TECHNICAL EVALUATION OF THE

GREENHOUSE GAS EMISSIONS REDUCTION QUANTIFICATION FOR THE

KINGS COUNTY ASSOCIATION OF GOVERNMENTS'

SB 375 SUSTAINABLE COMMUNITIES STRATEGY

OCTOBER 2015

California Environmental Protection Agency

Air Resources Board

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I. EXECUTIVE SUMMARY

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

For the Kings County Association of Governments (KCAG) region, the Board set targets at five percent per capita decrease in 2020 and a ten percent per capita decrease in 2035 from a base year of 2005. The KCAG Board adopted the final Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS), known as the 2014 RTP/SCS, on July 30, 2014. KCAG's SCS projects that the region would achieve GHG emissions reductions beyond the established targets, reducing GHG emissions by five percent per capita in 2020 and 12 percent per capita in 2035. KCAG transmitted the adopted RTP/SCS and GHG quantification to ARB for review on September 25, 2015.

The KCAG region is located in the San Joaquin Valley (Valley) and KCAG is one of the smallest MPO's in California, with a population of about 153,000. The region is predominately rural with 90 percent of the land designated as agricultural, the majority of which is under Williamson Act or Farmland Security Zone contracts that protect the land from development. The transportation system is primarily auto-dependent, although two transit operators offer about a dozen routes that provide local connections within and between Kings County cities—Hanford, Lemoore, Corcoran, and Avenal—as well as service to Fresno and Visalia. Development in the region has been mostly low density, single-family residential located near the four incorporated cities.

The 2014 RTP/SCS continues to prioritize agricultural preservation while encouraging growth in existing urbanized areas. Efforts within local jurisdictions to increase connectivity and mix of uses will help provide more housing choices for residents and decrease travel distances to destinations. The SCS includes transportation projects that aim to meet the needs of residents such as a new park and ride facility, two new transit routes, and new bike and pedestrian facilities. Given the long commute distances common in the county, vanpools will continue to be an effective alternative to single occupant vehicle travel for some residents.

This report represents ARB staff's technical analysis of KCAG's SCS and GHG determination, and describes methods used to evaluate the MPO's GHG quantification. ARB staff has concluded that the SCS, if implemented, would achieve the region's targets of five and 10 percent reduction in 2020 and 2035, respectively. This conclusion is based on multiple factors, including the sensitivity of the MPO's travel model, the impact of assumptions used in the model, the types of projects and strategies in the SCS that support compact infill development, and qualitative evidence from SCS performance indicators that indicate the region's ability to reduce per capita emissions.

II. KINGS COUNTY ASSOCIATION OF GOVERNMENTS

In California, MPOs are responsible for preparing and updating RTPs[1] that include an SCS[2], demonstrating a reduction in regional GHG emissions from automobiles and light trucks to meet targets set by ARB.

KCAG is the federally designated MPO and state designated Regional Transportation Planning Agency (RTPA) for Kings County (county). KCAG's Commission is composed of two representatives from the county and one representative from each of the county's four cities—Avenal, Corcoran, Lemoore, and Hanford. The Commission is advised by a Transportation Policy Committee and Technical Advisory Committee, which include representatives from all members of the Commission plus Caltrans.

A. Background

The KCAG region encompasses approximately 1,396 square miles in the south-central San Joaquin Valley (Figure 1). About 90 percent of the land area is designated as agricultural and 75 percent of that is under Williamson Act or Farmland Security Zone contracts, which protect the land from development for 10 and 20 years, respectively.

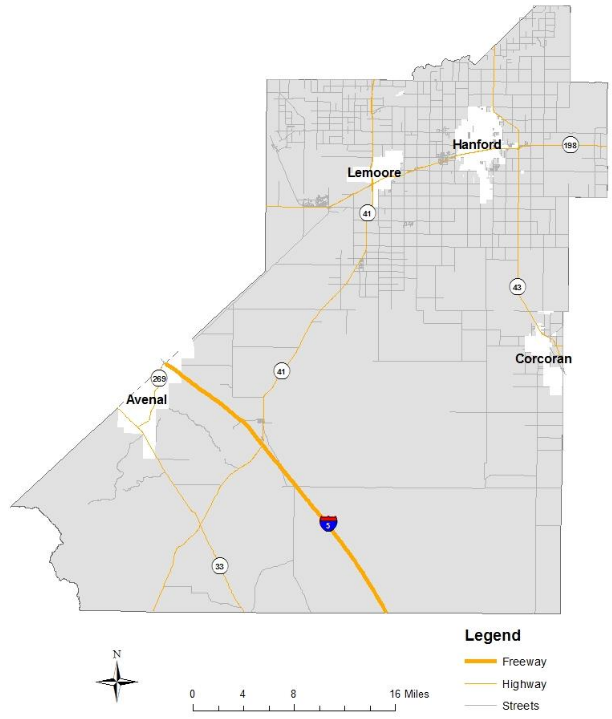
KCAG is the third smallest MPO in terms of population, after the Madera and Tahoe MPO regions. The region's 153,000[3] residents are mostly concentrated in the four cities of Hanford, Lemoore, Avenal, and Corcoran. The largest of these cities, Hanford, has a population of about 54,000. The county's few rural communities have populations under 5,000 and the Santa Rosa Rancheria of the Tachi-Yokut Tribe is home to about 1,000 people.

Because the population centers in Kings County are dispersed, commute trips can be long. The largest sector of the region's economy is agricultural and related industries. Many agricultural employers and processing centers are located away from urban cities and require long distance commuting. This is also true for the county's large employment centers including the Lemoore Naval Air Station (LNAS), Tachi Palace Hotel and Casino, and three California Department of Corrections facilities.

[1] An RTP is a federally required plan to finance and program regional transportation infrastructure projects, and associated operation and maintenance for the next 20 years.
[2] The SCS sets forth a forecasted development pattern for the region which, when integrated with the transportation network and other transportation measures and policies, will reduce the greenhouse gas emissions from automobiles and light trucks. It shall include identification of the location of uses, residential densities and building densities, information regarding resource areas and farmland.
[3] 2010 U.S. Census

Figure 1: KCAG Context Map

Figure 2: Kings County



Source: GIS layers from Caltrans and Kings County

B. Transportation Planning in the Region

The RTP is a long range plan that integrates the growth policies of local governments and the transportation system need to support that growth. KCAG developed the 2014 RTP/SCS in coordination with its member cities and county, Caltrans, Federal Highways Administration (FHWA), Federal Transit Administration, the San Joaquin Valley Air Pollution Control District, Kings County Area Public Transit Agency, Tachi-Yokut Tribe, and community groups.

1. Transportation Systems

The transportation network consists of freeways, highways, local roadways, and transit. The following section describes the existing transportation network.

Roadways

The main transportation facilities in the KCAG region include Interstate 5 (I-5); State Routes (SR) 41, 43, 137, and 198; and several local arterials (Figure 2).

The KCAG region is reliant on the roadway system for both residents and goods movement as well as the social and economic well-being of the region. The highway network includes about 2,300 lane miles of highways, expressways, arterials and collector roads, which is expected to increase to about 2,400 lane miles by 2040, mostly through the increase in arterial and collector roads. I-5 is the major north-south connector that carries pass-through goods and travelers, whereas SR 198 carries the majority of local travelers and commuters.

Transit

The region has two transit operators: Corcoran Area Transit and Kings Area Rural Transit, which serve the county, Hanford, Lemoore, and Avenal with about a dozen routes. In March 2015, KCAG released a five year Transit Development Plan, which includes a marketing plan and strategies to improve current services.

Source: http://www.kingscog.org/assets/2007%20HSTCP%20Final.pdf

KCAG is also served by Amtrak rail service, with stations in Corcoran and Hanford. Amtrak provides rail access to other cities in the San Joaquin Valley, like Fresno, as well as outside the Valley, like Oakland in the Bay Area. For active transportation, the existing bike facilities are shared use, meaning that bikes share the same lane with motorized vehicles.

Transportation Demand Management

KCAG provides guidance and resources to employers required to comply with the San Joaquin Valley's Employer Trip Reduction Implementation Plan (eTRIP) Rule 9410. This program requires employers of over 100 eligible employees to encourage employees to reduce single-occupancy vehicle trips. This can include strategies like providing preferential parking for vanpools and rideshare, bicycle parking, and other facilities suitable for the type of business.

CalVans currently operates 78 vanpools that originate their trips within the county and travel to destinations within Kings County or to nearby Fresno County. An additional 70 vanpools originate in other counties, like Tulare and Fresno, and travel to worksites within Kings County.[4]

Source: http://www.kingscog.org/assets/2007%20HSTCP%20Final.pdf

r 10, 2015, Attachment E)

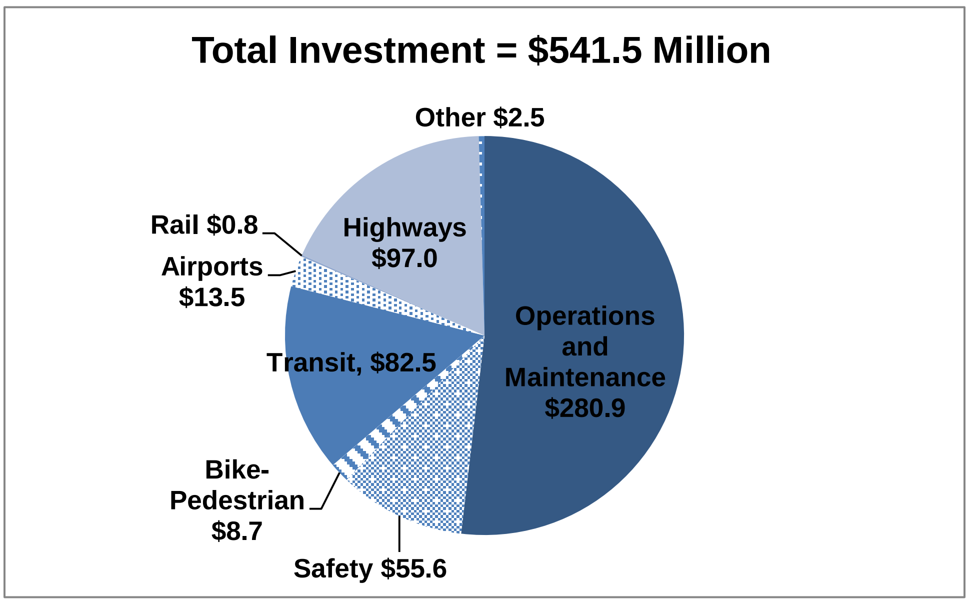
Goods Movement
According to Caltrans traffic counts, truck traffic can account for almost 15 percent of all vehicle miles travelled (VMT) in the county compared to 10 percent average in the State[5]. With the substantial amount of goods movement originating in or passing through the county along I-5 and SR 41, the county experiences a high volume of truck traffic, which impacts the county's air quality and GHG emissions.

