TECHNICAL EVALUATION OF THE GREENHOUSE GAS EMISSIONS REDUCTION QUANTIFICATION FOR THE SAN JOAQUIN COUNCIL OF GOVERNMENTS' SB 375 SUSTAINABLE COMMUNITIES STRATEGY

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California Environmental Protection Agency

Air Resources Board

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Executive Summary

The Sustainable Communities and Climate Protection Act of 2008 (Senate Bill 375) is intended to support the State's broader climate goals by encouraging integrated regional transportation and land use planning that reduces greenhouse gas (GHG) emissions from passenger vehicle use. Now in its sixth year of implementation, SB 375 has resulted in several regional Sustainable Communities Strategies (SCS) which are developed as part of the Regional Transportation Plan (RTP). These SCSs demonstrate whether, if implemented, the metropolitan planning organizations (MPOs) of California can meet the per capita passenger vehicle GHG emissions targets for 2020 and 2035 set by the California Air Resources Board (ARB or Board) in 2010.

For the San Joaquin Council of Governments (SJCOG), the MPO for the county of San Joaquin, the Board set passenger vehicle GHG emissions reduction targets of 5 percent per capita reduction in 2020 and 10 percent reduction in 2035 from a base year of 2005. The SJCOG board of directors adopted its first SCS on June 26, 2014 and made a finding that, if implemented, the SCS would meet the GHG reduction targets established by the Board. SJCOG submitted the adopted SCS and related GHG determination to ARB for review on March 27, 2015. The ARB staff evaluation presented in this report affirms that SJCOG's 2014 SCS would, if implemented, meet the Board-adopted per capita GHG emissions reduction targets.

San Joaquin County (county) is in the San Joaquin Valley (Valley), a significant agricultural region of the state with unique socioeconomic characteristics and environmental challenges. The county is home to over 700,000 people, making it the third most populous of the eight counties that comprise the Valley. It is the northernmost of the eight Valley counties, directly south of Sacramento County and east of Alameda and Contra Costa Counties. Its proximity to large employment centers in the San Francisco Bay Area and availability of relatively affordable housing make San Joaquin County attractive to residents who commute long distances to jobs outside the county.

Of the seven incorporated cities in the county, Stockton is the largest, with a population of just under 300,000. Tracy, Manteca and Lodi are the next largest cities, all with populations well under 100,000. About 20 percent of the region's population lives in unincorporated rural towns, some with populations of only a few hundred people, and approximately three-fourths of the land area is used for agriculture. Only about 10 percent of the county's land area is encompassed within the incorporated boundaries of cities.

The urban development pattern in the county over the last thirty years has been characterized by low density housing and suburban style commercial development with dispersed job centers. This past pattern of sprawl development has contributed to conversion of important agricultural land and open space, as cities have grown outward from their centers in the relatively flat agricultural valley floor. The city of Stockton has experienced significant growth and expansion in the last two decades, but the recession of 2008 led to an historic number of homes in foreclosure and economic recovery has been long and slow. Recognizing the need to minimize land consumption, preserve natural resources and increase travel choices, SJCOG adopted the *San Joaquin County Regional Blueprint* (Blueprint) in 2010. The Blueprint established the policy foundation for subsequent development of the 2014 RTP/SCS with the identification of regional goals that included targeting growth in existing urban areas, promoting infill and redevelopment, providing a variety of housing choices, offering multi-modal transportation options, and sustaining agricultural lands.

SJCOG is a single-county MPO in which low density development has been the trend, travel patterns are greatly influenced by interregional commuting, and whose economy has been significantly impacted by the recession. The land use and transportation strategies in its 2014 RTP/SCS attempt to address these issues by offering residents more mobility options and reducing vehicle trip lengths. Key SCS land use strategies include increasing the amount of infill development within existing urbanized areas, leading to denser development and an increase in the proportion of multi-family and small-lot single-family homes as compared to conventional lot sizes. Coupled with this policy of more compact urban development, especially in the county's largest cities, the plan dedicates an increased amount of funding for active transportation infrastructure and public transit, with six additional bus rapid transit routes in Stockton as well as some expansion of transit services in other communities. With this emphasis on transit-oriented development, the region anticipates that nearly 50 percent of new jobs and 40 percent of new homes will be located within a half mile of transit service and a substantial amount of prime farmland will be conserved through the plan year of 2040.

SB 375 directs the Board to accept or reject the determination of each MPO that its SCS would, if implemented, achieve the GHG emissions reduction targets for 2020 and 2035. This report represents ARB staff's technical analysis of SJCOG's SCS and GHG determination, and describes the methods used to evaluate the MPO's GHG quantification.

ARB staff's technical analysis was enhanced by being able to run SJCOG's travel model which was provided by the MPO. The travel demand model used by SJCOG was developed jointly by SJCOG, the Merced County Association of Governments, and the Stanislaus Council of Governments to forecast travel demand in these three counties. Also known as the Three-County Model, it is a conventional travel demand model similar in structure to most other models used by MPOs in the San Joaquin Valley.

The influence of a large amount of interregional travel in this single-county planning area, coupled with the method used by the MPO to estimate interregional travel, and the data inputs used in its model are important factors in staff's evaluation of SJCOG's GHG quantification. While SJCOG's estimates of 24 percent per capita GHG reduction in 2020 and 2035 are high compared to other SCSs, ARB staff based its conclusion that the region would be able to meet its targets on multiple factors. These include the sensitivity of the Three-County Model to SCS strategies, the impact of assumptions for interregional travel data, the types of projects and strategies reflected in the SCS, and supporting evidence from SCS performance indicators. Model sensitivity tests, conducted by SJCOG staff with assistance from ARB, showed that the model does respond, though subtly in some instances, to changes in key inputs. ARB also conducted a sensitivity test with the Three-County Model using more recent data on interregional trips to evaluate the potential effect on GHG estimation. Finally, the SCS strategies that encourage compact infill development and staff's evaluation of several performance indicators provide evidence of appropriate per capita GHG reductions. Staff's evaluation of these multiple factors supports the conclusion that the SCS, if implemented, would achieve the region's targets of 5 and 10 percent in 2020 and 2035.

The evaluation identified several areas in which the MPO could improve the quality of its data inputs and assumptions for improved forecasting of GHG emissions in future planning cycles. Throughout this report are several recommendations for modeling improvements that should be considered by SJCOG in its 2016 update of the Three-County Model. If implemented, these recommended improvements should enable the model to better capture the GHG benefits of the land use and transportation strategies in SJCOG's next SCS.

I. San Joaquin Council of Governments

The San Joaquin Council of Governments (SJCOG) is both the State-designated Regional Transportation Planning Agency (RTPA) and the federally designated Metropolitan Planning Organization (MPO) for San Joaquin County. Federal regulations designate MPOs as the responsible agencies to prepare Regional Transportation Plans (RTP), and California's Senate Bill 375, the Sustainable Communities and Climate Protection Act of 2008 (SB 375, Chapter 728, Statutes of 2008) designates MPOs as the responsible agencies to prepare Sustainable Communities Strategies (SCS). SB 375 requires preparation of an SCS as part of the RTP to demonstrate a reduction in regional GHG emissions from automobiles and light trucks through policies that coordinate land use and transportation planning. The *2014-2040 Regional Transportation Plan/Sustainable Communities Strategy for San Joaquin County* (2014 RTP/SCS) is SJCOG's response towards fulfillment of these federal and State requirements, laying out the region's policies, strategies, and financial plan to achieve the region's transportation and GHG emissions reduction goals.

The SJCOG Board of Directors is composed of 15 members, including representatives from the region's seven incorporated cities (Escalon, Lathrop, Lodi, Manteca, Ripon, Stockton, and Tracy), San Joaquin County, and three non-voting members representing Caltrans District 10, the San Joaquin Regional Transit District, and the Port of Stockton. This Board worked with technical and policy advisory committees, members of the public, various stakeholder groups, and several governmental agencies to develop the 2014 RTP/SCS. The SJCOG Policy Board adopted the 2014 RTP/SCS on June 26, 2014, and submitted its GHG determination to ARB on March 27, 2015.

A. Planning Area

San Joaquin Valley Context

San Joaquin County is the northernmost of the eight counties in the San Joaquin Valley (Valley). The Valley is characterized by agricultural communities and small urban areas predominantly located near the State Route 99 (SR-99) corridor, which runs north-south through the center of this central California region (Figure 1). There is heavy truck travel on SR-99 and along the Interstate 5 (I-5) corridor, which runs along the western edge of the Valley and serves as the backbone for goods movement throughout the State.

Figure 1. San Joaquin County in California's Central Valley

San Joaquin County is the third most populous of the eight counties that comprise the San Joaquin Valley. The eight counties in the San Joaquin Valley (Fresno, Kern, San Joaquin, Stanislaus, Tulare, Merced, Kings, and Madera) account for about 11 percent of California's population. As the Valley continues to grow, it is expected to account for 15 percent of California's population by 2050.

> With a population of 702,000, San Joaquin County is the third most populous of the eight counties in the San Joaquin Valley.

The residents of the San Joaquin Valley face challenges of poor air quality, high unemployment, and below average incomes. Most of the jobs across the Valley in 2012 were in education, health and social services (21.5 percent), agriculture (12 percent), retail trade (11.3 percent), and manufacturing (8.5 percent). The unemployment rate in 2012 averaged 15.3 percent, which is higher than the 11.4 percent State average. Education levels for Valley residents lag behind California's, with only 24 percent of people aged 25 years or older having a college degree, compared to 39 percent statewide. Related to these unemployment and educational factors, the Valley's 2012 median household income of $45,000 was less than 78 percent of the State average of $58,000.

San Joaquin County

San Joaquin County is largely flat, but includes a portion of the Sierra Nevada foothills along the eastern border, and mountains of the Coastal range in the southwestern portion of the county. Near the northeastern border of the county, Camanche Reservoir is an attraction for boating, fishing, and camping. Four main rivers flow through the county, primarily draining into the Sacramento-San Joaquin River Delta (Delta) in the western portion of the county. The Delta provides much of the water to central and southern California, and its waterways are deep enough for passage of large cargo ships, serving as major transportation routes for goods movement through the ports of Stockton and Sacramento.

With a population of approximately 702,000, San Joaquin County's residents (Table 1) are largely concentrated in its seven incorporated cities (Stockton, Tracy, Manteca, Lodi, Lathrop, Ripon, and Escalon, in descending order of population), with over 40 percent of the population in Stockton. Approximately 20 percent of the region's population lives in the unincorporated areas of the county. While portions of the county's four largest cities are considered "urbanized areas" according to the U.S. Census Bureau (having at least 50,000 residents), the county as a whole is largely rural in nature.

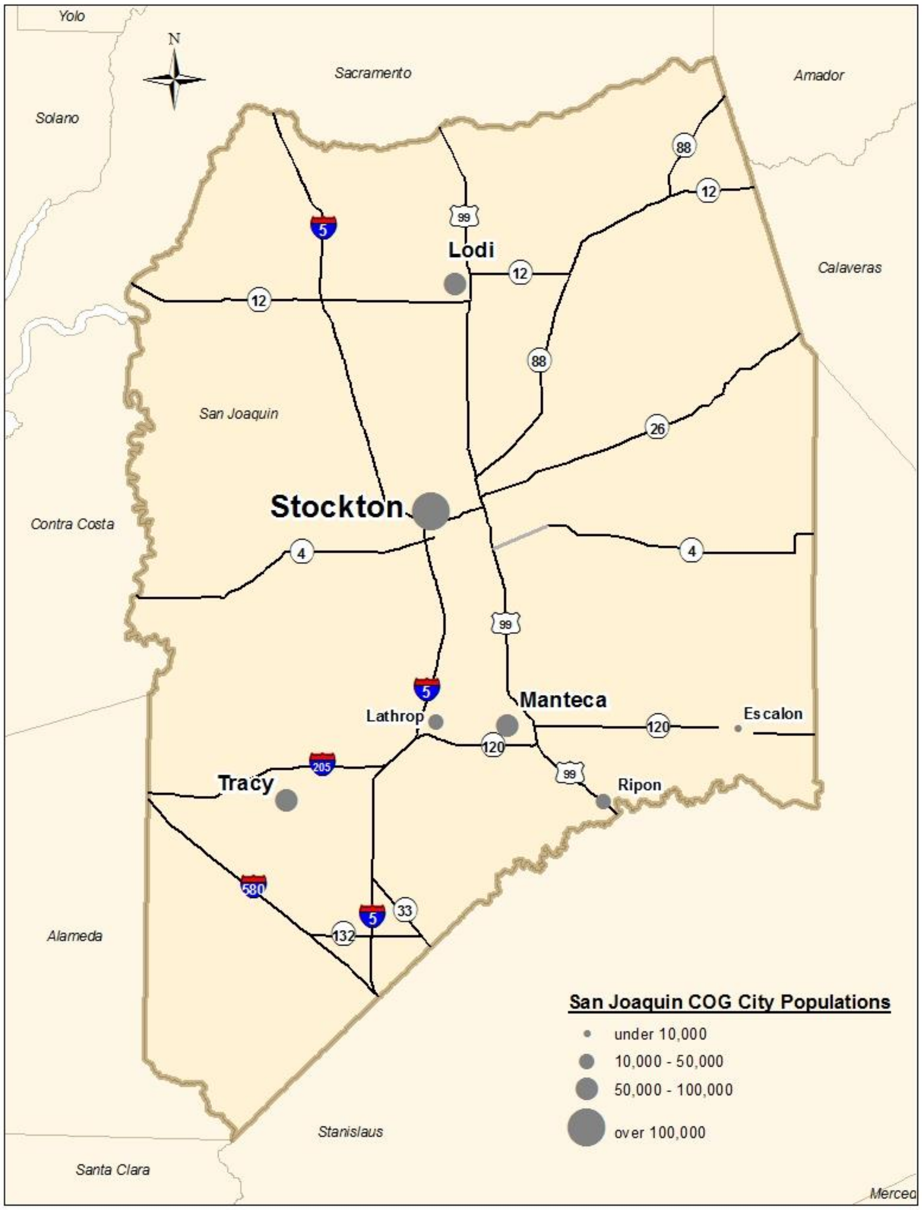
Table 1. Population of Cities and Unincorporated Areas of San Joaquin County

City/Area	DOF Estimates 2013
Stockton	297,757
Tracy	84,466
Manteca	71,507
Lodi	63,233
Lathrop	19,302
Ripon	14,676
Escalon	7,243
Unincorporated Areas	143,561
County Total	701,745

Source: California Department of Finance's estimates for January 1, 2013 at http://www.dof.ca.gov/research/demographic/reports/estimates/e-1/view.php

The majority of the region's population (Figure 2) is located between I-5 and SR-99, although the second largest city, Tracy, is west of I-5 in the triangle formed by Interstates 5, 205, and 580. There are many unincorporated communities scattered throughout the county, with the majority of these small towns located east of SR-99. In 2010, they ranged in size from fewer than 300 to fewer than 11,000 residents.

Figure 2. San Joaquin County



While the San Joaquin Valley as a whole is known for its agricultural industry, San Joaquin County has a greater concentration of transportation and warehousing jobs, and a smaller concentration of farm jobs than in the rest of the Valley. The greatest proportion of the jobs in the region in 2012 were in government (18.3 percent), wholesale and retail trade (17.9 percent), health and education (14.6 percent), and manufacturing (8.9 percent), with farm employment representing only 7.5 percent of the region's employment. Employment is relatively dispersed across San Joaquin County, however, as the county seat and largest city in San Joaquin County, the City of

Stockton is the largest employment center, containing over 50 percent of the region's jobs.

The recession of 2007 – 2009 hit San Joaquin County especially hard. By about the middle of 2008, one out of 76 housing units was in foreclosure. While unemployment in the Valley has typically lagged behind that of the State and the nation, San Joaquin County's unemployment levels were especially high, rising above 18 percent during several months in 2010 and 2011. The recession has impacted San Joaquin County's transportation sales tax and development fee revenues; however the region has been recovering, as indicated by factors such as an increase in jobs and a decrease in homes in foreclosure.

B. Current Land Use

San Joaquin County's 912,640 acres include such uses as farmland, developed residential, industrial, and commercial land, roadways, parks and other open space lands, waterbodies and waterways such as the Delta and the rivers that lead to it, and mining areas. About 10 percent of the county's lands are in the incorporated cities and 90 percent are unincorporated areas. As of 2008, the base year of the RTP, approximately 75 percent of the county's acreage was agricultural land.

Agricultural land is an important aspect of the character of the county and to the county's economy. Well over half of the county's total land area in 2011, or 530,985 acres, were protected under the Williamson Act, providing those participating landowners with property tax relief for a period of ten or twenty years, during which time the land must remain undeveloped. Even though the amount of protected land has declined by about 2 percent over the past twenty years, as of 2011, San Joaquin County had 11 percent of the State's total acreage enrolled under the Williamson Act.

> Three-fourths of the land in San Joaquin County is farmland, including much of the Delta, which accounts for about 35 percent of San Joaquin County's landmass.

Commercial and industrial uses in the county include retail and office space, manufacturers, food processors, and warehousing and distribution centers. In addition to commercial land uses in downtown areas and residential areas within each of the region's incorporated cities, there is also commercial land in the unincorporated area east of Stockton within the city's sphere of influence, and in urban unincorporated communities, such as Lockeford and Linden. Each city in the county also has some industrial lands, especially on the outer edges of city limits or along freeway corridors. In addition, industrial land is located in the unincorporated area east of Stockton, along the I-580 corridor west of Tracy, and in the communities of Lockeford and French Camp.

C. Current Transportation System

With the vast majority of its population relying on passenger vehicles to transport them within San Joaquin County and to destinations outside the county, roadways continue to be important both for passenger vehicles as well as for goods movement. Ten different highways/freeways connect the region's cities and towns and provide access to other regions. The network of local streets, roads, arterials, and highways consists of a total of 7,114 roadway lane miles.

Major thoroughfares include I-5 and SR-99, both of which run north-south connecting southern and northern California, and carry truck volumes greater than the statewide average. SR-99 averages 11,000 trucks per day between Stockton and the Stanislaus County line, while I-5 averages between 25,000 and 30,000 trucks per day; both of these major highways are important goods movement routes in the state, and also carry passenger vehicles that begin and end their journeys outside of San Joaquin County. Interstates 205 and 580, are major east-west highways connecting to the San Francisco Bay Area, and State Routes 132, 120, 4, and 12 also provide east-west access. I-205 is one of the most impacted travel routes in the county, providing a major corridor from the northern San Joaquin Valley to the Bay Area. State Routes 26 and 88 carry a significant amount of recreational traffic and increasingly serve commute traffic, to Calaveras and Amador counties.

In addition to these highways, several arterial roadways form links between communities within the county, and to other counties. These arterials provide connections between the downtowns of the various communities, connect to major activity centers throughout the county, and handle some of the highest traffic volumes on the local system.

Transit

San Joaquin County has several forms of transit services available including bus rapid transit (BRT), intercity and interregional bus services, on-demand (dial-a-ride) bus services for rural areas, local buses within the individual cities, interregional passenger rail services, and other multi-modal services such as vanpools. Eight local transit operators provide bus service in San Joaquin County, and Greyhound provides interregional service with stops in Stockton, Tracy, and Lodi.

> Stockton's Metro Express bus rapid transit routes make San Joaquin the only county in the Valley with high quality transit corridors.

With its Metro Express BRT routes in Stockton, San Joaquin is currently the only county in the Valley with high quality transit corridors, defined in SB 375 as those with no greater than 15 minute headways during peak commute hours. Opening in January 2007 with 213,000 riders in its first six months, the San Joaquin Regional Transit District's (SJRTD) BRT system has seen a steady rise in ridership, achieving 1,878,940 riders in the 2012/2013 fiscal year, giving it the largest ridership, and the highest farebox revenue production of all routes in Stockton. The BRT system provides passengers with access to shopping, schools and colleges, medical facilities, and the San Joaquin County airport. BRT service is synchronized with other Stockton transit routes for greater interoperability, and Metro Express BRT bike racks are filled to capacity on almost every trip. Using a traffic signal prioritization system and fare vending machines for pre-paid fares, the BRT routes have ten-minute headways during peak periods, and 15-30 minute frequencies during the rest of the day. The three existing BRT routes cover 16.1 miles through Stockton, and six more routes are planned through the 2014 RTP/SCS horizon year of 2040.

In addition to the BRT services, SJRTD provides standard bus service on many routes within Stockton, intercity routes throughout the county, and eight interregional commute routes to and from several locations in the Bay Area (Livermore, the Dublin/Pleasanton BART Station, Silicon Valley, and San Jose) and Sacramento. Bicycle racks and cargo area storage spaces on the buses have carried an estimated 600 to 850 bicycles per weekday. Along with its fixed routes, SJRTD offers curb-to-curb, general public dial-a-ride service in the rural areas of San Joaquin County, and any area that is not served by one of the county's transit operators.

Five of the region's smaller cities also have transit operators. Lodi's Grapeline, the Tracy Tracer, and Manteca Transit each provide both fixed route bus service and dial-a-ride, or paratransit services for seniors and disabled passengers. While Escalon's transit service, eTrans, is much more limited than those in the region's larger cities, it does connect Escalon with medical, shopping, and educational destinations in Modesto in Stanislaus County, provides dial-a-ride service to Riverbank (also in Stanislaus County), and connects with Ripon's transit system. Ripon's Blossom Express provides service two days per week in a loop around Ripon, then to medical and shopping destinations in Modesto.

San Joaquin County benefits from two interregional passenger rail services, the Altamont Corridor Express (ACE) and Amtrak. On weekdays, ACE provides four trains in each direction between Stockton and San Jose, with ten stops along the 86 mile route. ACE opened during the last quarter of 1998 with 714 riders, but by the 2011/2012 fiscal year, averaged 3,123 riders daily, yielding over 785,947 riders for the year. Amtrak also serves the region, connecting San Joaquin County with Sacramento, the Bay Area, and other parts of the Valley.

Over 100 vanpools are registered in San Joaquin County through the Commute Connection program which provides ride-matching services for carpools and vanpools, as described further in Section II.

Bicycle Facilities

San Joaquin County has 267 miles of Class I, II, and III bikeways,[1] almost all within the city limits of six of the seven incorporated cities (all except Lathrop), with a few miles of Class III bikeways in the unincorporated areas. The vast majority of the 73 miles of Class I paths are in or near the region's two largest cities, Stockton and Tracy, with the longest path along the California Aqueduct, in and around Tracy. There are nearly 108 miles of Class II bike lanes, often on commercial streets within the incorporated cities. The region's nearly 87 miles of Class III bike routes are generally on streets with smaller amounts of traffic. In 2012, SJCOG adopted its *Regional Bicycle, Pedestrian, and Safe Routes to School Master Plan*, which identifies a regional system of bikeways and pedestrian routes, and supports the local jurisdictions when competing for active transportation funding. Five of the region's cities have bicycle master plans to guide the development of future bikeway improvements and additions.

San Joaquin COG's Sustainable Communities Strategy Development of SJCOG's 2014 RTP/SCS began in 2011 with the development of a public participation plan. The following section describes the policy foundation for the SCS; the development of the SCS based on strategies, scenarios, and performance measures; selection of the preferred scenario; and the public input process that led to adoption of the final plan.

D. SCS Foundational Policies

Many aspects of the 2014 RTP/SCS are rooted in policies developed and agreements made in years prior to 2014. Below is a description of some of the key policies that have influenced and set the direction for SJCOG's 2014 RTP/SCS and are moving the region toward more sustainable development.

<u>San Joaquin County Regional Blueprint</u>

SJCOG adopted the *San Joaquin County Regional Blueprint: A Year 2050 Transportation, Land Use, Environmental Vision* (Blueprint) in January 2010, with the intent of minimizing land consumption, preserving natural resources, and increasing travel choices. The Blueprint considered the quality of life in the region through the lens of transportation, land use, and the environment. The view through this lens illuminated the need for integrated planning to drive the economic, environmental, and social changes the region was seeking. The Blueprint provided the initial public outreach, technical analysis, and scenario foundations for the 2014 RTP/SCS. Many of the

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[1] Class I bikeways are known as bike paths, and provide completely separate rights-of-way for bicycles and pedestrians. Class II bikeways, or bike lanes, are designated for bicycle use with a striped lane on streets and highways. Class III bikeways are also known as bike routes, and use signs or pavement markings to indicate shared use for bicycles, pedestrian, and motor vehicles.

committee members involved in the development of the Blueprint also served on the RTP/SCS Advisory Committee starting in mid-2012.

Many of the Blueprint's goals are especially relevant to the development of SJCOG's SCS, such as: providing support for sustainable planning and growth strategies which target growth in existing urban areas, with an emphasis on efficient design, land conservation, infill, and redevelopment; providing a variety of housing choices; providing multi-modal transportation and mobility options with intra- and inter-city/regional connections; and sustaining agricultural lands and supporting the preservation of natural resource and open space lands.

Measure K Local Sales Tax Measure

San Joaquin County is a "self-help" county, with voters having passed Measure K, a half-cent sales tax dedicated to transportation projects. SJCOG expects over $3.6 billion to be available for projects in the 2014-2040 RTP/SCS, based on Measure K revenues and the assumed passage of a future quarter-cent increase to the existing transportation sales tax program. Measure K was originally passed by the region's voters in 1990 for improvements to the region's highways and local roadways, bus and rail transit systems, bicycle facilities, and other transportation projects for 20 years. In 2006, voters approved the renewal of Measure K for another 30 years, which includes a Smart Growth Incentive Program (see below). Measure K is expected to provide approximately one-third of the total revenues for the transportation projects committed in the adopted RTP.

Smart Growth Incentive Program

With $65 million from Measure K, SJCOG established the Smart Growth Incentive Program in 2008 to provide local jurisdictions with matching funds for projects that help local agencies integrate land use and transportation to a greater degree. Both planning and infrastructure projects are eligible for these incentive funds , such as street calming endeavors, improvements to transit amenities, projects that create more walkable communities, and those that increase the use of alternative modes of transportation. These funds are available to support infill development, neighborhood revitalization, and downtown improvements, but projects on greenfield sites are prohibited from receiving funding from this program. As of the 2013/14 fiscal year, $1.5 million has been awarded through the Smart Growth Investment Program.

Regional Smart Growth/Transit-Oriented Development Plan

In March 2012, the SJCOG Board of Directors adopted the Regional Smart Growth/Transit-Oriented Development Plan which defines smart growth as, "growth that revitalizes central cities and older suburbs; supports and enhances public transit; promotes walking and bicycling; preserves open spaces and agricultural lands; and is sensitive to the context and communities in which it is found." This plan provides examples of smart growth development in San Joaquin County, provides tools to help local jurisdictions evaluate potential development proposals, and recommends land use regulations that would encourage smart growth. This plan encourages local governments to promote infill development by identifying appropriate locations throughout the county where infill development could occur, and analyzing the financial feasibility of projects that could be built on those sites. The Regional Smart Growth/Transit-Oriented Development Plan guides the decisions regarding which projects receive Smart Growth Incentive Program funding.

