both aggressive and achievable and was selected as the preferred growth scenario.

1. Characteristics of the Preferred Scenario

The 2035 preferred growth scenario assumes a development pattern that is more compact than the existing condition, and a more compact distribution of future employment. This scenario allocates 37 percent of all new housing as multi-family and 90 percent of all new jobs in urban or urbanized areas. The remaining housing stock is allocated to 12 percent single family attached, 51 percent single family detached and less than 3 percent rural residential. Implementation of the preferred scenario is forecast to result in an increase in the total regional share of multi-family housing to approximately 20 percent. The preferred scenario assumes a reduction in development in the unincorporated area compared to historical trends, and some reinvestment in existing commercial corridors.

2. Public Input

The development of the preferred scenario began by building on the results from the public outreach undertaken with development of the *Community 2050* Blueprint and the *2010 RTP/Pre-SCS*. The outreach for these plans engaged the public and stakeholders through interactive workshops held at multiple locations. Participants in these workshops overwhelmingly indicated a preference for directing new development to existing communities and in more compact development forms than would be indicated by historical trends. At the direction of the SLOCOG Board of Directors, SLOCOG staff started development of growth scenarios for the 2014 RTP/SCS with the preferred scenarios from the two previous planning efforts.

During development of the 2014 RTP/SCS, SLOCOG staff brought each chapter of the plan before the SLOCOG Board of Directors at their public meetings to discuss progress and receive direction from the Board. Outreach was conducted through presentations to various Chambers of Commerce, Community Advisory Committees, and Service Clubs in the communities of Atascadero, Morro Bay, Paso Robles, Pismo Beach, City of San Luis Obispo, Cambria, and Nipomo.

To involve segments of the population that do not normally attend public meetings, SLOCOG developed two web tools to gather opinions and comments. One web tool, the SLOCOG Budget Tool, offered the public information on the fiscal challenges with limited and inflexible funding. The tool allowed respondents to identify preferences and priorities of competing transportation choices including transit. The second web tool, the RTP Project Mapping Tool, gathered public input on specific planned improvements, including active transportation projects, as identified in the Draft RTP/SCS.

SLOCOG conducted a workshop and two public meetings on the Draft RTP/SCS. The first public meeting was held during December 2014 in Grover Beach. The workshop and the second public meeting were held during January 2015 in Atascadero. The SLOCOG Board of Directors adopted the 2014 RTP/SCS at a public hearing held April 1, 2015 in San Luis Obispo.

IV. ARB Staff Review of SLOCOG's GHG Quantification

A. Application of ARB Staff Review Methodology

The review of SLOCOG's RTP/SCS focused on the technical aspects of regional modeling that underlie the quantification of GHG emissions reductions. To assess the technical soundness and general accuracy of the SLOCOG GHG quantification, four central components of the SLOCOG GHG analyses were evaluated: data inputs and assumptions, modeling tools, model sensitivity, and performance indicators. The evaluation of these four components is described below. ARB staff tailored the general methodology in its July 2011 document entitled "Description of Methodology for ARB Staff Review of Greenhouse Gas Reductions from Sustainable Communities Strategies Pursuant to SB 375" to address the unique characteristics of the SLOCOG region and its transportation modeling approach.

ARB staff evaluated how the SLOCOG modeling tools operate and perform in estimating travel demand, and how well they provide for quantification of GHG emissions reductions associated with the RTP/SCS. In evaluating whether the SLOCOG models are reasonably sensitive for these purposes, ARB staff examined how well SLOCOG's travel demand model (TDM) responded to specific changes in input values, as well as how accurately it replicated observed results.

To help address these issues, ARB staff used publicly available information in the SLOCOG RTP/SCS, including RTP technical appendices, the travel model description, and validation reports.

B. Data Inputs and Assumptions

This section describes the demographic, land use, and transportation network modeling inputs and assumptions that underlie the GHG quantification completed for SLOCOG's SCS.

1. Methodology Used in the Regional Growth Forecast

Demographic data describe a number of key characteristics used in TDMs. The TDM uses demographic data to describe where the region's population lives, works, and travels during the planning period .

Population

Population was projected using a traditional top-down approach that starts with the collection and analysis of population projections for the State. With that analysis, controls were established for low-, medium-, and high-growth scenarios. Future "fair shares" of growth in San Luis Obispo County were established using a variety of data sources, historic trends, and projected changes in the region. Future projections of population were established for five year increments using the "fair share" of population growth the County can expect.

Housing Units

Housing units were estimated based on analysis of historic trends to estimate future persons per household, along with vacancy rates. The last 20 years of demographic information, domestic migration, and changes in household formation rates were used to project a 30 year trend in persons per household. This information, together with projected declines in housing vacancy rates, were used to project the total number of housing units in the County in 2035.

To allocate the total housing projections to sub-areas within the County, (i.e. incorporated cities, towns, and unincorporated areas), housing information was provided by local jurisdictions and compared with the top-down estimates to refine previous estimates using a bottom-up approach. The growth forecast suggests very little anticipated development until 2020, with estimated housing unit delivery of about 6,000 to 8,000 units between 2010 and 2040, or an average of about 600-800 housing units per year County-wide.

Employment

Employment projections in the 2040 RGF were developed in two phases: First, total County employment was estimated from an analysis of the economy at both the State and regional levels and California Employment Development Department (EDD) projections. In the second phase, the resulting projected County total employment was allocated by industry to County sub-regions and individual jurisdictions.

EDD provides historic and projected employment estimates for the County. Key growth sectors in the County detailed in the 2040 RGF include education services, health and social assistance, leisure and hospitality, and government. In addition, 1,800 new jobs are estimated for the professional and business services sector and 1,500 new jobs are estimated for the retail trade sector. Five major industry sectors are expected to grow at a slower pace than the regional average, with manufacturing showing a negative growth rate for the forecast period.

EDD projections do not provide data at the sub-County jurisdiction level. To allocate the employment data at this level, additional data sources were used to refine employment projections in specific sectors. The resulting employment projections were provided for low-, medium-, and high-growth scenarios.

2. Results of the Regional Growth Forecast

SLOCOG expects that the region will see an addition of 43,824 residents, 19,930 jobs, and 17,839 housing units between the 2010 base year of the plan and 2035. Table 2 summarizes the population, employment, and housing growth forecasts for the SLOCOG region over the RTP planning horizon. SLOCOG's population projections are within three percent of the California Department of Finance's (DOF) population projections for San Luis Obispo County in years 2020 and 2035 (DOF 2014).

Table 2: SLOCOG Regional Growth Forecast Demographic Assumptions (Population, Employment, Housing)					
	2005	**2010**	**2020**	**2035**	**Percent Change (2010-2035)**
Population	259,213	269,467	284,803	313,291	16%
Employment	100,800	92,471	101,072	112,401	22%
Housing Units	113,466	118,439	125,631	136,278	15%

Sources: SLOCOG 2015b.

As described previously, the regional population forecast was estimated based on a "fair-share" apportionment of the total growth expected in the State under low, medium, and high growth scenarios (AECOM 2011). The regional housing forecast was developed by applying household formation rates from the U.S. Census to the population forecast after adjusting for group quarters population and vacancy data. The SLOCOG Board, at its April 2014 meeting, accepted staff's recommendation to assume the low population and housing growth scenarios and the moderate employment growth scenario because staff and the Board considered these scenarios to most accurately reflect trends in the region.

3. Current and Future Land Use Development Patterns

SLOCOG, with the assistance of Placeways (the software developer), used the CommunityVis Scenario 360 GIS-based land use analysis software to develop its regional land use scenario. The software is a decision support tool that allows SLOCOG to allocate future growth at the parcel level (or to groups of parcels), and which generates performance measures associated with a particular land use scenario, such as dwelling units per acre or total developed acres. The results of each land use scenario were output at the traffic analysis zone (TAZ) level, and were then input and tested with the regional TDM.

Current Land Use: General Plan and Land Use Categories

There are eight jurisdictions in the SLOCOG region (seven incorporated cities and San Luis Obispo County) that adopt unique comprehensive land use plans commonly known as general plans. The land uses identified in these general plans are categorized in a variety of ways by the jurisdictions. Land use information had to be standardized for use in the regional land use allocation tool and the TDM. SLOCOG staff reviewed each jurisdiction's general plan and zoning ordinance to develop a uniform land use classification system to use in the regional land use model.

SLOCOG staff reviewed and aggregated 2011 parcel-level data into groups of similar land use types based on density, zoning, and development features. Once categorized into this uniform land use classification system, land uses were then spatially assigned into TAZs for use in the TDM.

Vehicle Miles Traveled Adjustment Factor

The metric for the GHG reduction target relies on a 2005 base year. SLOCOG used a base year of 2010 for its plan, and did not have a land use model or TDM calibrated to year 2005. To estimate 2005 daily VMT, SLOCOG back-cast VMT from the 2010 base year using an adjustment factor of 5.04 percent that was derived from 2005 and 2010 publicly available highway traffic count data throughout the County. SLOCOG observed a reduction in VMT on the state highway system between 2005 and 2010 that can be attributed to the recession. Therefore, VMT in SLOCOG was higher in 2005 than in 2010 (SLOCOG 2014; Appendix C).