2. Transportation Funding

RTPs must be financially constrained, meaning that funding for planned transportation projects must be reasonably foreseeable. The 2014 RTP/SCS includes a total of $541.5 million for expenditures during the 2014-2040 planning period. Funding for the projects in the RTP/SCS comes from a combination of federal (23.5 percent), State (42.9 percent), and local sources (35.4 percent). The region has not implemented a self-help taxation measure, which other regions have used to raise additional transportation revenue.

The SCS invests over half (52 percent) of the RTP budget in the operation and maintenance of the current transportation network, 15 percent for transit, 10 percent for safety measures, and two percent for bike and pedestrian improvements. It includes no freeway expansion projects. The summary of all expenditures in the plan is shown in Figure 3.

Figure 3: Summary of Expenditure 2014-2040 (in Millions of $)



Source: KCAG 2014 RTP/SCS

[5] KCAG 2014 RTP/SCS

Kings and other rural counties have difficulty competing for funding against larger counties and transportation agencies across the State because they lack the same level of congestion problems. This leads to challenges in Kings County for maintaining current investments as well as funding new projects. For example, some roads in the county are being converted to gravel due to insufficient resources to maintain them.

Despite these challenges, Kings County has been able to secure grants to fund specific planning and operations projects. Kings County was awarded grant funds ($51,000) through the Low Carbon Transit Operations Program to fund a bus route expansion that will serve disadvantaged areas in Hanford and Lemoore.[6]

Kings County will also benefit from the Affordable Housing and Sustainable Communities grant award ($3 million from the Strategic Growth Council) to the California Vanpool Authority (CalVans) to provide vanpool opportunities for rural communities.[7]

In addition, Caltrans has awarded funds to the Kings County region through multiple programs. Through the Transportation Planning Grant Program, Kings has received funding for an SR 198 Corridor Preservation and Improvement Strategic Plan, Kings County Transit Development Plan Update, and a Smart Growth SR 41 Corridor Improvement Plan.

Caltrans also recently awarded a Transportation Planning Grant to the eight Valley MPOs and the University of California at Davis, Institute of Transportation Studies for a shared access pilot program to help address transit needs in rural areas. This program will look at car, bike, and ridesharing options as well as other alternatives that may meet the transit needs of smaller communities in the Valley.

Caltrans has also awarded funds for a Valley-wide goods movement planning effort that includes an Interstate 5 (I-5)/SR-99 Corridor Study and a Goods Movement Implementation Plan Update. The Corridor Study will look at strategies to reduce truck emissions and the number of trucks on I-5/SR-99 and may also include a demonstration project for autonomous freight. The Implementation Plan Update will look at strategies to improve truck routing, parking needs, and other ways to reduce truck emissions Valley-wide.

[6] http://www.dot.ca.gov/hq/MassTrans/Docs-Pdfs/LCTP_14-15_Final_Projects.pdf
[7] http://www.sgc.ca.gov/docs/Attachment_B_Summary_of_AHSC_Recommendations.pdf

III. 2014 RTP/SCS DEVELOPMENT

This section describes the planning context within which the RTP/SCS was developed and the process through which a final plan was formulated and adopted. KCAG began its public process in 2013 by consulting with various public and local agency representatives to gather input for alternative investment scenarios and to hold public workshops to explain the scenarios and provide opportunities to comment. These scenarios illustrated different options for the future of the region through 2040.

A. SCS Foundational Policies

Blueprint

In 2005, KCAG initiated a Blueprint effort as part of a joint grant application with the seven Councils of Governments (COGs) in the Valley. This was the first time that KCAG engaged with member agencies specifically about land use and transportation integration. In 2008, the KCAG Commission adopted Blueprint Principles, which include directing future growth to existing urbanized areas, minimizing outward expansion into important farmlands, and balancing the need for growth and economic development with reinforced preservation of prioritized agricultural resources.

General Plans

Many of the smart growth policies articulated by the Blueprint Principles have been integrated into recently updated local general plans. The County of Kings updated its plan in 2010, the City of Lemoore updated its plan in 2008, and the other three cities are currently in the process of updates.

In addition to the Blueprint Principles mentioned above, local general plans prioritize the preservation of agricultural land. Seventy-five percent of the county’s land is currently under Williamson Act and Farmland Security Zone contracts, which offer property tax relief to land owners in exchange for ten and twenty-year agreements, respectively, that the land will not be developed.

Climate Action Plan

With grant funding from KCAG, the cities of Avenal and Hanford collaborated to develop a Regional Climate Action Plan (CAP), which was accepted by both cities in May 2014. This is a long-range plan that identifies voluntary, cost effective measures to reduce GHG emissions. It includes measures to encourage low carbon and alternative fuel vehicles, electric vehicle readiness, and employer-based transportation demand management. The CAP also includes performance criteria for transit ridership and infill and mixed use development. The CAP may also be used for California Environmental Quality Act (CEQA) streamlining or to support grant applications for public and private funds.

Active Transportation

In 2011, KCAG released a Regional Bicycle Plan to address climate and health concerns. This plan serves as a starting point for implementing the bicycle projects included in the 2014 RTP/SCS.

The City of Hanford is incorporating an Active Transportation Plan into their General Plan, which is currently being updated. Cities and the county have also demonstrated interest in Safe Routes to School (SRTS) strategies. Lemoore applied for funds in 2015 to implement an SRTS program, and the county has applied for funds on behalf of the unincorporated areas.

Source: KCAG 2011 Regional Bicycle Plan

To provide a coordinated vision and approach to the region's active transportation efforts, KCAG plans to prepare a Regional Active Transportation Plan within the 2015-16 fiscal year.

B. Development and Selection of the SCS Scenario

KCAG began the planning process by updating its demographic and socioeconomic growth forecasts, which are fundamental to an understanding of the needs of the people who live, work and travel in the region (see section IV. D. Data Inputs and Assumptions) for more information on the growth forecast). An SCS Working Group was created, representing stakeholders and members of the public. KCAG's Transportation Policy Committee was tasked with assessing policy alternatives and providing recommendation to the KCAG Commission. A set of goals for the RTP/SCS were established, including: Mobility and Accessibility, Environmental Quality, Safety and Health, Sustainable Development Pattern, and System Preservation.

KCAG exchanged information and coordinated with member agencies to base the SCS on existing and planned land use and transportation policies, and considered the needs of tribal and federally controlled land. Local agencies provided planning information to inform the initial SCS scenario development, and provided feedback on the consistency of the alternative scenarios with existing general plans and how they would affect future land use decisions.

Based on this exchange of information with local agencies, the public, and the Transportation Policy Committee, KCAG staff developed four alternative SCS scenarios shown in Table 1.

All scenarios assumed the same socio-economic data, but vary in their transportation investment priorities and land use assumptions. The scenarios range from no new investments to a 30 percent increase in transit investment.

Table 1: SCS Scenarios

Scenario	Description
1) Historical Trend	• Transportation projects are the same as the 2011 RTP. • Land use planning does not reflect the Blueprint Principles.
2) 10-15 Percent Transit Investment	• Transportation investments include a 10-15 percent increase in budget allocation for transit projects compared to the 2011 RTP. • Land use planning reflects recent and future general plan updates that integrate Blueprint Principles.
3) 30 Percent Transit Investment	• Same as Scenario 2, but reflects a 30 percent increase in budget allocation for transit projects compared to the 2011 RTP.
4) No-build	• All transportation development and construction stops, even projects planned in previous RTP.

These scenarios and their modeled outputs were presented in public workshops and Working Group meetings. Attendees were asked to rank the scenarios by a number of criteria, including their ability to meet GHG reduction targets and RTP plan goals.

Scenarios 2 and 3 were ranked equally by attendees in their ability to meet targets and RTP goals, and compatibility with attendees' own priorities. Although both ranked highly, the Transportation Policy Committee preferred Scenario 2 because increasing the allocation of transit funding by 10-15 percent was achievable with expected revenue. Scenario 3 would require diverting funds away from the already deficient funds for road maintenance, which would negatively impact transportation system preservation.

Scenario 2 was selected as the preferred scenario at the June 25, 2014 KCAG Commission meeting and ratified with the adoption of the 2014 RTP/SCS on July 30, 2014. The preferred scenario incorporates land use policies from recently updated general plans and transportation policies that were included in the 2015 Transit Development Plan.

Land Use Characteristics of the SCS

The adopted SCS reflects the following land use recommendations:

1. Increase the connectivity between housing and commercial and community facilities, including designs and standards that allow for more walkability and bikability.
2. Encourage a mix of housing types in infill areas and within the same development in order to provide a range of housing options, and at higher densities to more effectively use land.
3. Encourage mixed use development through mixed-use zoning.
4. Create a jobs/housing balance through either developing near existing job clusters or along transit routes.

Growth in each city is based on the general plans but limited by the availability of water, as the ongoing drought has impacted water supplies for new development. The cities of Hanford and Lemoore are expected to attract the most growth, especially in retail and associated with the LNAS, respectively.