Regional Bicycle, Pedestrian, and Safe Routes to School Master Plan

SJCOG's 2012 Regional Bicycle, Pedestrian, and Safe Routes to School Master Plan guides the region's local agencies as they plan, develop, and manage the bicycle and pedestrian network throughout the region. The goals of the plan are to increase the commute mode share for bicycling and walking, and to support safe active transportation to and from schools. One objective of this plan is to increase the number of miles of bicycle and pedestrian facilities in the county by 10 percent in the next five years and by 20 percent in the next ten years. Another objective is to identify projects for consideration for Measure K funding. Funding the priority projects in this plan is projected to cost approximately $27.4 million dollars, but with only about $8.9 million available from Measure K over the next 10 years, the county will need to leverage other funding sources to fully implement this plan.

Commute Connection

A transportation demand management program provided by the MPOs in the three northernmost San Joaquin Valley counties (San Joaquin, Stanislaus, and Merced), Commute Connection serves commuters and employers in the three-county region by providing a free ride-matching system for carpoolers and vanpoolers, as well as promoting bicycling, walking, and public transit to reduce the number of single occupancy vehicles on the road. The Commute Connection program, working directly with employers and commuters, provides transit and tax credit information, commuter subsidies, and an emergency ride home program. This program has helped San Joaquin County to support 115 vanpools in the 2013-14 fiscal year, serving over 10,000 commuters in the three counties.

San Joaquin County Multi-Species Habitat Conservation and Open Space Plan

In 2001, SJCOG, Inc., a non-profit organization composed of the SJCOG board members, adopted the San Joaquin County Multi-Species Habitat Conservation and Open Space Plan (SJMSCP) to guide the region as it considers the need to conserve open space and protect the region's agricultural economy. The SJMSCP provides for the long-term management of plant, fish, and wildlife species; provides and maintains multiple-use open spaces; accommodates a growing population while minimizing costs to project proponents and society at large; all while preserving landowner property rights. Under the SJMSCP, 100,241 acres are planned to be preserved through conservation easements and fee title acquisition. As of 2013, about 12 percent, or 11,884 acres, of the planned acreage have been preserved.

Local General Plans, Climate/Sustainability Action Plans,

Several local jurisdictions have recently updated or are in the process of updating their General Plans,[2] resulting in greater alignment with the goals and policies of the 2014 RTP/SCS. The cities of Lodi and Tracy have recently updated their General Plans, San Joaquin County has released a draft General Plan update, and the City of Stockton is beginning its General Plan update process.

The region's second and fourth largest cities (Tracy and Lodi, respectively) were the first to complete their General Plan updates since passage of SB 375. Tracy's 2011 General Plan highlights sustainable practices, including those that could reduce GHG emissions. It includes support for higher residential density, infill development, and mixed use buildings in the downtown area, and is intended to be consistent with the city's 2011 Sustainability Action Plan. Tracy's Sustainability Action Plan, adopted at the same time as the General Plan, sets a GHG emissions reduction target for the city, along with targets for per capita VMT, energy, farmland preservation, and air quality.

Adopted shortly after SJCOG's Blueprint was adopted, Lodi's 2010 General Plan promotes walkable neighborhoods, improved bicycle and pedestrian connections, and preservation of the agricultural and viticulture lands that surround the city, by calling for compact urban development. Lodi's Climate Action Plan, adopted in November 2014, includes a policy commitment for higher density, mixed-use, and infill development in appropriate locations of the city. It also includes a guiding policy for maintaining and updating streets using a complete streets concept.

The San Joaquin County Draft 2035 General Plan includes significant changes over the previous version, including policies to encourage complete streets on both urban and rural county streets, and to reduce GHG emissions through reduced auto trips and infill development.

The City of Stockton adopted a Climate Action Plan in December 2014 which, if fully implemented, would achieve GHG emissions reductions of 20 percent below the city's 2005 levels by 2020. In addition, the City is working to amend its General Plan to accommodate 4,400 new housing units in the downtown area and 14,000 new units within the city limits at build-out.

The City of Manteca's 2003 General Plan was updated in 2011 to include a new circulation element which stresses the need for a complete streets approach to planning roadway facilities. In addition, in October 2013, the Manteca City Council adopted a Climate Action Plan which focuses on reducing GHG emissions to 1990 levels by 2020.

[2] General Plans are comprehensive long-range plans, required for municipalities in California that establish the growth policy direction for the next 20 years.

Regional Housing Needs Assessment

A regional housing needs assessment (RHNA) is, for San Joaquin County and other Valley MPOs, a county-level housing target set by the California Department of Housing and Community Development (HCD) to ensure that local governments adequately plan to meet current and future housing needs of the population in four family income categories. At the end of 2013, HCD determined SJCOG's overall RHNA allocation of 40,360 housing units for the 2014-2023 housing element cycle. SB 375 requires that the housing distribution to the local jurisdictions be consistent with the land use distribution in the RTP/SCS. However, the different projection period cycles of RHNA and the RTP/SCS (ten years and 27 years, respectively) prevent direct comparisons. The SJCOG Board adopted the final Regional Housing Needs Allocation Methodology near the end of March 2014; the local jurisdictions had 60 days to review the housing unit allocations delineated in the RHNA Methodology, however no local jurisdictions asked for any changes. The SJCOG Board of Directors adopted, in August 2014, the final 2014 – 2023 Regional Housing Needs Plan, accommodating the number of housing units required by HCD, and detailing the total number of housing units for which each city and the unincorporated county must plan. Local jurisdictions have 18 months from the August 2014 adoption date, to update their local housing elements showing that they meet the allocations set by SJCOG.

Regional Transit Systems Plan

Completed in 2009, SJCOG's San Joaquin County Regional Transit Systems Plan laid out an approach for meeting long-term travel demand needs through transit expansion, as well as proposed reducing congestion through increasing the density of development projects, supporting alternative modes of transportation, and identifying multi-modal and commercial joint developments. Focusing especially on intercity and interregional transit services, this plan aimed to improve the overall connectivity of the regional public transit system. It examined opportunities to better coordinate the existing transit systems serving the county, examined transit performance measures, and identified potential transit-oriented development sites throughout the county. SJCOG is in the process of updating their Regional Transit System Plan.

E. Public Outreach Process

While SJCOG's first public workshops and presentations on SB 375, scenario planning, and public participation opportunities were held in 2012, the MPO staff began laying the foundation for the RTP/SCS development process in 2011 with adoption of an expanded Public Participation Plan. Their goal was to go beyond the requirements and provide a variety of opportunities and methods in which the community could contribute to the planning process. In addition to the public workshops, SJCOG, in conjunction with the other seven Valley MPOs, used online surveys, social media, YouTube videos, newspapers, and radio and television advertisements in their effort to reach as many community members and interested groups as possible.

In mid-2012, SJCOG created an RTP/SCS Advisory Committee, including many members of the Blueprint committees already familiar with SB 375 and regional transportation planning, and representatives from local planning agencies, transit agencies, environmental groups, low-income housing advocates, land developers, business and economic development groups, and civic engagement advocates. The committee, which provided both the main technical advice regarding the scenarios and the input on performance indicators as they were developed, met ten times between October 2012 and December 2013.

In late July and early August 2013, SJCOG held a series of public workshops, starting with six public Listening Sessions to gather public opinions about the basic elements of the scenarios. SJCOG collected approximately 170 surveys, available in both English and Spanish, from the Listening Sessions and online. SJCOG learned that respondents generally favored a multi-modal approach to transportation improvements, preservation of farmland, revitalization of existing downtown areas, and concentration of future growth in existing cities.

Throughout this time, the RTP/SCS Advisory Committee and other stakeholder groups met to shape the region's four alternative scenarios A through D (described later in this report). In August 2013, SJCOG staff held workshops to gather the public's thoughts on these scenarios, especially with respect to the pattern of land development and growth locations, the options for housing types, and the types of transportation projects of each scenario. Again, the presentation and survey from this workshop series was available online, resulting in about 85 participants between the in-person and online outreach efforts. Generally, participants favored Scenario C for its greater inclusion of bus, rail, and active transportation options, and Scenarios C and D for their focus on compact development to increase opportunities for non-automotive modes of transportation and for increased choice in housing types.

In September 2013, the SJCOG Board directed SJCOG staff to develop Scenario C as the preferred scenario, with some key elements from Scenario D that the public had preferred. The draft 2014 RTP/SCS was released at the end of February 2014, and the draft Environmental Impact Report (EIR) was released in mid-March, with the public comment period for both documents ending in mid-April.

F. 2014 RTP/SCS Development

1. Regional Growth Forecast

Forecasting how a region's population, housing, and employment are expected to change over time is a foundational piece for RTP/SCS development. For instance, knowing how many people will be in a region can help determine how many more houses need to be built, which influences where the new focus on transit and/or roads needs to be. Knowing how many new jobs, and in what types of industries, might be expected, can help guide the location for the new housing units, and transit and roadway needs. These forecasts are fundamental to the development of transportation and land use scenarios.

For SJCOG, as for all of the Valley MPOs, demographic forecasts were prepared by The Planning Center in March 2012, resulting in three primary forecasts for population, households, and housing units. SJCOG relied upon an employment forecast developed by the University of the Pacific Business Forecasting Center, generated in the winter of 2012. SJCOG's growth forecasts from The Planning Center and the University of Pacific Business Forecasting Center projections are summarized in Table 2.

Table 2. San Joaquin County Regional Growth Forecasts

Year	Population	Households	Employment
2005	652,339	205,346	221,017
2010	685,306	215,007	203,367
2020	807,099	249,764	234,235
2035	1,003,843	302,258	282,613
2040	1,070,486	319,756	299,717

Source: SJCOG 2014 RTP/SCS pg. 1-3

The rate of population growth in San Joaquin County is projected to be about 56 percent between 2010 and 2040. Although this represents a considerably higher growth rate than that found in the Bay Area, Sacramento, San Diego, or Southern California regions, the result is the addition of just over 385,000 people in the 30-year timespan.

2. Performance Indicators

Working with the RTP/SCS Advisory Committee, and considering input from stakeholder groups and the public, SJCOG developed a set of 25 performance indicators under eight broad categories (Table 3), which would be used to compare and evaluate alternative SCS scenarios. The performance indicators were evaluated using the SJCOG travel demand model and the Envision Tomorrow™ land use sketch planning tool.

Table 3. SJCOG's 2014 RTP/SCS Performance Indicators

Measure of Effectiveness	Description
Travel Related Indicators	
Vehicle Miles Traveled (VMT) per Capita	Vehicle miles traveled per person/total 2040 population
Trip Mode Share	Percent of trips by mode of travel (e.g., single occupant auto, bike, walk, transit, carpool 2+)
Congested Travel Time—Vehicle Hours of	The difference expressed in hours

Delay	between total optimal travel time for all vehicles and actual modeled travel time for all vehicles
Average Trip Length	Total vehicle miles traveled / number of trips for all purposes
Total Miles of Bikeways by Class	Miles of Class I, II, and III facilities
Transit Ridership	Number of passenger trips
Bike and Walk Trips (Active Transportation)	Number of bike and walk trips
Health and Environmental Indicators	
Criteria Pollutants per Capita	Total pollutants from all vehicle (passenger and freight) types
GHG Emissions per Capita	Total CO2 (GHG precursor) from passenger vehicles and light duty autos only. Targeted reduction of 5% by 2020 and 10% by 2035 below 2005 levels.
Resource Conservation Indicators	
Acres of Land Consumed	Total acres of land consumed due to new development
Acres of Prime Farmland Consumed	Total acres of prime farmland consumed due to new development
Efficiency	
Energy Usage per New Household	Total energy consumption from new growth
Water Consumption per New Household (Internal & External)	Total tons of water usage from new growth
Land Use Mix	Percentage of new development that is infill development, redevelopment, and Greenfield
Housing and Employment	
1. Housing and Employment near Major Transit Routes and Stations (SB 375 defined High Quality Transit Areas) 2. Housing and Employment near Quality Transit (any transit routes with 2 or more buses per hour)	1. Percent of new housing and employment located within ½ mile of major transit route (15-minute headway), bus transfer station, or ACE station 2. Percentage of new housing and employment located within ½ miles of quality transit route with 2 or more buses per hour
Residential Density	Change in residential density for new housing

Housing Type	Percent of new housing by type (large-lot, small-lot, attached, multi-family)
Equity (Environmental Justice Areas vs. Non-Environmental Justice Areas)	
Health Risk Assessment of Roadway Pollutants	Percentage of households within 500 feet of high-volume roadway (>100,000 average daily traffic)
Transportation Costs	Percent of household income spent on transportation
Safety	
Collision Rate	Statewide accident rate multiplied by VMT
Economic Vitality	
Job Creation	Number of direct and indirect jobs

Source: SJCOG's 2014 RTP/SCS Appendix M, Table M.1

3. Transportation Project Selection

Development of the 2014 RTP/SCS project list began with the development of a revenue estimate for the 27-year life of the plan. SJCOG coordinated with local jurisdictions to project local revenue sources dedicated to transportation and to project State and federal fund sources based on average growth. After finalizing the revenue projections, SJCOG coordinated with the local jurisdictions to develop, concurrently, the project list and the land use scenarios. SJCOG and local project sponsors held coordination meetings to ensure the project list reflected the needs of the jurisdictions, supported the land use pattern of SCS growth, and would meet the regional SCS policy objectives. Incorporating public input, ensuring that traffic volumes on local roadways as changed by the SCS still supported the need for the proposed project, reaching consensus on projects that would appear on the final lists, and analyzing the cost effectiveness of CMAQ projects were all part of the iterative process that led to the final project lists (constrained and unconstrained).

4. SCS Alternative Scenarios

SJCOG used a variety of tools and data inputs and assumptions to develop the four land use scenarios presented for discussion at public workshops. The main components of each scenario were the development patterns, housing options, growth locations and intensities, and transportation investments that would shape the region's land use, housing, and transportation over the next 27 years. Key elements of each scenario are described below.

Scenario A

Scenario A includes the policies and priorities of the previously adopted 2011 RTP, but with updated socioeconomic data to reflect the most recent growth estimates, and the latest transportation planning decisions and assumptions. In this scenario, future growth is based upon recent development trends in an outward and low density pattern in suburban, greenfield areas not well served by transit. Residential development would continue as 95 to 98 percent large-lot, single-family homes, resulting in a countywide average of 4.5 dwelling units per acre. Transportation investments focus on planned freeway and local road construction and expansion to accommodate outward development. There would be limited expansion of key transit services along with operations and maintenance of existing bus and passenger rail.

Scenario B

Future growth in this scenario is aligned with recent general plan updates, climate/sustainability action plans, and regional studies identifying walkable, mixed-use opportunities in targeted locations, along existing BRT corridors, and near rail stations. This scenario begins to shift from sprawl to infill development and reinvestment opportunities around downtowns and existing urban cores, thus showing greater sustainability than Scenario A. Mixed-use opportunities begin to support co-location of jobs and housing. Housing options begin to diversify, with an increase in multi-family and attached residential units in new growth areas, yielding new growth housing at 76 percent single-family and 24 percent multi-family. Transportation investments focus on congestion management, including transportation system management (TSM) and transportation demand management (TDM) strategies, along with bike, pedestrian, and transit in infill and reinvestment areas.

Scenario C

Future growth in this scenario builds upon Scenario B’s by shifting a greater proportion of growth from greenfill, urban edge development to existing and planned BRT and transit corridors and rail stations to promote increased biking, walking, and transit-friendly neighborhoods. Scenario C increases mixed-use building, and includes a more aggressive shift to multi-family development compared to Scenario B, resulting in 61 percent of new growth as single-family housing and 39 percent of new growth as multi-family housing, yielding a countywide average density of ten dwelling units per acre. Scenario C includes a greater focus on TSM and TDM strategies than on widening and new roadway construction, and more transit expansion and investments in bike and pedestrian facilities than in Scenario B. Overall, Scenario C results in greater benefits than Scenarios A and B, while remaining within the limits of the local general plans.

Scenario D

In this scenario, future growth is shifted from rural and suburban locations to existing urban core areas (within the existing city limits and spheres of influence), with an emphasis on co-locating jobs, housing, and transportation centers to support economic development, equity, and affordability. Growth is maximized at existing and future BRT and local transit routes, and at bus/rail hubs. The intensity and density of development is increased, with a shift to small-lot single-family and multi-family homes at a rate that the market supports. More transit expansion and investments in bike/pedestrian facilities are included than in Scenarios B and C. Roadway expansion is limited, while TSM and TDM strategies are increased. While Scenario D would result in greater benefits than the other three scenarios, it would do so by exceeding SJCOG's projected future housing demand and the local jurisdictions' land use plans.

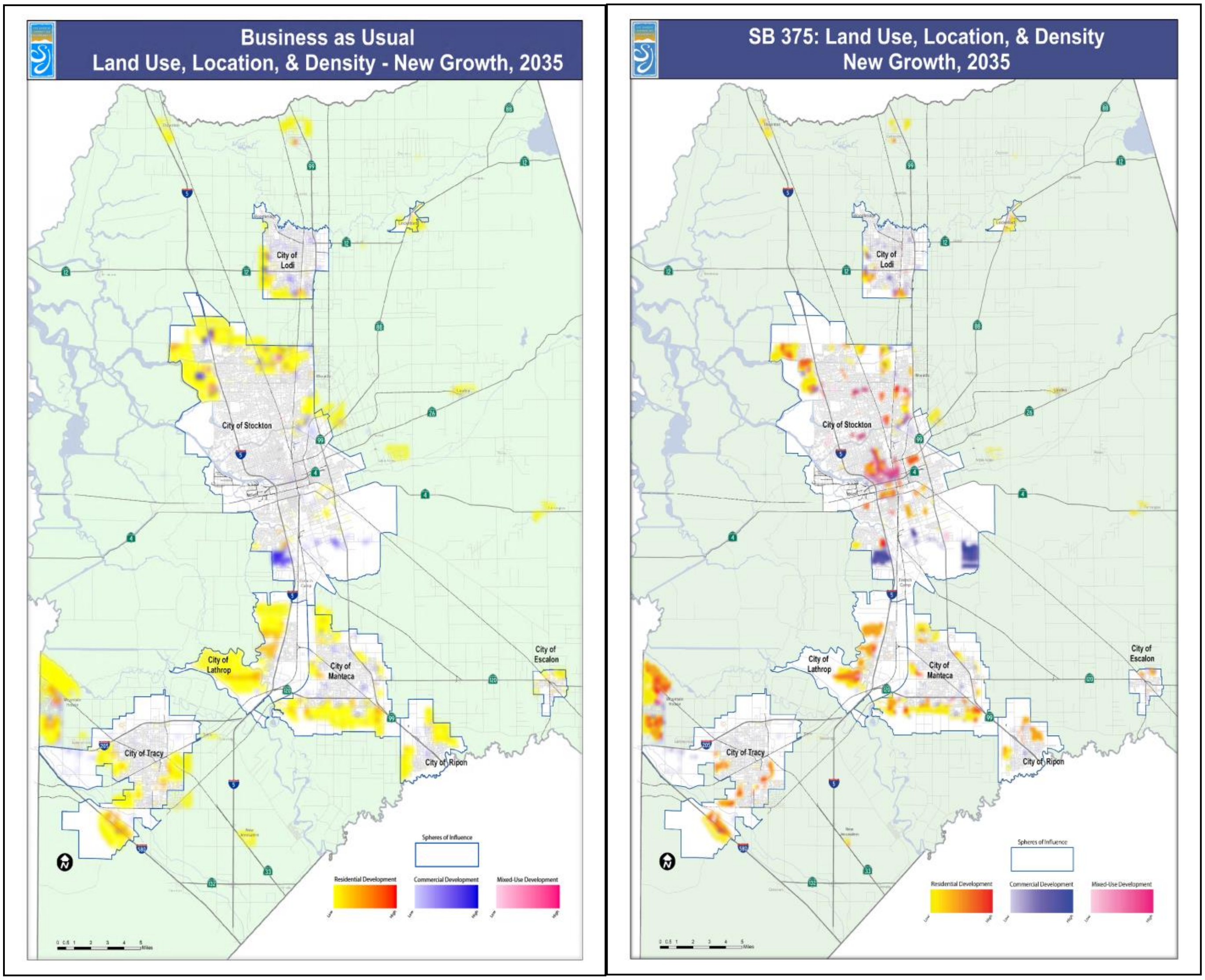
5. Selection of the SCS Preferred Scenario

Using the performance indicators described above, Scenarios B, C, and D were compared to Scenario A. Scenarios B, C, and D generally showed increasing levels of sustainability, with greater daily transit ridership, fewer total acres of land and prime farmland consumed by new development, a higher percentage of housing and employment near transit, lower VMT per capita, greater residential and employment density, a greater percentage of multi-family housing, and lower greenhouse gas emissions per capita as compared to Scenario A.

Taking into consideration the recommendations of SJCOG's RTP/SCS Advisory Committee and Citizen Advisory Committee, and the feedback from all the public outreach efforts, in September 2013, the SJCOG Board of Directors chose a preferred scenario that was based largely upon Scenario C, with elements of Scenario D added. Notably, the elements of Scenario D that the SJCOG Board wished to include in the preferred scenario were the assumptions about BRT corridor frequency improvement projects, and an additional 4,400 housing units in downtown Stockton. The preferred scenario moves the region away from Scenario A conditions with respect to land use patterns (Figure 3) and transportation investments.

Figure 3. Scenario A vs Adopted SCS - Land Use Intensity

Scenario A **Preferred Scenario**



G. 2014 RTP/SCS Land Use and Transportation Strategies

1. Land Use Strategies

SJCOG's 2014 RTP/SCS forecasts reductions in GHG emissions based on its ability to reduce the number of miles that passenger vehicles are driven, which is influenced greatly by the proximity of the region's housing to jobs, shopping areas, and other amenities, and residential and employment densities. SJCOG worked with its local jurisdictions to incorporate into the 2014 RTP/SCS, such foundational policies and programs as those set in recent general plan updates, local climate or sustainability action plans, the Smart Growth and Transit-Oriented Development Plan, and others described earlier in this report.

The maps in Figure 3 above show that the 2014 RTP/SCS directs growth away from the outer edges of the incorporated cities' spheres of influence, with higher densities in each city than what would be expected under business as usual conditions. As a result, the 2014 RTP/SCS is expected to result in approximately 17,000 fewer acres of land consumed than would be under the Scenario A conditions, including 10,707 fewer acres of prime farmland.

Stockton, Tracy, and Lodi have largely identified their downtown areas as locations where mixed-use building and denser development is most appropriate. As the largest city in the county, Stockton would accommodate the largest number of infill sites. The 2014 RTP/SCS assumes that downtown Stockton would accommodate 4,400 new housing units, consistent with the City's currently proposed General Plan amendments. In addition, all the other incorporated cities, and the unincorporated community of Mountain House, have identified infill opportunity sites, in addition to the expected growth in greenfield areas at the edges of these communities.

With their proximity to the Bay Area and major highways, those communities in the south-eastern portion of the county—Mountain House, Tracy, Lathrop, and Manteca—are expected to grow at a greater rate than other communities in the region. Mountain House, located north of Tracy along the western border of the county, is envisioned to have an efficient land use design with a balance of jobs, housing, transit and other services, leading to a reduction in the need for use of single-occupancy vehicles. Mountain House is a Master Planned community with approximately 10,000 residents, with a 20-year plan resulting in 39,191 residents in a 4,784-acre area. As shown in Table 4, the 2014 RTP/SCS would result in the consumption of approximately 18,123 acres of currently undeveloped areas region-wide by 2040, resulting in development beyond the county's existing urban footprint. However, this is only about half the amount of consumption of 35,194 acres by 2040 under Scenario A.

Table 4. 2014 RTP/SCS Land Consumption

	Acres of Impact by 2040	
Community Type	**No Project (Scenario A)**	**2014 RTP/SCS**
Total Land Consumed	35,194	18,123
Prime Farmland Consumed	15,352	4,645
Statewide Farmland Consumed	7,755	3,405
Unique Farmland Consumed	767	90
Important Farmland Consumed (Total)	**23,875**	**8,140**

Source: 2014 San Joaquin COG RTP/SCS Draft EIR Table 4.2-5

One focus of the 2014 RTP/SCS is to coordinate improvements to transit services with land use development policies that complement and support transit use. To this end, the 2014 RTP/SCS aims to increase residential and commercial development around multi-modal transit stations, and to include mixed-use buildings, multi-family housing, park-and-ride lots, bicycle facilities, pedestrian amenities, and telecommute work stations in the areas surrounding these transit stations. Focused growth along existing and planned BRT routes in Stockton is also a high priority in the 2014 RTP/SCS.

In support of infill and transit-oriented development, downtown revitalization, and increased use of active transportation, more than $115 million is slated for such community enhancement projects as sidewalks, pedestrian streetlights, landscaping, and traffic calming projects. With these 2014 RTP/SCS investments improving the public environment, SJCOG's goal is to encourage greater use of transit, bicycles, and walking.

The 2014 RTP/SCS envisions nearly doubling residential density in 2035, compared to Scenario A by reducing the percent of new growth in large-lot single-family housing, and increasing small-lot single-family housing and multi-family housing. As a result, new housing is expected to be about 59 percent single-family homes and 40 percent multi-family homes, as compared to the mix of existing homes (in 2008) of about 69 percent single-family and 28 percent multi-family.

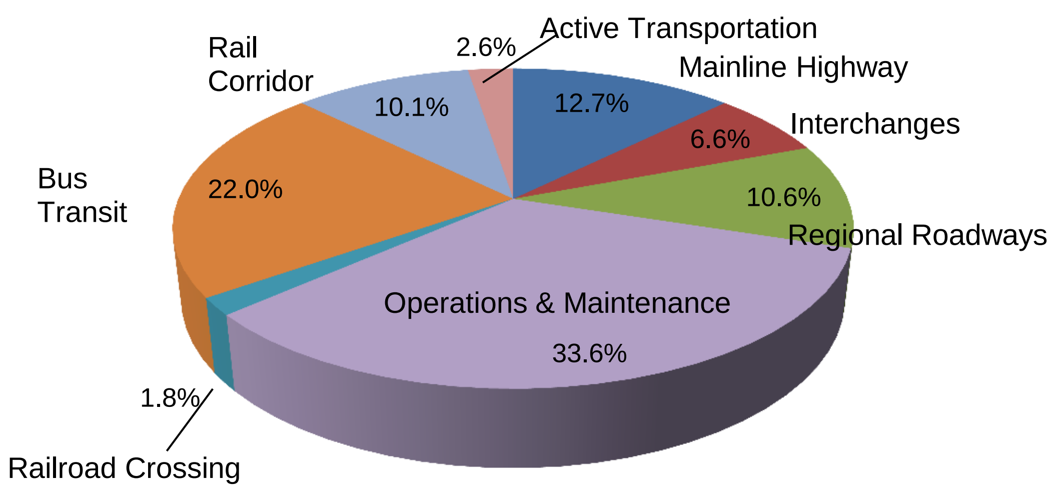
2. Transportation Strategies

The 2014 RTP/SCS devotes a much greater amount of funding to transit, active transportation, and operations and maintenance of existing roadways than the previous 2011 RTP. With a total budget of about $11 billion, SJCOG's 2014 RTP/SCS lays out the region's priorities for operating, maintaining, and improving the region's transportation system through 2040. In addition, it makes connections between transportation and land use planning called for in SB 375. Under federal requirements, an MPO's long-range plan must be a financially constrained plan, with projects and services not exceeding reasonably expected federal, State, and local funding sources.