Future Land Use Pattern

The future land use pattern envisioned in SLOCOG's plan anticipates an increase in housing units allocated as multi-family housing and an increase in the share of new employment allocated in existing urbanized areas compared to today and compared to a business-as-usual scenario. The percent change in new housing allocated as multi-family and new employment allocated in urbanized areas is summarized in Table 3.

The share of new multi-family housing presented in Table 3 excludes housing associated with the Cal Poly campus. A substantial portion of the region's new multi-family housing is planned for construction on the Cal Poly campus during the next 20 years, which will free up some of the current supply of off-campus multi-family housing in the City of San Luis Obispo. The region's total share of new housing constructed as multi-family is expected to increase compared to current conditions and compared to historical trends, and total supply of multi-family units will continue to increase. The share of new multi-family units declines slightly between 2020 and 2035 due to the timeline and phasing of projects. The near-term projects that influence the data for 2020 are far along in the entitlement process. This includes several projects in the City of San Luis Obispo, which includes substantial amounts of mixed-use development.

Table 3: SLOCOG Future Land Use Scenario Development

Year	Share of New Housing Allocated as Multi-Family[1]	Share of New Employment allocated in Urbanized Areas
2010 (Base Year)	17%	83%
2020	44%	93%
2035	35%	90%

Notes:
[1] Excludes Cal Poly on-campus multi-family housing.
Source: SLOCOG 2014.

SLOCOG notes that many of its member jurisdictions' zoning codes have been updated to allow mixed-uses. Flexibility in land use regulations, combined with changing housing preferences and previous investments that have revitalized downtown areas have begun to result in more concentrated development patterns in urban areas. These trends are also supported by strong policies to protect agricultural land adjacent to urban areas. Finally, resource constraints, such as water supply have also imposed limits on urban expansion in several communities (SLOCOG 2014).

4. Transportation Network Inputs and Assumptions

The current transportation network for the SLOCOG region is composed of roadways, transit, intercity rail, bicycle and pedestrian paths, and airports. SLOCOG's major roadways and transit routes are depicted in Figure 3, and existing and planned bikeways are depicted in Figure 4. ARB staff reviewed the key transportation network inputs and assumptions used in SLOCOG's TDM. This review included highway and transit network attributes as well as link capacity and free-flow speed assumptions. The review process was based on guidelines outlined in the 2010 California Transportation Commission (CTC) Regional Transportation Plan Guidelines (CTC 2010), National Cooperative Highway Research Program (NCHRP) Report 716[1], and commonly accepted model development practice.

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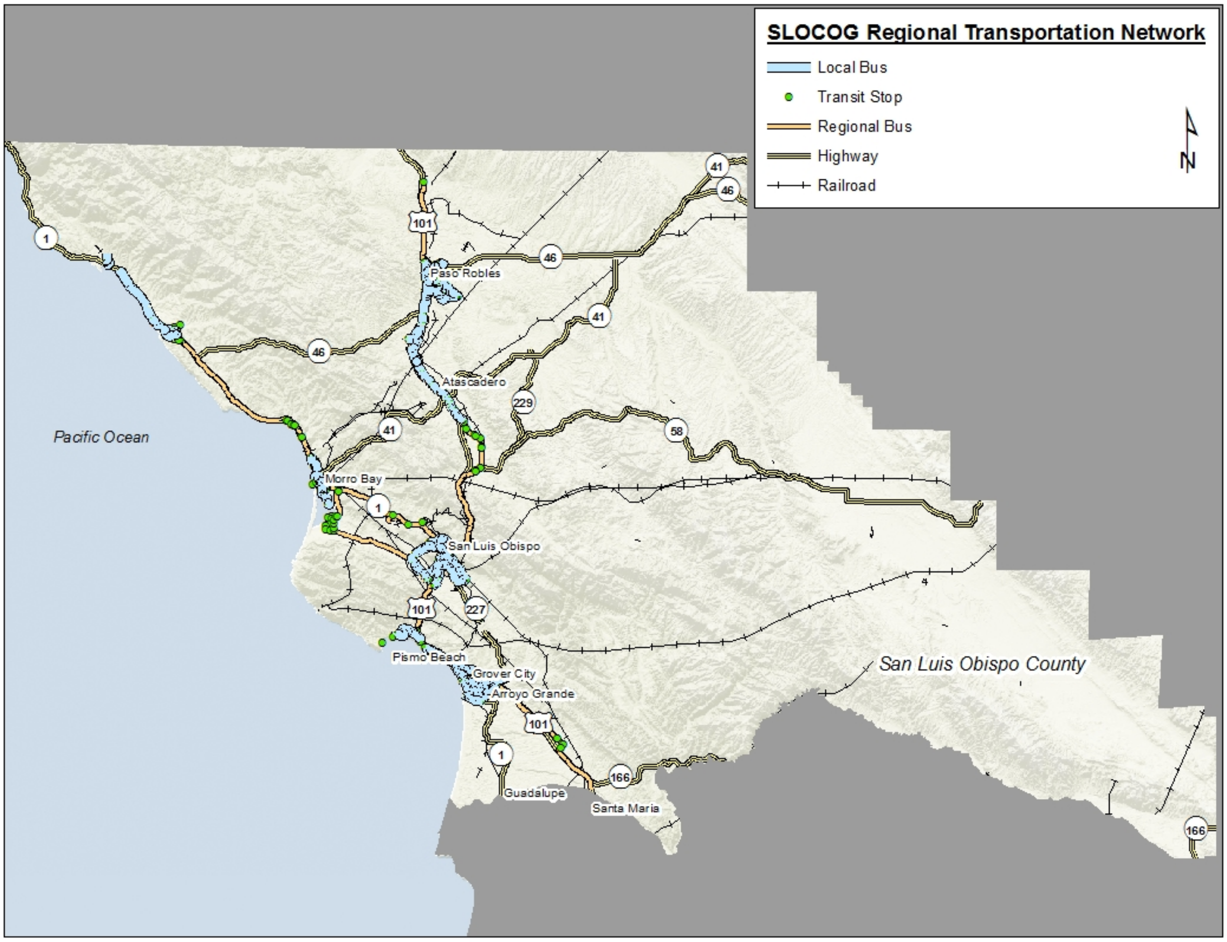
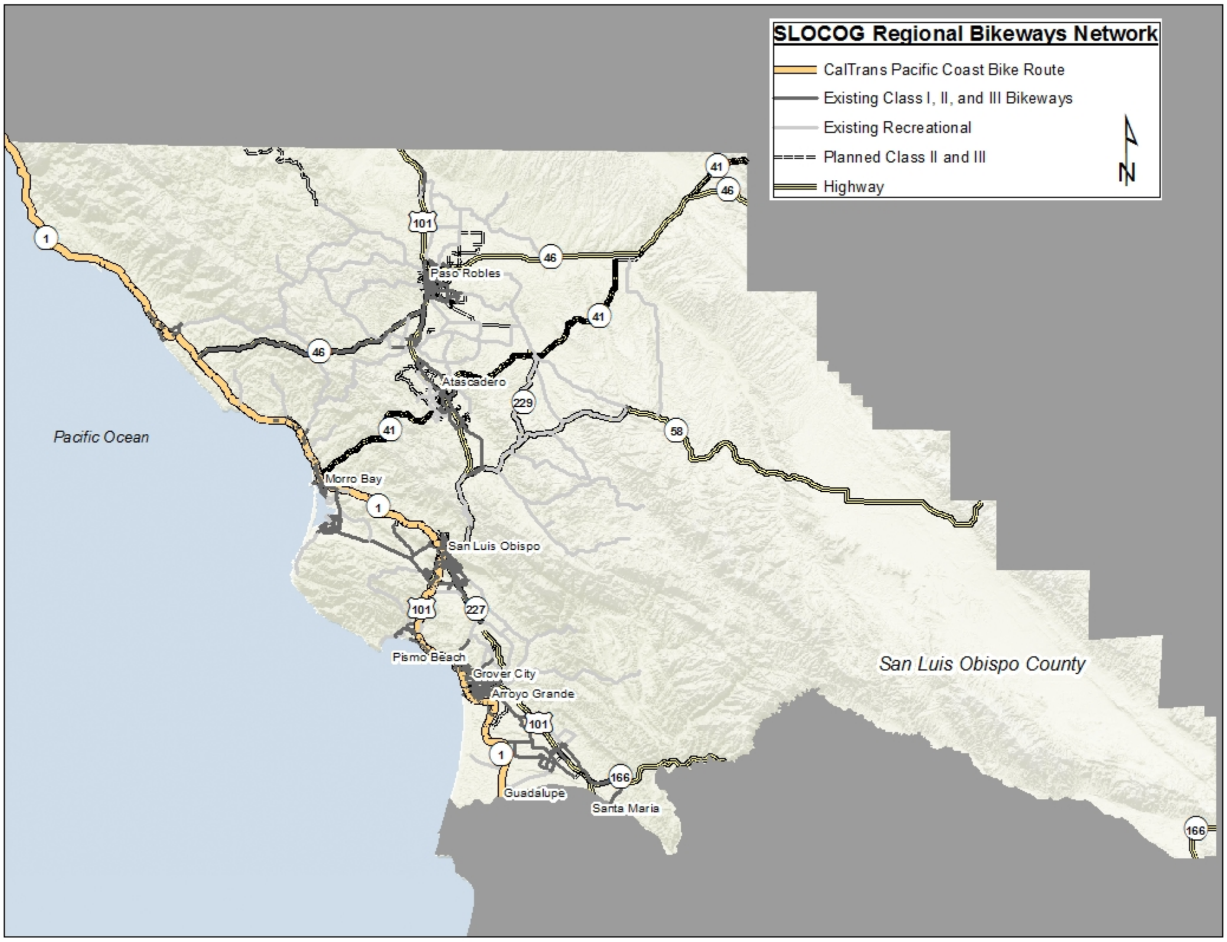
[1] NCHRP Report 716 revises and updates NCHRP Report 365. This report describes travel demand modeling theory and techniques, common applications by transportation planning agencies, and the use of observed data for key modeling parameters at the national level.