Lemoore provides an example of how land use policies are changing in the region. Originally, Victory Village was planned as a 270 single family and 29 multi-family unit residential development on the western edge of Lemoore near the LNAS. Informed by a cooperatively developed Joint Land Use Study, the city of Lemoore and LNAS agreed to relocate the planned location of 220 single family homes and 29 multi-family homes closer to the city center, with a smaller building footprint resulting from smaller lot sizes and incorporation of mixed uses. This has resulted in protection of much of the original development site as resource land, and allows the new households to be closer to community amenities.

Transportation Characteristics of the SCS

The adopted SCS increases transit funding by 10 to15 percent over past allocations, and includes four transportation recommendations, with associated projects:

1. Increase investment in bicycle and pedestrian facilities, focused near schools and connecting residential and commercial areas.
    - Pedestrian facilities included with several traffic signal installations
    - Bicycle facility projects planned for the cities of Lemoore and Hanford
2. Increase investment in public transportation.
    - New paratransit vehicle and new bus
    - Bus intelligence system: provides transit location and schedule information through a mobile app
    - Two new morning bus routes
    - Park-and-ride lot in Hanford
3. Encourage the development of alternative fuel infrastructure and the use of alternative fuel vehicles by government agencies and private businesses.
    - CNG filling station in Lemoore

- Electric charging station at Hanford’s city corporation yard

4. Implement Intelligent Transportation Systems to reduce congestion.
   - Traffic signal synchronization

In addition to the projects listed above, CalVans will continue to provide vanpool services within the county. In the future, Avenal is interested in a volunteer driver program, which would provide on-demand ride service to rural residents. In other counties, this is implemented through a sales tax measure, but a new funding source would be needed for this to occur in Kings County.

IV. ARB STAFF REVIEW

KCAG's quantification of GHG emissions reductions in the SCS is central to its determination that the SCS would meet the targets established by ARB. Those targets for KCAG are 5 percent per capita reduction in 2020 and 10 percent per capita reduction in 2035 from 2005 levels. This section describes the method ARB staff used to review KCAG's determination that its SCS would meet its targets, and reports the results of staff's technical evaluation of KCAG's quantification of passenger vehicle GHG emissions reductions.

KCAG's analysis estimates that the SCS, if implemented, would achieve a 5.2 percent per capita reduction in GHG emissions from passenger vehicles by 2020, and a 12.1 percent per capita reduction by 2035. Based on ARB staff's evaluation of KCAG's SCS and its technical documentation, the SCS, if implemented, would meet the GHG emissions reduction targets set by the Board.

Methodology

ARB's review of KCAG's quantification focused on the technical aspects of regional modeling that underlie the quantification of GHG emissions reductions. To assess the technical soundness and general acceptability of the KCAG GHG quantification, four central components were evaluated: 1) data inputs and assumptions, 2) modeling tools, 3) model sensitivity, and 4) performance indicators. 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.

ARB staff evaluated how KCAG'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 the KCAG's models are reasonably sensitive for these purposes, ARB staff examined how well KCAG's travel demand model (TDM) responded to specific changes in input values, as well as how accurately it replicated observed results.

ARB staff used publicly available information in KCAG's RTP/SCS and accompanying documentation, including the RTP technical appendices, model documentation and validation reports, and data table (see Appendix A). KCAG provided a copy of its TDM to ARB staff, which enabled a first-hand assessment of the model's structure and performance.

A. Data Inputs and Assumptions

KCAG'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) regional socioeconomic characteristics, 2) the region’s transportation network inputs and assumptions, and 3) cost assumptions. In evaluating these three input types, ARB staff reviewed the assumptions KCAG used to 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. Land Use Assumptions and Growth Forecast

Demographic data and forecasts describe a number of key characteristics used in TDMs. The regional forecast describes how many people will live in the region, how many jobs the region will have, and the anticipated number of households.

For KCAG, similar to the other Valley MPOs, demographic forecasts for population and households were prepared by The Planning Center. The Planning Center’s March 2012 report, “San Joaquin Valley: Demographic Forecasts 2010 to 2050,” cites data sources including the U.S. Census Bureau, the California Department of Finance (DOF), and the California Employment Development Department (EDD). KCAG used the Planning Center forecast as the countywide control values and then disaggregated the information to the local level with input from local agencies. The employment forecast used the EDD employment by sector data. KCAG’s growth forecast is summarized in Table 2. The population of the KCAG region is forecast to grow from about 153,000 in 2010 to 223,000 in 2035.

Table 2: Demographic Forecast (2010-2035)

	Population*	Households*	Employment**
2010	153,000	41,200	41,214 *(2005 Data)*
2020	181,000	46,500	50,502
2035	223,000	55,000	62,485

**From the Planning Center Demographic Forecast*
*** From the Data Table*

Population

The average annual population growth is expected to be about 2 percent, which is lower than the growth rate in the 1970s (2.93 percent) and 1990s (3.75 percent) but higher than the growth rate in 1980s (1.41 percent). KCAG’s population forecast for 2020 and 2035 are both within three percent of DOF’s forecast.

Housing Units and Households

Housing units were estimated based on the general plans of the cities and the county. Local jurisdictions provided potential housing growth by transportation analysis zone (TAZ). KCAG then corroborated potential housing growth by TAZ with expected growth totals. Due to the correctional facilities in the region, KCAG's group quarter's population is a greater share of the population (14 percent in 2010) than other Valley Counties. The Planning Center Forecast showed KCAG average household size increasing from 3.19 in 2010 to 3.77 by 2050, which would allow some of the future population growth to be accommodated by existing units.

The Planning Center forecast indicates that multifamily housing will increase at a faster rate than single-family housing in Kings County.

Consistency with the Regional Housing Needs Assessment

SB 375 requires the coordination of housing planning with regional transportation planning through the RTP/SCS. The State of California, through the Department of Housing and Community Development (HCD), issued an eight-year Regional Housing Needs Determination to KCAG. HCD calculates the amount of housing needed within four income distribution categories based on demographic projection information from DOF. The preferred SCS scenario supplies enough residential housing capacity by jurisdiction to meet the housing need within the region as determined by HCD.

Employment

Employment projections in the 2014 RTP/SCS were developed from the EDD projections. Employment in Kings County is forecast to increase by about 21,271 jobs between 2010 and 2035, yielding an annual employment growth rate of about 1.7 percent.

Land Use Assumptions

There are five local jurisdictions in the KCAG region (four cities and Kings County) that adopt unique comprehensive land use plans commonly known as general plans. Current land use was simulated through GIS, but future land use was not mapped. Future land use assumptions used by KCAG were provided by the local jurisdictions through the housing growth by TAZ mentioned above.

2. Transportation Network Inputs and Assumptions

The transportation network is a map-based representation of the transportation system serving the KCAG region. One part of KCAG's transportation network is the roadway network, which consists of an inventory of the existing road system, and highway travel times and distances. Another part of the transportation network is the synthetic transit network, which is a simplified representation of the transit lines in the region. The model includes roadway network and transit network for the model base year of 2005 and for future years (i.e. 2020, 2035). ARB staff reviewed the KCAG regional roadway network, and network assumptions such as link capacity and free-flow speeds. The methodologies KCAG used to develop the transportation network and model input assumptions is consistent with guidelines provided in the National Cooperative Highway Research Program (NCHRP) Report 365.

Roadway Network

KCAG's roadway network is a representation of the automobile roadway system, which includes freeways, highways, expressways, arterials, collectors, local roads, and freeway ramps in the region. The roadway network provides the basis for 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.The KCAG model uses facility type classifications consistent with the FHWA-approved functional system.

Table 3 summarizes the reported roadway lane miles in the KCAG region in 2005 by facility type. The KCAG model uses facility type classifications consistent with the FHWA-approved functional system.

Table 3: Lane Miles in 2005 by Facility Type

Facility Type	Lane miles in 2005
Highway	472
Expressway	1,421
Arterial	193
Collector	258

Link Capacity and Free Flow Speed

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 KCAG model is for congestion impact, which can be estimated as the additional vehicle-hours of delay based on the 2000 Highway Capacity Manual (2000 HCM). The capacity assumptions of each road segment in the network were reviewed, and found to be consistent with the 2000 HCM.

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. KCAG estimated the free-flow speed of each link segment using the Bureau of Public Roads formulas suggested in the 2000 HCM. The methodology used in estimating highway free-flow speeds in the KCAG region was reviewed. KCAG'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

KCAG's model utilizes a synthetic transit network, which contains peak and off-peak headway information to represent the average wait time for transit at TAZ level. 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. The methodology KCAG used in developing its transit network was reviewed and found consistent with the procedures discussed in the NCHRP Report 365 and USDOT-FHWA Manual. For future model improvement, KCAG should consider developing a GIS-based transit network that includes geocoded transit lines, stops, and headways to better estimate transit travel time.

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 KCAG's model. To examine the responsiveness of the model to changes in the cost variable or other model inputs, model sensitivity tests (e.g., auto operating cost and transit frequency) performed by KCAG 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 KCAG model. KCAG defined auto operating costs as the cost of fuel alone. 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 effect on VMT.

KCAG followed a similar method as other Valley MPOs to estimate auto operating cost as 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 forecast using the historical trend from 1998 to 2008 in the KCAG region. The corresponding auto operating costs were then derived by dividing the fuel price for the year by the fuel efficiency assumptions. KCAG estimated the auto operating cost (fuel price per gallon) to be $0.11 in 2005, $0.18 in 2020 and $0.19 in 2035.