With San Joaquin County's Measure K sales tax program, local transportation funds, general funds, developer fees, traffic impact fees, bus and Altamont Corridor Express (ACE) fares, and a variety of other local sources of revenue dedicated to fund 2014 RTP/SCS projects, 59 percent of the funding sources for this plan are expected to come from local sources. Twenty five percent of the plan's revenue sources are expected to be State-funded, from such programs as the State Gas Tax Subvention, State Highway Operation and Protection Program, and State Transportation Improvement Program. SJCOG anticipates only about 16 percent of the funding to be provided by federal programs such as the Federal Transit Administration, Surface Transportation Program, and Congestion Mitigation and Air Quality.

With these resources, SJCOG's 2014 RTP/SCS allocates 35.4 percent of the $11 billion to roadway operations and maintenance projects, 32.1 percent to bus and rail transit, 29.9 percent to roadway capacity expansion, and 2.6 percent to active transportation projects. Figure 4 further breaks down some of these expenditure categories.

Figure 4. 2014 RTP/SCS Expenditures by Project Category



Source: SJCOG 2014 RTP/SCS

Compared to the expenditures for the 2011 RTP, SJCOG's 2014 RTP/SCS allocates approximately 15 percent more in funds towards roadway operations, maintenance, and safety; 28 percent more in funds towards transit; 79 percent more in funds towards active transportation and other community enhancements; and 26 percent less in funds towards roadway capacity expansion.

Transit

Helping to create a balanced, multi-modal plan to achieve the region's long-term transportation goals, all transit projects combined receive nearly a third of the 2014 RTP/SCS's investments. San Joaquin County's transit-dependent riders, and those who ride by choice, benefit from approximately $3.52 billion in transit investments, helping to improve air quality, reduce traffic congestion, and reduce regional VMT.

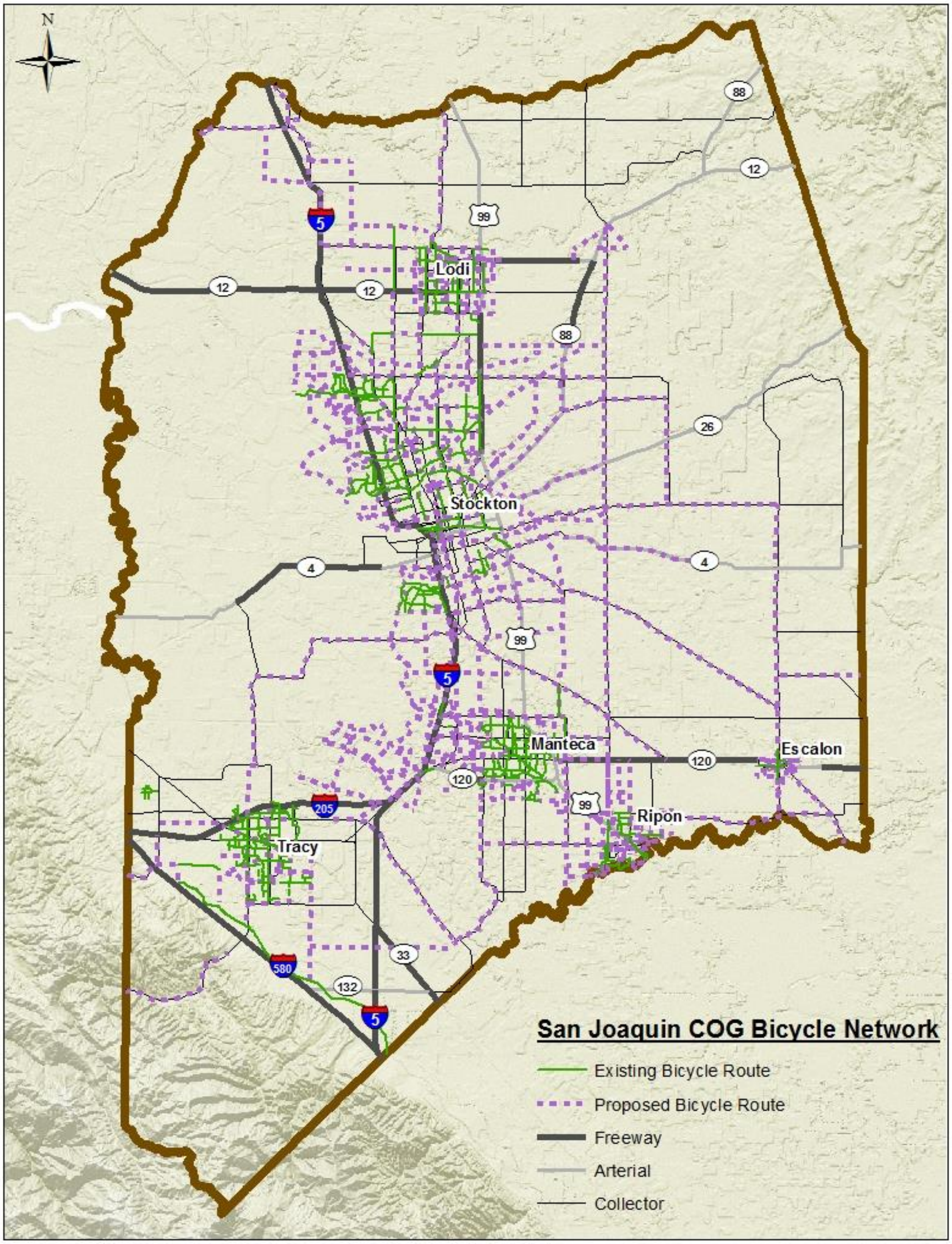
Approximately $652 million of bus transit operations and capital investments are directed toward expansion of the bus system. Transit expansion projects include expansion of the region's BRT routes; development/improvement of intracity transit for the cities of Escalon, Manteca, Tracy, and Ripon; and expansion of the ACE passenger rail service to Sacramento, Modesto, and Merced (providing a connection to the State's planned high speed rail system). Transit operations and maintenance projects include an increase in bus service frequency throughout the region, and replacement of buses, train cars, tracks, and other capital equipment. On the whole, 64 percent of the transit budget is targeted towards system maintenance, and 36 percent towards system expansion.

> Transit projects include expansion of BRT routes; improvement of intracity transit; expansion of the ACE passenger rail service; increase in bus service frequency; and replacement of buses, train cars, tracks, and other capital equipment.

Active Transportation and Community Enhancement

Approximately $282 million is to be directed towards active transportation and community enhancement projects in SJCOG's 2014 RTP/SCS, a 78.5 percent increase in spending over the 2011 RTP. These projects include bicycle, pedestrian, and Safe Routes to School projects, and streetscape enhancement projects that are intended to incentivize infill development. Active transportation infrastructure projects, including over 800 miles of new bikeways (Figure 5), account for 53 percent of the funds in the active transportation and community enhancement category. Additional projects include programs that support bicycling and walking, such as education programs, and transit integration projects, in recognition of active transportation's benefits to serve as an alternative mode of travel to automobiles when making connections to and from transit. Community enhancements to support infill and transit-oriented development, such as enhanced sidewalks, pedestrian street lighting, traffic-calming measures, and landscaping compose the remaining 41 percent of these funds.

Figure 5. Existing and Proposed Bikeways in San Joaquin County



Roadway Operations/Maintenance/Safety

Of the approximately $3.88 billion to be spent on roadway operations, maintenance, and safety projects, approximately 73 percent is dedicated to maintenance of local streets and roads, while 10 percent will help maintain State highways in the region, and 17 percent will provide operational and safety improvements to both local roadways and State highways. Many of the projects in this category for SJCOG involve rehabilitation of streets and roads, transportation system management (TSM) projects, and railroad grade crossing safety projects. TSM projects include those that improve the efficiency of traffic flow without adding more lanes, and can include such projects as modifying interchange ramps, improving road shoulders, improving intersections, synchronizing traffic signals, and building turn pockets.

Roadway Capacity Expansion

Several highways and arterial streets in San Joaquin County are expected to meet or exceed the amount of traffic the roadways are built to accommodate. In particular, I-5, SR-99, I-205, and SR-120 are expected to see much higher levels of traffic in the future. To increase capacity on these and selected other roadways, approximately $3.27 billion is budgeted in the 2014 RTP/SCS for roadway capacity projects. A crosstown freeway extension to the Port of Stockton on SR-4 is scheduled to be open to traffic in 2017, but all other highway widening projects will be completed between 2030 and 2040. One key component of the I-5 and I-205 widening projects is the addition of high occupancy vehicle (HOV) lanes. Of the roadway capacity investments in the 2014 RTP/SCS, 58 percent target regional roadway widening and new interchanges between these roadways and highways. These investments support access to infill development areas and bus transit, in addition to providing congestion relief. Many of the roadways to be widened are in areas that have been master planned for future job growth. If jobs are added to these areas in the future, potentially fewer San Joaquin County residents will rely upon commuting to the Bay Area for jobs, thus reducing interregional travel. New regional roadways to be built during the 2014 RTP/SCS horizon are expected to support local and regional bicycle, pedestrian, and Safe Routes to School plans.

H. RTP/SCS Environmental Justice Analysis

SJCOG prepared an environmental justice (EJ) analysis of its RTP, per President Clinton’s Executive Order 12898 on environmental justice. SJCOG’s EJ analysis is intended to ensure that minority and low income communities are not disproportionately impacted by any adverse effects of the RTP/SCS, and that these communities have a reasonable share of the benefits of the RTP/SCS’s investments.

SJCOG used the U.S. Census Bureau’s definitions to identify minority and low income populations. According to the 2007-2011 American Community Survey 5-Year Estimates, approximately 63 percent of the countywide population was in the minority category, and 14 percent of the county’s population lived in poverty. Environmental justice areas made up just below 61 percent of the population, measured at the Census block group level.

For its EJ analysis, SJCOG evaluated two performance indicators with respect to the entire population—housing type mix and percent of household income spent on auto-related transportation—and three additional measures with respect to the identified communities of concern as compared to the region as a whole—transit accessibility, the number of households within 500 feet of a major transportation facility, and roadway expenditure benefits. The 2014 RTP/SCS indicates an increase in the percentage of multi-family compared to single-family housing, as compared to conditions under Scenario A, based on the historical trends. This suggests that more rental housing, which is generally more affordable housing, would be available under the 2014 RTP/SCS than under Scenario A's conditions. In addition, for all households the percent of household income spent on auto-related transportation decreases with the 2014 RTP/SCS as compared to the conditions of Scenario A. Under the 2014 RTP/SCS, a significantly higher percentage of EJ communities' households and jobs are expected to be within a half-mile walking distance of bus transit stations or stops than would be for the population as a whole. This indicates that EJ communities would benefit more from transit investments in the 2014 RTP/SCS than would the general population. However, EJ communities are more likely to reside within 500 feet of a major transportation facility than the general population, and a smaller percent of daily vehicle trips on the improved roadways are expected to originate from EJ communities, as compared to the population on the whole, indicating that EJ communities do not benefit to the same extent from roadway improvement expenditures as the general population.

I. Plan Implementation and Next Steps

SJCOG has taken several steps to implement the 2014 RTP/SCS. Recognizing the potential to reduce commute VMT by providing residents with job opportunities within the county, SJCOG is developing an economic incentive program to encourage job-creating businesses to locate in San Joaquin County. SJCOG is also helping local governments in the region to be better positioned to compete for Cap and Trade funds by developing prioritization criteria for the Strategic Growth Council's Affordable Housing and Sustainable Communities program, which provides priority for projects that implement the SCS. SJCOG has also developed a Consistency Checklist to help applicants determine if their proposed projects would be consistent with the RTP/SCS. In addition, in cooperation with the seven other Valley MPOs, SJCOG is planning for a pilot program utilizing shared access services (car, bike, ridesharing) and other alternatives for meeting transit needs in the rural areas of the region.

In addition to these initial steps to implement the 2014 RTP/SCS, SCJOG has begun looking at ways to improve the next RTP/SCS planning cycle. In July 2014, the SJCOG Board approved a 2014 RTP Working Group, and subsequently approved membership composition and topics for the group to consider. The group consists of those members already represented on the RTP/SCS Advisory Committee plus one representative each for public health, environmental justice, and infill builders. It is anticipated that this group will meet approximately six times over the course of a year. The topics on which the group will focus are:

- Methods for tracking progress of the 2014 RTP/SCS
- Statewide MPO best practices literature review
- Methods for further incorporation of public health into SJCOG planning process
- Better methods to encourage active transportation in the region
- Methods for continued incorporation of environmental justice communities' voices into SJCOG planning process
- Methods for enhancing the SJCOG Public Participation Process, based on lessons learned during 2014 RTP/SCS public outreach process

The 2014 RTP Working Group will help to identify and develop health performance metrics that could be used for establishing baselines and to monitor progress over time. Examples of such measures include, tracking per capita non-motorized trips, bike and walk trips per capita by community type in the region, and average daily walk/bike time. In addition, the 2014 RTP Working Group may discuss the incorporation of more robust complete streets policies into the SJCOG planning process.

II. ARB Staff Technical Analysis

Senate Bill 375 calls for ARB's "acceptance or rejection of the MPO's determination that the Sustainable Communities Strategy (SCS) would, if implemented, achieve the greenhouse gas emission reduction targets" in 2020 and 2035. SJCOG's quantification of GHG emissions reductions in the SCS is central to its determination that the SCS would meet the targets established by ARB in September 2010. Those targets for SJCOG are 5 percent per capita reduction in 2020 and 10 percent per capita reduction in 2035. The remainder of this report describes the method ARB staff used to review SJCOG's determination that its SCS would meet its targets, and reports the results of staff's technical evaluation of SJCOG's quantification of passenger vehicle GHG emissions reductions.

Government Code section 65080(b)(2)(J)(i) requires the MPO to submit a description to ARB of the technical methodology it intends to use to estimate GHG emissions from its SCS. SJCOG's September 2012 technical methodology identifies its transportation modeling system, which includes the regional travel demand model, model inputs and assumptions, land use projections, growth forecast, performance indicators, and sensitivity analyses, as the technical foundation for its quantification.

SJCOG's analysis estimates that the SCS, if implemented, would achieve a 24.4 percent per capita reduction in GHG emissions from passenger vehicles by 2020, and a 23.7 percent per capita reduction by 2035. ARB staff's evaluation of SJCOG's SCS and its technical documentation indicates that if implemented, the SCS would meet the GHG emissions reduction targets set by the Board.

A. Application of ARB Staff Review Methodology

ARB's review of SJCOG's quantification focused on the technical aspects of regional modeling that underlie the quantification of GHG emissions reductions. The review is structured to examine SJCOG's modeling tools, model inputs, application of the model, and modeling results. The general method of review is outlined in ARB's 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 each MPO region and modeling system, ARB's methodology is tailored for the evaluation of each MPO. SJCOG provided a copy of its Three-County travel demand model to ARB staff which enabled a first-hand assessment of the model's structure and performance.

ARB staff evaluated how SJCOG's model operates and performs when estimating travel demand, land use impacts, and future growth, and how well it is able to quantify GHG emissions reductions associated with the SCS. In evaluating whether or not SJCOG's model is reasonably sensitive for this purpose, ARB staff examined issues such as:

- How does the growth forecast reflect the recent economic recession?
- What is the basis for allocation of land use changes?
- How well does SJCOG’s travel demand model replicate observed results?
- Are cost assumptions (fuel price and auto operating cost) used in the model reasonable?
- How sensitive is SJCOG’s Three-County Model to changes in key land use and transportation variables as compared with the empirical literature?
- How well is inter-regional travel addressed in SJCOG’s RTP/SCS?

To help answer these and other questions, ARB staff used publicly available information in SJCOG's RTP/SCS and accompanying documentation, including the RTP technical appendices and the model description and validation report. In addition, SJCOG provided clarifying information, sensitivity analyses, and a data table, as listed in Appendix A.

Four central components of SJCOG's GHG quantification methodology and supporting analyses were reviewed for technical soundness and general accuracy:

- Data Inputs and Assumptions for Modeling Tools
- Modeling Tools
- Model Sensitivity Analyses
- Performance Indicators

Data Inputs and Assumptions for Modeling Tools

SJCOG’s key model inputs and assumptions were evaluated to assess whether they represent current and reliable data, and were appropriately used in their model. Specifically, a subset of the most relevant model inputs were reviewed, including: 1) regional socioeconomic characteristics, 2) the region’s transportation network inputs and assumptions, and 3) cost assumptions. In evaluating these four input types, model inputs were compared with underlying data sources. The assumptions SJCOG used to forecast growth and VMT were also reviewed. This involved using publicly available, well documented sources of information, such as national and statewide survey data on socioeconomic and travel factors. ARB staff also evaluated documentation of regional forecasting processes and approaches.

Modeling Tools

ARB staff assessed how well the Three-County Model replicates observed results based on both the latest inputs (socioeconomic, land use, and travel data) and assumptions used to model the SCS. The documentation of SJCOG’s application of the Envision Tomorrow™ scenario planning tool and results were reviewed to assess whether an appropriate methodology was used to quantify the expected reduction in GHG emissions from its SCS. SJCOG’s modeling practices were also compared against California Transportation Commission (CTC) “2010 California Regional Transportation Plan Guidelines,” the Federal Highway Administration’s (FHWA) “Model

Validation and Reasonableness Checking Manual," and other key modeling guidance and documents.

Model Sensitivity Analysis

Sensitivity testing is often used to assess whether a model is reasonably responsive to changes in key inputs, including changes to land use and transportation factors. These tests often involve systematically changing model input variables and measuring variations in output variables. They can also be performed by examining variations in independent and dependent variables across a dataset, and evaluating the correlations between the variables. SJCOG conducted sensitivity tests of the Three-County Model to support its GHG emissions quantification analyses. The results of SJCOG's sensitivity tests were compared to those found in the available empirical literature.[3] As part of the sensitivity analysis review, responsiveness of the Three-County Model to changes for the SJCOG region in the following input variables was examined:

- Auto operating costs
- Household income distribution
- Transit frequency
- Proximity to transit
- Residential density

Regional Performance Indicators

Performance indicators help explain changes in VMT and related GHG emissions that are expected to occur, whether through changes in travel modes, vehicle trip distances, or through some other means. SJCOG developed several performance indicators to evaluate the effect of implementation of the 2014 RTP/SCS on changes in VMT and GHG emissions. These performance indicators include residential density, mix of housing types, jobs/housing balance, land consumption, passenger VMT, bus rapid transit service coverage, and transportation investments. ARB staff performed a qualitative evaluation to determine if increases or decreases in a subset of these individual indicators are directionally consistent with SJCOG's modeled GHG emissions reductions.

B. Data Inputs and Assumptions for Modeling Tools

SJCOG's key model inputs and assumptions were evaluated to confirm that model inputs represent current and reliable data, and were used appropriately. Specifically, a subset of the most relevant model inputs were reviewed, including: 1) the regional growth forecast, 2) the region's transportation network, and 3) cost assumptions. In evaluating these three input types, ARB staff reviewed the assumptions SJCOG used to

[3] Empirical literature elasticities were taken from a series of empirical literature reviews commissioned by ARB. These reviews can be accessed on ARB's website at : http://arb.ca.gov/cc/sb375/policies/policies.htm.

forecast growth and VMT, and compared model inputs with underlying data sources. This involved using publicly available, authoritative sources of information, such as national and statewide survey data on socioeconomic and travel factors, as well as region-specific forecasting documentation.

1. Demographics and the Regional Growth Forecast

Demographic data and growth forecasts describe a number of key characteristics used in travel demand models. The regional growth forecast projects how many people will live in the region, how many jobs the region will have, and the anticipated number of households. The population and household projections for San Joaquin County were conducted by The Planning Center in March 2012, while the employment forecasts were conducted by the University of the Pacific Business Forecasting Center in March 2012. The population forecasts, shown earlier in Table 4, were confirmed to be valid in January 2013 when DOF released projections for San Joaquin County that differed by less than three percent for each relevant year.

The Planning Center's report cites data sources including the California Department of Finance (DOF), U.S. Census Bureau, and the California Employment Development Department, and describes the application of the least-squares method to determine a line of best fit for the trend data for the primary forecasts. The forecast for an increase in households was used to derive the forecasted population. The population, household, and housing unit forecasts used the projections of several trends including: household trend, total housing unit trend, housing construction trend, employment trend, cohort-component model, population trend, average household size trend, and household income trend. The employment forecast developed by the University of the Pacific Business Forecasting Center used State and national employment trends, as well as knowledge of several factors unique to San Joaquin County, including the opening and closing of large facilities, local real estate market trends, major infrastructure projects, a gradually declining farm employment sector, and an expected reduction in housing starts due to housing prices falling below the cost of production of new houses.

Population

The county is projected to grow at a rate of 1.42 percent annually between 2008 and 2040 which is lower than the annual growth rate of 2.54 percent experienced between 1970 and 1990, and slightly lower than the annual growth rate of 1.79 percent between 1990 and 2010.

Employment

The employment forecast included consideration of anticipated changes to recent employment figures as a result of planned developments that would impact employment in the region, such as the building of the California Healthcare Facility in Stockton. Employment in San Joaquin County is forecast to increase by about 79,000 jobs between 2008 and 2040, yielding an annual employment growth rate of about 0.96 percent, which is not proportionate to the higher rate of population growth in the same time period.

Households

SJCOG projects household size will increase slightly from an average of 3.19 persons per household in 2008 to 3.29 persons per household in 2040. The number of households is projected to increase in the same time period by more than 111,000, yielding an annual growth rate in households of about 1.35 percent. Given the increase in household size, the slightly smaller annual growth rate of households as compared to an annual growth rate in total population of 1.42 percent in the same time period seems reasonable.

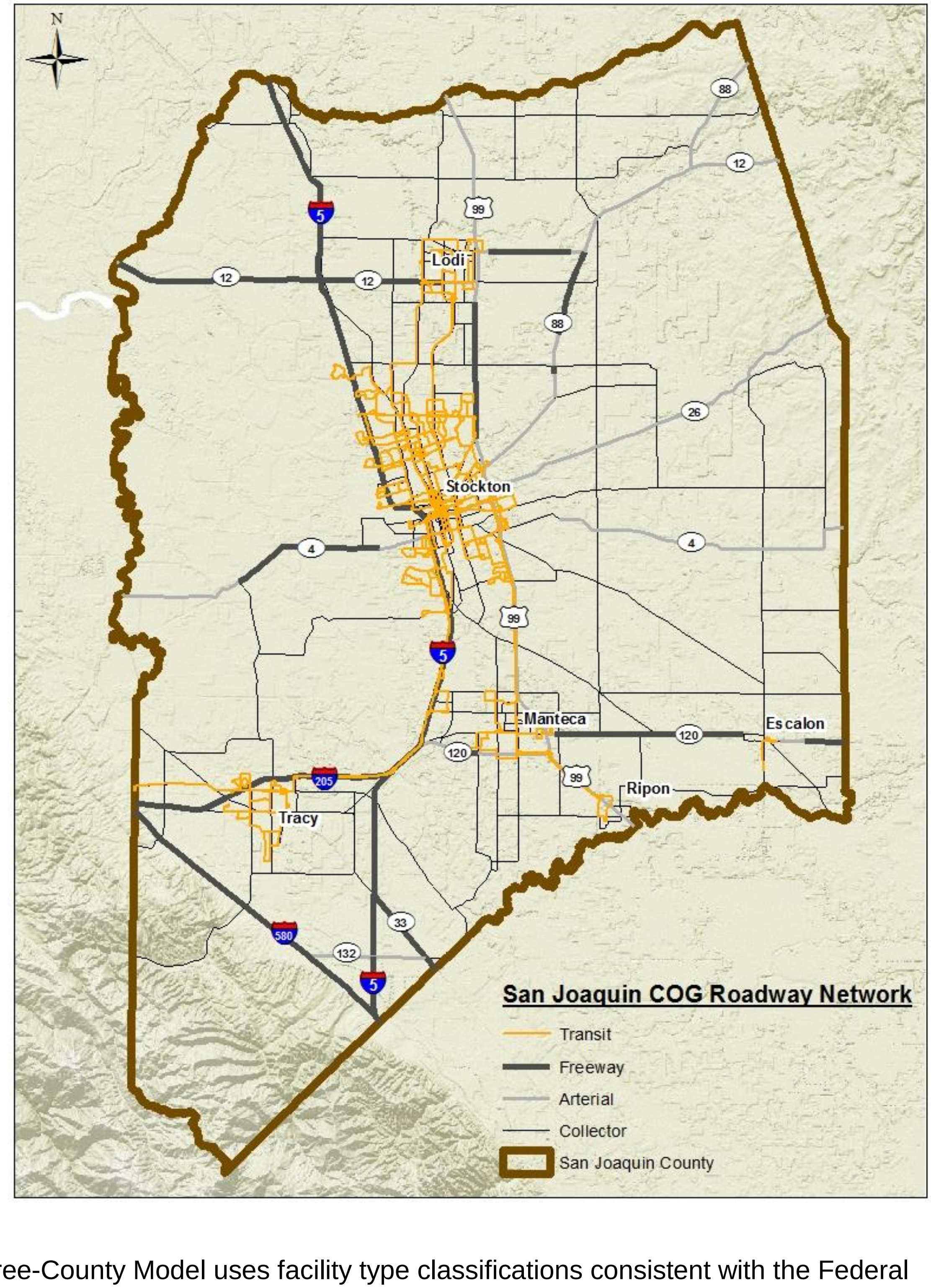
2. Transportation Network Inputs and Assumptions

The transportation network is a map-based representation of the transportation system serving the SJCOG region. One part of the transportation network is the roadway network, which consists of an inventory of the existing road system, and highway travel times and distances. The other part of the transportation network is the transit network, which contains data such as route name, stop locations, transit fares, headway, and type of transit service. The Three-County Model includes roadway and transit networks for both the model base year of 2008 and for future years (i.e. 2020, 2035). ARB staff reviewed the SJCOG regional roadway network, transit network, and network assumptions such as link capacity and free-flow speeds. The methodologies SJCOG used to develop the transportation network and model input assumptions is consistent with guidelines given in the National Cooperative Highway Research Program (NCHRP) Report 365.

Roadway Network

SJCOG's roadway network is a representation of the automobile roadway system, which includes freeway, highway, expressway, arterial, collector, local and freeway ramps in the region. Roadways in the model were also grouped by adjacent development (i.e. central business district, fringe, urban, suburban, or rural) and terrain (i.e. flat, rolling, or mountains). Figure 6 shows the current condition of the roadway and transit network in the SJCOG region. The roadway network provides the basis of estimating zone-to-zone travel times and costs (in terms of travel distance and travel time) for the trip distribution and mode choice steps of the modeling process, and for trip routing in vehicle assignments.

Figure 6. Existing Roadways and Transit Service in SJCOG



The Three-County Model uses facility type classifications consistent with the Federal Function Highway Classification system. Table 5 summarizes the reported roadway lane miles in the SJCOG region in 2008 by facility type. In the roadway network, link attributes (e.g. route/street name, distance, capacity, speed) are coded for each roadway segment.