Figure 3: SLOCOG Major Roadways and Transit Routes



Source: SLOCOG 2015a.

Figure 4: SLOCOG Existing and Planned Bicycle Network



Source: SLOCOG 2015a.

Highway Network

The highway network coded in a travel model represents the roadway system in a region. The SLOCOG highway network (Figure 3) includes nearly 9,000 lane miles of freeways, highways, arterials, collectors, and local streets. Table 4 summarizes the reported base year lane miles by facility type in the SLOCOG region.

Table 4: SLOCOG Highway Network Lane Miles by Facility Type in 2010	
Facility Type	**Lane Miles**
Freeways and ramps	347
Highways	465
Arterials	675
HOV	--
Rural arterials	319
Collectors	586
Local	6,506

Notes: HOV = high occupancy vehicle.
Source: SLOCOG 2014.

ARB staff reviewed the SLOCOG highway network development methodology and found that SLOCOG's travel modeling procedures followed accepted modeling practice, and its methodology and network coding are consistent with the NCHRP 716 Report.

Link Capacity and Free-Flow Speed

Link capacity is defined as the number of vehicles that can pass a certain point of the roadway at free-flow speed within an hour. TDMs use free-flow speed to estimate the shortest travel time between the origin and the destination of a trip that is assigned to the street network. Terrain variables, which affect speed, are also reflected in SLOCOG's TDM. SLOCOG's link capacity and free flow speed model input assumptions are summarized in Table 5 below.

Table 5: SLOCOG Link Capacity and Free Flow Speed by Facility Type in 2010						
Facility Type	Link Capacity Range by Terrain (vehicles/hour/lane)			Free Flow Speed Range (mph)		
	Flat	Rolling	Mountain	Flat	Rolling	Mountain
Freeway	1,750 to 2,100	1,580 to 1,800	1,310 to 1,500	55 to 70	65 to 70	55 to 65
Highway	1,300 to 1,600	1,060 to 1,300	570 to 700	40 to 45	40 to 45	40 to 45
Expressway	800 to 1,600	650 to 1,300	350 to 700	40 to 55	50 to 65	40 to 55
Arterial	750 to 1,600	610 to 1,300	330 to 700	25 to 45	30 to 45	30 to 45
Collector	700 to 1,600	570 to 1,300	310 to 700	35 to 50	50	25 to 40
Local	600 to 1,100	550 to 1,000	330 to 600	25 to 40	50	25 to 40
Ramps	1,250 to 1,800	1,250 to 1,800	1,250 to 1,500	45 to 50	45 to 50	45 to 50

Source: SLOCOG 2014.

The methodology used to develop SLOCOG's lane capacity assumptions and free-flow speeds are consistent with the 2010 Highway Capacity Manual's suggested procedures for estimating highway capacity and are consistent with acceptable practice as described in NCHRP Report 716.

Transit and Non-Motorized Networks

The transit network attributes in the TDM are built upon the SLOCOG regional roadway network (Figure 3). Attributes that have been coded into the transit network include transit fare, access, and headway information by transit providers. SLOCOG's TDM does not include a transit assignment step, therefore, changes to the transit network attributes would only affect mode split.

In future model updates, SLOCOG should consider including transit routes and stops and bike and pedestrian facilities (e.g. bike path, bike lanes) in the coded transit network to reflect walk- or bike-access to transit stations. These improvements may increase the model's sensitivity to changes in the transit network and transit related assumptions. ARB staff reviewed the inputs and assumptions SLOCOG used in developing its transit and non-motorized networks and found them consistent with acceptable practice as described in NCHRP Report 716.

5. Travel Demand Inputs and Assumptions

Inputs and assumptions used in travel demand modeling, such land use allocations, trip generation rates, and trip assignment factors affect the estimation and forecasting of travel occurring in a region. ARB staff reviewed the inputs and assumptions used in the SLOCOG TDM and compared them with modeling procedures described in NCHRP Report 716, observed household travel data from the 2010-2012 California Household Travel Survey (2012 CHTS), the 2010 U.S. Census, and empirical literature. ARB staff found that input assumptions were reasonable and consistent with these references. The structure and operation of the regional TDM, inputs, assumptions, and model process are discussed further in the following section.

C. Modeling Tools

1. Land Use Allocation Tool

CommunityViz, the regional land use allocation tool used by SLOCOG, was discussed previously in Section B.3., "Data Inputs and Assumptions". The tool distributes households and employment associated with each land use scenario at the TAZ level for input to the SLOCOG regional TDM.

The land use allocation tool is first tested for accuracy in predicting population, household, and employment data against state or U.S. Census data. The tool predicted population about 5 percent lower than the U.S. Census/DOF estimates for 2010 (Table 6). This difference can be explained by different data measured by the Census and the SLOCOG land use allocation tool. SLOCOG staff adjusted the base year population to match the Census data during the land use allocation tool calibration process.

Table 6: Land Use Validation Estimates Before Calibration

Validation Statistic	Model	Census	% Difference	Evaluation Criterion
Total Population	255,317	268,636	-4.96%	+/- 3%
Total Households*	103,814	105,391	-1.50%	+/- 3%

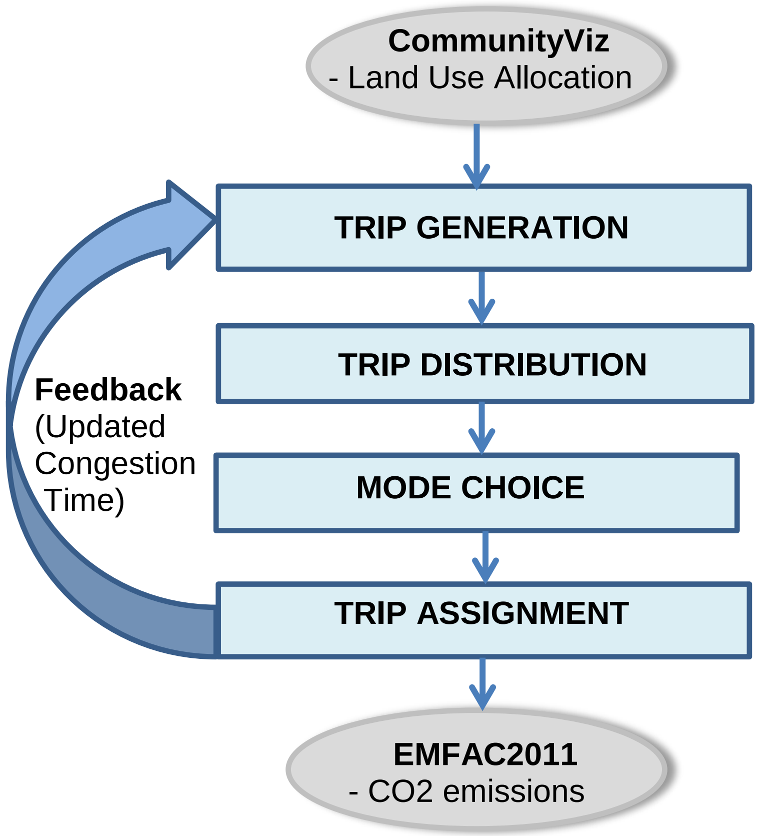
Notes: *SLOCOG model reflects the number of housing units, while the Census reflects the number of households. These data points are not directly comparable.
Source: SLOCOG 2014.

2. Travel Demand Model

The SLOCOG TDM is a TransCAD platform-based model consisting of trip generation, trip distribution, mode choice, and trip assignment steps (Figure 5). The model area includes San Luis Obispo County and its seven cities. There are 2,000 TAZs in the model area. Travel to and from the model area is represented by 100 gateway zones (not included in the 2,000 TAZs that represent the County). The SLOCOG TDM was calibrated and validated using data from the 2012 CHTS, California Statewide Travel

Demand Model (CSTDM), the 2010 U.S. Census, DOF, California Economic Development Department, and local transit and traffic counts (SLOCOG 2014).