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

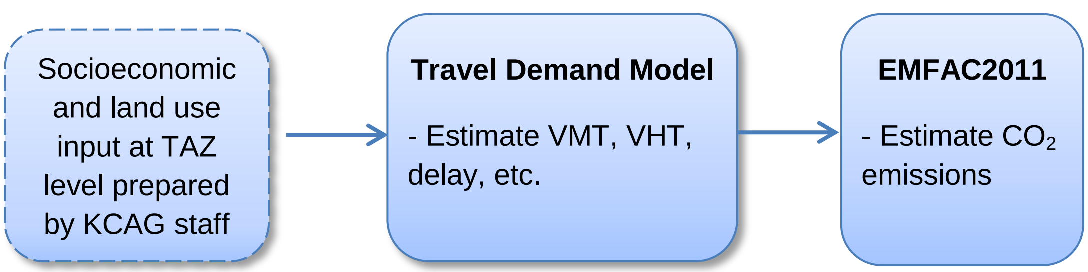
Cost of Time

A value-of-time assumption is used, in the trip distribution step, to estimate the travel cost of alternative routes. KCAG staff converted travel cost to cost-of-time using a value of time. The average perceived value of time that KCAG used, similar to that used by other MPOs in the Valley, was six dollars per hour per person.

B. Modeling Tools

KCAG used a GIS-based land use tool, a trip-based TDM, 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 4 shows the flow chart of the modeling process. KCAG collected demographic data (e.g. population and housing units) and future socioeconomic demands from local jurisdictions, and used a GIS-tool and a spreadsheet tool to prepare data at TAZ level as inputs for the TDM. Results from the TDM, such as VMT by time of day and vehicle hours of travel (VHT), were input to EMFAC2011 to estimate GHG emissions associated with the 2014 RTP/SCS. KCAG did not use any off-model adjustments to quantify the GHG reductions in its SCS.

Figure 4: KCAG's Modeling Tools



1. Land Use Tool

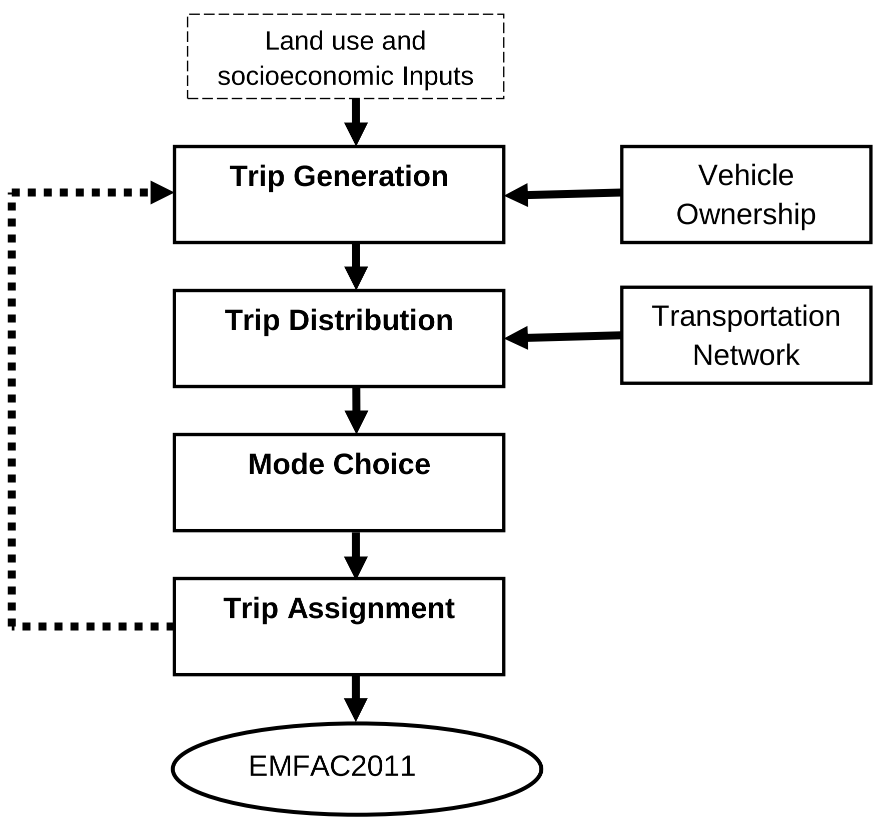
KCAG staff used a GIS-tool to input the model base year land use information. For future year development patterns, KCAG gathered information from local jurisdictions in a spreadsheet tool to prepare TAZ level data as input to the TDM. Besides using a GIS-based tool for base year information, ARB staff recommends that KCAG forecast future year scenarios of housing, population, and employment allocation using a GIS-tool for the next RTP/SCS update.

2. Travel Demand Model

In 2010, the eight MPOs in the Valley began a collaborative process to improve their TDM 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 TDMs of the Valley MPOs and improved their ability to evaluate land use and transportation strategies central to meeting SB 375 requirements.

Additionally, in 2012, KCAG had a consultant, Fehr & Peers, complete the validation for various components of the MIP model for Kings County. The resulting model is known as the KCAG TDM (or KCAG model). The 2014 RTP/SCS is the first RTP to be developed by KCAG using the new model. The KCAG model is a four-step model that includes trip generation, trip distribution, mode choice, and trip assignment (Figure 5). The model uses land use, socioeconomic, and roadway network data to estimate travel patterns, roadway traffic volumes and transit volumes. The model contains approximately 700 TAZs representing origins and destinations of travel in the model area. Travel to/from and through the model area is represented by 31 gateway zones at major road crossings of the county line in order to estimate interregional travel.

Figure 5: The KCAG MIP Travel Demand Model



Vehicle Ownership

Modeling of vehicle ownership is a new component of the KCAG model, which estimates the number of vehicles that are available in a household. Previously KCAG used a fixed rate of vehicle ownership. The output of this component is a critical input to the trip generation step, accounting for travelers' long-term decisions for mode of transportation.

KCAG had Fehr & Peers estimate vehicle ownership from 2009 NHTS survey data such as household size, housing type, accessibility, household income for the eight Valley counties, and then calibrate the results using 2006-2010 American Community Survey (ACS) data from the census for Kings County. The modeled auto ownership is summarized inTable 4. There were only slight differences between modeled and observed auto ownership for most household types.

Table 4. KCAG Auto Ownership Model Validation Results

Household	KCAG Model	CHTS
0 vehicle	5.7%	7.8%
1 vehicle	28.5%	29.1%
2 vehicles	40.9%	39.7%
3+ vehicles	24.9%	23.4%
Total	100.0%	100.0%

Source: Fehr and Peers (2012). Documentation for the Eight San Joaquin Valley MPO Traffic Models to Meet the Requirements of SB375

ARB staff evaluated the structure and variables used in the vehicle ownership model, and compared them to the approach commonly used by other MPOs. 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 FHWA's "Model Validation and Reasonableness Checking Manual" (FHWA 2010). For future model improvements, KCAG should consider using the latest California Household Travel Survey (CHTS) for calibration and ACS data for the validation process. Also, KCAG can consider increasing the model's sensitivity to land use and transit accessibility in modeling auto ownership, and 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. KCAG 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 CHTS. There are eight trip purposes contained in this step of the 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), and highway commercial.

Consistent with a conventional trip-based TDM, the KCAG model has two trip ends, trip production[8] and trip attraction.[9] Table 5 summarizes the trip production and attraction rates by trip purpose. The differences between estimated trip productions and attractions were within 6 percent, consistent with the guidance in the 2010 FHWA's Travel Model Validation and Reasonable Checking Manual. The modeled person trip rates were then converted to vehicle trips using average auto occupancies for the county for each trip purpose (i.e. drive alone, shared ride 2, shared ride 3+)[10]

[8] 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.
[9] 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.
[10] Shared ride 3+ includes vehicles with 3 or more riders including driver in the vehicle, calculated as 3.5 persons per vehicle.

Table 5: Trip Productions and Attractions

Trip Purpose	Productions	Attractions	Percent Difference	FHWA Criterion
HBW	78,956	79,117	<+1%	±10%
HBSchool*	43,768	43,649	<-1%	±10%
HBO**	174,271	170,757	-2%	±10%
NHB***	179,102	168,028	-6%	±10%
Total	476,097	461,551	-3%	±10%

**HBSchool is an aggregation of HBK12 and HBCollege.*
***HBO is an aggregation of HBO and HBShop.*
**** NHB is an aggregation of WBO and OBO*
Source: Fehr and Peers (2012). Documentation for the Eight San Joaquin Valley MPO Traffic Models to Meet the Requirements of SB375.

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 KCAG model indicates that trip rates tend to increase as household income and household size increases, similar to other Valley MPOs' models. Overall, the trip generation model followed the process for estimating trip generation outlined in NCHRP Report 365.

As part of future model improvement, KCAG 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 KCAG use the latest available independent data sources such as the National Household Travel Survey (NHTS), Census Transportation Planning Package (CTPP), and the ACS to validate the travel model.

Trip Distribution

The trip distribution step is the second step of the KCAG model, which utilizes a gravity model[11] 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,

[11] 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.

zone-to-zone travel cost, and friction factors[12] that define the effect of travel time. The travel time 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.

Because time is an important factor in trip distribution, the model added terminal times to reflect the average time to access one's vehicle at the each end of the trip. The KCAG model assumed a terminal time of one minute for all TAZs in the model area, which is similar to some other MPOs in the Valley.

In evaluating the trip distribution step of the KCAG model, the average travel time by trip purpose was reviewed. Table 6 shows the average travel time by trip purpose from the model. Similarly to other Valley MPOs, the differences between the modeled travel time and the observed travel time (CHTS) range from 5 to 18 percent, and are due to the limited samples from the 2000/2001 CHTS for the region, the time gap between model base year (i.e., 2005) and survey year, and the variation in where the survey data was collected compared to the region.

Table 6: Average Travel Time by Trip Purpose (Minutes)

Trip Purpose	Model	CHTS
HBW	17.2	18.1
HBO	16.0	13.9
NHB	11.1	13.6

Source: Fehr and Peers (2012). Documentation for the Eight San Joaquin Valley MPO Traffic Models to Meet the Requirements of SB375.