Table 5. Lane Miles in 2008 by Facility Type

Facility Type	Lane miles in 2008
Freeway	706
Arterial	1,856
Collector	1,576
Local	654

Link Capacity

Link capacity is defined as the number of vehicles that can pass a point of roadway at free-flow speed in an hour. One important reason for using link capacity as an input to the Three-County Model is for congestion impact, which can be estimated as the additional vehicle-hours of delay traveling based on the 2000 Highway Capacity Manual (2000 HCM). Table 6 summarized the reported link capacity assumptions used in the Three-County Model. The capacity of each road segment in the network is based on the terrain, facility type, and area type, and is determined using the methodology suggested in the 2000 HCM.

Table 6. Default Link Capacity

Facility Type	Terrain		
	Flat	Rolling	Mountain
Freeway	1,750 to 2,100	1,580 to 1,800	1,310 to 1,500
Highway	1,300 to 1,680	1,060 to 1,300	570 to 700
Expressway	800 to 1,155	650 to 1,300	350 to 700
Arterial	750 to 945	610 to 1,300	330 to 700
Collector	700 to 735	570 to 1,300	310 to 700
Local	600	550 to 1,000	330 to 600
Ramps	1,250 to 1,900	1,250 to 1,800	1,250 to 1,500

Free-Flow Speed

Free-flow speed is used to estimate the shortest travel time between origin and destination zone in the highway network. Factors such as prevailing traffic volume on the link, posted speed limits, adjacent land use activity, functional classification of the street, type of intersection control, and spacing of intersection controls can affect link speed. SJCOG estimated the free-flow speed of each link segment (Table 7) using the Bureau of Public Roads formulas suggested in the 2000 HCM.

Table 7. Free-Flow Speed Assumptions

Facility Type	Terrain		
	Flat	Rolling	Mountain
Freeway	55 to 70	65 to 70	65
Highway	40 to 45	40 to 45	40 to 45
Expressway	40 to 55	50 to 65	40 to 55
Arterial	25 to 45	30 to 45	30 to 45
Collector	35 to 50	50	25 to 40
Local	25 to 40	50	25 to 40
Ramps	45 to 50	45 to 50	35 to 50

The methodology used in estimating highway free-flow speeds in the SJCOG region was reviewed. SJCOG's estimation of free-flow speed, based on the posted speed, is consistent with the recommended practice indicated in the NCHRP Report 365.

Transit Network

Besides the roadway network, the transportation network of the Three-County Model also includes a transit network. SJCOG staff built the transit network using the completed roadway network to which transit routes and stops information was added. Figure 6 shows the existing transit service in the SJCOG region. The purposes of developing a transit network are: verification of access links and transfer points, performance of system level checks on frequency and proximity between home and transit station or stop, and relating transit speed to highway speeds.

Elements coded in the transit network include walk/bike access to transit, drive access to transit, park-and-ride lots, highway based (i.e. bus) and non-highway based (i.e. rail) transit in the study area. Some attributes coded in the transit network include transit fare, travel time, park-and-ride locations, and maximum distance for walk and ride to transit stops. SJCOG estimated transit bus travel times from the highway network, with a delay factor to account for stops and slow operating speeds. The Three-County Model assumes a walking speed of three miles per hour for walk access in estimating transit travel time. SJCOG also reported operation miles for BRT and passenger rail (Table 8).

Table 8. Existing and Future Transit Operation Miles

Transit Service	2008	2035
Bus Rapid Transit	1,860	7,148
Passenger Rail	92	224

The methodology SJCOG used in developing its transit network was reviewed and found consistent with the procedures discussed in the NCHRP Report 365 and USDOT-FHWA Manual. In future model updates, SJCOG should consider coding transit routes and stops on a GIS-based layer, and include bike and pedestrian facilities (e.g. bike paths, bike lanes) in the transit network to reflect walk- or bike-access to transit stations, which may increase the model's sensitivity to transit trips.

3. Cost Inputs and Assumptions

Travel cost is one of the major factors determining the mode of transportation for any given trip. ARB staff reviewed basic travel cost components, such as auto operating cost and value of time, that were used as inputs in the Three-County Model. To examine the responsiveness of the Three-County Model to changes in the cost variable or other model inputs, model sensitivity tests performed by SJCOG, such as auto operating cost, and transit frequency were evaluated. The results of the sensitivity tests are presented in the model sensitivity analysis section of this report.

Auto Operating Cost

Auto operating cost is a key parameter used in the mode choice step of the Three-County Model. SJCOG staff defined auto operating costs solely from cost of fuel. Fuel cost is an important factor that influences per capita VMT. The price of fuel is the amount consumers pay at the pump for regular grade gasoline (in dollars/gallon). When gasoline prices go up, drivers are expected to decrease their frequency of driving, reduce their travel distance, increase their use of public transit, and/or switch to more fuel efficient cars. Lower gas prices would be expected to have the opposite effects on VMT.

SJCOG staff followed the procedures documented in the 2009 Regional Transportation Plan Analysis performed by the Metropolitan Transportation Commission (MTC) to forecast fuel price in the region. The fuel price in 2020 and in 2035 was forecasted using the historical trend from 1998 to 2008 in the SJCOG region. The corresponding auto operating costs were then derived by dividing the fuel price in each year by the fuel efficiency assumptions. Table 9 summarizes the reported year 2008 and future years' auto operating cost in the SJCOG region.

Table 9. Auto Operating Cost in SJCOG (in 2009 Dollars)

	2008	2020	2035
Auto Operating Cost	0.19	0.22	0.24

Though fuel cost is the major component of travel cost of auto mode, other minor costs such as the cost of vehicle maintenance and tire replacement are considered in some California MPO regional travel demand models. ARB staff recommends SJCOG include these minor costs such as tire and maintenance costs in estimating auto operating cost in its future model update.

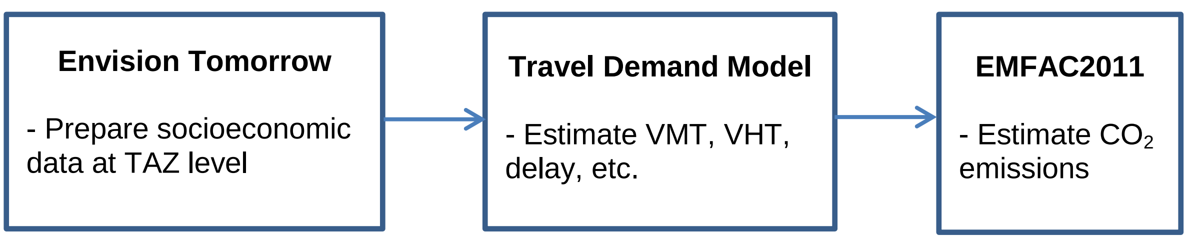
Cost of Time

A value of time assumption is used, as in the trip distribution step, to estimate the travel cost of alternative routes. SJCOG staff converted travel cost to cost of time using a value of time. The average perceived value of time that SJCOG used, similar to that used by other MPOs in the Valley, was six dollars per hour per person. The value of time was also further adjusted according to vehicle ownership status.

C. Modeling Tools

Similar to other MPOs in the Valley (e.g. Fresno Council of Governments, Stanislaus Council of Governments), SJCOG used a land use scenario planning tool (Envision Tomorrow™), a trip-based travel demand model, and the ARB vehicle emission model (EMFAC2011) to quantify the GHG emissions for its 2014 RTP/SCS. The analysis years for the GHG emissions were 2005, 2020, and 2035. Figure 7 shows the flow chart of the modeling process. The Envision Tomorrow™ land use tool takes demographic data (e.g. population, housing units) and future socioeconomic changes as inputs, and then allocates growth in housing, employment, and population at the Transportation Analysis Zone (TAZ) level. The outputs of the land use tool were fed as inputs to the travel demand model to estimate the amount of travel in the SJCOG region. Results from the travel model, such as VMT by time of day, were input to EMFAC2011 to estimate GHG emissions associated with the 2014 RTP/SCS.

Figure 7. SJCOG's Modeling Tools



1. Land Use Tool

SJCOG used the Envision Tomorrow™ land use tool to develop and compare alternative land use scenarios for its 2014 RTP/SCS. For each planning scenario, SJCOG used Envision Tomorrow™ to allocate the projected number and types of housing and employment at the parcel-level within specific planning areas. Land use modeling results and calculation elements associated with a scenario are stored in look-up table and GIS-map based files. Different land use scenarios based on different policies were then developed for evaluation and comparison purposes. The spreadsheet formatted outputs associated with SJCOG's preferred scenario served as inputs to the travel demand model (i.e. the Three-County Model).

For validation purposes, SJCOG developed a base year land use database to provide inputs to the tool for the 2008 model base year. The 2008 population and household inputs were initially developed based on 2000 U.S. Census information by census block. The increment between the 2000 Census and the 2008 model base year was based on building permits.

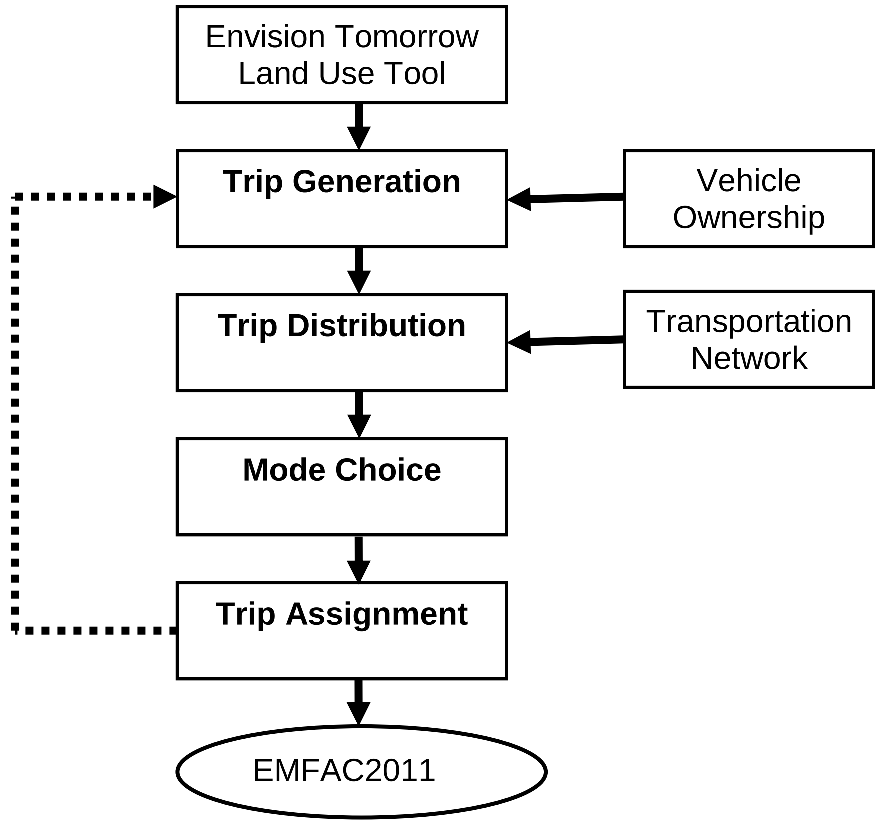
2. Travel Demand Model

In 2010, the eight MPOs in the Valley began a collaborative process to improve their travel demand modeling capabilities. This process, known as the San Joaquin Valley Model Improvement Plan (MIP) was funded by the Strategic Growth Council (SGC) and was completed in 2012. The MIP effort substantially upgraded and standardized travel demand models of the Valley MPOs and improved on their ability to evaluate land use and transportation strategies pertinent to meeting SB 375 requirements.

Additionally, in 2013, SJCOG together with the Merced County Association of Governments and Stanislaus Council of Governments further updated the MIP model to reflect model base year (2008) conditions of their regions. The resulting model, covering all three counties, is known as the Three-County Model. The 2014 RTP/SCS is SJCOG's first RTP to be developed using the Three-County Model. Similar to most regional travel demand models, the Three-County Model is a four-step model that includes trip generation, trip distribution, mode choice, and trip assignment (Figure 8). The model uses land use, socioeconomic, and roadway network data to estimate travel patterns, roadway traffic volumes and transit volumes. The model contains approximately 6,600 transportation analysis zones (TAZs) representing origins and destinations of travel in the model area. Travel to/from and through the model area is represented by 100 gateway zones at major road crossings of the county line for an interregional travel estimate.

Zonal level land use inputs from the Envision Tomorrow™ land use tool to the Three-County Model include population-related inputs such as total population and numbers of households by structure type, household income, age of population in households, and housing density- and employment-related inputs such as employee by detailed sector and employment density, and student enrollment.

Figure 8. Three-County Travel Demand Model



Vehicle Ownership

Modeling of vehicle ownership is a new component of the Three-County Model. Previously SJCOG used a fixed rate of vehicle ownership. The new model calculates the number of motor vehicles in the SJCOG region based on demographic characteristics, auto operating cost, and accessibility, which helps to capture the economic characteristics of each household. The output of this component is a critical input to the trip generation step, accounting for travelers' long term decisions for mode of transportation.

ARB staff evaluated the structure and variables used in the vehicle ownership model, as well as whether the model followed the state of the practice.[4] The model captures the relationship between household characteristics and vehicle ownership, and shows that the number of vehicles available per household increases as the average household income rises. This is consistent with the recommended practice in the Federal Highway Administration's "Model Validation and Reasonableness Checking Manual" (FHWA 2010). For future model improvements, SJCOG should consider including the sensitivity to land use and transit accessibility in modeling auto ownership, as well as

[4] The state of the practice indicates the methods used by most MPOs in developing their travel demand models.

validating the vehicle ownership model results against the Department of Motor Vehicles' (DMV) data.

Trip Generation

Trip generation, the first step of travel demand modeling, quantifies the amount of travel in terms of person-trips in a model area. SJCOG estimates person-trips by trip purpose using cross-classification, which is similar to a look-up table of residential data, employment information, and school enrollment based on the 2000/2001 California Household Travel Survey (CHTS) and is supplemented by information from previously developed models. There are 11 trip purposes contained in this step of the Three-County Model: home-based work (HBW), home-based shopping (HBShop), home-based K12 (HBK12), home-based college (HBCollege), home-based other (HBO), work-based other (WBO), other-based other (OBO), highway commercial, trucks-small, trucks-medium, and trucks-large.

Consistent with a conventional trip-based travel demand model, the Three-County Model has two trip ends, trip production[5] and trip attraction.[6] The trip production rates for HBW trips by housing type and by auto ownership, and for WBO by employment type were derived from survey results from the 2000/2001 CHTS. The Three-County Model also used survey results from all eight counties in the Valley to ensure larger sample sizes. HBW trip attraction rates were also derived from the 2000/2001 CHTS because the survey has records of surveyed households and their employment information. Table 10 summarizes the trip production and attraction rates by trip purpose. The differences between estimated trip productions and attractions were within the 10 percent difference stated in the 2010 FHWA's Travel Model Validation and Reasonable Checking Manual, except for HBW trips, which were within 15 percent. SJCOG stated the reason for the difference in HBW trips is due to limited sample sizes for Valley counties from the 2000/2001 CHTS. ARB staff recommends SJCOG use the latest available household travel survey data for their next model update.

Table 10. Trip Productions and Attractions

Trip Purpose	Productions	Attractions	Percent Difference	FHWA Criterion
HBW	510,513	587,396	15%	±10%
HBSchool*	294,572	296,142	1%	±10%
HBO	1,135,038	1,173,813	3%	±10%
NHB	719,092	740,799	3%	±10%
Total	2,659,215	2,798,150	5%	±10%

Source: Fehr & Peers (2014). Three-County Model Description.
*HBSchool is an aggregation of HBK12 and HBCollege.

[5] Trip production is defined as the home end of any home-based trip, regardless of whether the trip is directed to or from home. If neither end of the trip is a home, it is defined as the origin end.
[6] Trip attraction is defined as the non-home end of a home-based trip. If neither end of the trip is a home, the trip attraction is defined as the destination end.

The OBO trip production and attraction rates for each employment type were estimated by comparing the trip generation derived from the 2000/2001 CHTS to standard vehicle trips in the Institute of Transportation Engineers (ITE) Trip Generation manual. The modeled person trip rates were then converted to vehicle trips using average auto occupancies for the three counties for each trip purpose (i.e. drive alone, shared ride 2, shared ride 3+).[7]

As part of the evaluation of the trip generation step, ARB staff reviewed the parameters used in the trip production and attraction models, their association to trip rates, and the responsiveness of trip rates to key parameters in the model. Analysis of the trip generation component of the Three-County Model indicates that trip rates tend to increase as household income and household size increases. Overall, the trip generation model followed the process for estimating trip generation outlined in NCHRP Report 365. As part of future model improvement, SJCOG should consider including some sensitivity to land-use mix, particularly in areas with high transit use to capture the transit-oriented development travel behavior. ARB staff recommends SJCOG use the latest available independent data sources such as the National Household Travel Survey (NHTS), Census Transportation Planning Package (CTPP), and the American Community Survey (ACS) to validate the travel model.

Trip Distribution

The trip distribution step is the second step of the Three-County Model, which utilizes a gravity model[8] to estimate how many trips travel from one zone to any other zone. The inputs to the gravity model include the person trip productions and attractions for each zone, zone-to-zone travel cost, and friction factors[9] that define the effect of travel time. The travel time (or skim) between a pair of zones is based on the shortest path connecting the two zones. The results of the zone-to-zone travel times serve as input to the trip distribution process. Intrazonal travel times were assumed to be 100 percent of the average travel time to the nearest adjacent urban TAZ and one-third the average travel time to the nearest adjacent rural TAZ.

Because time is an important factor in trip distribution, the Three-County Model added terminal times to reflect the average time to access one's vehicle at the each end of the trip. The model estimated terminal time by taking the difference between the model estimate of roadway network travel time and the reported travel times for trips in the three counties from the 2000/2001 CHTS. The three counties agreed to use a terminal time of one minute for all TAZs in the model area of the Three-County Model.

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[7] Shared ride 3+ includes vehicles with 3 or more riders including driver in the vehicle, calculated as 3.5 persons per vehicle.

[8] 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.

[9] Friction factors represent the effect that travel time exerts on the propensity for making a trip to a given zone.

In evaluating the trip distribution step of the Three-County Model, the average travel time by trip purpose was reviewed. Table 11 shows the average travel time by trip purpose from the model. SJCOG explained that the differences between the modeled travel time and the observed travel time (CHTS) are due to the limited samples from the 2000/2001 CHTS for the three counties, the time gap between model base year (i.e. 2008) and survey year, and also the survey data collected from other locations in California which could vary from the three counties' demographic make-up. In addition, ARB staff also reviewed the interregional travel pattern in SJCOG. The details are discussed in the Interregional Travel section later in this report.

Table 11. Average Travel Time by Trip Purpose

Trip Purpose	Model	CHTS
HBW	14.9	21.5
HBO	23.8	15
NHB	15.1	14.4

To better estimate the GHG reductions associated with SCS strategies in the future, ARB staff recommends that SJCOG consider developing a destination choice model, which can improve the sensitivity of changes to land use and socioeconomic factors on trip distribution by better reflecting the attributes that influence a person's decision to travel. SJCOG should also provide goodness-of-fit statistics in future model documentation and the frequency distribution of trip lengths along with coincidence ratios for different trip types to evaluate the travel model.

Mode Choice

The mode choice step of the Three-County Model uses demographics, travel cost and time from trip distribution outputs, and average ratios of persons to vehicle from travel surveys to assign person-trips by mode of transportation. The Three-County Model uses a multinomial logit model[10] to assign the person-trips to mode of drive-alone, shared ride 2 people, shared ride 3+ people, local bus, regional bus, BRT, or walk and bike. For the transit modes, the model further distinguishes between walk- and drive-access. The mode choice model estimates for the 2008 base year were calibrated using the 2000/2001 CHTS survey data. Table 12 shows the calibrated percent mode share in the model base year for the SJCOG region. Mode share estimates were compared against the observed data from CHTS. The differences between model estimates and observed data were expected due to the time gap between the model base year and the time of the survey.

[10] A multinomial logit model assigns the probability of using a particular mode based on an attractiveness measure or utility for an alternative mode in relation to the sum of the attractiveness measures for all modes.

Table 12. Person-trips by Mode in 2008

Mode	Model	CHTS
SOV	41.0%	52.0%
HOV	49.7%	44.0%
Transit	1.5%	1.0%
Bike and walk	7.8%	3.0%

The Three-County Model estimated transit ridership for each of the transit services for the 2008 base year. The model estimate for fixed-route bus ridership in 2008 is 35,033, while the observed ridership from survey data shows 21,908. The model estimate is about 37 percent higher than reported data from the San Joaquin Regional Transit District and Merced Country Transit in 2008. This difference falls outside the suggested evaluation criterion of 20 percent difference that SJCOG chose. However, FHWA does not suggest a reasonable range for transit ridership validation. SJCOG attributed the difference between the observed ridership and the modeled ridership to the nature of transit in the rural areas of the region. For example, fixed-route bus transit stops in the rural areas are still far from some households, and service coverage is quite limited.

In evaluating the mode choice component of the Three-County Model, ARB staff reviewed the model structure, the input data, and data sources that the three counties used to develop and calibrate the model, model parameters, and auto-occupancy rates[11] by purpose. Estimated mode share by trip purpose was also compared against the observed data, including transit ridership.

The method the three counties used to develop their mode choice model is consistent with the approaches used nationwide as cited in NCHRP Report 365. However, the coefficients and constants used in the mode choice model are based on other regional models. In future model updates, the three counties should consider developing a nested logit based mode choice model since they have more than two mode choices. The mode choice model should consider including demographic and socioeconomic characteristics in allocating the trips between modes. Model documentation should consider including more details on the model estimation process, estimated parameters, and statistical significance of the estimates. The three counties should also consider auto occupancy rates by trip purpose in the mode choice step, and use the latest household travel survey data.

Trip Assignment

In the trip assignment step, vehicle trips from one zone to another are assigned to specific travel routes between the zones in the transportation network. Congested travel information serves as feedback to the beginning of the process until convergence is reached. This process utilizes a user equilibrium assignment concept to assign vehicles to roadways in the network. The iteration runs until no driver can shift to an

[11] Auto-occupancy indicates the number of people, including the driver, in a vehicle at a given time.

alternative route with a faster travel time. The convergence criteria used in the SJCOG model is 0.001 relative gap,[12] or a maximum internal iteration of 20 iterations for peak and off-peak period traffic assignments and 50 iterations for peak hour traffic assignments. The Three-County Model used the Bureau of Public Roads (BRP) formula to estimate congested travel time, which is a common practice among transportation planning agencies.

For transit trip assignment, the best path was chosen based on in-vehicle time plus weighted out-of-vehicle times. Transit trips were assigned in four groups: peak period, walk access; peak period, drive access; off-peak, walk access; and off-peak, drive access.

After the initial trip distribution and assignment using free-flow speed on the roadway network, the congested travel time from the most recent A.M. peak three-hour period is used as input to the HBW trip distribution, and the congested travel times from the most recent off-peak traffic assignment are used for the other trip purposes. However, the Three-County Model was not calibrated with a feedback mechanism for each step. ARB staff recommends the three counties include the feedback mechanism in the next model update.

In evaluating the trip assignment step, ARB staff reviewed the assignment function used in the model, and the estimated and observed volume counts by facility type (Table 13). ARB staff also compared these estimated volume counts by facility type with observed data in the region. The travel model uses an assignment function as required by CTC's "2010 California RTP Guidelines" to estimate the link volumes and speeds. The coefficients used in the assignment function were consistent with FHWA guidelines. Comparison of estimated and observed traffic counts at the screenline[13] locations by facility type in Table 13 shows that the differences did not fall within the recommended range of FHWA guidelines. SJCOG attributed this large difference to the lack of data points from certain facility types (e.g. freeway, collector). Between now and the next model update, SJCOG should consider gathering more recent traffic count data at different facility types to ensure there are sufficient sample sizes.

[12] Relative gap measures the relative difference of traffic flow between current iteration and the previous iterations.

[13] The screenline is an imaginary line used to split the study area into different parts. Along these lines, traffic counts are collected to compare against the model estimates.

Table 13. Estimated and Observed Traffic Counts for SJCOG Region

Facility Type	Model Estimate	Traffic Count	Percent Difference	FHWA Guidelines
Freeway	107,840	72,655	48%	±7%
Expressway	79,131	65,031	22%	±15%
Arterial	947,199	1,073,014	-12%	±10%
Collector	9,253	22,347	-59%	±20%

The estimated VMT from the Three-County Model for the SJCOG region and the observed data from the Caltrans Highway Performance Monitoring System (HPMS)[14] were compared at the county level (Table 14), and the difference was about one percent.

Table 14. Model Validation - VMT for SJCOG Region

	Model	HPMS	Percent Difference
VMT	17,474,339	17,257,156	1%

Model Validation

Model validation, usually the last step in the development of any regional travel demand model, reflects how well the model estimates match with observed data. The California Transportation Commission (CTC) Regional Transportation Guidelines suggests validation for a travel model should include both static and dynamic tests. The static validation tests compare the model's base year traffic volume estimates to traffic counts using the statistical measures and the threshold criteria. Testing the predictive capabilities of the model is called dynamic validation and it is tested by changing the input data for future year forecasts. During the model development process, the three counties performed five dynamic tests including adding lanes to a link in the network, adding/deleting a link, changing link speed, adding a toll fee, and reducing roadway capacity. In addition, SJCOG conducted model sensitivity tests as part of their model dynamic testing during ARB's evaluation process of SJCOG's 2014 RTP/SCS, which is summarized and discussed later in this report. SJCOG's model validation was based on a traffic count database, the Caltrans Performance Measurement System (PeMS), and HPMS. Based on the results presented in Table 15, the Three-County Model estimates for the SJCOG region has a correlation coefficient of 0.97 between the modeled and the observed volumes. However, the root mean square error (RMSE) for daily traffic assignment in the model is 55 percent, which is higher than the suggested

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

criterion of 40 percent. Also, only 45 percent of the links with volume-to-count ratios from the Three-County Model for the SJCOG portion are within the Caltrans deviation allowance. The reason for the model estimates not meeting the criteria is probably due to aggregation of traffic count data from 2001 to 2012. In addition, the variation in methods used to collect data and the geographical locations of data collection may have contributed to this difference.

Table 15. Static Validation According to CTC's Guidelines

Validation Item	Criteria for Acceptance	Three-County Model for SJCOG
Correlation coefficient	at least 0.88	0.97
Percent RMSE	below 40%	55%
Percent of links with volume-to-count ratios within Caltrans deviation allowance	at least 75%	45%

EMFAC Model

ARB's Emission Factor model (EMFAC2011) is a California-specific computer model which calculates weekday 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 CO_2 emissions. It uses vehicle activity provided by regional transportation planning agencies, 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. EMFAC2011-SG uses the inventory from EMFAC2011-LDV and EMFAC2011-HD modules, and scales the emissions based on changes in total VMT, VMT distribution by vehicle class, and speed distribution. To estimate per capita CO_2 emissions, SJCOG estimated passenger vehicle VMT and speed profiles for the region using the travel demand model, and applied them to the EMFAC2011-SG model. SJCOG then divided the estimated CO_2 emissions for passenger vehicles by the year 2005, 2020, and 2035 residential populations to obtain CO_2 emissions per capita.