Figure 5: Flow Chart of Modeling Process



Trip Generation

Trip generation rates are used in a TDM to estimate the amount of travel demand in a region by trip purpose. SLOCOG used calibrated Institute of Transportation Engineers (ITE) trip generation rates cross-classified by land use and employment category. The trip rates were calibrated to ensure that the number of trip productions and attractions are balanced within the model. Table 7 summarizes the results of the trip production and attractions balancing step.

Table 7: Trip Generation: Productions and Attractions Balance				
Trip Purpose	**Productions**	**Attractions**	**% Difference**	**Evaluation Criterion**
Home-Based-Work	189,857	191,725	-1%	+/- 10%
Home-Based-Shop	226,555	225,552	<+1%	+/- 10%
Home-Based-Other	341,382	362,358	-6%	+/- 10%
Non-Home-Based	355,320	354,393	<+1%	+/- 10%

Source: SLOCOG 2014.

The SLOCOG model also includes interregional trips (i.e., gateway or cordon trips) that cross over the model study area boundaries (i.e., the County border). Interregional trips are sometimes referred to as "internal-external" or "external-internal" trips (abbreviated I-X or X-I trips, respectively). These trips are not calculated using trip generation rates, but rather are derived from the CSTDM developed by Caltrans and updated to represent 2010 conditions. The model includes these trips that cross over the model boundary at fixed gateway zones. There are 10 active gateways in the model that represent the major highways that cross the County border.

During the trip generation step, the SLOCOG TDM uses time-of-day factors to apportion trip departures and arrivals by AM, mid-day, PM, and evening time periods as well as during the AM- and PM-peak hour. These time-of-day factors were calibrated using reported roadway volume data.

Trip Distribution

The SLOCOG TDM uses a standard gravity model[2] method for distributing trips on the roadway network. The gravity model distributes trips from origin to destination zone based on friction factors associated with trip length and travel time. Travel time between zones is initially calculated by the shortest time path along the network. Travel times are updated based on congested network conditions during model feedback loops following the trip assignment step of the model.

Table 8 below summarizes modeled travel times by trip purpose as compared to the results from the CSHTS. Although the model underestimates travel time for the home-based-work trip purpose and overestimates travel time for other trip purposes, these modeled travel times fall within a reasonable range. ARB staff recommends SLOCOG make the TDM sensitive to cost variables (e.g., travel cost, parking cost) in addition to travel time to potentially improve consistency of model results with CHTS data.

[2] A gravity model assumes that urban places will attract travel in direct proportion to their size in terms of population and employment, and in inverse proportion to travel distance.

Table 8: Average Travel Time by Trip Purpose (minutes)					
Home-Based-Work		**Home-Based-Other**		**Non-Home-Based**	
CHTS	**Model**	**CHTS**	**Model**	**CHTS**	**Model**
21.3	17.2	14.1	18.9	11.9	16.1

Source: SLOCOG 2014.

Mode Choice

The mode choice step of the SLOCOG TDM estimates how many trips will occur between zones by each mode. Mode choice is based on travel time between zones for the respective mode based on the network. Four travel modes are modeled in this step of the TDM including auto drive alone, shared ride, transit, and non-motorized (walk and bike). The person trip mode assumptions are summarized below in Table 9 as compared to the results from the CHTS. Overall, the model results generally track with the CHTS data within a 3 percent difference.

Table 9: Person Trip Mode Split Percentages (Average for all trip purposes)		
Mode	**Model**	**CHTS**
Drive Alone	44.0%	42.7%
Shared Ride 2	26.1%	27.5%
Shared Ride 3+	24.5%	23.8%
Transit	0.1%	0.5%
Walk	1.8%	4.4%
Bike	3.5%	1.0%

Source: SLOCOG 2014.

Trip Assignment

The traffic assignment step takes output from previous steps (e.g. trip generation, travel time, mode) to determine flows on the network links and path choice. There are six time periods used in the SLOCOG TDM: AM peak period (6 am to 9 am), PM peak period (4 pm to 7 pm), mid-day period (9 am to 4 pm), off-peak period (7 pm to 6 am), AM peak hour (7 am to 8 am), and PM peak hour (5 pm to 6 pm).

The model uses the User Equilibrium Method in traffic assignment, which begins by assigning all trips to the shortest paths based upon free-flow travel time. Congested travel time is then estimated using a delay function based on the traffic volume assigned to each link in the network. The model uses the Bureau of Public Roads (BPR) formula to estimate congested travel time, which is a common practice among transportation planning agencies. The model runs several feedback iterations using alternate paths until the user equilibrium solution is achieved.

A comparison of the estimated VMT from the model with observed traffic data from the Highway Performance Monitoring System (HPMS)[3] yields a difference outside of the evaluation criteria for Minor Arterials and Collector facilities (Table 10). Freeways and major arterials/highways-the facilities that accommodate most of the region's traffic-were within the evaluation criteria range.

Table 10: Traffic Assignment Volume-to-Count Ratio by Functional Classification

Functional Classification	Model Deviation from Traffic Count Data	Evaluation Criterion
Freeway	+6%	+/- 7%
Major Arterial/Highway	-8%	+/- 10%
Minor Arterial	-18%	+/- 15%
Collector	-38%	+/- 25%

Source: SLOCOG 2014.

The HPMS database relies on samples of roadway volumes that may not be counted every year. Roadway volumes are estimated for roadways that are not actually counted in a given year. Additionally, the HPMS database may not be geographically consistent with the SLOCOG modeling domain. Thus, variations in data collection and quality may explain why the modeled volumes for smaller capacity roadway facilities were outside of the range.

As noted in Table 10, the model is slightly overestimating freeway VMT compared to observed data. SLOCOG indicated that this could be addressed in its model improvement program by adjusting friction factors to better reflect sub-regional willingness-to-travel in respective portions of the region.

Transit Assignment

SLOCOG's TDM does not complete a transit assignment step. Transit ridership between TAZs based on mode choice is the greatest level of detail possible for SLOCOG's model.

Feedback

At the completion of the trip assignment step, estimated congested travel times are fed back into the input travel times at the beginning of the modeling process. The model re-

[3] Highway Performance Monitoring System is a federally mandated program to collect roadway usage statistics for essentially all public roads in the US.

runs all four steps. The model will run the feedback loop for the number of user-specified iterations or until the model converges on equilibrium.

Model Validation

Model validation examines how well the TDM output can replicate observed conditions in the base year. The CTC's 2010 RTP Guidelines recommend both static and dynamic model validation be performed for a region the size of the SLOCOG region. The results of the static validation test are summarized in Table 11. The results indicate the SLOCOG TDM's performance is within the acceptable range as described in the 2010 CTC RTP Guidelines.

Table 11: Traffic Assignment Model Static Validation Test Results

Validation Item	SLOCOG's Model	CTC's RTP Criteria for Acceptance
Percent of links with volume-to-count ratios within Caltrans deviation allowance	77%	≥75%
Correlation coefficient	0.95	≥0.88
Percent root mean squared error (RMSE)	37%	<40%

Notes: CTC = California Transportation Commission; RTP = Regional Transportation Plan.
Source: CTC 2010; SLOCOG 2014.

SLOCOG's total VMT output from the model's major roadways is summarized in Table 12. The deviation from the HPMS VMT data is within an acceptable range.

Table 12: VMT Model Output Validation Test Results

Modeled VMT	HPMS VMT	Model Deviation	Evaluation Criterion
8,208,935	7,810,549	5.1%	+/- 5%

Notes: HPMS = Highway Performance Monitoring System; VMT= vehicle miles traveled.
Source: SLOCOG 2014.

For dynamic model validation, SLOCOG staff changed several model inputs and parameters to test the sensitivity of the model in response to changes in independent variables. As part of model validation, SLOCOG performed dynamic model validation tests by making changes in link capacity and link speed. The model responds as expected to each of the dynamic model validation tests.

Planned Model Improvements

This section describes the planned modeling improvements under consideration by SLOCOG. SLOCOG's TDM already exceeds the applicable requirements of the CTC RTP Guidelines, because it includes a mode choice step. SLOCOG is contemplating the model improvements and adjustments, listed below, to enhance the quality of analytical tools used to inform regional decision makers. Completion of these improvements would be dependent on staff time and resource availability, but SLOCOG expects that many of these data collection and testing-related improvements will be accommodated before the next RTP due in 2019.

- Collect available cost-to-income ratio and commuting costs data, and assign to a geographic area (e.g., planning area, TAZ, or tract) for use in future SCS and RHNA development.
- Develop and update assumptions for income changes.
- Collect and geographically assign parking supply and pricing information for use in RTP/SCS parking pricing policy testing.
- Collect historic and current school enrollment for performance monitoring and reporting.
- Update population, housing, and employment projections (i.e., the RGF).

SLOCOG staff developed the following list of desired tool enhancements for future versions of the land use allocation tool and TDM, but these efforts would be subject to availability of funding to hire contract staff. The following items are SLOCOG's long-term model improvement priorities, but may not be completed prior to the 2019 RTP/SCS, unless funding becomes available.