ARB staff recommends that KCAG consider developing a destination choice model or other method to improve the sensitivity of changes to land use and socioeconomic factors on trip distribution. This will better reflect the attributes that influence a person's decision to travel, and improve estimates of GHG reductions associated with SCS strategies in the future. KCAG should also provide goodness-of-fit statistics, the frequency distribution of trip lengths, and coincidence ratios for different trip types in future model documentation.

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

Mode Choice

The mode choice step of the KCAG 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 model uses a multinomial logit model[13] to assign the person-trips to these modes: drive-alone, shared ride 2 people, shared ride 3+ people, transit, walk, or bike. The mode choice model estimates for the 2005 base year were calibrated using the 2000/2001 CHTS survey data. Table 7 shows the calibrated percent mode share in the model base year for the KCAG region. Mode share estimates were compared against the observed data from CHTS. The modeled mode share results are similar to the observed data. The small 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.

Table 7: Person-trips by Mode in 2005

Mode	Model	CHTS
Drive alone	41%	42%
Shared ride 2	26%	26%
Shared ride 3+	26%	26%
Transit	1%	0%
Walk	6%	5%
Bike	0%	0%
Total	100%	100%

Source: Fehr and Peers (2012). Documentation for the Eight San Joaquin Valley MPO Traffic Models to Meet the Requirements of SB375.

In evaluating the mode choice component of the KCAG model, ARB staff reviewed the model structure, the input data, and data sources that KCAG used to develop and calibrate the model, model parameters, and auto-occupancy rates[14] by purpose. Estimated mode share by trip purpose was also compared against the observed data, including transit ridership.

[13] 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.

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

The method KCAG used to develop their mode choice model is consistent with the approaches used nationwide as cited in NCHRP Report 365. However, the current model choice component does not model transit trips, but estimates transit trips based on the 2000-2001 CHTS survey data. In future model updates, KCAG should consider developing a mode choice model that can model transit trips based on socioeconomic data. Model documentation should consider including more details on the model estimation process, estimated parameters, and statistical significance of the estimates. KCAG 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 alternative route with a faster travel time. The convergence criterion used in the KCAG model is a maximum of 20 iterations for peak and off-peak period traffic assignments and 50 iterations for peak hour traffic assignments. The 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 model chooses the best path 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.

The initial trip distribution and assignment was performed using the free-flow speed on the roadway network. The resulting congested travel time from the A.M. peak three-hour period and the off-peak traffic assignment are then inputted back to the trip generation step to re-run the model until the output and input congested travel time converges.

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 8). ARB staff also compared these estimated volume counts by facility type with observed data in the region. The TDM uses an assignment function as required by California Transportation Commission’s (CTC) 2010 California RTP Guidelines to estimate the link volumes and speeds. The coefficients used in the assignment function were consistent with FHWA guidelines. Table 8 shows that the differences between the modeled volume and count volume by facility type. The results are outside the recommended range of FHWA guidelines except for the volume of arterial. The differences between modeled and observed values are commonly attributed to the lack of data points from certain facility types (e.g. freeway and collector). Between now and the next model update, KCAG should continue to gather the most recent traffic count data at different facility types to ensure there are sufficient sample sizes.

Table 8: Estimated and Observed Traffic Counts for KCAG Region

Facility Type	Percent Difference between Modeled and Count Volume	FHWA Guidelines
Freeway	+15%	±7%
Expressway	+24%	±15%
Arterial	+5%	±15%
Collector	+29%	±25%

The estimated total VMT for the region from the KCAG model and the observed data from the Caltrans Highway Performance Monitoring System (HPMS)[15] was 4,154,117 and 3,615,697, respectively. The modeled VMT was 14.9 percent higher than observed data, which is outside the 5 percent evaluation criterion used by KCAG.

Model Validation

Model validation, usually the last step in the development of any regional TDM, reflects how well the model estimates match observed data. The CTC's 2010 California RTP 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, KCAG performed dynamic tests to study the responsiveness of the model to changes in land use, traffic assignment, travel cost, induced demand, and auto ownership. In addition, KCAG conducted model sensitivity tests as part of their model dynamic testing during ARB's evaluation process of the 2014 RTP/SCS, which is summarized and discussed later in this report.

KCAG'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 9, the KCAG model estimate for the region has a correlation coefficient of 0.81 between the modeled and the observed volumes. The root mean

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

square error (RMSE) for daily traffic assignment in the model is 69 percent, which is outside the suggested criterion of 40 percent. Additionally, only 60 percent of the links with volume-to-count ratios from the model for the KCAG region 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 where data was collected may have contributed to this difference. For next model update, KCAG can consider gathering more VMT and volume count data, and at more locations within the region to improve the validation of the model.

Table 9: Static Validation According to CTC's 2010 RTP Guidelines

Validation Item	Criteria for Acceptance	KCAG Model
Correlation coefficient	at least 0.88	0.81
Percent RMSE	below 40%	69%
Percent of links with volume-to-count ratios within Caltrans deviation allowance	at least 75%	60%

EMFAC Model

ARB's Emission Factor model (EMFAC2011) is a California-specific model that calculates weekday emissions of air pollutants from all on-road motor vehicles including passenger cars, trucks, and buses for calendar years 1990 to 2035. KCAG used EMFAC 2011, which was the latest approved version of the model to quantify GHG emissions at the time KCAG's SCS was developed and adopted.

3. Planned Model Improvements

For the next RTP update anticipated in 2018, KCAG plans to continue to refine its TDM to better estimate trips and VMT in the region. The immediate and ongoing model improvement efforts include using the latest regional or local demographic data and using the 2010 Census, 2012 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, distribution for internal and interregional travel, and vehicle speeds (which is critical for air quality analysis). Besides using the latest household survey data, ARB recommends KCAG consider using a GIS-based land use tool to project population, housing and employment allocation associated with different scenarios and compare the impacts.

In this staff report, throughout the above sections on data inputs and assumptions, and modeling tools, ARB staff offers recommendations and suggestions for KCAG to improve the model's forecasting ability. These recommendations are summarized in Table 10, below. These recommendations should be incorporated into the model improvement program that KCAG is currently developing.

Table 10: Suggestions and Recommendations for Model Improvement

ARB Staff Suggestions for KCAG Model Improvements
Include minor costs such as cost of vehicle maintenance and tire replacement in future estimations of auto operating cost
Develop a GIS-based transit network that includes geocoded transit lines, stops, and headways to better estimate transit travel time
Forecast future year scenarios of housing, population, and employment allocation using a GIS-tool
Increase the model's sensitivity to land use and transit accessibility in modeling auto ownership, and validate the vehicle ownership model results against the Department of Motor Vehicles' (DMV) data
Include some sensitivity to land-use mix, particularly in areas with high transit use to capture the transit-oriented development travel behavior
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
Develop a destination choice model or other method, 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
Develop a mode choice model that can model transit trips based on socioeconomic data. Model documentation should consider including more details on the model estimation process, estimated parameters, and statistical significance of the estimates. KCAG should also consider auto occupancy rates by trip purpose in the mode choice step, and use the latest household travel survey data
Continue to gather the most recent traffic count data at different facility types to ensure there are sufficient sample sizes

C. Model Sensitivity Analysis

Model sensitivity tests are used to study the responsiveness of the TDM 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 examines change to one input variable at a time. Sensitivity analyses are not intended to quantify model inputs or outputs or provide analyses of actual modeled data.

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

- Auto operating cost
- Household income distribution
- Transit frequency
- Residential density

In addition, ARB staff assisted KCAG 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.

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 ARB policy briefs and corresponding technical background documents[16] 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 test results could not be specifically corroborated by the empirical literature, ARB staff has indicated whether the model was at least sensitive directionally, meaning that changes in model inputs resulted in expected changes to model outputs.

1. Auto Operating Cost Sensitivity Test

Auto operating cost is an important factor influencing travelers' auto use. KCAG used four scenarios to examine the responsiveness of the model to changes in auto operating cost. These four scenarios included a 25 percent decrease, 50 percent

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[16] 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

decrease, 25 percent increase, and 50 percent increase from base case. KCAG's definition of auto operating cost for the region includes fuel price only, similar to other Valley MPOs. When auto operating cost increases, the number of drive-alone trips is expected to shift to shared-ride-2 (SR2), shared-ride-3-plus (SR3+), transit, bicycling, and/or walking. With respect to VMT, it is expected that as auto operating cost increases, travelers are expected to drive less. Conversely, when auto operating cost decreases, travelers are expected to drive more.

Figure 6 summarizes the change in mode share for the four modeled scenarios. As expected, as auto operating cost increases, the percentage of drive alone trips decreases while the percentages of other modes such as shared-ride and non-motorized increase, although the percentage increases in these modes are small. KCAG staff explained the subtle changes in mode share are due to Kings County's rural development patterns with limited transit service coverage and frequency that leads to a reliance on auto modes. Additionally, the current model utilized a synthetic transit network, so the lack of geographic transit and transit boarding data made it difficult to capture transit mode share change due to the increase in auto operating cost.