Planned Model Improvements

For the next RTP update anticipated in 2018, SJCOG plans to continue to refine its travel demand model to better estimate trips and VMT in the region. Immediate model improvements seek to increase model sensitivity to land use and transportation policies. The immediate and ongoing model improvement efforts include using the latest regional or local demographic data and using the 2010 Census, 2012 American Community Survey (ACS), and the 2012 CHTS travel data for model recalibration and revalidation. These model improvements will increase the accuracy of estimates and forecasts of external trips, trip modes, and distribution for internal and inter-regional travels; and vehicle speeds (which is critical for air quality analysis).

Additional improvements to the Three-County Model will be realized through a series of Valley-wide model improvements, known as the Valley Model Improvement Program 2 (VMIP2). In VMIP2, the Valley MPOs are planning to review and refine their models' TAZ structure, using 2010 Census geography to update TAZ boundaries and the GIS layers.

In Sections III. B and C (Data Inputs and Assumptions, and Modeling Tools) of this staff report, ARB staff also offers recommendations and suggestions for SJCOG to improve the Three-County Model's forecasting ability. These recommendations should be incorporated into the model improvement program that SJCOG is currently developing.

D. Interregional Travel Analysis

San Joaquin County experiences a significant amount of interregional travel, mainly due to commute travel to neighboring counties, particularly in the Bay Area and Sacramento regions. This section summarizes ARB staff's assessment of SJCOG's methodology for estimating interregional travel, the ability of the Three-County Model to capture its effects, and how interregional travel affects their GHG quantification.

In general, travel is defined by trips, which can be categorized by the internal or external locations of each trip's origin and destination. In any travel demand model, trips are categorized as Internal trips (II), or those that begin and end in the model region; Internal to External (IX) trips, or those that begin in the model region and end outside the model region; and External to Internal (XI) trips, or those that begin outside the model region and end within the model region. External-External trips (XX), also known as through-trips, are those which travel through the model region, but do not stop in the region. An example of an IX trip is a trip that begins in San Joaquin County and ends in a neighboring region such as the Bay Area, Sacramento, or Los Angeles. A trip that begins outside the region and ends in San Joaquin County is an example of an XI trip. A trip from Los Angeles to Sacramento would be a through-trip for San Joaquin County. It is important to note that through-trips (XX) are not subject to the SB 375 targets, as there is little that an individual MPO can do to influence them. These IX, XI, and XX trips are collectively defined as interregional travel.

Appropriately accounting for each type of interregional travel is important for greenhouse gas (GHG) quantification. SJCOG's travel demand model forecasts how much travel is occurring in-county, but it has limited capability to characterize the full trip length once the trip leaves the region. This is true for all regional travel demand models. Interregional travel varies dramatically between small (single-county) and larger (multi-county) MPOs. For example, an internal trip within the SCAG region may be 200 miles long, and never leave the MPO boundary. However, a much shorter trip from San Joaquin County to Stanislaus County is considered an interregional trip. Most of the SCSs that ARB staff has reviewed to date have been for multi-county regions in which interregional travel was a relatively small portion of the region's total travel. However, there is a particularly strong component of interregional travel that affects the northern San Joaquin Valley because a substantial number of residents of San Joaquin and Stanislaus Counties have and will continue to commute to the Bay Area for work.

Role of IRT in the SJCOG Region

The relatively large proportion of interregional travel compared to in-county travel poses a challenge to both the design of the Valley SCSs and the quantification of GHG reductions from the SCSs. This is influenced by both the method used by MPOs to estimate interregional travel, as well as the travel model's sensitivity to different assumptions regarding the distribution of interregional trips.

The methodology that SJCOG used for quantifying interregional travel was similar to the methodology used by many MPOs, including the four largest MPOs in the state. They included 100 percent of VMT from internal (II) trips, 100 percent of VMT from interregional (IX and XI) trips, and excluded all of the VMT from through-trips (XX). However, for single-county MPOs, like SJCOG, the proportion of interregional trips to internal trips is greater than for multi-county regions. This affects both the total VMT and GHG per capita emissions calculation. Most SCS strategies in regional plans address internal travel, either by reducing the number of trips or shortening the length of these trips.

The unusually high per capita GHG reductions estimated in the northern-most counties of the San Joaquin Valley (Valley) is likely the result of several factors. Per capita VMT for in-county travel in San Joaquin and Stanislaus counties declines rapidly between 2005 and 2020, and we know this is related, in part, to the recession. After 2020, it continues to decline, but at a slower rate. On the other hand, per capita VMT for interregional travel is increasing over time.

SJCOG has the highest amount of interregional travel in the Valley, due in part to the presence of major north-south transportation corridors, such as Interstate 5 (I-5) and State Route 99 (SR-99) which carry significant amounts of traffic through the Valley. Further, corridors such as Interstate 580 (I-580), Interstate 205 (I-205), State Route 4 (SR-4), and State Route 12 (SR-12) connect San Joaquin County to the San Francisco Bay Area (Bay Area). In addition, the proximity of San Joaquin County to major job centers in the Bay Area and Sacramento region contribute to a significant amount of commute travel by San Joaquin County residents.

In 2010, there were 45,845 San Joaquin County residents commuting to and from the Bay Area based on an analysis conducted by the Business Forecasting Center in 2014. The majority of these commute trips are in single occupancy vehicles. The most common out-of-county commute for San Joaquin residents is to Alameda County, with a mean travel time of 104.1 minutes, and a mean travel distance of 61.5 miles. This commute is on the list of the nation's top ten longest mega commutes. The mean travel time nationwide is 26.1 minutes and the mean commute distance nationwide is 18.8 miles (Rapino and Fields, 2012). Because of the relatively low cost and available supply of housing in San Joaquin County compared to the Bay Area (median home value is $208,000 in San Joaquin County and $543,000 in the Bay Area), there are a substantial number of Bay Area workers who live in San Joaquin County. Most of these travelers use I-580 and I-205 for their regular commute.

SJCOG Methodology to Estimate IRT

The Three-County Model was used to estimate both the in-county travel (II) as well as interregional travel (XI, IX and XX). The major sources of data used to estimate interregional travel came from the Caltrans 2003 California Statewide Travel Demand Model (CSTDM) and the observed traffic counts on the gateway roads/TAZs.[15] The Three-County Model has 47 gateway locations for monitoring the traffic into, out of, and through the three-county region.

The 2003 CSTDM used in this analysis is a trip based model that uses aggregated trip productions and attractions to statewide TAZs. This model includes some trips for rural areas and external trips to perform a statewide trip distribution, mode choice and trip assignment. A limited update of the 2003 CSTDM was done in 2008 to reflect the latest land use information from adopted RTPs, but socioeconomic and network characteristics were not updated. The model was calibrated and validated to the 2000 traffic counts throughout the state. This model lacks comprehensive long distance travel data. When SJCOG began their modeling work for the 2014 RTP/SCS, the 2003 CSTDM was the best available tool to estimate interregional travel for the Valley.

The following describes the methodology that SJCOG used to estimate the fraction of total trips that are interregional. The three-county region collected the observed traffic counts from Caltrans along with the estimated traffic volumes from the neighboring counties/MPOs.

Table 16 shows the traffic counts for the base year 2008 on all the major gateway roads/TAZs at the boundaries of the three-county region. This data also distinguished the traffic counts for trucks. These traffic counts were used as the targets for the preparation of the gateway trip generation[16] (IX and XI trips), and through trips (XX).

[15] To capture the trips that enter or leave the model region a special TAZs are introduced at the boundaries of the model region.

[16] Trip generation predicts number of trips produced and attracted to each individual TAZ. Trip production and attraction should not be confused with origin and destination which uses a different method of accounting for trips. For example, in any home-based trips, the production is always at the home end of the trip, whether home is the starting point or the ending point.

Table 16. Estimated 2008 Traffic Volume at Gateway Locations of the Three-County Region

Locations	All Vehicles	Trucks
I-5	53,000	12,137
SR-99	60,000	8,040
SR-88	9,900	852
SR-12	6,900	497
SR-26	4,950	401
Milton Rd	1,682	168
SR-4	4,800	216
SR-120	12,700	1,486
La Grange Rd	647	65
SR-132	1,550	102
SR-140	4,300	473
SR-152	33,500	5,327

Locations	All Vehicles	Trucks
Del Puerto Canyon Rd	129	13
I-580	37,000	4,625
I-205	117,000	14,040
SR-4	8,300	938
SR-12	17,500	2,468
I-5	34,000	9,697
SR-33	3,000	420
SR-152	17,000	3,570
Bliss Rd	700	70
SR-99	37,500	9,750
Minturn Rd	1,200	120
Santa Fe Ave	1,000	100

Source: Fehr & Peers (2014)

The proportion of IX, XI and XX trips from the 2003 CSTDM were used to split the gateway traffic volumes. Based on the estimated proportions, gateway person-trip production (XI) and attraction (IX) trip matrices were developed, similar to the trip patterns from the 2003 CSTDM for each trip purpose (HBW, HBShop, HBK12, HBCollege, HBO, WBO, OBO) as shown in Table 17. However, for XX trips, a through-trips matrix by purpose was developed instead of trip production and attraction since these trip origins or destinations are not known. The total trips at each gateway by purpose are dynamic and adjust to the traffic count targets. These gateway trips were then distributed to TAZs along with the in-county (II) trips. To forecast the future year gateway traffic counts, the annual growth rate from the 2003 CSTDM was applied for each gateway.

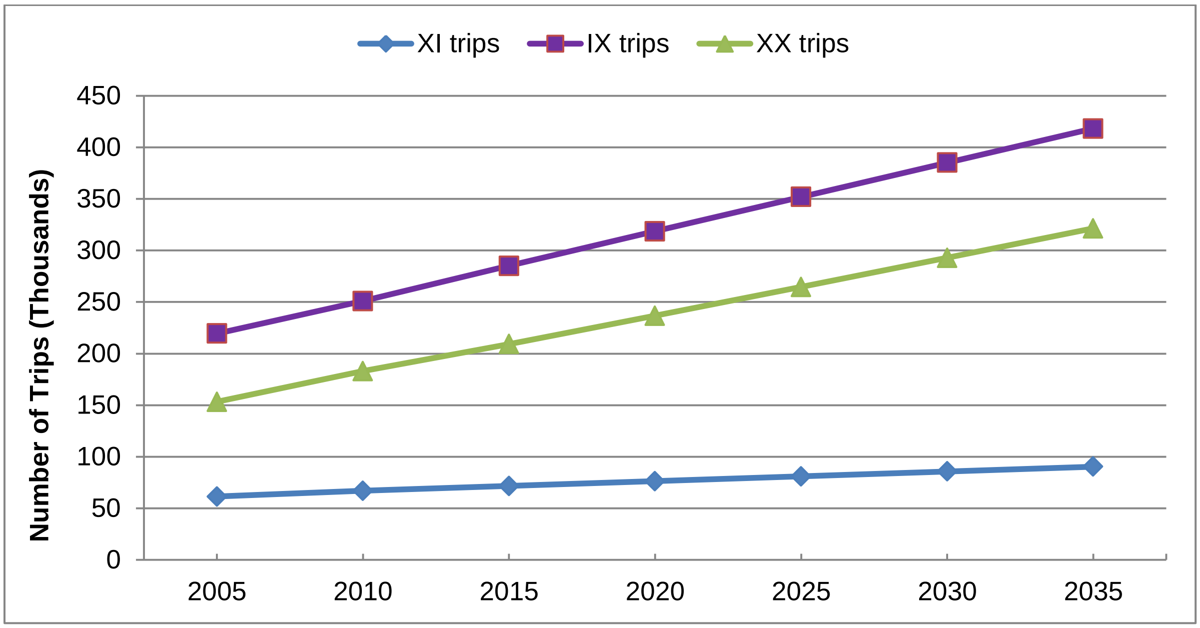
Table 17. Trip Productions and Attractions at Gateways, 2008

Trip Purpose	Productions (XI)	Attractions (IX)
HBW	12,879	118,389
HBShop	7,881	15,257
HBK12	0	0
HBCollege	74	873
HBO	10,003	118,082
WBO	12,076	9,066
OBO	16,185	21,406

Source: Fehr & Peers (2014).

Figure 9 shows the breakdown of how the Three-County Model estimated the interregional travel (IX, XI and XX) for the three-county region for the period 2005 to 2035. The bottom line on the figure (XI) can be thought of as representing the sum of all production trips and the top line on the figure (IX) can be thought of as the sum of all attraction trips. The share of IX trips is higher than the share of XI and XX trips. This trend is an indication of home prices in San Joaquin County being considerably lower than those in the neighboring counties, especially those in the Bay Area. As a result, many people who are employed in the Bay Area and, to a lesser extent, Sacramento and other surrounding counties, choose San Joaquin County as their place of residence. In addition, the share of XX trips doubles over the period of 30 years which might be due to increased through-traffic from southern/northern California.

Figure 9. Three-County Model: Interregional Trips (2005-2035)



ARB Review of IRT Estimation

To evaluate the performance of the Three-County Model to estimate interregional travel, ARB staff compared the base year (2008) estimates of the gateway trip production and attraction in the Three-County Model to the observed data from more recent travel surveys. These include the American Community Survey (ACS) which reflects data from the period 2008-2012 and the 2010-2012 California Household Travel Survey (CHTS). Both of these sets of data are used extensively in development of travel models and also are important in estimating the gateway trips. It should be noted that these data sets were not available to the Valley MPOs during the Three-County Model development which began in 2010.

Table 18 compares the model-estimated gateway trip production (XI) and attraction (IX) to the recent observed data from the surveys mentioned above by trip purpose for the three-county region. The sample size for trip purposes such as HBShop, HBK12, HBCollege, HBO were small, hence these trips were combined in this analysis. In general, the trip productions (XI) are underestimated in the range of 57- 66 percent and trip attractions (IX) are overestimated in the range of 9 - 31 percent for all trip purposes. This may be due to an artifact of using data from the 2003 CSTDM which relied on old surveys and may have inflated the number of through-trips (XX) in the Three-County Model. To understand the effect of using more current travel data on the magnitude of change in interregional travel, ARB staff conducted an analysis as described in the next section.

Table 18. Comparison of Three-County Model Estimation and Observed Data

	Three-County Model Estimation		Observed Data[a]		Differences (%)	
Trip Purpose	**Productions (XI)**	**Attractions (IX)**	**Productions (XI)**	**Attractions (IX)**	**Productions (XI)**	**Attractions (IX)**
HBW	12,879	118,389	30,282	90,385	-57.5%	31.0%
Other trip purposes	46,219	164,684	136,533	150,621	-66.1%	9.3%

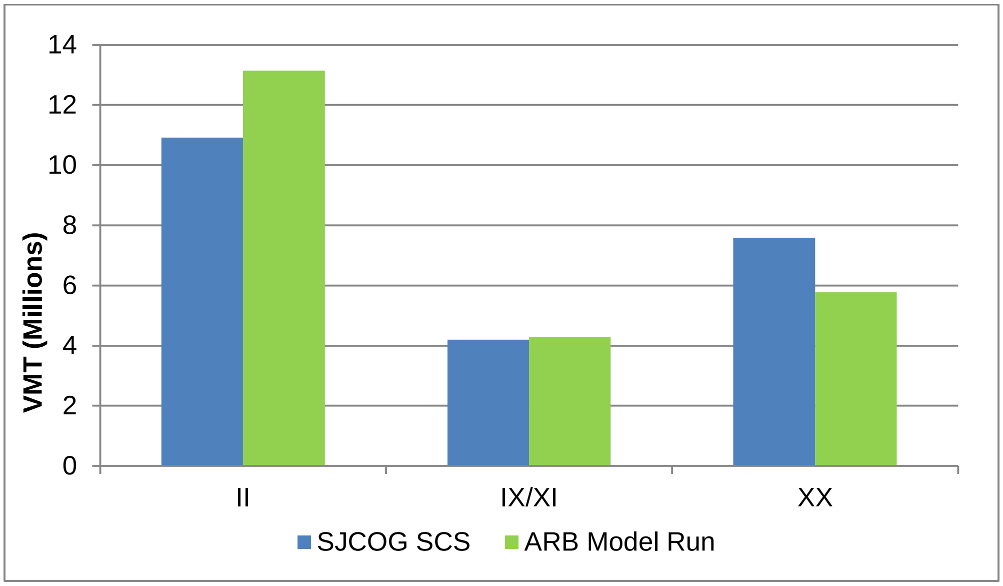
[a] 2008-2012 ACS and 2012 CHTS

IRT Sensitivity Analysis

To understand the sensitivity of the Three-County Model to interregional travel data, ARB staff ran the Three-County Model for the year 2035 using different assumptions based on the latest available ACS and CHTS data. Other inputs such as land use, network characteristics and socioeconomic data were left unchanged. Based on the relative differences between estimated versus observed data in Table 18, the gateway trip productions (XI) and attractions (IX) for the three-county region were updated in the model. For this analysis, the proportions of gateway traffic counts by trip types and the trip patterns by trip purpose were left unchanged. Once the updated XI and IX trips were input to the model, the Three-County Model then automatically recalculated the number of XX trips at the gateway locations, based on the principle that the total traffic counts at each of the gateways remains constant.

Figure 10 compares the VMT estimation by trip types between SJCOG's SCS and ARB's model run. In the ARB model run, the amount of interregional (IX, XI and XX) VMT is 14 percent lower and in-county (II) VMT is 20 percent higher compared to the SJCOG SCS. Overall, the total VMT subject to SB 375 increases by 15 percent over the SJCOG SCS, thereby increasing the region's average VMT per capita. This result is mainly due to the redistribution of trips by trip type (IX, XI and XX) as observed in the ACS and CHTS data.

Figure 10. Comparison of SJCOG's SCS and ARB Model Run VMT for 2035



In 2035, the VMT per capita from SJCOG's SCS and ARB's model run is 14.7 and 16.9 miles/day, respectively (Table 19). Compared to the VMT per capita for the base year of 2005, the SJCOG SCS results in a 26.9 percent reduction in VMT per capita, while the ARB sensitivity run results in a 15.7 percent reduction in VMT per capita. This ARB model run reflects a change in only one variable in the model inputs but it does provide insight into the magnitude of change that would result from using more current travel data. To conduct a comprehensive review of interregional VMT, the analysis should include many other variables such as trip patterns and trip types, and this would more appropriately be done by the MPO as part of its model improvement program. Although the VMT per capita reduction in ARB's sensitivity run is less than that from the SJCOG SCS, based on the correlation between VMT and GHG emissions, taken together with other factors such as the sensitivity of the model to SCS strategies, the types of land use strategies in the SCS, and supporting performance indicators, staff concludes that SJCOG's SCS would meet the targets.

Table 19. Comparison of VMT Per Capita for SJCOG's SCS and ARB's Model Run

VMT (Thousands)			VMT Per Capita (miles/day)			Percent Reduction (%)	
2005	SJCOG SCS (2035)	ARB Model Run (2035)	2005	SJCOG SCS (2035)	ARB Model Run (2035)	SJCOG SCS (2035)	ARB Model Run (2035)
13,087	15,114	17,438	20.1	14.7	16.9	-26.9%	-15.7%

To improve future interregional travel estimation, ARB staff recommends that SJCOG use the most current data available when updating its Three-County Model. In addition, ARB staff recommends that SJCOG work with neighboring MPOs to improve data quality for the gateway volumes by collecting additional cordon volumes along the San Joaquin County boundaries.

E. Model Sensitivity Analysis

Model sensitivity tests are used to study the responsiveness of the travel demand model to changes in selected input variables. The responsiveness, or sensitivity, of the model to changes in key inputs indicates whether the model can reasonably estimate the anticipated change in VMT and associated GHG emissions resulting from the policies in the SCS. A sensitivity test usually assumes one input variable change at a time and examines the range of output change. Sensitivity analyses are not intended to quantify model inputs or outputs or provide analyses of actual modeled data.

ARB requested that SJCOG conduct a series of sensitivity analyses for its model using the following variables:

- Auto operating cost
- Household income distribution
- Transit frequency
- Proximity to transit
- Residential density

In addition, ARB staff assisted SJCOG in conducting the sensitivity tests by preparing input files for the income distribution test and providing general procedures on how to perform different test runs.

Following the methodology in ARB's "Description of Methodology for ARB Staff Review of Greenhouse Gas Reductions from Sustainable Communities Strategies (SCS) Pursuant to SB 375" (2011), ARB staff reviewed results from model sensitivity test runs on land use and transportation-related variables. Model sensitivity test results were compared to findings in the empirical literature as discussed in the ARB-funded policy briefs and corresponding technical background documents[17] in order to evaluate the model's ability, given the data inputs and assumptions, to produce reasonable estimates. In those cases where the findings were corroborated by the empirical literature, the findings were referred to as either sensitive directionally, meaning that the direction of change was consistent with findings in the empirical literature, or sensitive in magnitude, meaning that the amount of change predicted was consistent with the literature. In those cases where sensitivity analysis findings could not be specifically corroborated by the empirical literature, ARB staff indicated whether the model was

[17] These policy briefs and technical background documents, which seek to identify the impacts of key transportation and land use policies on vehicle use and greenhouse gas emissions, based on the scientific literature, can be found at http://arb.ca.gov/cc/sb375/policies/policies.htm

sensitive directionally, meaning that changes in model inputs resulted in expected changes to model outputs.

1. Auto Operating Cost Sensitivity Test

SJCOG used three scenarios to examine the responsiveness of the model to changes in auto operating cost. Auto operating cost is an important factor influencing travelers' auto use. SJCOG's definition of auto operating cost for the region includes fuel price only. When the auto operating cost increases, travelers are expected to drive less. Conversely, when auto operating cost decreases, travelers are expected to drive more. In relation to mode share, it is expected that as auto operating cost increases, the number of drive-alone trips would shift to shared-ride-2 (SR2), shared-ride-3-plus (SR3+), transit, bicycling, and/or walking.

Figure 11 summarizes the change in mode share with a 50 percent decrease, 25 percent decrease, base case, 25 percent increase, and 50 percent increase from base case in auto operating cost. As expected, as auto operating cost increases, the percentage of drive alone trips decreases while percentages of other modes such as SR2, SR3+, transit, and non-motorized trips increase, although the percentage increases in these modes are small. SJCOG staff explained the subtle changes in mode share are due to the limitation of transit service coverage within the region and also due to commuting to work places outside the region. Even when auto operating cost increases or decreases, residents in the SJCOG region still rely on the auto mode to reach their destinations.

Figure 11. Mode Share Split and Auto Operating Cost

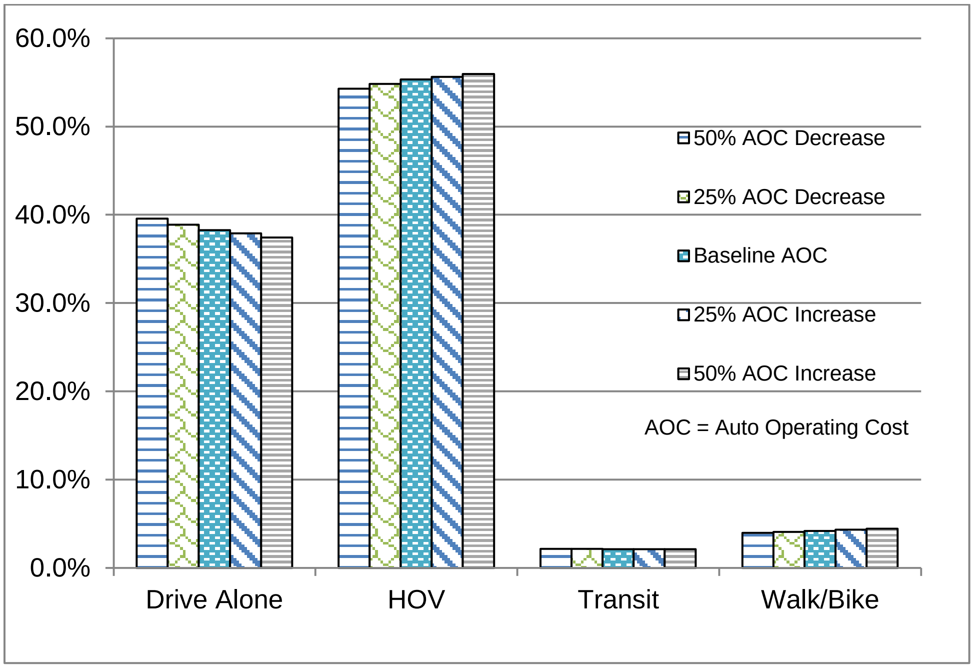


Figure 12 shows the VMT changes with respect to changes in auto operating cost. As auto operating cost increases, the model shows a decrease in VMT. The percentage of VMT change from the base case in each test scenario ranged from -7.8 percent to 9.3 percent.

Figure 12. VMT Change and Auto Operating Cost

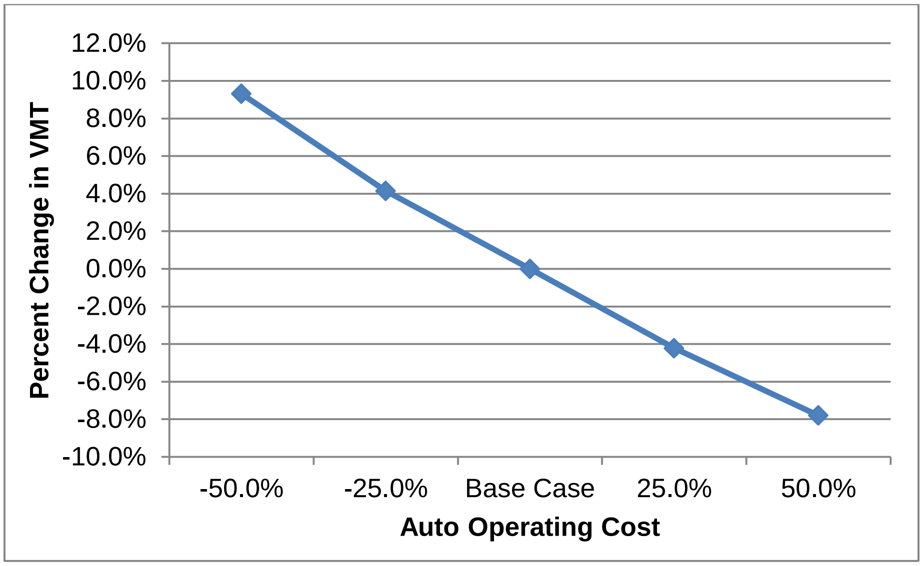


Table 20 summaries the VMT changes related to changes in auto operating cost. As auto operating cost increases, the model shows a decrease in VMT, which is expected. ARB staff compared these modeled VMTs to the expected range of VMT estimated based on elasticity[18] of VMT with respect to the change in auto operating cost from the empirical literature. Studies[19] showed that the short-run elasticities (less than five years) of VMT with respect to auto operating cost ranged from -0.026 (Small and Van Dender, 2010), -0.195 (Burt and Hoover, 2006), and -0.091 to -0.093 (Boilard, 2010). The long-run elasticities (greater than five years) ranged from -0.131 (Small and Van Dender, 2010), and -0.29 to -0.31 (Goodwin et al., 2004). The modeled VMT for each of the tests changed in the expected direction and fell within the expected range.

[18] Elasticity is defined as the percent change in one variable divided by the percent change in another variable.