- Increase the sensitivity of the land use allocation tool to income level information and streamline the outputs from the tool for use in TDM.
- Activate the toll and/or vehicle-travel-pricing utility in the TDM.
- Make improvements to the way the TDM handles group quarters information (e.g., assisted living, military, and universities).
- Calibrate and implement a mode-shift analysis tool to improve the ability to measure the effects of vanpooling and ride-sharing measures.
- Update interregional data in the TDM through incorporating updated data from the California Statewide Travel Demand Model (CSTDM), the Central Coast Origin-Destination study of the U.S. 101 corridor, and allow for adjustable interregional processing.
- Update regional data: Integrate place type and trip distribution based on CHTS data, and improve calibrations for regional travel by adjusting friction factors within the model to better represent VMT and volume on Cuesta Grade (i.e., a steep section of U.S. 101 between San Luis Obispo and Atascadero).

SLOCOG is also contemplating further research on transportation strategies that require off-model adjustments to the GHG quantification, such as studying autonomous vehicles, their infiltration into the vehicle fleet, and their anticipated effects.

ARB supports SLOCOG in their attempts to improve their model, and recognizes that resources are limited. ARB recommends TDM improvements in addition to those that

SLOCOG has already identified. ARB recommends model improvements to increase model sensitivity to transit strategies. This could involve adding a transit assignment step in the model. ARB recommends that SLOCOG prioritize model improvements related to treatment of interregional travel, and strive to incorporate those improvements into their TDM prior to development of the next RTP/SCS. Finally, ARB recommends that SLOCOG include a forecast for auto-operating cost to make the model sensitive to future changes in cost of travel.

3. EMFAC Model

The ARB Emission Factor model (EMFAC2011) is a California-specific computer model that calculates emissions of air pollutants from all on-road motor vehicles including passenger cars, trucks, and buses for calendar years 1990 to 2035. The model estimates exhaust and evaporative hydrocarbons, carbon monoxide, oxides of nitrogen, particulate matter, oxides of sulfur, methane, and carbon dioxide (CO_2) emissions. It uses vehicle activity provided by regional transportation planning agencies such as SLOCOG, and emission rates developed from testing of in-use vehicles. The model estimates emissions at the statewide, county, air district, and air basin levels.

The EMFAC2011 modeling package contains three components: EMFAC2011-LDV for light-duty vehicles, EMFAC2011-HD for heavy-duty vehicles, and EMFAC2011-SG for future growth scenarios. SLOCOG input the estimated regional VMT by speed bin into EMFAC 2011 to estimate GHG emissions for baseline as well as forecasted years for its SCS preferred scenario. The GHG emissions estimates from EMFAC 2011 are presented as tons of CO_2 per day. Finally, the estimated total weekday CO_2 emissions for years 2005, 2020, and 2035 were converted to per capita CO_2 emissions.

D. Model Sensitivity

One component of ARB staff's technical evaluation methodology requires the MPO to perform model sensitivity tests to examine the model's responsiveness to key SCS strategies.

SLOCOG performed a land use model sensitivity test as part of the model development process that was intended to examine the interaction between land use change and its modeled impact on trip generation and associated VMT. This test examined the model's sensitivity to land use in two ways. The first test changes the geographic location of an analysis zone by moving a zone and its associated place type from one geographic location to another that can accommodate that place type while keeping control totals for population, employment, and households unchanged. For example, a mixed-use zone from an urban geography in one part of the model area is moved to a rural geography in another part of the model area. The impact of that geographic change on total trip generation is analyzed. The second test involves changing a zone's land use place type designation without a change in geography. For example, the model developer changes the place type for a particular zone from mixed-use to large format retail. The impact of the change in place type on total trip generation is analyzed.

The model developers analyzed the total net change in trip generation from both the primary zone that was changed and the adjacent zones that were affected. SLOCOG conducted this sensitivity test for 22 zones in the model; 11 tests were conducted for geography changes, and 11 were conducted for place type changes. Table 13 below summarizes sample results from the land use sensitivity test. In general, the results showed that vehicle trips per resident and per employee increased when density decreased (and vice-versa), and the model behaved as expected when place type or geography were switched.

Table 13: Summary of Selected Land Use Sensitivity Test Results

Test	Original TAZ	Original Place Type	Test TAZ	Test Place Type	Change in Vehicle Trips/ (population + employment)
Geography Change	669, Rural, North County (Cambria)	Town Mixed-Use	1860, Rural, North County (Templeton)	Town Mixed-Use	+12.27
Geography Change	559, Urban, North County (Atascadero)	Rural Residential	2008, Rural, South County (Nipomo)	Rural Residential	+14.02
Place Type Change	1376, Urban, North County (Eastern Paso Robles)	Large Lot Residential	1376, Urban, North County (Eastern Paso Robles)	Mixed-Office/R&D	-65.57
Place Type Change	1258 Urban, North County (Western Paso Robles)	Town Mixed Use	1258 Urban, North County (Western Paso Robles)	Retail/Strip Mall/Big Box	+13.86

Source: Fehr & Peers 2015.

E. Performance Indicators

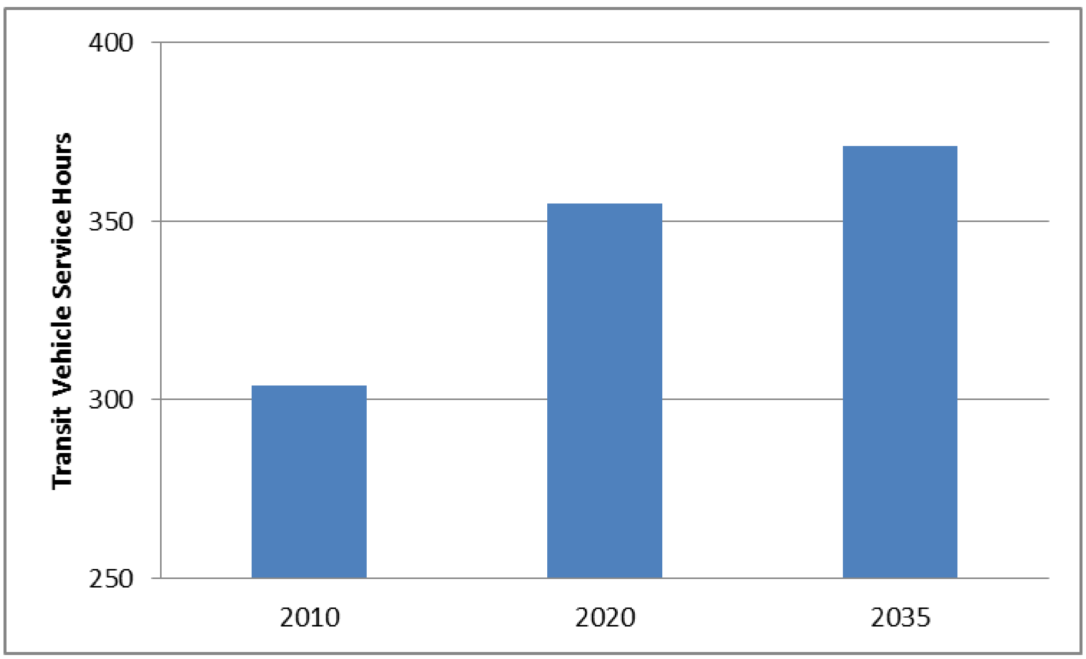
ARB staff evaluated changes in important non-GHG indicators that describe SCS performance. These indicators are examined to determine if they can provide qualitative evidence that the SCS, if implemented, could meet its GHG targets. The evaluation looked at directional consistency of the indicators with SLOCOG's modeled GHG emissions reductions, as well as the general relationships between those indicators and GHG emissions reductions based on the empirical literature as discussed in the ARB-funded policy briefs and corresponding technical background documents. The SCS performance indicators evaluated include transit service hours, residential density, and per capita passenger VMT. The staff assessment relies on key empirical studies for each indicator that illustrate qualitatively how changes in these indicators can increase or decrease VMT and/or GHG emissions.

1. Transit Vehicle Service Hours

Increases in transit service hours offer the opportunity for residents to avoid using single occupancy vehicles for work or shopping trips. Studies have shown that increasing transit service hours or miles increases transit ridership. GHG reductions can result from the increase in transit service hours when fuel efficient transit vehicles are used (Handy and Lovejoy, 2013).

Implementation of SLOCOG's SCS anticipates an increase in both residential density and employment growth in TDAs together with an increase in frequency of existing transit service. Figure 6 summarizes the increase in Total Daily Transit Service Hours in 2020 and 2035 compared to the modeled base year of 2010. This increase in service hours indicates an increase in available transit service in the preferred scenario.

Figure 6: SLOCOG Transit Vehicle Service Hours



Source: SLOCOG 2015b.

2. Residential Density

Residential density is a measure of the average number of dwelling units per acre of developed land. When residential density increases, it is expected to change travel behavior including reductions in average trip length, and eventually a decrease in regional VMT, which is supported by relevant empirical literature. Brownstone and Golob (cited in Boarnet and Handy 2014) analyzed National Household Travel Survey (NHTS) data and observed that denser housing development reduces annual VMT and fuel consumption, which directly results in the reduction in GHG emissions. They also reported that households in areas with 1,000 or more units per square mile drive 1,171 fewer miles and consume 64.7 fewer gallons of fuel than households in less dense areas. Boarnet and Handy (2014) reported that doubling residential density reduces VMT an average of 5 to 12 percent.