Figure 6: Mode Share Split and Auto Operating Cost

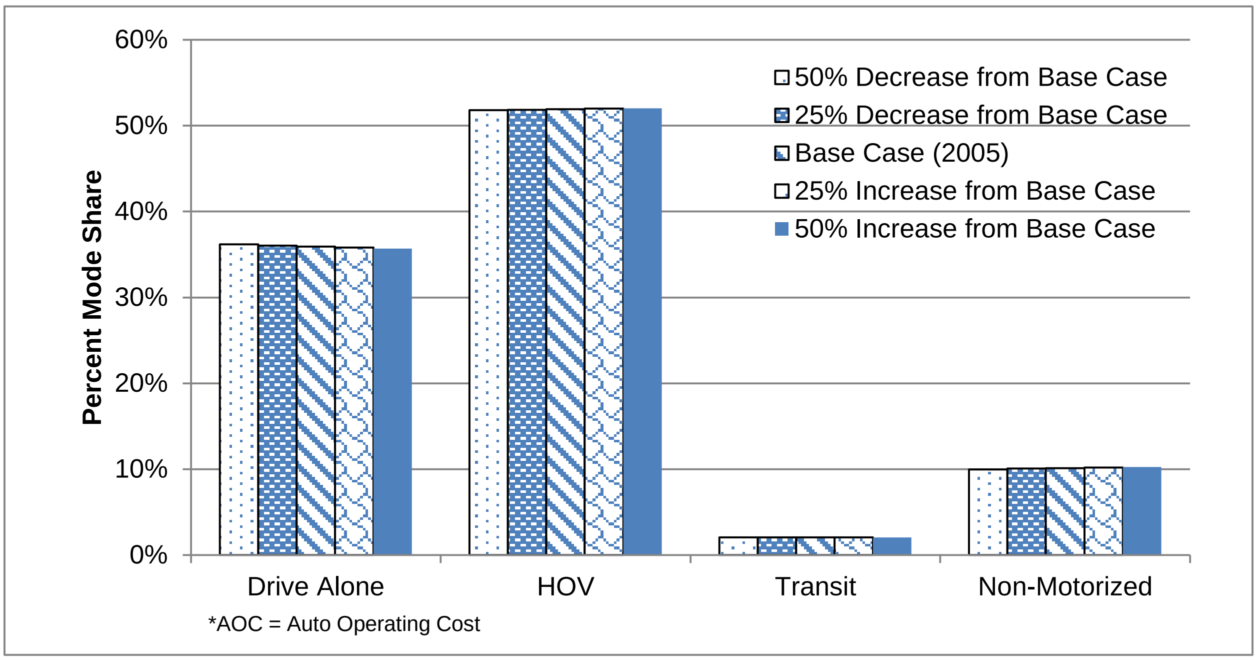


Table 11 summarizes the VMT changes related to changes in auto operating cost. As auto operating cost increases, the model shows a decrease in VMT, which is expected. ARB staff compared these modeled VMTs to what would be expected based on the elasticity[17] of VMT with respect to the change in auto operating cost from the empirical literature. The modeled VMT from each of KCAG's sensitivity tests changed in the expected direction and fell within the expected range of short-run VMT. The change in modeled VMT is smaller than the expected range of long-run VMT. The smaller change is probably due to the limited options of alternative mode of transportation in the KCAG region. Therefore, residents and commuters have to rely on auto modes for transportation activities.

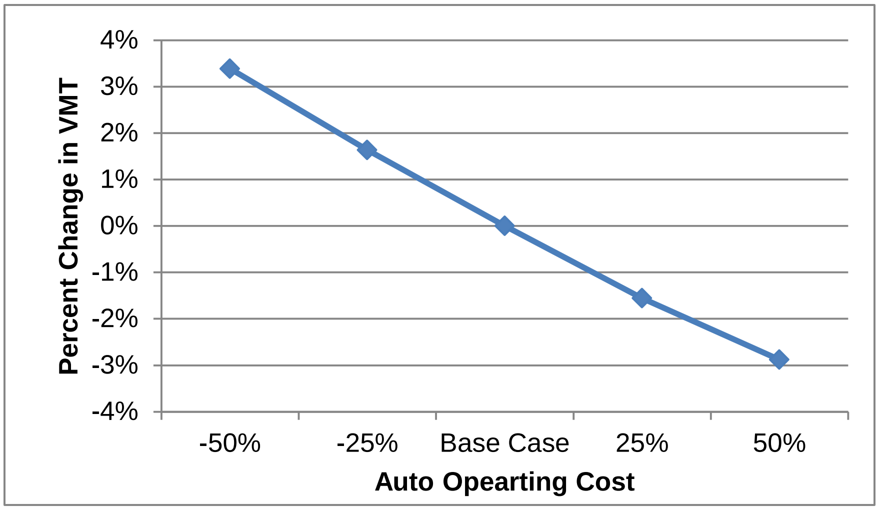
Table 11: Auto Operating Costs – Sensitivity Results

Test	Modeled VMT	Expected VMT (Short-Run)	Expected VMT (Long-Run)
50% Decrease from Base Case	3,615,315	3,531,925 - 3,899,105	3,689,288 - 4,091,437
25% Decrease from Base Case	3,554,077	3,514,440 - 3,698,030	3,593,121 - 3,794,196
Base Case (2005)	3,496,955	--	--
25% Increase from Base Case	3,442,438	3,295,880 - 3,479,470	3,199,714 - 3,400,789
50% Increase from Base Case	3,396,212	3,094,805 - 3,461,985	2,902,473 - 3,304,622
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.			

Figure 7 shows the VMT changes with respect to changes in auto operating cost under the four scenarios as compared to the base case. As auto operating cost increases, the model shows a decrease in VMT.

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

Figure 7: VMT Change and Auto Operating Cost



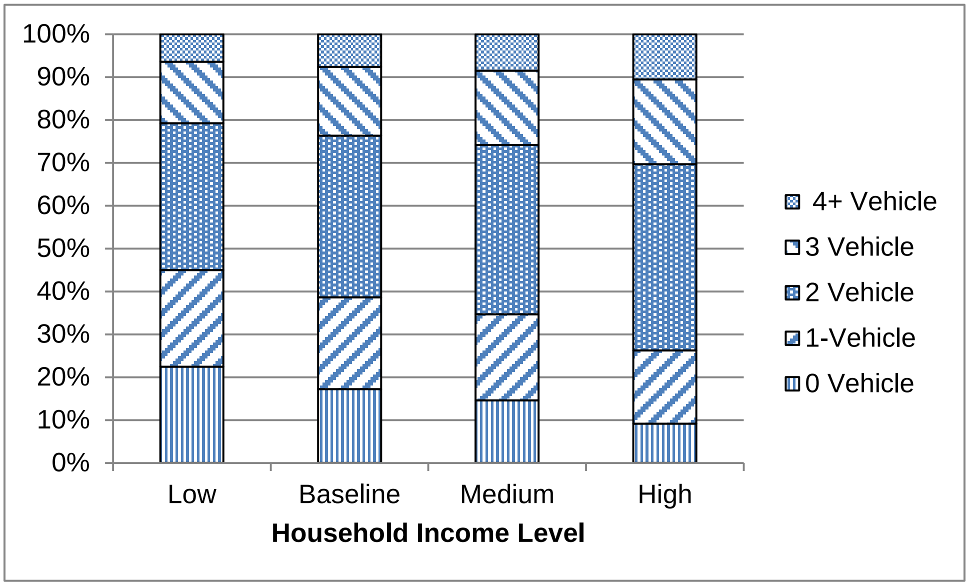
2. Household Income Distribution

Household income distribution plays an important role in the trip generation step of the TDM. 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 test 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 KCAG model to changes in household income distribution, three 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 2010 average household income of $49,012 from the KCAG model was used as the base case. ARB staff designed three scenarios with average household incomes of Low ($42,101), Medium ($54,407) and High ($66,117).

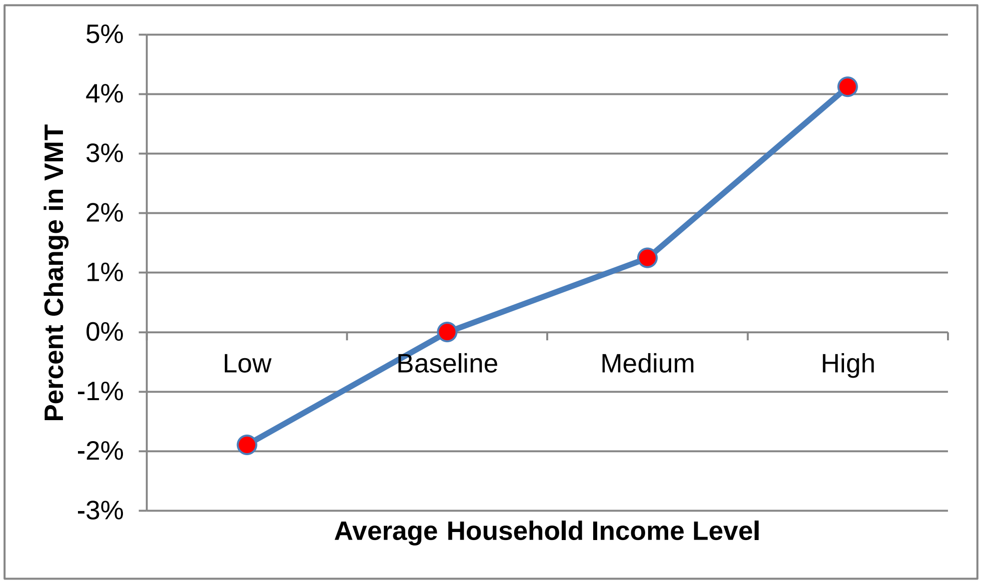
Table 8 summarizes the auto ownership changes under the different household income scenarios. As expected, households shift towards having more vehicles available as household income increases, and vice versa.