[19] These studies are cited in the ARB-funded policy brief on the Impact of Gas Price on Passenger Vehicle Use and Greenhouse Gas Emissions, which can be found at http://www.arb.ca.gov/cc/sb375/policies/gasprice/gasprice_brief.pdf

Table 20. Auto Operating Costs – Sensitivity Results

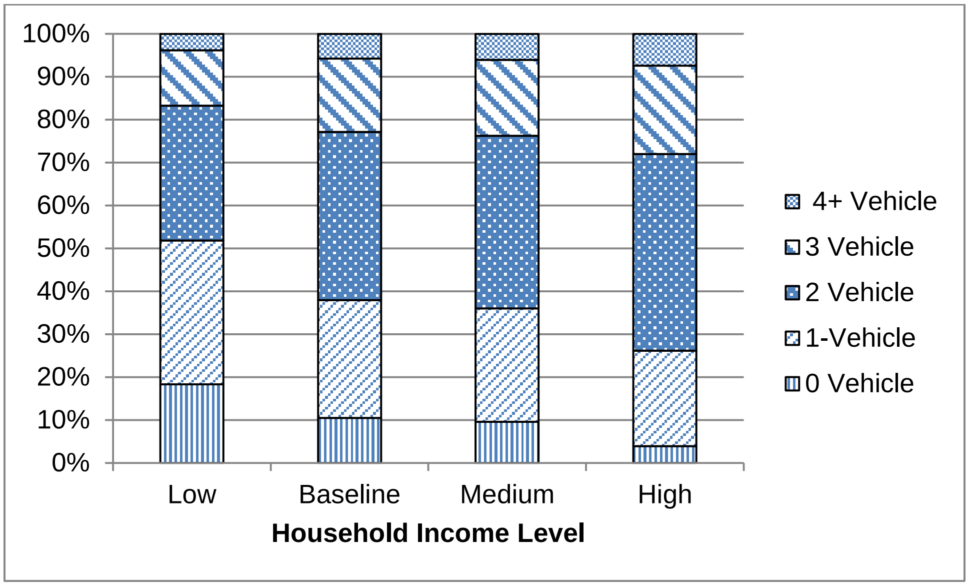
Test	Modeled VMT	Expected VMT (Short-Run)	Expected VMT (Long-Run)
50% Decrease from Base Case	19,004,367	17,611,490 - 19,080,563	18,524,228 - 20,080,228
25% Decrease from Base Case	18,106,308	17,498,485 - 18,233,021	17,954,853 - 18,732,854
Base Case (2008)	17,385,479	--	--
25% Increase from Base Case	16,651,202	16,537,937 - 17,272,473	16,038,104 - 16,816,105
50% Increase from Base Case	16,029,699	15,690,395 - 17,159,468	14,690,730 - 16,246,730
Source: -0.026 (Small and Van Dender, 2010) , -0.195 (Burt and Hoover, 2006), and -0.091 to -0.093 (Boilard, 2010) for short-run; -0.131 (Small and Van Dender, 2010), and -0.29 to -0.31 (Goodwin et al., 2004) for long-run.			

2. Household Income Distribution

Household income distribution plays an important role in the trip generation step of the travel demand model. Household income is linked to the available number of vehicles which then impacts the total number of trips. The expectation of the income distribution sensitivity testing is that as household income increases, so will the proportion of households with a greater number of vehicles. Given the predetermined trip generation rates in the model, if a household has more vehicles, it generates more trips and more VMT. If the income distribution shifts downward, it is expected that the vehicle ownership model will predict more households with fewer available vehicles and similarly, fewer trips and less VMT.

To test the responsiveness of the Three-County Model to changes in household income distribution, three testing scenarios were designed and tested using the average household income as an indicator, while controlling the total number of households at approximately the same as in the base case. The 2008 average household income of $55,304 from the Three-County Model for the SJCOG region was used as the base case. ARB staff designed three testing scenarios with average household incomes of Low ($37,471), Medium ($60,685) and High ($70,529). Figure 13 summarizes the auto ownership changes under the different household income scenarios. As expected, households shift towards having more vehicles available as household income increases, and vice versa.

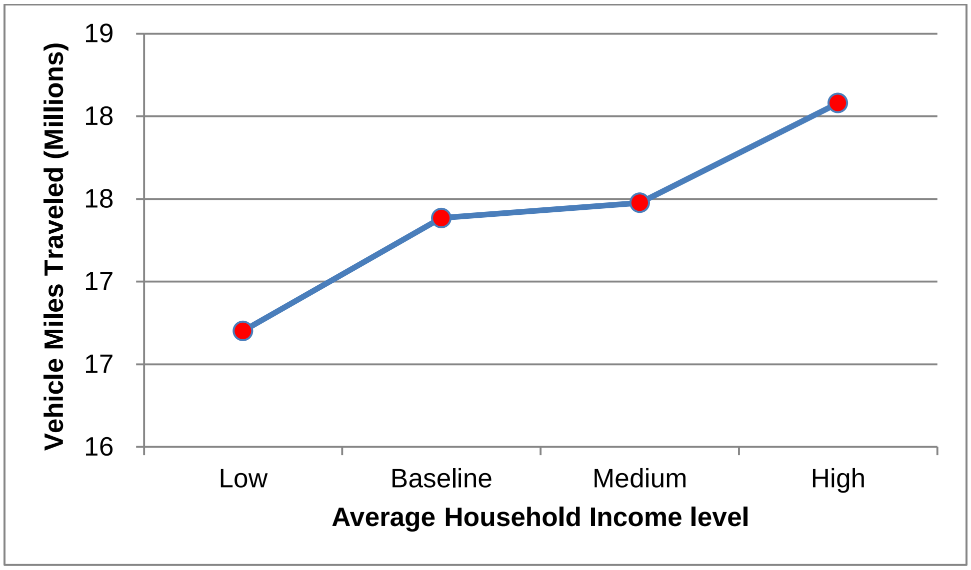
Figure 13. Household Vehicle Ownership Type Distribution



There is relatively little in the empirical literature that cites the direct effect of household income on household VMT. Murakami and Young (1997) report that low income households make 20 percent fewer trips than other households. Since this number counts all trips (including walking and transit), the effect on VMT is even more significant: VMT per household in low income households is about half of that in other households.

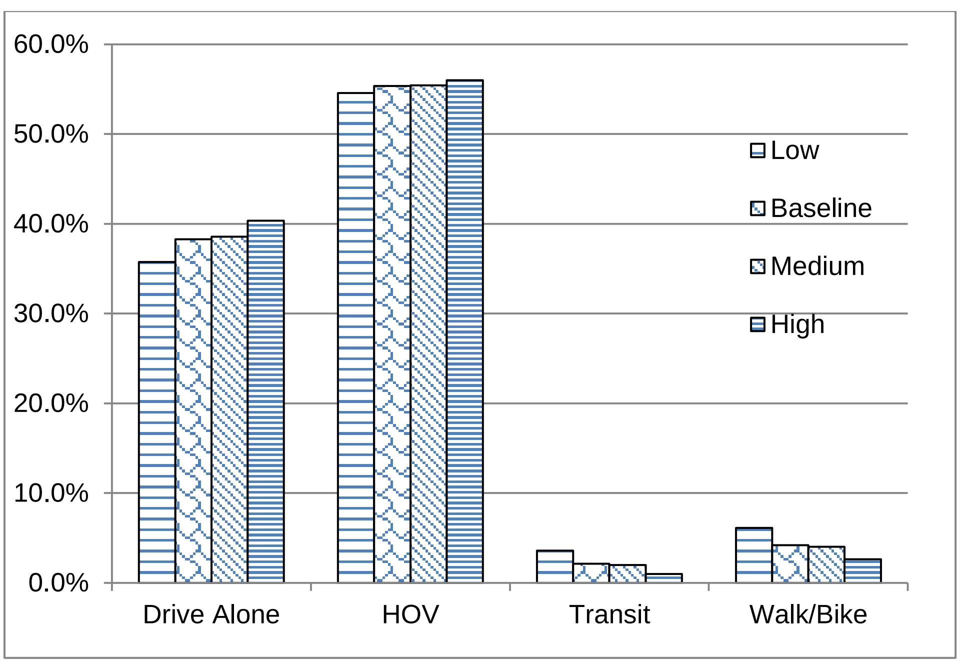
Figure 14 lists the modeled VMT for each test scenario of household income distribution. The test results showed the Three-County Model responds to changes in household income distribution in the right direction (i.e. more income correlates with more VMT), but the degree of change cannot be evaluated since no elasticities specific to income were identified in the empirical literature. However, the responsiveness of the Three-County Model to the change in average household income is similar to that of other MPO models in California.

Figure 14. VMT Changes for Household Income Distribution Scenarios



The impact of household income on daily mode share was also examined. It is expected that as household income increases, travelers will be more likely to drive autos or use the auto mode in general. As shown in Figure 15 the mode share responded to household income distribution changes as expected. The drive alone share increased when household income increased while transit and non-motorized trips decreased.

Figure 15. Mode Share Response to Household Income Changes



3. Transit Frequency

Transit service frequency is a key to the effectiveness of regional transit service. To determine the responsiveness of the Three-County Model to transit frequency, four alternative frequencies were tested: 1) 50 percent increase; 2) 50 percent decrease; 3) 75 percent decrease; and 4) 100 percent decrease from the base case. As transit service becomes more frequent, transit ridership is expected to increase, and conversely, transit ridership is expected to decline with decreasing frequency. Table 21 summarizes the response of ridership to the change in transit frequency. The test results were compared to expected values based on the empirical literature[20] which suggests that a 1 percent increase in frequency results in a 0.5 percent increase in ridership. As expected, the modeled transit ridership decreases as transit frequency declines compared to base case, and vice versa. The change in magnitude is not as great as the nationwide average, probably due to less public transit service coverage and transit users in the SJCOG region relative to urban transit centers that were studied in the national surveys.

Table 21. Transit Frequency Impact on Ridership

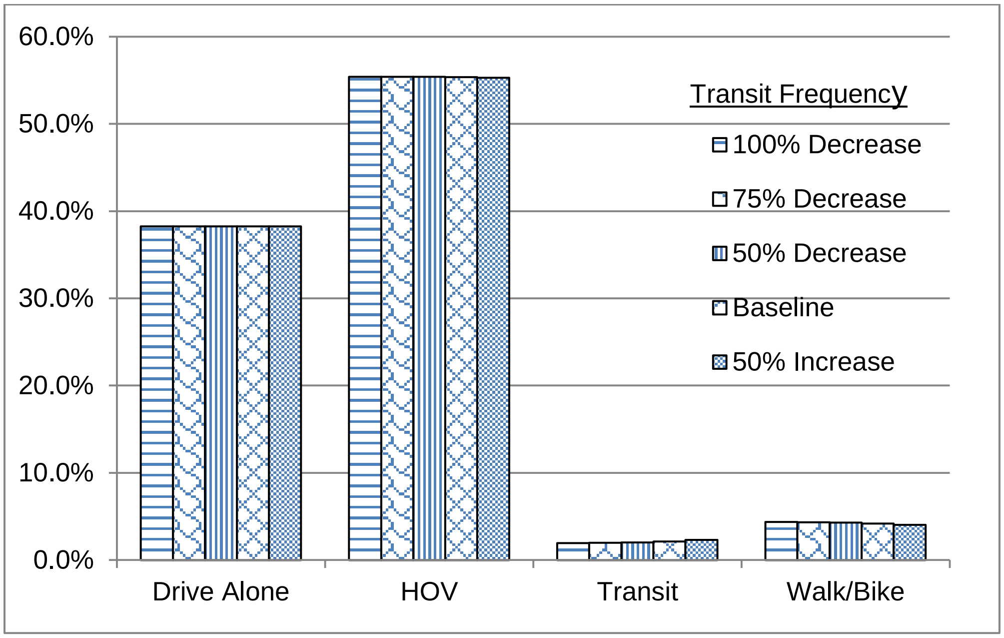
Test	Modeled Transit Ridership	Modeled Urban Transit Ridership	Expected Transit Ridership	Expected Urban Transit Ridership
100% Decrease from Base Case	50,414	41,349	29,237	23,911
75% Decrease from Base Case	51,935	43,469	36,546	29,889
50% Decrease from Base Case	53,686	44,020	43,856	35,867
Base Case (2008)	**58,474**	**47,822**	--	--
50% Increase from Base Case	68,015	55,878	73,093	59,778
Source: Evans (2004), 0.5% increase in bus ridership in 1% increase in service frequency. Taylor et al.(2009), 0.5% increase in total ridership for 1% increase in service frequency.				

Figure 16 shows the change in mode share as transit frequency changes. When transit frequency increases, it is expected that transit mode share will increase as travelers are more attracted to use public transit when waiting time is shortened. The test results do not show a significant difference from one test scenario to another. SJCOG explained this was due to the overall very low transit mode share in SJCOG and limited transit coverage in the base year. Although the magnitude of change in mode share is subtle,

[20] The empirical literature cited in the ARB-funded policy brief on the Impact of Transit Service Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions, which can be found at http://www.arb.ca.gov/cc/sb375/policies/transitservice/transit_brief.pdf

the model is sensitive to change in transit frequency directionality. For example, with a 50 percent increase in transit frequency, the transit mode share peaks with 2.3 percent of the total trips, whereas the 100 percent decrease in transit frequency results in a transit mode share of 2.0 percent of total trips.

Figure 16. Impact of Transit Frequency on Mode Share



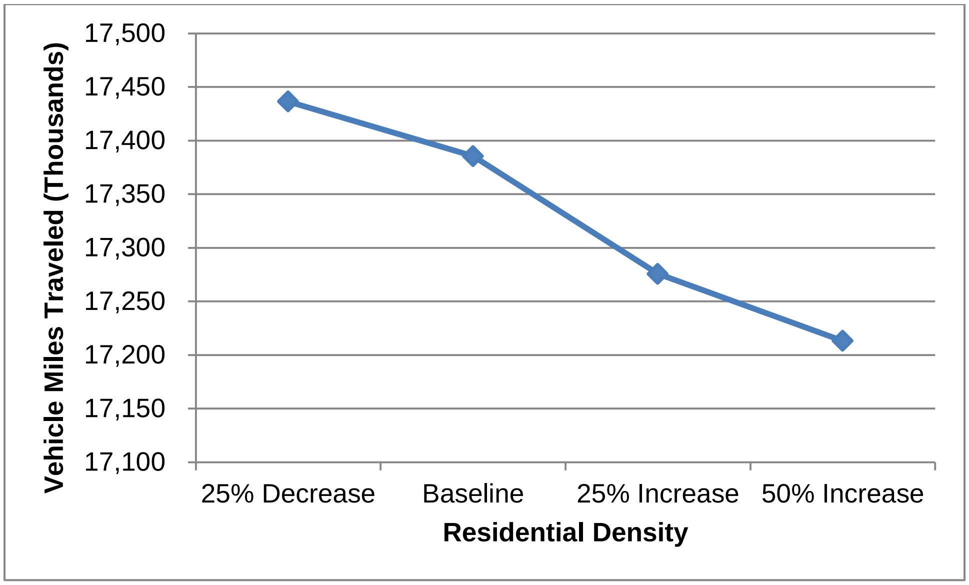
4. Proximity to Transit

The responsiveness of the Three-County Model to residential proximity to transit was tested by reallocating households to be along existing transit corridors (i.e. in transit-oriented development areas). Households relocated to transit corridors would be more likely to use transit which would, in turn, increase transit ridership and decrease household travel cost.

SJCOG tested the responsiveness of the Three-County Model to proximity to transit by placing more or less housing units in TAZs within a half-mile of transit stops or stations. Using the 2008 totals for each housing type as a base case, TAZs within a half-mile of a transit line either lost or gained units to represent decreases and increases in density, respectively. The total household counts for each TAZ were adjusted proportionally to maintain their respective countywide totals. The aggregated household total for TAZs near transit was compared against the base household count to calculate the countywide residential housing unit redistribution. When more households are located near transit, more households would be expected to use transit instead of autos, which leads to a decrease in VMT, and vice versa.

Figure 17 shows the VMT response to changes in proximity to transit. As expected, regional VMT decreases when the number of residential units near transit increases, and vice versa.

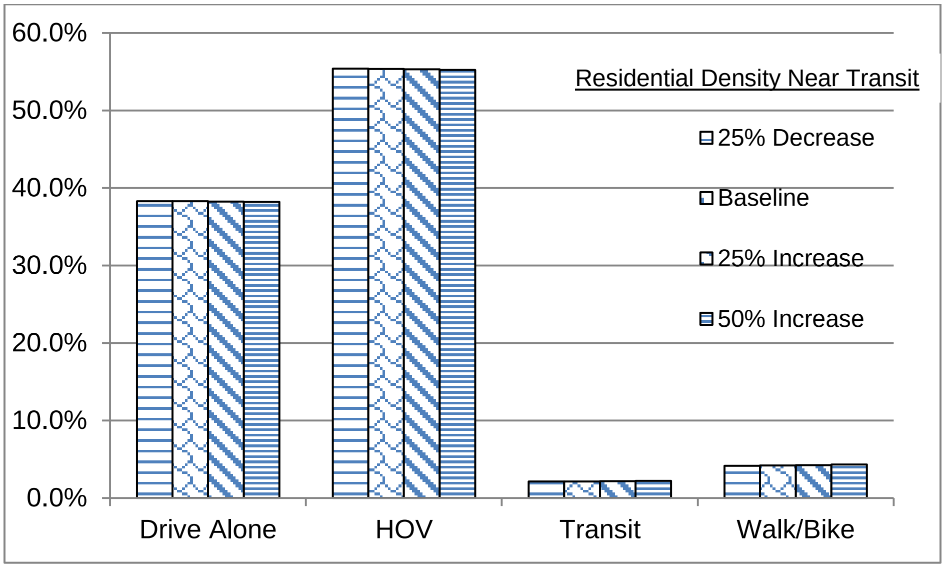
Figure 17. Impact of Residential Density near Transit on VMT



The model's change is sensitive directionally to the change in residential density near transit. SJCOG explained the low magnitude change from scenario to scenario is likely due to the limited transit options in the region.

Figure 18 summarizes the change in mode share as residential density near transit changes. Though not large in magnitude, transit mode share increases slightly, and overall auto mode share decreases, as residential density increases near transit stops or stations. The model's change is sensitive directionally to the change in residential density near transit. SJCOG explained the low magnitude change from scenario to scenario is likely due to the limited transit options in the region.

Figure 18. Mode Share Changes in Response to Change in Residential Density Near Transit



5. Residential Density

Residential density is usually defined as the number of housing units per acre. Increasing residential density has been considered an effective land use strategy to reduce VMT in a region because denser residential developments tend to be associated with fewer trips and less VMT.

SJCOG, with assistance from ARB staff, developed a methodology to examine the sensitivity of the Three-County Model to changes in residential density. The three sensitivity tests involved a 25 percent decrease, 25 percent increase, and 50 percent increase in average residential density. Changes to residential density focused on the urban areas of the SJCOG region to match the urban area focus of the empirical literature. For each test, SJCOG kept the totals for each housing type the same as the 2008 base case. For the density-increasing scenarios, SJCOG assumed that TAZs that currently have higher than average residential density would be more likely to gain more housing units than those with a lower than average residential density. SJCOG incorporated a residential index system to indicate which TAZs have higher and which TAZs have lower than average residential density as compared to the regional average.

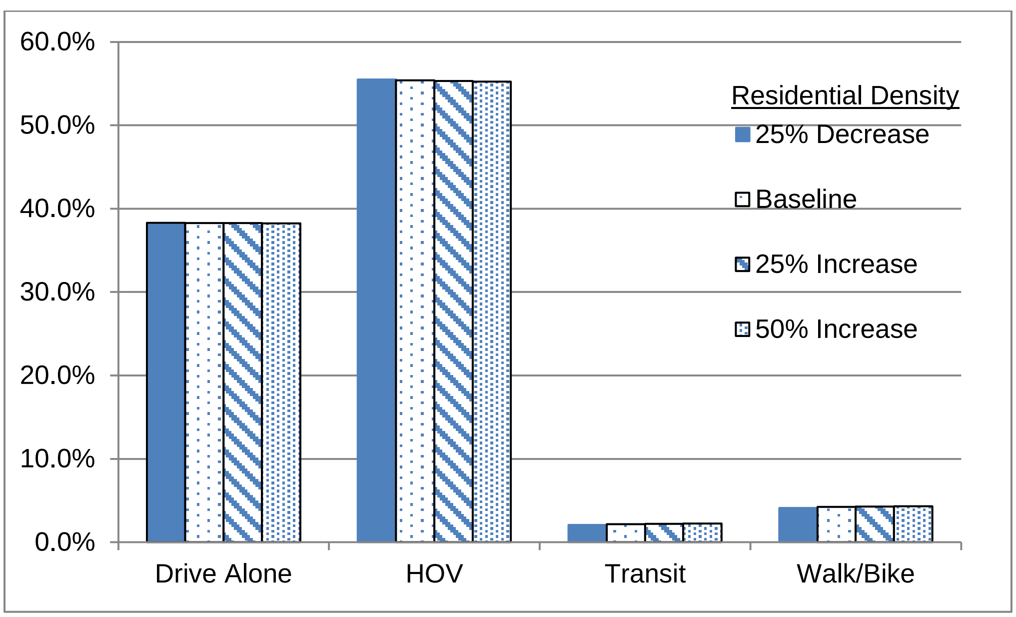
Most of the studies cited in the empirical literature that relate to residential density focus on overall population density, which is probably the best proxy for residential density. The elasticities for the impacts of population density on VMT cited in the studies range from -0.05 to -0.12 (Boarnet and Handy, 2014). As expected, when residential density increases, VMT decreases, and vice versa (Table 22). SJCOG's sensitivity analysis indicates that the Three-County Model is directionally sensitive to changes in residential density. The change in magnitude is lower than observations from the case studies in large urban areas. This is probably due to that fact that the SJCOG region is less populated, and transportation connectivity in the region is not as developed as regions cited in the empirical literature.

Table 22. Impact of Residential Density on VMT

Test	Modeled VMT	Expected VMT
25% Decrease from Base Case	17,561,407	17,602,797 - 17,907,043
Base Case (2008)	**17,385,479**	--
25% Increase from Base Case	17,258,678	16,863,915 - 17,168,161
50% Increase from Base Case	17,184,366	16,342,350 - 16,950,842
Source: Boarnet and Handy (2014) the impacts of population density on VMT range from -0.05 to -0.12.		

As residential density in the region increases, mode shares for auto decrease slightly due to some travelers switching to using transit and non-motorized mode (Figure 19). The Three-County Model is sensitive directionally but not in magnitude to changes in residential density due to limited existing transit options and walk/bike facilities in the region.

Figure 19. Impact of Residential Density on Mode Share



F. SCS 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 SJCOG'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.[21] The SCS performance indicators evaluated include residential density, mix of housing types, jobs and housing near transit, farmland preservation, per capita passenger VMT, bus rapid transit service coverage, and transportation investment. 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. Land Use Indicators

To determine the benefits of the development pattern in the SCS on GHG emissions from passenger vehicles, the evaluation focused on four performance indicators related to land use: changes in residential density, mix of housing types, jobs and housing near transit, and farmland preservation.

Residential Density

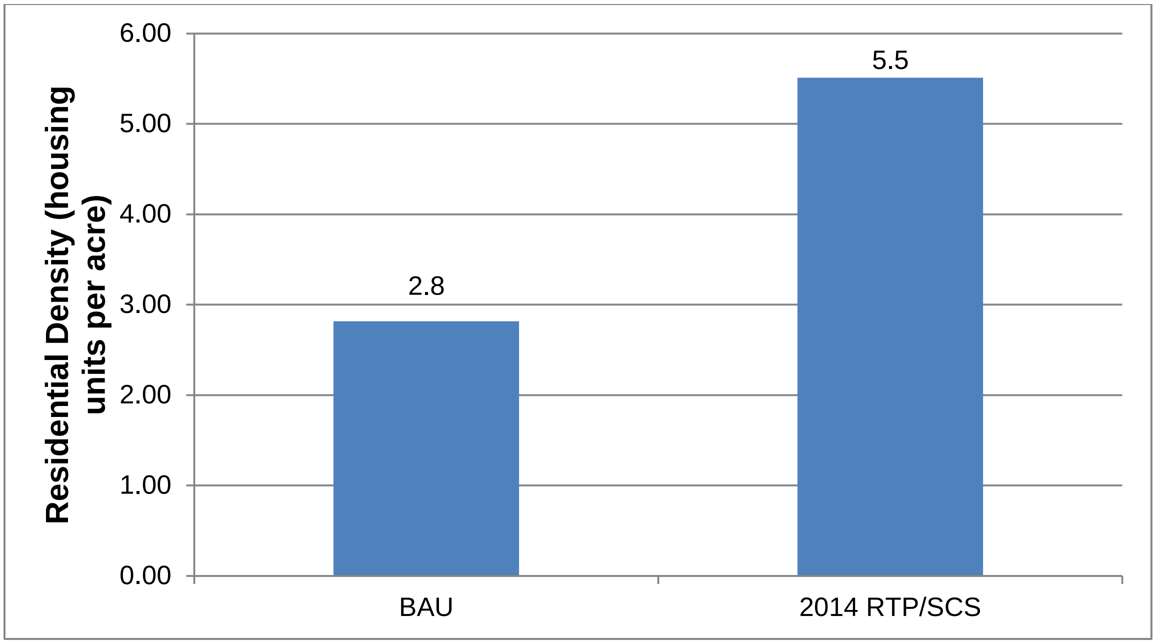
Residential density is a measure of the average number of dwelling units per acre of developed land. When residential density increases, it is expected to change travel behavior including reductions in average trip length, and eventually a decrease in regional VMT, which is supported by relevant empirical literature. Brownstone and Golob (2009) analyzed National Household Travel Survey (NHTS) data and observed that denser housing development significantly 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.

Based on the reported 2014 RTP/SCS land use data, residential density of new development from 2008 to 2035 in the SJCOG region will increase to 5.5 dwelling units per acre. The residential density associated with new growth almost doubled in the 2014 RTP/SCS compared to its BAU scenario, the 2011 RTP's policies and project list with updated demographic data (Figure 20). This increase in residential density is consistent with the empirical literature which indicates the likelihood of reductions in

[21] These policy briefs and technical background documents, which seek to identify the impacts of key transportation and land use policies on vehicle use and greenhouse gas emissions, based on the scientific literature, can be found at http://arb.ca.gov/cc/sb375/policies/policies.htm

household VMT and auto trip length, shifts in travel mode away from single occupant vehicles, and resulting reductions in GHG emissions.

Figure 20. Residential Density of New Development (2008 – 2035)



Mix of Housing Types

Housing type mix influences the land use patterns that can be achieved in a region. The greater the proportion of housing growth that is small-lot and attached housing types, the more opportunity a region has to accommodate future growth through a more compact land use pattern. As the housing market shifts from single unit homes on large lots to single unit homes on smaller lots and multi-family housing, the travel characteristics in the SJCOG region are expected to change.