The share of multi-family housing directly impacts the residential density in a given area, and implementation of the SCS would result in more multi-family housing. Table 14 shows the increased share of multi-family housing toward the regional total in 2020 and 2035 compared to 2010 both with and without the contribution of on-campus housing associated with Cal Poly. As discussed previously, Cal Poly serves about 20,000 students annually, but only about 6,500 reside on campus. The remaining student population represents additional demand for housing; usually lower cost and higher density.

Table 14: Total Regional Share of Multi-Family Housing

Share of Total Housing that is Multi-Family	2010	2020	2035 Preferred Scenario
With Cal Poly	21.6%	23.6%	25.0%
Without Cal Poly	17.3%	18.6%	19.6%

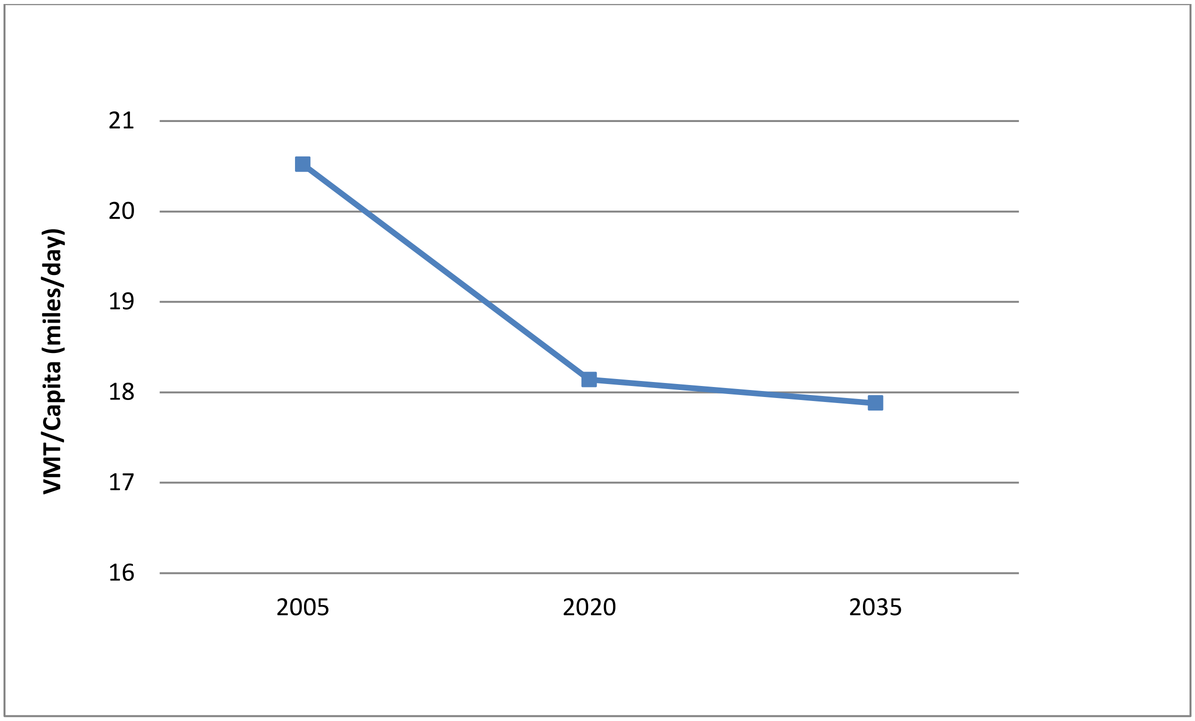
Source: SLOCOG 2015b.

SLOCOG's SCS focuses both housing development and employment growth in TDAs and urbanized areas, with the preferred scenario allocating 35 percent of new multi-family housing and 90 percent of all new employment to urbanized areas. This more compact development pattern offers the opportunity for workers to live closer to, and travel shorter distances to work, reducing GHG emissions. By locating TDAs in and near existing commercial and residential development in the urban areas, travel to other destinations, such as schools, shopping, and entertainment can be reduced.

3. VMT per Capita

The SLOCOG 2014 RTP/SCS shows a decline in per capita passenger vehicle VMT between 2005 and 2035, as show in Figure 7. Per capita VMT decreases by 11.6 percent and 12.9 percent between 2005 and 2020 and between 2005 and 2035, respectively. These results are directionally consistent with and support SLOCOG's reported GHG emissions reduction trend over time.

Figure 7: SLOCOG per Capita Passenger VMT



Source: SLOCOG 2015b.

The per capita CO_2 emission reduction targets that ARB set for the SLOCOG region are eight percent by 2020 and eight percent by 2035. SLOCOG estimates that the SCS would achieve a 9.4 percent CO_2 per capita reduction from 2005 in 2020 and a 10.9 percent CO_2 per capita reduction from 2005 in 2035.

V. Conclusion

This report documents ARB staff's technical evaluation of the SLOCOG's RTP/SCS. This evaluation affirms that SLOCOG's SCS would, if implemented, meet the Board-adopted per capita GHG emissions reduction targets of eight percent in both 2020 and 2035, compared to 2005.

VI. References

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SLOCOG. See *San Luis Obispo Council of Governments*.

APPENDIX A: SLOCOG RTP/SCS Data Table

SLOCOG 2014 Analysis Outputs	**2005** (not modeled)	**2010** Base Year	**2020** Scenario	**2035 S1** (Business As Usual)	**2035 S2** (Recommended Scenario)
DEMOGRAPHICS					
Total population	259,213	269,467	284,803	314,105	313,291
Group quarters population	15,840	16,596	18,071	19,436	19,436
Total employment (employees)	100,800	92,471	101,072	112,434	112,401
Average unemployment rate (%)	4.3%	10.0%			
Total number of households		100,605	105,883	114,434	114,415
Persons per household		2.51	2.64	2.62	2.61
Population density (people per sq. mile)		248	261	286	287
Auto ownership per household		2.04	2.04	2.04	2.04
Median household income (2010 $)		$57,365	$57,365	$57,365	$57,365
Total college enrollment		30,588	39,813	50,000	50,000
Cal Poly-SLO enrollment		19,000	24,000	30,000	30,000
Cuesta College enrollment		11,588	15,813	20,000	20,000
Total on-campus beds (dorms)		6,247	7,722	9,087	9,087
LAND USE					
Total acres within MPO *(in thousands)*		3,290	3,290	3,290	3,290
Total resource area acres (CA GC Section 65080.01)		**578,756**	**583,446**	**586,298**	**586,295**
National Forest		231,439	231,439	231,439	231,439
National Monument		226,752	226,752	226,752	226,752
State Parks		15,075	15,075	15,075	15,075
Publicly-accessible open space		87,345	91,517	91,517	91,517
Neighborhood open space		9,186	9,704	12,556	12,553
Other resource areas		8,959	8,959	8,959	8,959
Total farmland acres (CA GC Section 65080.01)		**1,093,963**	**1,093,288**	**1,091,035**	**1,091,239**
Grazing and Ranch Lands		1,020,004			
Irrigated Agriculture		9,479			
Vineyard		54,424			
Winery		454	454	454	454
Other Agriculture		9,602			
Total developed acres		**1,044,686**	**1,060,285**	**1,066,716**	**1,063,912**

SLOCOG 2014 Analysis Outputs	**2005** (not modeled)	**2010** Base Year	**2020** Scenario	**2035 S1** (Business As Usual)	**2035 S2** (Recommended Scenario)
Total non-residential developed acres (employment)		348,852	363,022	363,956	363,994
Total residential developed acres		695,834	697,263	702,760	699,918
SF Detached		33,773	34,355	37,170	36,374
SF Attached		668	822	984	1,045
MF Residential		1,511	1,746	1,927	2,151
Mobile Home [MHP]		980	980	980	988
Rural Residential		658,943	660,175	663,680	661,267
Total housing units		**118,439**	**125,631**	**136,279**	**136,278**
SF Detached		67,081	69,505	75,861	74,560
SF Detached (Large-Lot)		49,700	51,652	57,488	56,123
SF Detached (Small-Lot)		17,203	17,827	18,617	18,793
SF Attached		7,809	8,480	9,341	9,285
MF Residential		25,631	29,615	32,484	34,045
On-campus student housing		6,247	7,722	9,087	9,087
Mixed-use units		1,445	2,096	2,081	2,809
Other MF Residential		17,939	19,797	21,316	22,149
Mobile Home [MHP]		7,772	7,772	7,772	7,824
Rural Residential		10,146	10,260	11,095	10,565
New housing units		**--**	**7,192**	**17,840**	**17,839**
SF Detached		--	2,424	8,780	7,479
SF Detached (Large-Lot)		--	1,952	7,788	6,423
SF Detached (Small-Lot)		--	624	1,414	1,590
SF Attached		--	671	1,532	1,476
MF Residential		--	3,984	6,853	8,414
On-campus student housing		--	1,475	2,840	2,840
Mixed-use units		--	651	636	1,364
Other MF Residential		--	1,858	3,377	4,210
Mobile Home [MHP]		--	-	-	52
Rural Residential		--	114	949	419
Share of new housing units		**--**	**100.0%**	**100.0%**	**100.0%**
SF Detached		--	33.7%	49.2%	41.9%
SF Detached (Large-Lot)		--	27.1%	43.7%	36.0%
SF Detached (Small-Lot)		--	8.7%	7.9%	8.9%
SF Attached		--	9.3%	8.6%	8.3%