Figure 8: Household Vehicle Ownership Distribution



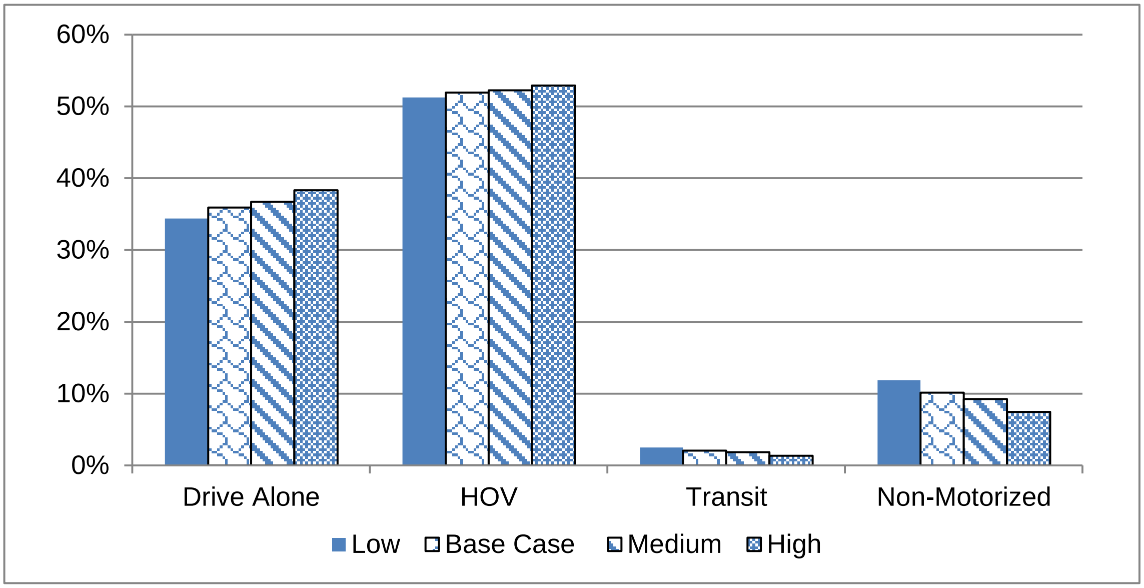
There is relatively little in the empirical literature that cites the direct effect of household income on household VMT. Murakami and Young (1997) report that low income households make 20 percent fewer trips than other households. Since this number counts all trips (including walking and transit), the effect on VMT is even more significant: VMT per household in low income households is about half of that in other households. Figure 9 shows the change in VMT for each household income scenario. The test results showed the KCAG 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 KCAG model to the change in average household income is similar to that of other MPO models in California.

Figure 9: VMT Changes for Household Income Distribution Scenarios



ARB staff also examined the impact of household income on daily mode share. 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 10 the mode share responded to household income distribution changes as expected. The auto mode share increased consistently when household income increased while transit and non-motorized trips decreased.

Figure 10: Mode Share Response to Household Income Changes

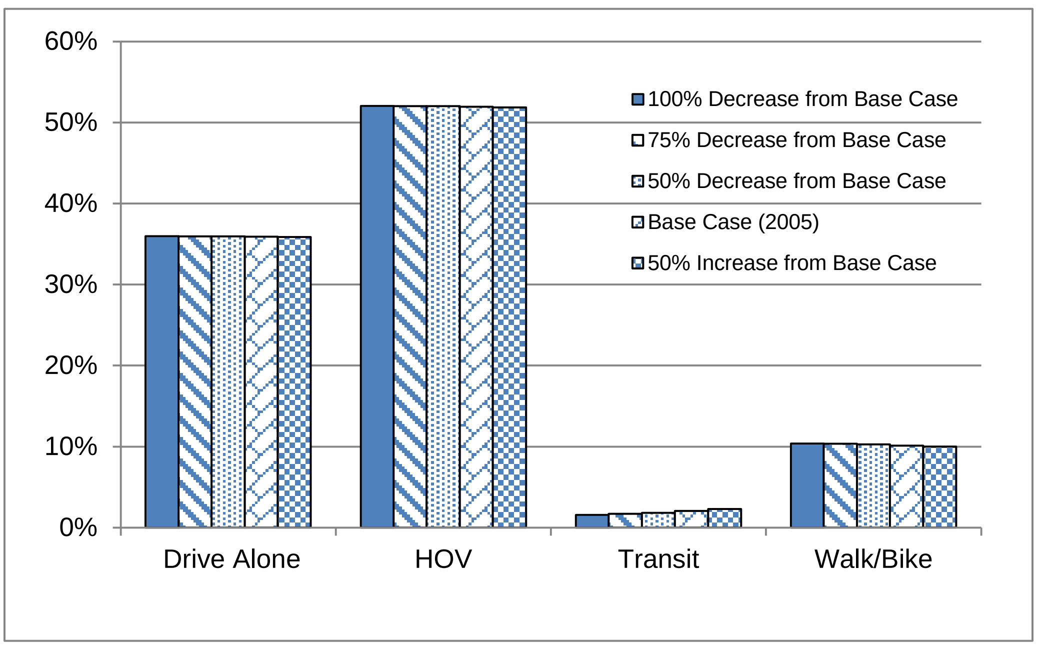


3. Transit Frequency

Transit service frequency is a key to the effectiveness of regional transit service. To determine the responsiveness of the KCAG 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. When transit frequency increases, it is expected that transit mode share will increase as travelers are attracted by shortened waiting times.

Figure 11 shows the change in mode share as transit frequency changes. The test results do not show a significant difference in the auto modes and the non-motorized mode from one test scenario to another, though the change was in the expected direction. Similar to some Valley MPOs that are dominated by rural area, residents and commuters in the KCAG region rely on auto mode for their activities due to the limited coverage of transit service.

Figure 11: Impact of Transit Frequency on Mode Share



4. 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.

KCAG, with assistance from ARB staff, developed a methodology to examine the sensitivity of the 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 KCAG region to match the urban area focus of the empirical literature. For each test, KCAG kept the totals for each housing type the same as the 2005 base case. For the density-increasing scenarios, KCAG 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. KCAG 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.

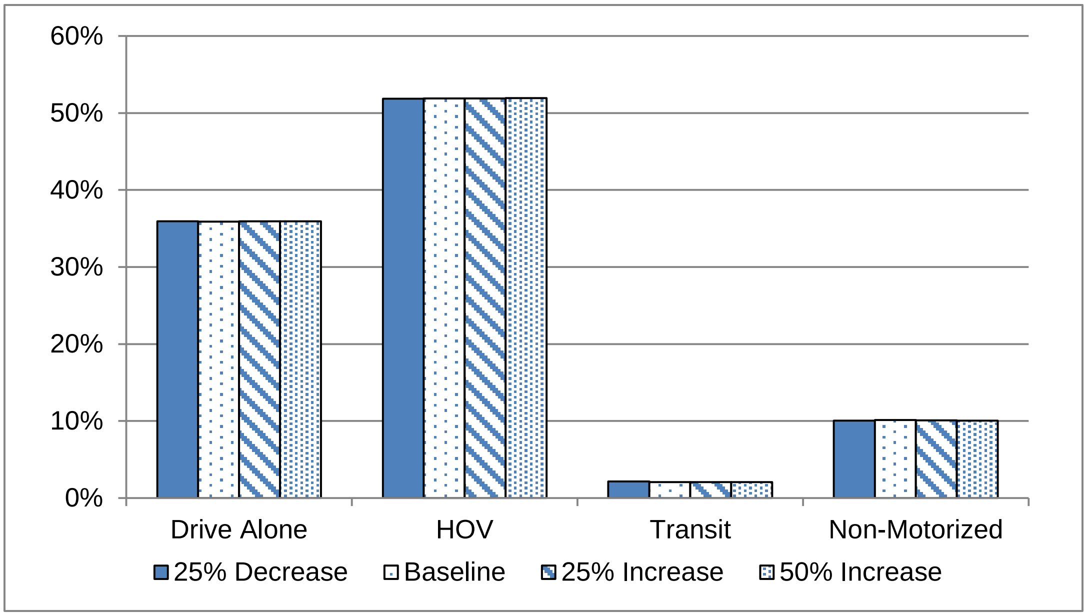
Most of the studies cited in the empirical literature that relate to residential density focus on overall population density, which is probably the best proxy for residential density. As expected, when residential density increases, VMT decreases, and vice versa (Table 12). KCAG's sensitivity analysis indicates that the model is directionally sensitive to changes in residential density. However, not all changes of VMT in magnitude are within the expected range, which is probably because KCAG has mostly rural areas and very limited urban areas, similar to some other Valley counties; the residential density at the TAZ level stayed almost unchanged from one test scenario to another.

Table 12: Impact of Residential Density on VMT

Test	Modeled VMT	Expected VMT
25% Decrease from Base Case	3,497,567	3,540,667 - 3,601,864
Base Case (2005)	3,496,955	--
25% Increase from Base Case	3,494,615	3,453,243 - 3,392,046
50% Increase from Base Case	3,489,402	3,409,531 - 3,287,138
Source: Boarnet and Handy (2013) the impacts of population density on VMT range from -0.05 to -0.12.		

As residential density in the region increases, test result also shows that mode shares for auto stayed almost unchanged across scenarios (Figure 12). This is possibly due to the nature of the KCAG model lacking sensitivity to land use, especially the mode choice component.

Figure 12: Impact of Residential Density on Mode Share



D. SCS Performance Indicators

ARB staff examined changes in non-GHG indicators that describe SCS performance to determine if they can provide qualitative evidence that the SCS could meet the region's targets. The evaluation looked at directional consistency of the indicators with KCAG'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-published policy briefs and corresponding technical background documents.[18] Because KCAG did not forecast future land use patterns, and assumed the ratios of single-family and multi-family to remain constant, land use indicators were not available for evaluation. For the next RTP/SCS update, KCAG should consider using a land use tool to forecast and compare different land use development patterns.

ARB staff evaluated three transportation-related performance indicators: average vehicle trip length, passenger VMT, and transportation investments.