The 2014 RTP/SCS categorizes three types of single-family housing units: single-family housing units on small lots[22], single-family units on conventional lots[23], and single-family housing units on large lots[24]. Between 2008 and 2035, SJCOG's 2014 RTP/SCS shows a significant increase in single-family small-lot compared to conventional-lot and large-lot housing (Figure 21). Of the total single-family housing units in the region, the share of single-family on small-lot housing is estimated to increase from 2.4 percent in 2008 to 15.5 percent by 2035.

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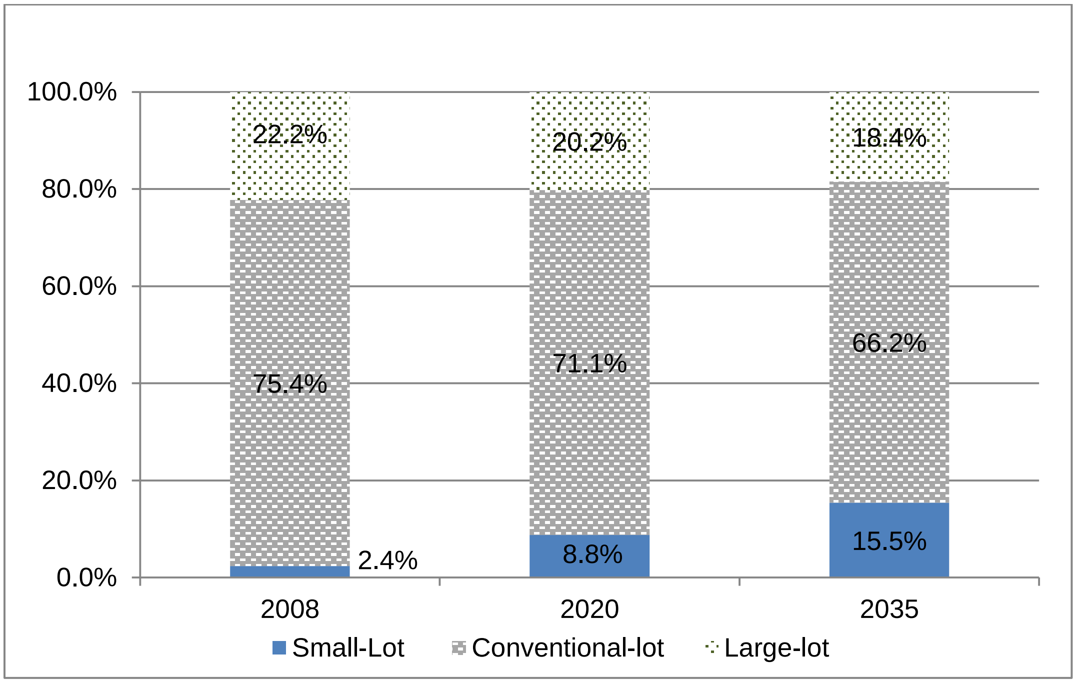
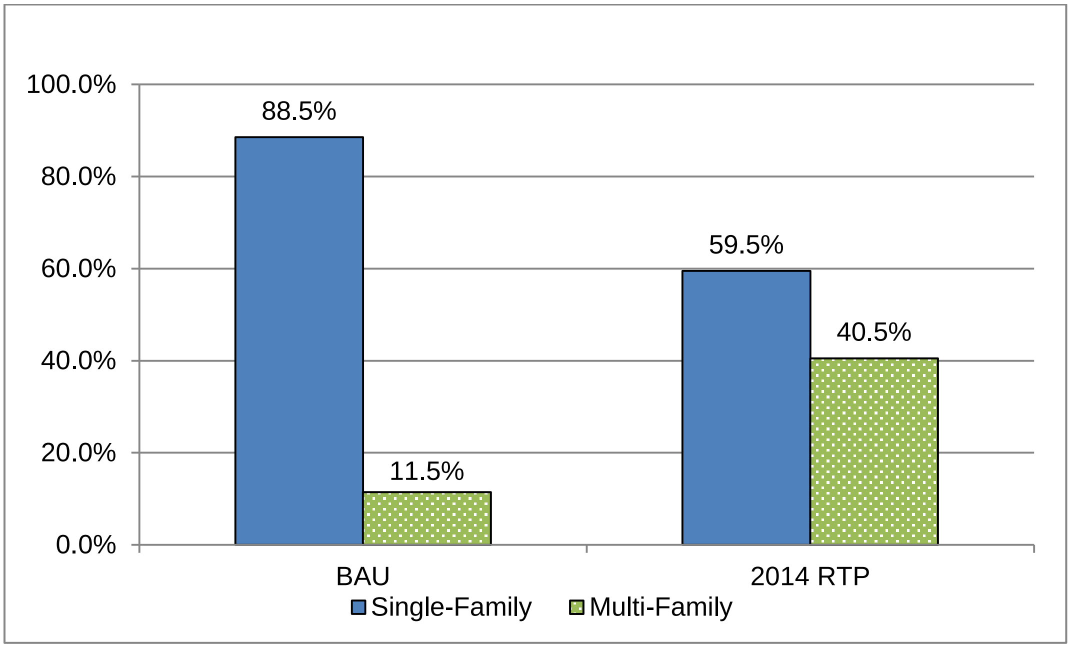
[22] Lot size equal to or less than 5,000 square feet
[23] Lot size between 5,001 and 7,000 square feet
[24] Lot size larger than 7,001 square feet

Figure 21. Shift towards Smaller Lot Size for Single-Family Housing Units



SJCOG's 2014 RTP/SCS also indicates a shift towards a greater percentage of new multi-family housing units. Figure 22 shows the percentage of new housing types anticipated by the BAU scenario and the 2014 RTP/SCS. By 2035, the share of new multi-family housing units is forecasted to increase from 11.5 percent of the total new housing units (BAU) to 40.5 percent (2014 RTP/SCS). The share of single-family units decreases from 88.5 percent of new units to 59.5 percent of new units by 2035.

Figure 22. Shift towards Multi-Family Housing (2008-2035)



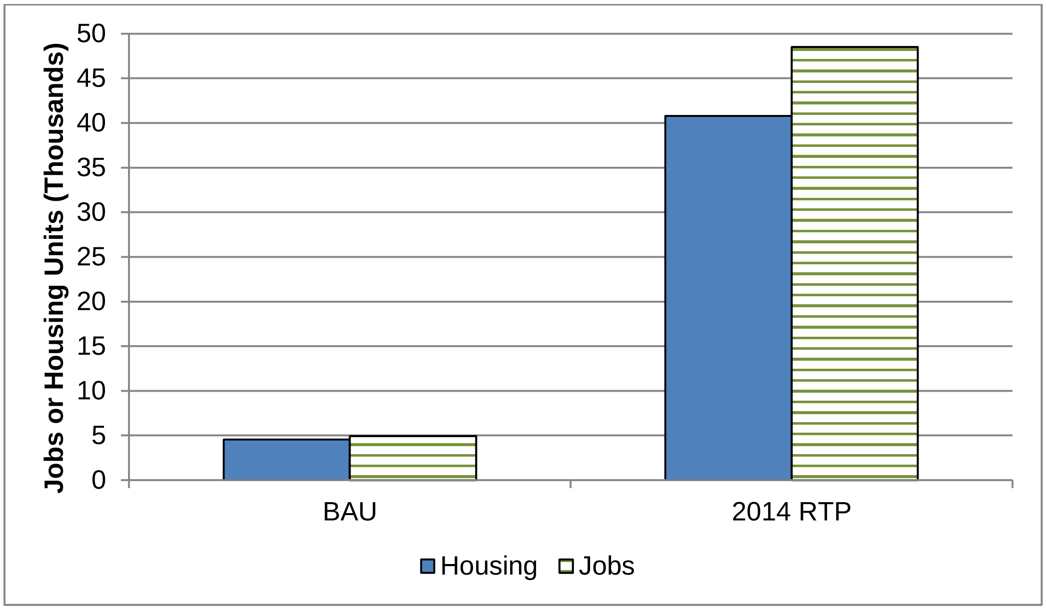
Jobs and Housing near Transit

Proximity of housing and employment to transit is a commonly used performance indicator for evaluating the effectiveness of transit-oriented development (TOD). The empirical literature indicates that focusing growth in areas with access to transit will encourage the use of transit, reducing vehicle trips, and subsequently reducing passenger vehicle-related GHG emissions.

Studies show that proximity of housing and employment to transit stations or stops is highly correlated with increased transit ridership as housing and employment increases within a one mile radius of transit stations (Kolko 2011). Other studies also illustrate significant VMT reductions through placement of housing and employment closer to rail stations and bus stops (Tal, et.al 2013).

Figure 23 summarizes the forecasted number of jobs and housing units within ½-mile of transit stations or stops based on SJCOG's BAU scenario and the 2014 RTP/SCS. Compared to SJCOG's BAU scenario, its 2014 RTP/SCS shows an increase in the numbers of jobs and housing units near transit, between 2008 and 2035.

Figure 23. Jobs and Housing near High Quality Transit Areas (2008 – 2035)

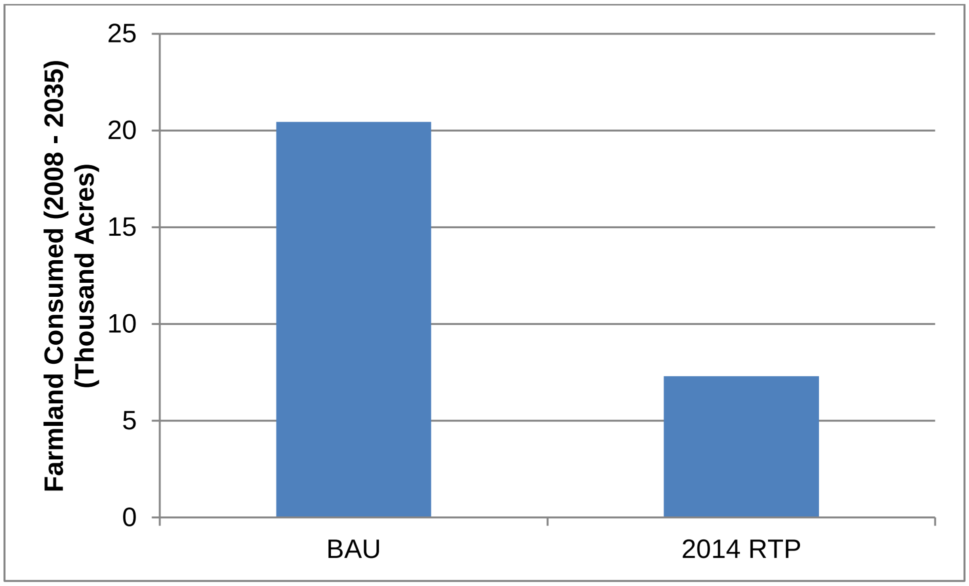


Farmland Preservation

The San Joaquin Valley is known as a major agriculture production area in the U.S. SJCOG's 2014 RTP/SCS encourages development within existing communities to preserve farmland in the region. Figure 24 compares the forecasted consumption of farmland as defined in SB 375[25] and indicated in the BAU scenario, with the 2014 RTP/SCS. Between 2008 and 2035, the 2014 RTP/SCS consumes significantly fewer acres of farmland by 2035 as compared to the 2011 RTP.

[25] Important farmland outside of existing spheres of influence.

Figure 24. Farmland Consumed (2008 - 2035)



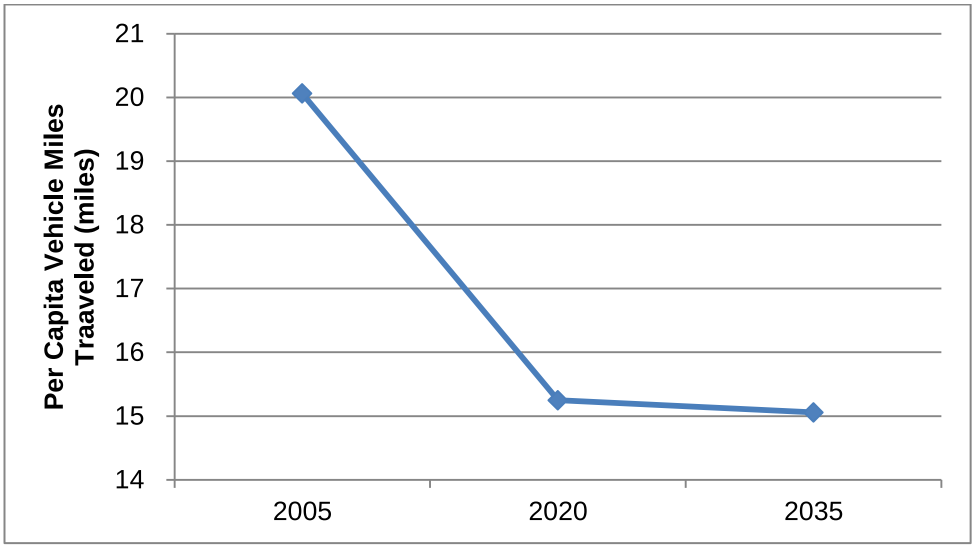
2. Transportation-related Indicators

Besides the land use-related performance indicators, ARB staff also evaluated three transportation-related performance indicators along with supporting data inputs, assumptions, and sensitivity analyses. These indicators are passenger VMT, bus rapid transit service coverage, and transportation investments.

Vehicle Miles Traveled (Per capita VMT)

The SJCOG 2014 RTP/SCS shows a decline in per capita passenger vehicle VMT between 2005 and 2035, as shown in Figure 25. Per capita VMT decreases by 24 percent between 2005 and 2020, and by 25 percent between 2005 and 2035. The reported statistics show that average weekday trip length for shared ride 2 and shared ride 3+ for all trip types, which together make up over 50 percent of all vehicle trips in the SJCOG region, will be reduced from 2008 to 2035 consistently. Moreover, the quantification of GHG emissions from passenger vehicles is a function of VMT and vehicle speeds. These results are directionally consistent and support SJCOG's reported per capita GHG emissions reduction trend over time.

Figure 25. Per Capita Passenger VMT

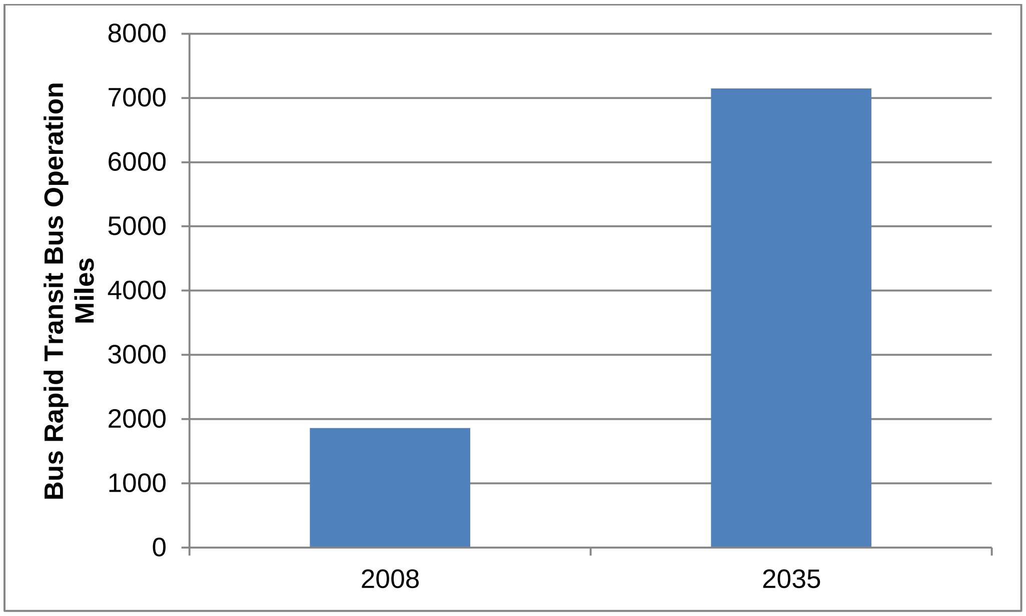


Bus Rapid Transit Service Coverage

The bus rapid transit (BRT) system for standard passenger buses in SJCOG is similar in function and service to a light rail train. The purpose of having BRT is to increase speed and reduce travel time for bus service. The empirical literature states that BRT may have more potential than regular bus transit service to attract riders from cars, but this also depends on the specific context. Diaz and Hinebaugh (2009) found that the estimate of new BRT ridership drawn from private vehicles for one line in Boston was 2 percent of riders, while for another line in Boston, it was 50 percent of riders. Thole et. al (2009) also studied a BRT line in Eugene, OR, and found that 16 percent of new BRT riders were drawn from the auto mode.

SJCOG collected BRT ridership data from 2006 to 2012. On average, ridership of BRT in the SJCOG region increased by 130 percent from 2006 to 2012. In the 2014 RTP/SCS, SJCOG significantly expands its BRT system with the addition of nearly three times the operation miles, compared to 2008. Figure 26 summarizes the increase in BRT operation miles between 2008 and 2035.

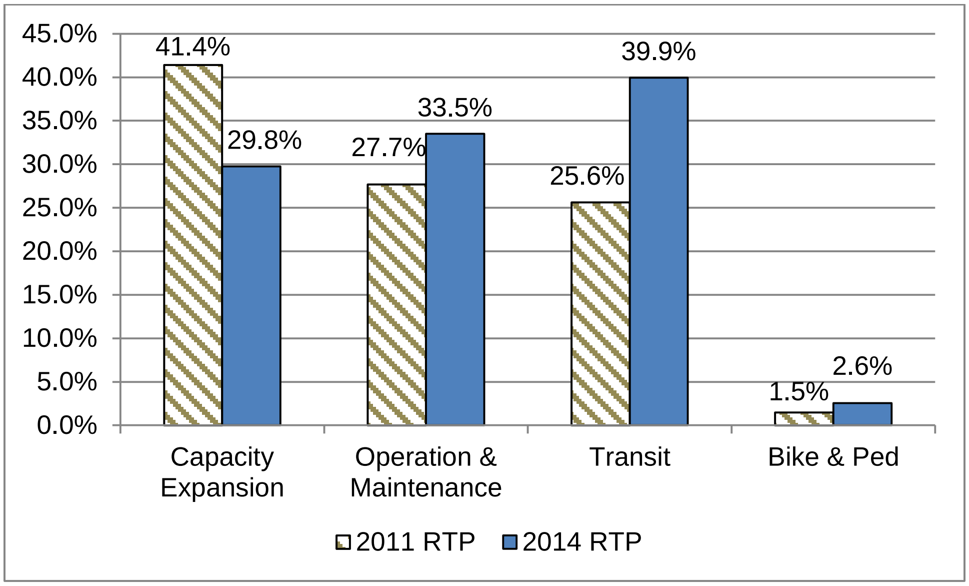
Figure 26. Increase in Bus Rapid Transit Operation Miles



Transportation Investment

The 2014 RTP/SCS increases investment in bike and walk facilities and public transit as compared to the 2011 RTP (Figure 27). Investment in bike and pedestrian infrastructure increases from 1.5 percent of the total RTP budget to 2.6 percent of the total budget, or $2.7 billion. Similarly, investment in transit increases from 25.6 percent to 39.9 percent of the total budget, or $4.4 billion. The increase in investments in public transit and bike and walk facilities is expected to provide greater opportunities for travelers to take advantage of these non-automobile modes of travel, thereby encouraging a shift away from vehicle use and with it, a reduction in GHG emissions.

Figure 27. Increased Investment in Transit and Bike/Walk Facilities



III. Conclusion

This report documents ARB staff's technical evaluation of SJCOG's adopted 2014 RTP/SCS. This evaluation affirms that SJCOG's adopted 2014 SCS would, if implemented, meet the Board adopted per capita GHG emissions reduction targets of five percent reduction in 2020 and 10 percent reduction in 2035.

IV. References

ACE Altamont Corridor Express, *Passenger News*, “ACE Welcomes Millionth Passenger for its 15-Year Anniversary,” 18 December 2013, <http://www.acerail.com/About/News/2013/ACE-Welcomes-Millionth-Passenger-for-its-15-Year-A> (Web Accessed 11 February 2015).

Boarnet, Marlon G., and Susan Handy, “Policy Brief on the Impacts of Residential Density on Passenger Vehicle Use and Greenhouse Gas Emissions,” 30 September 2014, <http://www.arb.ca.gov/cc/sb375/policies/density/residential_density_brief.pdf> (Web Accessed 2015).

California Department of Conservation, Division of Land Resource Protection, The California Land Conservation Act 2012 Status Report, The Williamson Act, October 2013, <http://www.consrv.ca.gov/dlrp/lca/stats_reports/Documents/2012%20WA%20Status%20Report.pdf> (Web Accessed 9 February 2015).

California Department of Finance, *E-1 Population Estimates for Cities, Counties, and the State—January 1, 2013 and 2014*, “E-1 Cities, Counties, and the State Population Estimates with Annual Percent Change—January 1, 2013 and 2014,” May 2014, <http://www.dof.ca.gov/research/demographic/reports/estimates/e-1/view.php> (Web Accessed 2 March 2015).

California Employment Development Department, *San Joaquin County Profile*, “County to County Commute Patterns (U.S. Census Bureau Year 2000),” <http://www.labormarketinfo.edd.ca.gov/cgi/dataBrowsing/localAreaProfileQSResults.asp?menuChoice=localareapro&state=true&geogArea=0604000077&selectedArea=San%20Joaquin%20County> (Web Accessed 13 February 2015)

California Department of Transportation, *Long-Term Socio-Economic Forecasts by County*, “San Joaquin County Economic Forecast,” 2013, <http://www.dot.ca.gov/hq/tpp/offices/eab/socio_economic_files/2013/San_Joaquin.pdf> (Web Accessed 18 November 2014).

City of Lodi, CA, *Lodi General Plan*, April 2010, <http://www.lodi.gov/community_development/general_plan/Final%20General%20Plan/Lodi_GP_cover_CH1_final.pdf > (Web Accessed 25 February 2015).

City of Lodi, CA, *City of Lodi Climate Action Plan*, prepared by AECOM Design + Planning, 20 November 2014, <http://www.lodi.gov/community_development/pdf/CAPdocNegDec.pdf > (Web Accessed 25 February 2015).

City of Manteca, CA, *Final Draft Climate Action Plan City of Manteca*, prepared by Michael Brandman Associates, 15 October 2013, < http://www.ci.manteca.ca.us/communitydevelopment/Documents/Final%20Climate%20Action%20Plan.pdf> (Web Accessed 2 March 2015).

City of Manteca, CA, *General Plan Circulation Element*, 5 April 2011, <http://www.ci.manteca.ca.us/communitydevelopment/Documents/General%20Plan%20Circulation%20Element%20Final%20EIR.pdf> (Web Accessed 2 March 2015).

City of Stockton, CA, *City of Stockton Climate Action Plan*, prepared by ICF, August 2014, <http://www.stocktongov.com/files/Climate_Action_Plan_August_2014.pdf > (Web Accessed 26 February 2015).

City of Tracy, CA, *City of Tracy General Plan*, 1 February 2011, <http://www.ci.tracy.ca.us/documents/2011_General_Plan.pdf > (Web Accessed 25 February 2015).

City of Tracy, CA, *City of Tracy Sustainability Action Plan*, 1 February 2011, <http://www.ci.tracy.ca.us/documents/Sustainability_Action_Plan.pdf > (Web Accessed 25 February 2015).

Commute Connection, *The Commute Enquirer*, Fiscal Year 2013-14, <http://www.commuteconnection.com/assets/pdf/CC-Annual-Report-2013-2014.pdf > (Web Accessed 2 March 2015).

Diaz, Roderick B. and Dennis Hinebaugh. "Characteristics of Bus Rapid Transit for Decision-Making (CBRT)", U.S. Department of Transportation, February 2009, <http://www.fta.dot.gov/documents/CBRT_2009_Update.pdf> (Web Accessed March 2015).

Fehr & Peers (2014) Model Description: Three-County (MCAG, SJCOG, StanCOG) Travel Demand Model 2008 Base, Prepared for Merced County Association of Governments (MCAG), San Joaquin Council of Governments (SJCOG), and Stanislaus Council of Governments (StanCOG), February 2014, <http://www.sjcog.org/DocumentCenter/View/919> (Web Accessed 2014).

Handy, Susan, and Kristin Lovejoy, “Impacts of Transit Service Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions.” 8 October 2013, <http://www.arb.ca.gov/cc/sb375/policies/transitservice/transit_brief.pdf> (Web Accessed 2014).

Kolko, Jed. Making the Most of Transit: Density, Employment Growth, and Ridership around new stations. February 2011. <http://www.ppic.org/content/pubs/report/R_211JKR.pdf>. (Web Accessed March2015)

Metropolitan Transportation Commission, “Change in Motion: Travel Forecasts Data Summary, Transportation 2035 Plan for the San Francisco Bay Area,” December 2008, <http://www.mtc.ca.gov/planning/2035_plan/Supplementary/T2035-Travel_Forecast_Data_Summary.pdf >.

Murakami, Elaine and Young, Jennifer. Daily travel by persons with low income. 1997 Washington, D.C.: U.S. Federal Highway Administration.

Pogue, Thomas E., et al., University of the Pacific’s Eberhardt School of Business, Business Forecasting Center, *An Analysis of Commuting Patterns in the North San Joaquin Valley*, 29 September 2014 <http://forecast.pacific.edu/nsjv/NSJV%20Commuting%20Patterns%20v2.pdf> (Web Accessed 13 February 2015).

Rapino, Melanie A. and Alison K. Fields, Mega Commuting in the U.S.: Time and Distance in Defining Long Commutes Using the 2006-2010 American Community Survey, poster presented at the Association for Public Policy Analysis and Management Fall Conference, Baltimore, MD, November 8-10, 2012.

San Joaquin Council of Governments, Inc., *San Joaquin County Multi-Species Habitat Conservation and Open Space Plan, 2013 Annual Report,* 31 December 2013,<http://www.sjcog.org/DocumentCenter/View/595> (Web Accessed 15 February 2015).

San Joaquin Council of Governments, *2013/2014 Measure K Annual Report*, 2014, <http://www.sjcog.org/ArchiveCenter/ViewFile/Item/140> (Web Accessed 23 January 2015).

San Joaquin Council of Governments, *2008 Measure K Smart Growth Incentive Program in the San Joaquin County,* <http://ca-sjcog.civicplus.com/DocumentCenter/View/60> (Web Accessed 5 March 2015).

San Joaquin Council of Governments, *2014-2040 Regional Transportation Plan and Sustainable Communities Strategy for San Joaquin County*, June 2014, <http://www.sjcog.org/DocumentCenter/View/489> (Web Accessed 13 June 2014).

San Joaquin Council of Governments, *2014 Regional Transportation Plan & Sustainable Communities Strategy,* PowerPoint presentation to the RTP/SCS Advisory Committee, 19 December 2013.

San Joaquin Council of Governments, *Draft Programmatic Environmental Impact Report 2014 Regional Transportation Plan & Sustainable Communities Strategy for San Joaquin County*, Prepared by Impact Sciences, Inc., March 2014, <http://www.sjcog.org/DocumentCenter/View/549> (Web Accessed 4 April 2014).

San Joaquin Council of Governments, *Regional Bicycle, Pedestrian and Safe Routes to School Master Plan*, prepared by Alta Planning + Design, September 2012, < http://www.sjcog.org/documentcenter/view/61> (Web Accessed 12 February 2015).