SLOCOG 2014 Analysis Outputs	**2005** (not modeled)	**2010** Base Year	**2020** Scenario	**2035 S1** (Business As Usual)	**2035 S2** (Recommended Scenario)
MF Residential		--	55.4%	38.4%	47.2%
On-campus student housing		--	20.5%	15.9%	15.9%
Mixed-use units		--	9.1%	3.6%	7.6%
Other MF Residential		--	25.8%	18.9%	23.6%
Mobile Home [MHP]		--	0.0%	0.0%	0.3%
Rural Residential		--	1.6%	5.3%	2.3%
Residential density in urban areas (du/sq. mi.)		**2,118**	**2,227**	**2,214**	**2,304**
Residential density in urban areas (du/ac)		**3.31**	**3.48**	**3.46**	**3.60**
SF Detached		2.41	2.46	2.50	2.51
SF Attached		11.78	8.78	9.61	9.32
MF Residential		18.40	18.40	18.41	17.17
Mobile Home [MHP]		8.66	8.66	8.66	8.64
Total single-family detached housing units		**77,227**	**79,765**	**86,956**	**85,125**
Rural residential units (2-acre lots and above)		10,146	10,260	11,095	10,565
Total single-family detached housing units		67,081	69,505	75,861	74,560
Large-lot single-family detached units (between 6,000 sq. ft. lot and 2-acre lots)		49,700	51,652	57,488	56,123
Small-lot single-family detached units (smaller than 6,000 sq. ft. lot)		17,203	17,827	18,617	18,793
Total single-family attached housing units		7,809	8,480	9,341	9,285
Total multi-family housing units		25,631	29,615	32,484	34,045
On-campus student housing		6,247	7,722	9,087	9,087
Mixed-use units		1,445	2,096	2,081	2,809
Other multi-family units		17,939	19,797	21,316	22,149
Mobile Home Park units (in MHPs)		7,772	7,772	7,772	7,824
Single-family/multi-family ratio		3.62	3.24	3.20	3.00
Region's NEW housing units that are multi-family (w/Cal Poly housing)		--	3,984	6,853	8,414
Share of region's NEW housing units that are multi-family (w/Cal Poly housing)		--	55.4%	38.4%	47.2%

SLOCOG 2014 Analysis Outputs	2005 (not modeled)	2010 Base Year	2020 Scenario	2035 S1 (Business As Usual)	2035 S2 (Recommended Scenario)
Region's NEW housing units that are multi-family (w/o Cal Poly housing)		--	2,509	4,013	5,574
Share of region's NEW housing units that are multi-family (w/o Cal Poly housing)		--	43.9%	26.8%	37.2%
Region's TOTAL housing units that are multi-family (w/Cal Poly housing)		25,631	29,615	32,484	34,045
Share of region's TOTAL housing units that are multi-family (w/Cal Poly housing)		21.6%	23.6%	23.8%	25.0%
Region's TOTAL housing units that are multi-family (w/o Cal Poly housing)		19,384	21,893	23,397	24,958
Share of region's TOTAL housing units that are multi-family (w/o Cal Poly housing)		17.3%	18.6%	18.4%	19.6%
Housing vacancy rate (countywide)		Avg 12.3%	Avg 12.3%	Avg 12.3%	Avg 12.3%
Total households within 1/4-mile of regular transit		37,816	39,723	41,413	42,456
Share of households within 1/4-mile of regular transit		37.6%	37.5%	36.2%	37.1%
Total households within 1/4-mile of transit w/30-minute frequency		8,557	8,803	9,153	9,278
Share of households within 1/4-mile of transit w/30-minute frequency		8.5%	8.3%	8.0%	8.1%
Total of households within 1/2-mile of regular transit		59,773	62,959	65,793	67,301
Share of households within 1/2-mile of regular transit		59.4%	59.5%	57.5%	58.8%
Total households within 1/2-mile of transit w/30-minute frequency		12,974	13,390	13,825	14,022
Share of households within 1/2-mile of transit w/30-minute frequency		12.9%	12.6%	12.1%	12.3%
Total employment within 1/2-mile of regular transit		53,798	59,669	63,190	63,153
Share of employment within 1/2-mile of regular transit		58.2%	59.0%	56.2%	56.2%
Total employment within 1/4-mile of transit w/30-minute frequency		13,313	14,034	14,499	14,463
Share of employment within 1/4-mile of transit w/30-minute frequency		13.2%	13.3%	12.7%	12.6%
Total employment within 1/2-mile of regular transit		65,843	74,182	81,467	80,822
Share of employment within 1/2-mile of regular transit		71.2%	73.4%	72.5%	71.9%

SLOCOG 2014 Analysis Outputs	2005 (not modeled)	2010 Base Year		2020 Scenario	2035 S1 (Business As Usual)	2035 S2 (Recommended Scenario)
Total employment within 1/2-mile of transit w/30-minute frequency		18,439		19,354	20,493	20,305
Share of employment within 1/2-mile of transit w/30-minute frequency		19.9%		19.1%	18.2%	18.1%
Average distance to transit (residential, in miles)		4.77		4.75	4.90	4.77
Average distance to transit (non-residential, in miles)		4.50		4.89	5.48	5.44
Share of region's NEW housing located in target development areas		--		38.0%	21.5%	30.3%
Share of region's TOTAL housing located in target development areas		22.0%		22.9%	22.0%	23.1%
Share of region's NEW employment located in target development areas		--		79.5%	78.9%	80.9%
Share of region's TOTAL employment located in target development areas		70.1%		70.9%	71.7%	72.0%
Residential density in TDAs (du/acre)		2.17		2.40	2.49	2.62
Employment density in TDAs (emp/acre)		5.39		5.96	6.70	6.73
Employment density (employees/acre)		**0.27**		**0.28**	**0.31**	**0.31**
North Coast		0.08		0.09	0.10	0.09
North County		0.40		0.45	0.48	0.53
Central County		3.39		3.58	3.98	3.81
South County		1.24		0.86	0.94	0.93
East County		0.00		0.00	0.00	0.00
Total Employees (all sectors)		**92,471**		**101,072**	**112,434**	**112,401**
Agriculture and Mining		1,927		2,202	2,377	2,384
Light Industrial		18,073		20,681	26,228	25,069
Retail		12,908		16,372	19,927	20,656
Office		13,944		14,520	14,935	15,048
Government		10,271		10,504	10,613	10,619
Education and Health		16,000		16,404	16,888	17,103
Leisure and Hospitality		14,135		14,909	15,692	15,693
Other Services		4,562		4,962	5,377	5,447
Military		651		651	651	651
Total Employees (all sectors, share of all jobs)		**100.0%**		**100.0%**	**100.0%**	**100.0%**
Agriculture and Mining		2.1%		2.2%	2.1%	2.1%
Light Industrial		19.5%		20.5%	23.3%	22.3%

SLOCOG 2014 Analysis Outputs	**2005** (not modeled)	**2010** Base Year	**2020** Scenario	**2035 S1** (Business As Usual)	**2035 S2** (Recommended Scenario)
Retail		14.0%	16.2%	17.7%	18.4%
Office		15.1%	14.4%	13.3%	13.4%
Government		11.1%	10.4%	9.4%	9.4%
Education and Health		17.3%	16.2%	15.0%	15.2%
Leisure and Hospitality		15.3%	14.8%	14.0%	14.0%
Other Services		4.9%	4.9%	4.8%	4.8%
Military		0.7%	0.6%	0.6%	0.6%
Jobs per Household		**0.78**	**0.80**	**0.83**	**0.82**
JHB: North Coast		0.39	0.40	0.45	0.42
JHB: North Counity		0.72	0.77	0.73	0.82
JHB: Central County		1.39	1.36	1.40	1.31
JHB: South County		0.55	0.57	0.59	0.59
JHB: East County		0.19	0.25	0.37	0.39
School-aged children		58,055	61,270	68,048	67,697
Share of population (school-aged children)		21.5%	21.5%	21.7%	21.6%
Hotel rooms, current and future		9,177	10,898	12,330	12,330
New hotel rooms		--	1,721	3,153	3,153
TRANSPORTATION SYSTEM					
Total lane-miles	-	8,897	8,943	8,990	8,990
Freeway: mixed flow (lane-miles)		307	308	309	309
Ramps (lane-miles)		40	41	41	41
Highway (lane-miles)		465	500	525	525
HOV (lane-miles)		-	-	-	-
Arterial (lane-miles)		675	676	692	692
Rural Arterial (lane-miles)		319	322	322	322
Collector (lane-miles)		586	586	588	588
Local (lane-miles)		6,506	6,510	6,514	6,514
Freeway-to-Freeway (lane-miles)		-	-	-	-
Regional Fixed Route Rev. Miles (millions)		1.004	1.168	1.376	1.376
Transit total daily vehicle service hours		304	355	371	371
Bicycle and pedestrian trail (lane-miles)		661.4			
TRIP DATA					