San Joaquin Council of Governments, *Regional Smart Growth/Transit-Oriented Development Plan,* prepared by The Planning Center DC&E, March 2012, <http://www.sjcog.org/DocumentCenter/View/57> (Web Accessed 5 March 2015).

San Joaquin Council of Governments, *San Joaquin County Regional Transit Systems Plan,* prepared by Fehr & Peers, June 2009, <file:///C:/Users/jgray/Downloads/2009_Regional_Transit_Systems_Plan.pdf> (Web Accessed 5 March 2015).

San Joaquin Council of Governments, *San Joaquin County Regional Blueprint: A Year 2050 Transportation, Land Use, Environmental Vision*, 28 January 2010, <file:///X:/Land%20Use%20-%20Transp/SB375/001.%20SCS%20Evaluations/SJV/1.%20Plan%20Documents/Blueprints/San%20Joaquin/Blueprint_March2010_20130130.pdf > (Web Accessed 15 January 2015).

San Joaquin Council of Governments, *San Joaquin County Regional Congestion Management Program,* 15 November 2012, <http://www.sjcog-rcmp.org/> (Web Accessed 16 February 2015).

San Joaquin Council of Governments, *Staff Report, Subject: Direction on Draft Regional Transportation Plan Framework,* September 2013, <http://www.sjcog.org/AgendaCenter/ViewFile/Agenda/09262013-219> (Web Accessed 21 November 2014).

San Joaquin County, “About San Joaquin County,” <www.sjgov.org/about.aspx?id=1372> (Web Accessed 4 November 2014).

San Joaquin County, *Draft San Joaquin County 2035 General Plan Environmental Impact Report*, prepared by ESA, October 2014, <http://www.sjcgpu.com/pdf/San-Joaquin-2035-GP-DEIR-web_Part-1.pdf> and <http://sjcgpu.com/pdf/backgroundreport/prd_br_04s.pdf> (Web Accessed 26 February 2015).

San Joaquin County Office of the Agricultural Commissioner, *2013 Annual Crop Report*, 2013, <http://www.sjgov.org/agcomm/annualrpts.aspx> (Web Accessed 10 March 2015).

San Joaquin County Office of the Agricultural Commissioner, *Agenda Item Submittal Form San Joaquin County Board of Supervisors*, “Oral Presentation and Submittal of the San Joaquin County 2013 Agricultural Report,” 8 August 2014, <http://www.sjgov.org/board/board%20meetings/Agendas/082614/MG99141/AS99161/AI102389/DO102390/DO_102390.PDF> (Web Accessed 10 February 2015).

San Joaquin Regional Rail Commission, Meeting Agenda, 5 April 2013, <http://www.acerail.com/getdoc/24a05eb2-c39d-456c-bdc0-9cf7cd1aa854/default> (Web Accessed 11 February 2015).

San Joaquin Regional Transit District, *Metro Express* webpage, <http://www.sanjoaquinrtd.com/express/default.php> (Web Accessed 27 January 2015).

San Joaquin Regional Transit District, *Metro Express—BRT Works in Stockton, CA* video, 17 April 2012, <https://www.youtube.com/watch?v=BCHFJQ117no&feature=youtu.be> (Web Accessed 26 January 2015).

Tal, Gil, Susan Handy, and Marlon G. Boarnet. Policy Brief on the Impacts of Transit Access (Distance to Transit) Based on a Review of the Empirical Literature. 3 December 2013. <http://www.arb.ca.gov/cc/sb375/policies/transitaccess/transit_access_brief120313.pdf> (Web Accessed March 2015)

Thole, C., A. Cain, and J. Flynn. 2009. The EmX Franklin Corridor BRT Project Evaluation. 431Washington, DC: Federal Transit Administration, U.S. Department of Transportation.

United States Census Bureau, “2010 Census Urban and Rural Classification and Urban Area Criteria,” website <https://www.census.gov/geo/reference/ua/urban-rural-2010.html> (Web Accessed 12 March 2015).

APPENDIX A. SJCOG's Modeling Parameters for SCS Evaluation (Data Table)

This appendix contains SJCOG's responses to data requests, received on March 6, 2015, to supplement ARB staff's evaluation of SJCOG's quantification of GHG emissions. ARB requested this data in accordance with the general approach described in ARB's July 2011 evaluation methodology document.

Modeling Parameters[1]	2005 if available	2008 Base year	2020		2035		2040		Data Source(s)
			With Project[2]	Without Project[3]	With Project	Without Project	With Project	Without Project	
DEMOGRAPHICS									
Total population	652,339	681,842	807,099	807,099	1,003,843	1,003,843	1,070,486	1,070,486	The Planning Center Demographic Forecast March 2012
Group quarters population	17,118	16,558	16,610	16,610	17,180	17,180	17,737	17,737	The Planning Center Demographic Forecast March 2012
Total employment (employees)	221,017	220,667	234,235	234,235	282,613	282,613	299,717	299,717	University of the Pacific Business Forecasting Center March 2012
Average unemployment rate (%)	7.9%	10.4%	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Historical: Bureau of Labor Statistics / Employment Rate not Projected
Total number of households	205,497	208,305	249,764	249,764	302,258	302,258	319,756	319,756	The Planning Center Demographic Forecast March 2012. 2005 & 2008 are SJCOG Estimates from MIP Work
Persons per household	3.09	3.19	3.16	3.16	3.26	3.26	3.29	3.29	Calculated (Household Population/Households)
Auto ownership per household	1.974	1.975	1.997	2.004	2.014	2.043	2.018	2.053	MIP model
Median household income	$49,391	$54,882	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	1-Year ACS Estimates - 2005 & 2008 Inflation Adjusted Dollars / Median Income not Projected

Modeling Parameters	2005	2008	2020		2035		2040		Data Source(s)
	if available	Base year	With Project	Without Project	With Project	Without Project	With Project	Without Project	
LAND USE [4]									
Total acres within MPO	912,640	912,640	912,640	912,640	912,640	912,640	912,640	912,640	Table A-30 CA Dept of Conservation Farmland Monitoring Program
Total resource area acres (CA GC Section 65080.01)	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	
Total farmland acres (CA GC Section 65080.01)	622,098	615,690	612,696	610,615	608,388	595,246	606,752	590,123	Total important farmland without regard to SOI (includes prime, statewide, and unique) - Envision Tomorrow / GIS Analysis (Information obtained from scenario A, business as usual; not reflective of 2011 RTP)
Important farmland impacts (Total) in Acres	Not Applicable	Not Applicable	2,394	5,075	7,302	20,444	8,939	25,567	Acres consumed by new growth total (prime, statewide,unique) (Information obtained from scenario A, business as usual; not reflective of 2011 RTP)
Important farmland impacts (Outside of 2008 SOIs) in Acres	Not Applicable	Not Applicable	411	1,524	1,217	5,144	1,486	6,351	Acres consumed by new growth outside of 2008 SOIs (prime, statewide, unique) ((Information obtained from scenario A, business as usual; not reflective of 2011 RTP)
Total developed acres	Not Available	109,021	115,659	119,805	125,932	140,811	129,356	147,806	MIP Model + Envision Tomorrow New Growth (Information obtained from scenario A, business as usual; not reflective of 2011 RTP)

Modeling Parameters	2005	2008	2020		2035		2040		Data Source(s)
	if available	Base year	With Project	Without Project	With Project	Without Project	With Project	Without Project	
Total commercial developed acres	Not Available	48,456	49,050	49,104	50,367	50,898	50,805	51,497	MIP Model + Envision Tomorrow New Growth (Information obtained from scenario A, business as usual; not reflective of 2011 RTP)
Total residential developed acres	Not Available	60,565	66,608	70,721	75,565	89,913	78,551	96,310	MIP Model + Envision Tomorrow New Growth (Information obtained from scenario A, business as usual; not reflective of 2011 RTP)
Total housing units	217,090	232,224	260,171	260,171	314,852	314,852	333,079	333,079	Calculated from total Households & Housing Vacancy Rate
Housing vacancy rate	5.3%	10.3%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	2008 Estimated from Census data / Projection refelcts "healthy market vacancy rate"
Total households in single-family detached housing units	142,175	144,198	170,977	179,006	199,503	226,492	209,014	242,316	Total Growth+Existing (Households) MIP Model & Envision Tomorrow
Total households in small-lot single family detached housing units (5,000 sq. ft. lots and smaller)	Not Available	3,461	15,010	13,640	30,840	29,091	36,117	34,241	Total Growth+Existing (Households) MIP Model & Envision Tomorrow
Total households in conventional-lot single family detached units (between 5,001 and 7,000 sq. ft. lots)	Not Available	108,725	121,489	126,497	131,980	145,547	135,479	151,894	Total Growth+Existing (Households) MIP Model & Envision Tomorrow

Modeling Parameters	2005	2008	2020		2035		2040		Data Source(s)
	if available	Base year	With Project	Without Project	With Project	Without Project	With Project	Without Project	
Total households in large-lot single family detached units (7,001 sq ft. lots and larger)	Not Available	32,012	34,478	38,869	36,683	51,854	37,418	56,181	Total Growth+Existing (Households) MIP Model & Envision Tomorrow
Total single-family attached housing units (included in MF)									Included in Multi-Family
Total households in multi-family housing units	58,528	59,251	73,301	65,076	96,939	69,910	104,815	71,526	Total Growth+Existing (Households) MIP Model & Envision Tomorrow
Total households in mobile home units & other	4,794	4,856	5,486	5,682	5,816	5,856	5,927	5,914	Total Growth+Existing (Households) MIP Model & Envision Tomorrow
Total households in multi-family, MH & Other (Line 29 + Line 30)	63,322	64,107	78,787	70,758	102,755	75,766	110,742	77,440	Total Growth+Existing (Households) MIP Model & Envision Tomorrow
Households in infill areas (SJCOG TOD Sites)	Not Available	Not Available	1,021	852	4,414	1,351	5,545	1,517	New Growth Only (Households) GIS/Envision Tomorrow
Households in infill areas (FMMP Urbanized Area)	Not Available	Not Available	3,632	2,798	12,635	4,034	15,636	4,446	New Growth Only (Households) GIS/Envision Tomorrow
Households in Mixed Use Units included in Multi-Family Totals	Not Available	1,392	1,768	1,603	4,731	2,108	5,719	2,277	Total Growth+Existing (Households) MIP Model & Envision Tomorrow
Total households within 1/2 mile of frequent transit routes and transit hubs (defined as routes with at least 2 buses per hour)	62,148	62,259	97,659	67,844	104,507	71,998	107,371	73,859	Total Growth+Existing (Households) GIS Analysis

Modeling Parameters	2005	2008	2020		2035		2040		Data Source(s)
	if available	Base year	With Project	Without Project	With Project	Without Project	With Project	Without Project	
Total households within 1/2 mile of High Quality Transit Areas & Major Transit Routes as defined by SB 375.	32,978	32,780	50,984	37,421	73,584	37,323	76,287	37,724	Total Growth+Existing (Households) GIS Analysis
Total employment within 1/2 mile of frequent transit routes and transit hubs (defined as routes with at least 2 buses per hour)	86,938	87,259	111,807	89,858	125,418	101,618	131,101	106,394	Total Growth+Existing (Employment) GIS Analysis
Total employment within 1/2 mile of High Quality Transit Areas & Major Transit Routes as defined by SB 375.	63,041	63,214	80,354	65,315	111,741	68,158	116,961	69,528	Total Growth+Existing (Employment) GIS Analysis
TRANSPORTATION SYSTEM									
Freeway general purpose lanes – mixed flow lane miles									
Freeway	706	706	758	818	809	818	835	Not Available	
Arterial (lane miles)	1,858	1,856	1,956	2,162	2,150	2,162	2,165	Not Available	
Collector (lane miles)	1,576	1,576	1,586	1,655	1,642	1,655	1,642	Not Available	
Local (lane miles)	654	654	657	745	744	745	746	Not Available	

Modeling Parameters	2005	2008	2020		2035		2040		Data Source(s)
	if available	Base year	With Project	Without Project	With Project	Without Project	With Project	Without Project	
Local, express bus, and neighborhood shuttle operation miles	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Not Available	
Bus rapid transit bus operation miles		1860	3188	1860	7148	3188	7436	Not Available	
Passenger rail operation miles	92	92	224	224	224	224	224	Not Available	San Joaquin Regional Rail Commission
Transit total daily vehicle service hours	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Not Available	
Bicycle and pedestrian trail/lane miles	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Not Available	
Vanpool (total riders per weekday)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Not Available	
TRIP DATA [5]									
Number of trips by trip purpose									
Home-Work	393,925	398,905	451,477	461,937	555,083	574,053	591,458	Not Available	
Home-Shop	250,356	254,675	288,512	293,576	354,572	364,469	376,214	Not Available	
Home-Other	921,216	937,657	1,111,241	1,129,915	1,376,753	1,399,944	1,463,200	Not Available	
Work-Other	77,049	76,365	77,252	78,004	96,212	96,226	103,033	Not Available	
Other-Other	569,048	565,076	588,285	595,286	733,122	738,758	784,821	Not Available	

Modeling Parameters	2005	2008	2020		2035		2040		Data Source(s)
	if available	Base year	With Project	Without Project	With Project	Without Project	With Project	Without Project	
MODE SHARE									
Vehicle Mode Share (Peak Period)									
SOV (% of trips)	39.61%	38.93%	38.54%	38.62%	38.49%	37.96%	38.48%	Not Available	Note:Although mode share percentages are lower without the project, it is important to note, the without the project scenario results in more trips. For example, although the 2035 without project SOV trips as a percentage of all trips is lower thn the without project it results in more absolute trips (with oroject 2035 = 1,199,249 and 2035 without the project = 1,204,569
SharedRide2 (% Trips)	20.80%	20.85%	21.19%	21.13%	21.17%	21.22%	21.15%	Not Available	
SharedRide 3+ (% Trips)	34.89%	35.44%	35.66%	35.64%	35.88%	36.84%	35.95%	Not Available	
Transit (% of trips)	1.47%	1.51%	1.46%	1.41%	1.40%	1.24%	1.37%	Not Available	
Walk (% Trips)	0.77%	0.79%	0.79%	0.80%	0.78%	0.71%	0.78%	Not Available	
Bike (% Trips)	2.45%	2.49%	2.36%	2.39%	2.28%	2.03%	2.27%	Not Available	
Vehicle Mode Share (Whole Day)									
SOV (% of trips)	38.97%	38.28%	37.93%	38.02%	37.90%	37.43%	37.89%	Not Available	
SharedRide 2(% Trips)	20.46%	20.51%	20.85%	20.81%	20.84%	20.93%	20.83%	Not Available	

Modeling Parameters	2005	2008	2020		2035		2040		Data Source(s)
	if available	Base year	With Project	Without Project	With Project	Without Project	With Project	Without Project	
SharedRide 3+ (% Trips)	34.32%	34.85%	35.10%	35.09%	35.33%	36.33%	35.41%	Not Available	
Transit (% of trips)	2.10%	2.15%	2.08%	2.00%	1.99%	1.80%	1.96%	Not Available	
Walk (% Trips)	1.04%	1.06%	1.07%	1.09%	1.06%	0.95%	1.05%	Not Available	
Bike (% Trips)	3.12%	3.15%	2.96%	2.99%	2.87%	2.56%	2.86%	Not Available	
Average weekday trip length (miles)									
SOV	16.31	16.8	16.95	16.9	16.91	20.3	16.68	Not Available	
SharedRide 2	18.18	18.46	17.7	17.61	17.29	20.81	17.18	Not Available	
SharedRide 3+	19.12	19.52	18.15	18.04	17.39	21.98	17.24	Not Available	
Transit	6.44	7.26	6.86	7.43	7.18	8.18	6.76	Not Available	
Walk/Bike	3.02	3.04	3.19	3.22	3.29	3.41	3.3	Not Available	
Average weekday travel time (minutes)									
SOV	21.44	21.94	22.29	22.37	22.31	20.48	22.08	Not Available	
SharedRide 2	23.47	23.74	23.24	23.35	22.89	20.31	22.78	Not Available	
SharedRide 3+	24.06	24.45	23.48	23.56	22.87	21.26	22.72	Not Available	
Transit	11.58	12.39	12.06	12.78	12.34	10.94	11.93	Not Available	
Walk/Bike	7.2	7.22	7.44	7.48	7.51	7.16	7.51	Not Available	

Modeling Parameters	2005	2008	2020		2035		2040		Data Source(s)
	if available	Base year	With Project	Without Project	With Project	Without Project	With Project	Without Project	
Vehicle Trips By Purpose					2,243,327				
Home-Work	357,922	359,374	406,736	416,159	500,074	517,165	532,845	Not Available	
Home-Shop	187,034	187,261	212,142	215,865	260,715	267,992	276,628	Not Available	
Home-Other	598,090	608,868	721,585	733,711	893,995	909,055	950,130	Not Available	
Work-Other	66,523	65,832	66,597	67,245	82,942	82,953	88,821	Not Available	
Other-Other	392,215	389,707	405,714	410,542	505,601	509,488	541,256	Not Available	
Total VMT per weekday for passenger vehicles (ARB vehicle classes of LDA, LDT1, LDT2 and MDV) (miles)	13,087,000.0	Not Available	12,307,000.0	12,410,096.4	15,114,000.0	15,506,937.7	16,009,000.0	Not Available	Per Year
Total II (Internal) VMT per weekday for passenger vehicles (miles)	10,313,607.5	Not Available	8,939,541.7	8,983,479.3	10,914,301.6	11,153,688.6	11,676,534.2	Not Available	Per Day
Total IX/XI VMTper weekday for passenger vehicles (miles)	2,773,181.3	Not Available	3,366,973.1	3,426,619.0	4,199,734.2	4,353,250.8	4,332,834.8	Not Available	Per Day
Total XX VMT per weekday for passenger vehicles (miles)	3,611,971.0	Not Available	5,589,713.3	5,758,732.7	7,581,404.2	7,818,100.7	8,246,670.0	Not Available	Per Day
Congested Peak Hour VMT on freeways (Lane Miles, V/C ratios >0.75)	689693.39	733701.23	929775.66	To Be Calculated	1081076.26	To Be Calculated	1151537.8	Not Available	

Modeling Parameters	2005	2008	2020		2035		2040		Data Source(s)
	if available	Base year	With Project	Without Project	With Project	Without Project	With Project	Without Project	
Congested Peak VMT on all other roadways (Lane Miles, V/C ratios >0.75)	142887.7	201357.45	322328.94	To Be Calculated	653582.96	To Be Calculated	754528.45	Not Available	
CO2 EMISSIONS[6]									
Total CO2 emissions per weekday for passenger vehicles (ARB vehicle classes LDA, LDT1, LDT2, and MDV) (tons)	8166	Not Available	8705	8797	11249	11544	12085	Not Available	Per Day
Total II (Internal) CO2 emissions per weekday for passenger vehicles (tons)	5044	Not Available	4348	4350	5410	5520	5809	Not Available	Not Available
Total IX / XI trip CO2 emissions per weekday for passenger vehicles (tons)	1356	Not Available	1638	1659	2082	2154	2155	Not Available	Not Available
Total XX trip CO2 emissions per weekday for passenger vehicles (tons)	1766	Not Available	2719	2788	3758	3869	4120	Not Available	Not Available
Local, express bus, and neighborhood shuttle operation miles	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	

Modeling Parameters	2005	2008	2020		2035		2040		Data Source(s)
	if available	Base year	With Project	Without Project	With Project	Without Project	With Project	Without Project	
Bus rapid transit bus operation miles		1860	1860	To Be Calculated	7148	To Be Calculated	7436	Not Available	
Passenger rail operation miles	92	92	224	224	224	224	224	Not Available	San Joaquin Regfional Rail Commission
Transit total daily vehicle service hours	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	
Bicycle and pedestrian trail/ miles	Not Available	267	Not Available	Not Available	Not Available	Not Available	1067	Not Available	* 2008 Reflect 2012 Miles from Bicycle Master Plan
Vanpool (total riders per weekday)	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	
INVESTMENT (Billions)									
Total RTP Expenditure (*Year of Expenditure $)	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	$11.000	$10.724	Note: All Without Project Estimates Reflect the 2011 RTP (2035)
Highway capacity expansion (Year of Expenditure $)	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	$2.113	$3.213	Note: All Without Project Estimates Reflect the 2011 RTP (2035)
Other road capacity expansion (Year of Expenditure $)	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	$1.160	$1.228	Note: All Without Project Estimates Reflect the 2011 RTP (2035)
Roadway maintenance (Year of Expenditure $)	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	$3.684	$2.969	Note: All Without Project Estimates Reflect the 2011 RTP (2035)
BRT projects (Year of Expenditure $)	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	$0.828	$0.169	Note: All Without Project Estimates Reflect the 2011 RTP (2035)
Transit capacity expansion (Year of Expenditure $)	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	$1.275	$0.547	Note: All Without Project Estimates Reflect the 2011 RTP (2035)

Modeling Parameters	2005	2008	2020		2035		2040		Data Source(s)
	if available	Base year	With Project	Without Project	With Project	Without Project	With Project	Without Project	
Transit operations (Year of Expenditure $)	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	$2.291	$2.033	Note: All Without Project Estimates Reflect the 2011 RTP (2035) (Anticipated Cost to Maintain Existing Trasit Service)
Bike and pedestrian projects (Year of Expenditure $)	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	$0.282	$0.159	Note: All Without Project Estimates Reflect the 2011 RTP (2035)
TRANSPORTATION USER COSTS									
Vehicle operating costs (Year 2000 $ per mile)	0.1134	0.1534	0.1778	0.1778	0.1885	0.1885	0.1920	0.1920	MIP/Calculated
Gasoline price (Year 2000 $ per gallon)	$2.24	$3.65	$4.46	$4.46	$6.06	$6.06	$6.17	$6.17	MIP/Calculated
Average transit fare (Year XXXX $)									
Parking cost (Year XXXX $)	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	

SJCOG County Transit Fares

Agency	Fare (Regular)	Fare (Seniors)
eTrans	$1.50	$0.75
Grapeline	$1.25	$0.60
Manteca Transit	$1.00	$0.75
Blossom Express	$2.00	$1.00
Tracer	$1.25	$0.50
RTD	$1.50	$0.75

*Year of Expenditure reflect the year the dollars are actually expended.. For documentation regarding the year of expenditure estimation process, please see SJCOG 2014 RTP/SCS appendix I, Project Cost Estimation Template.

[1] When reporting $ units, indicate whether they are current dollars, YOE (year of exchange), or other.

[2] This scenario includes modeling of all planned and programmed projects in RTP/SCS for respective calendar year.

[3] This scenario should reflect the MPO's Business as Usual scenario, which for most is what would happen under the MPO's previously adopted RTP for the respective calendar year.

[4] In cases where "TOTAL" land use data is reflective of "GROWTH ONLY", please indicate those instances within the table.

[5] Please include any other trip type that may be applicable to your region.

[6] Please provide ARB staff with the EMFAC Input and Output files associated with these outputs.

APPENDIX B. 2010 CTC RTP Guidelines Addressed in SJCOG's RTP

This appendix lists the requirements in the California Transportation Commission's (CTC) Regional Transportation Planning (RTP) Guidelines that are applicable to the SJCOG regional travel demand model, and which SJCOG followed. In addition, listed below are the recommended practices from the CTC RTP Guidelines that SJCOG 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))
- The region shall achieve the requirements of the Transportation Conformity Regulations of Title 40 CFR Part 93.
- Network-based travel models shall be validated against observed counts (peak- and off-peak, if possible) for a base year that is not more than 10 years prior to the date of the conformity determination. Model forecasts shall be analyzed for reasonableness and compared to historical trends and other factors, and the results shall be documented. (Title 40 CFR Part 93.122 (b)(1)(i))
- Land use, population, employment, and other network-based travel model assumptions shall be documented and based on the best available information. (Title 40 CFR Part 93.122 (b)(1)(ii))
- Scenarios of land development and use shall be consistent with the future transportation system alternatives for which emissions are being estimated. The distribution of employment and residences for different transportation options shall be reasonable. (Title 40 CFR Part 93.122(b)(1)(iii))
- A capacity-sensitivity assignment methodology shall be used, and emissions estimates shall be based on methodology which differentiates between peak- and off-peak link volumes and speeds and uses speeds based on final assigned volumes. (Title 40 CFR Part 93.122 (b)(1)(iv))

- Zone-to-zone travel impedance used to distribute trips between origin and destination pairs shall be in reasonable agreement with the travel times that are estimated from final assigned traffic volumes. (Title 40 CFR Part 93.122(b)(1)(v))
- Network-based travel models shall be reasonably sensitive to changes in the time(s), cost(s), and other factors affecting travel choices. (Title 40 CFR Part 93.122 (b)(1)(vi))
- Reasonable methods in accordance with good practice shall be used to estimate traffic speeds and delays in a manner that is sensitive to the estimated volume of travel on each roadway segment represented in the network-based travel model. (Title 40 CFR Part 93.122(b)(2))
- Highway Performance Monitoring System (HPMS) estimates of vehicle miles travel (VMT) shall be considered the primary measure of VMT within the portion of the nonattainment or maintenance area and for the functional classes of urban area basis. For areas with network-based travel models, a factor (or factors) may be developed to reconcile and calibrate the network-based travel model estimates of VMT in the base year of its validation to the HPMS estimates for the same period. These factors may then be applied to model estimates of future VMT. In this factoring process, consideration will be given to differences between HPMS and network-based travel models, such as differences in the facility coverage of the HPMS and the modeled network description. Locally developed count-based programs and other departures from these procedures are permitted subject to the interagency consultation procedures of Section 93.105(c)(1)(i). (Title 40 CFR Part 93.122(b)(3))

Recommendations

- 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 post-processors could be developed for other non-D factors and policies, too.
- The models should address changes in regional demographic patterns.
- Geographic Information System (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.
- 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.
- These regions should develop 4-step travel models as soon as is possible. In the near-term, post-processing should be used.
- The travel model set should be run to a reasonable convergence towards equilibrium across all model steps.
- Simple land use models should be used, such as GIS rule-based ones, in the short term.
- Parcel data and an existing urban layer should be developed as soon as is possible.
- A digital general plan layer should be developed in the short-term.
- A simple freight model should be developed and used.
- Several employment types should be used, along with several trip purposes.
- The models should have sufficient temporal resolution to adequately model peak and off-peak periods.
- Agencies should, at a minimum, have four-step models with full feedback across travel model steps and some sort of land use modeling.
- In addition to the conformity requirements, these regions should also add an auto ownership step and make this step and the mode choice equations for transit, walking and bicycling and the trip generation step sensitive to land use variables and transit accessibility.
- Walk and bike modes should be explicitly represented.
- The carpool mode should be included, along with access-to-transit sub modes.
- Feedback loops should be used and take into account the effects of corridor capacity, congestion and bottlenecks on mode choice, induced demand, induced growth, travel speed and emissions.

- Freight models should be implemented in the short term and commodity flows models within a few years.
- Simple Environmental Justice analyses should be done using travel costs or mode choice log sums, as in Group C. Examples of such analyses include the effects of transportation and development scenarios on low-income or transit-dependent households, the combined housing/transportation cost burden on these households, and the jobs/housing fit.