SLOCOG 2014 Analysis Outputs	**2005** (not modeled)	**2010** Base Year	**2020** Scenario	**2035 S1** (Business As Usual)	**2035 S2** (Recommended Scenario)
Total # of Vehicle trips		709,666	770,928	862,703	864,567
Home-based work		164,330	173,539	191,018	190,498
Home-based other		333,130	366,827	416,215	417,822
Non-home-based other (includes non-home-based work)		212,206	230,562	255,470	256,247
MODE SHARE					
Vehicle Mode Share (PM Peak-3hr-Period)					
SOV (% of person trips)		47.9%	47.6%	47.6%	47.4%
HOV (% of person trips)		52.1%	52.4%	52.4%	52.6%
Vehicle Mode Share (Whole Day)					
SOV (% of person trips) (includes Truck trips)		44%	44%	44%	44%
HOV (% of person trips)		51%	51%	51%	51%
Transit (% of person trips)		0.3%	0.4%	0.2%	0.2%
Non-motorized (% of person trips)		4.7%	4.7%	4.7%	4.8%
Average weekday trip length (miles)					
SOV		8.4	8.2	8.4	8.1
HOV		6.6	6.5	6.5	6.3
Average weekday travel time (minutes)					
SOV		13.2	13.7	16.0	15.5
HOV		10.6	11.3	11.5	11.3
TRAVEL MEASURES					
2005 - 2010 VMT adjustment Factor	5.04%				
Total Daily VMT (100% w/Centroids)	7,837,225	7,461,182	7,998,615	9,051,666	847,059
% of II Travel		54.4%	54%	53%	52%
% of IX Travel		20.5%	21%	21%	22%
% of XI Travel		20.9%	21%	21%	22%
% of XX Travel		4.2%	4.3%	4.5%	4.6%
Total Daily VMT (IX, XI, XX adjusted, includes Centroids)	5,887,599	5,605,102	5,990,943	6,726,148	6,510,724
Total Daily VMT-adjusted/Capita	22.71	20.80	21.04	21.41	20.78
Total VMT per weekday for passenger vehicles (ARB vehicle classes of LDA, LDT1, LDT2 and MDV) (miles)	319,984	4,855,766	5,167,527	5,787,314	5,601,958

SLOCOG 2014 Analysis Outputs	**2005** (not modeled)	**2010** Base Year	**2020** Scenario	**2035 S1** (Business As Usual)	**2035 S2** (Recommended Scenario)
Total VMT per weekday for passenger vehicles (ARB vehicle classes of LDA, LDT1, LDT2 and MDV) (trips)	938,633	876,860	912,360	1,024,234	991,430
Passenger Vehicle Weekday VMT per Person (Miles)	20.52	18.02	18.14	18.42	17.88
Total II (Internal) VMT per weekday for passenger vehicles (miles)		4,060,602	4,324,883	4,808,593	4,582,103
Total IX/XI VMTper weekday for passenger vehicles (miles)		3,089,001	3,332,119	3,835,109	3,857,241
Total XX VMT per weekday for passenger vehicles (miles)		311,579	341,613	407,964	407,715
Congested PM Peak Hour VMT on freeways and highways (Lane Miles, V/C ratios >0.75)		59	78	128	121
Congested PM Peak VMT on all other roadways (Lane Miles, V/C ratios >0.75)		20	25	32	30
CO2 EMISSIONS					
Total CO2 emissions per weekday (metric tons)	2,453	3,079.19	3,258.62	3,673.47	3,588.32
Total II (Internal) CO2 emissions per weekday for passenger vehicles (metric tons)		1,676	1,762	1,951	1,858
Total IX / XI trip CO2 emissions per weekday for passenger vehicles (metric tons)		1,275	1,357	1,556	1,564
Total XX trip CO2 emissions per weekday for passenger vehicles (metric tons)		129	139	166	165
Total CO2 emissions Minus CO2 emissions from Exempt VMT (-100%XX, -50%I/X and X/I) per weekday for passenger vehicles (ARB vehicle classes LDA, LDT1, LDT2, and MDV) (tons)	2,453	2,313	2,441	2,730	2,641
Total CO2 (lbs) Minus Exempt CO2 / capita	**20.86**	**18.93**	**18.89**	**19.16**	**18.58**
% Change from 2005	0%	-9.27%	-9.43%	-8.15%	-10.91%
INVESTMENT ($ Millions)					
Total RTP Expenditure (to 2035)					2,177.1
Highway investments (S)					686.8
Other road investments ($)					62.3
Roadway maintenance ($)					616.2
BRT projects ($)					-
Maximizing System Efficiency					91.0
Transit investments ($)					588.9

SLOCOG 2014 Analysis Outputs	**2005** (not modeled)	**2010** Base Year	**2020** Scenario	**2035 S1** (Business As Usual)	**2035 S2** (Recommended Scenario)
Active Transportation (Bikes/Peds) ($)					131.9

* The SLOCOG Regional Traffic Model is a 3.5 Step model; Trip Assn. is not available for Transit and non-motorized travel.

APPENDIX B: 2010 CTC RTP Guidelines Addressed in SLOCOG's RTP/SCS

This appendix lists the requirements in the California Transportation Commission's (CTC) Regional Transportation Planning (RTP) Guidelines that are applicable to the SLOCOG regional travel demand model, and which SLOCOG followed. In addition, listed below are the recommended practices from the CTC RTP Guidelines that SLOCOG incorporated into its modeling system.

Requirements

- Each MPO shall model a range of alternative scenarios in the RTP Environmental Impact Report based on the policy goals of the MPO and input from the public.
- MPO models shall be capable of estimating future transportation demand at least 20 years into the future. (Title 23 CFR Part 450.322(a))
- For federal conformity purposes, each MPO shall model criteria pollutants from on-road vehicles as applicable. Emission projections shall be performed using modeling software approved by the EPA. (Title 40 CFR Part 93.111(a))
- Each MPO shall quantify the reduction in greenhouse gas emissions projected to be achieved by the SCS. (California Government Code Section 65080(b)(2)(G))
- The MPO, the state(s), and the public transportation operator(s) shall validate data utilized in preparing other existing modal plans for providing input to the regional transportation plan. In updating the RTP, the MPO shall base the update on the latest available estimates and assumptions for population, land use, travel, employment, congestion, and economic activity. The MPO shall approve RTP contents and supporting analyses produced by a transportation plan update. (Title 23 CFR Part 450.322(e))
- The metropolitan transportation plan shall include the projected transportation demand of persons and goods in the metropolitan planning area over the period of the transportation plan. (Title 23 CFR Part 450.322(f)(1))

Recommendations

- The use of three-step models can continue for the next few years. The models should be run to a reasonable convergence towards equilibrium.
- The models should account for the effects of land use characteristics on travel, either by incorporating effects into the model process or by post-processing.
- During the development period of more sophisticated/detailed models, there may be a need to augment current models with other methods to achieve reasonable levels of sensitivity. Post-processing should be applied to adjust model outputs where the models lack capability, or are insensitive to a particular policy or factor. The most commonly referred to post-processor is a "D's" post-processor, but

postprocessors could be developed for other non-D factors and policies, too. (See Section 3.6, Reference 3, for additional guidance)

- The models should address changes in regional demographic patterns.
- Geographic Information Systems (GIS) capabilities should be developed in these counties, leading to simple land use models in a few years.
- All natural resources data should be entered into the GIS.
- Parcel data should be developed within a few years and an existing land use data layer created.
- For the current RTP cycle (post last adoption), MPOs should use their current travel demand model for federal conformity purposes, and a suite of analytical tools, including but not limited to, travel demand models (as described in Categories B through E), small area modeling tools, and other generally accepted analytical methods for determining the emissions, VMT, and other performance factor impacts of sustainable communities strategies being considered pursuant to SB 375.
- Measures of means of travel should include percentage share of all trips (work and non-work) made by all single occupant vehicle, multiple occupant vehicle, or carpool, transit, walking, and bicycling.
- To the extent practical, travel demand models should be calibrated using the most recent observed data including household travel diaries, traffic counts, gas receipts, Highway Performance Monitoring System (HPMS), transit surveys, and passenger counts.
- It is recommended that transportation agencies have an on-going model improvement program to focus on increasing model accuracy and policy sensitivity. This includes on-going data development and acquisition programs to support model calibration and validation activities.
- For models with a mode choice step, if the travel demand model is unable to forecast bicycle and pedestrian trips, another means should be used to estimate those trips.
- When the transit mode is modeled, speed and frequency, days, and hours of operation of service should be included as model inputs.
- When the transit mode is modeled, the entire transit network within the region should be represented.
- Agencies are encouraged to participate in the California Inter-Agency Modeling Forum. This venue provides an excellent opportunity to share ideas and help to ensure agencies are informed of current modeling trends and requirements.
- MPOs should work closely with state and federal agencies to secure additional funds to research and implement the new land use and activity-based modeling methodologies. Additional research and development is required to bring these new modeling approaches into mainstream modeling practice.