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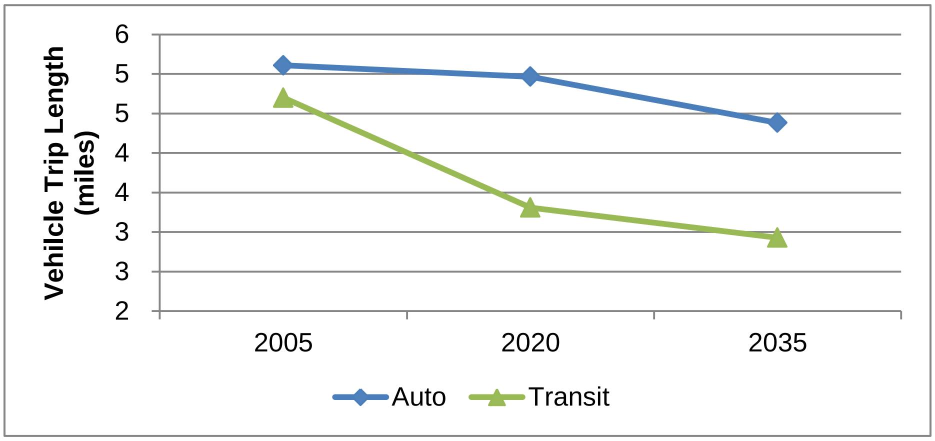
[18] These policy briefs and technical background documents, which seek to identify the impacts of key transportation and land use policies on vehicle use and greenhouse gas emissions, based on the scientific literature, can be found at http://arb.ca.gov/cc/sb375/policies/policies.htm

Average Vehicle Trip Length

Figure 13 shows the change in average vehicle trip length by mode for all trip purposes in the KCAG region. The data shows that the average auto trip length decreases by 14 percent between 2005 and 2035, while during the same time period, transit trip length also decreases by 38 percent by 2035. KCAG explained the significant reduction in transit trip length is due to the addition of new transit line(s) in the urban area. Given the rural nature of the KCAG region, KCAG staff expected that even a few new transit trips in the urban area will lead the average transit trip length in the county to decrease significantly. These trends support the GHG emissions reductions estimated for the KCAG region.

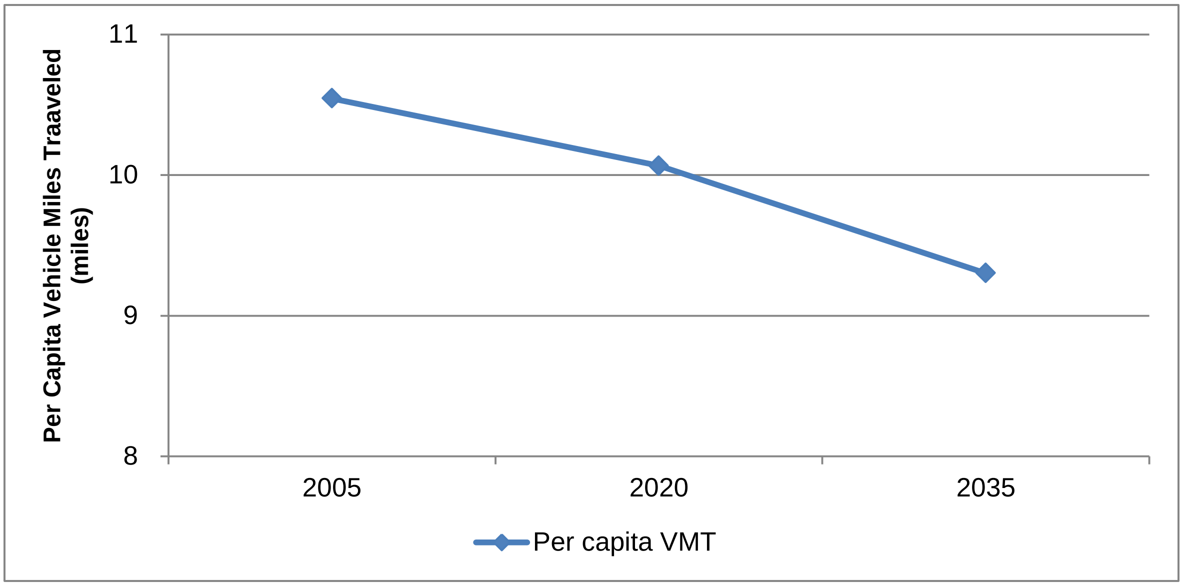
Figure 13: Average Vehicle Trip Length in KCAG Region



Per Capita VMT

The KCAG 2014 RTP/SCS shows a decline in per capita passenger vehicle VMT between 2005 and 2035, as shown in Figure 14. Per capita VMT decreases by 4.5 percent between 2005 and 2020, and by 11.8 percent between 2005 and 2035. Supporting statistics provided by KCAG show that average weekday vehicle trip length including single occupant vehicles, carpools, and transit modes for all trip purposes, which together make up over 85 percent of all trips in the region, will be reduced from 2005 to 2035. Reduction in per capita VMT indicates reduction in per capita GHG emissions because the quantification of GHG emissions from passenger vehicles is a function of VMT and vehicle speeds. These results are directionally consistent and support KCAG’s reported per capita GHG emissions reduction trend over time.

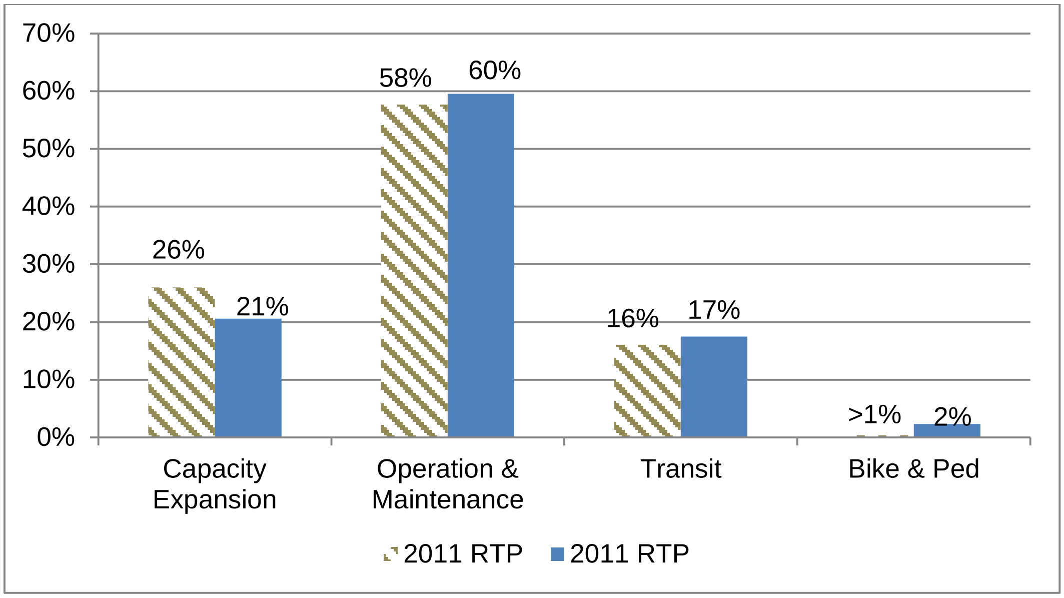
Figure 14: Daily Per Capita Passenger VMT



Transportation Investment

The 2014 RTP/SCS significantly increases investment in bike and walk facilities and public transit (by 9 percent) as compared to the 2011 RTP (Figure 15). Investment in bike and pedestrian infrastructure increases from less than one percent of the total RTP budget to about 2.4 percent of the total budget, or $8.8 million. Similarly, investment in transit increases from 16 percent to 17.5 percent of the total budget, or $66 million. These increases are 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. The following figure shows the investment in year of expenditure dollars.

Figure 15: Transportation Investments



V. CONCLUSION

This report documents ARB staff's technical evaluation of KCAG's adopted 2014 RTP/SCS. This evaluation affirms that the SCS would, if implemented, meet the Board adopted per capita GHG emissions reduction targets of five percent reduction in 2020 and ten percent reduction in 2035 compared with 2005 levels.

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APPENDIX A. KCAG's Modeling Data Table

Modeling Parameters	2005 (Base Year)	2020 With Project	2020 Without Project	2035 With Project	2035 Without Project	2040 With Project	2040 Without Project	Data Sources
DEMOGRAPHICS								
Total population	145,443	181,000	181,000	223,000	223,000	237,000	237,000	DOF; The Planning Center|DC&E, 2012
Group quarters population	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total employment (employees)	41,214	50,502	50,502	62,485	62,485	66,479	66,479	InfoUSA; The Planning Center|DC&E, 2012
Average unemployment rate (%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total number of households	37,373	46,500	46,500	55,000	55,000	57,800	57,800	DOF; The Planning Center|DC&E, 2012
Persons per household	3.89	3.89	3.89	4.05	4.05	4.10	4.10	
Auto ownership per household	1.75	1.71	1.71	1.73	1.73	1.73	1.73	
Median household income	$44,490	N/A	N/A	N/A	N/A	N/A	N/A	Census 2000, SF3, Year 2008 Dollars
LAND USE								
Total acres within MPO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total resource area acres (CA GC Section 65080.01)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total farmland acres (CA GC Section 65080.01)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total developed acres	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total commercial developed acres	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total residential developed	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

acres								
Total housing units	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Housing vacancy rate	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total single-family detached housing units	22,594	28,194	28,194	33,410	33,410	35,128	35,128	
Total small-lot single family detached housing units	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total conventional-lot single family detached units	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total large-lot single family detached units	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total single-family attached housing units	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total multi-family housing units	14,779	18,306	18,306	21590	21590	22672	22672	
Total mobile home units & other	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total infill housing units	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total mixed use buildings	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total housing units within 1/4 mile of transit stations and stops	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total housing units within 1/2 mile of transit stations and stops	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total employment within 1/4 mile of transit stations and stops	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total employment within 1/2 mile of transit stations and stops	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

TRANSPORTATION SYSTEM								
Freeway general purpose lanes – mixed flow lane miles	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Highway (lane miles)	472.32	488.17	488.17	488.17	488.17	488.17	488.17	
Expressway (lane miles)	1420.83	1407.29	1407.29	1395.5	1395.5	1395.5	1395.5	
HOV (lane miles)		-	-	-	-	-	-	
Arterial (lane miles)	192.79	253.17	253.17	293.49	293.49	293.49	293.49	
Collector (lane miles)	258.06	268.13	268.13	273.97	273.97	273.97	273.97	
Local (lane miles)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Freeway-Freeway (lane miles)	18.77	20.33	20.33	20.33	20.33	20.33	20.33	
Local, express bus, and neighborhood shuttle operation miles	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Bus rapid transit bus operation miles	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Passenger rail operation miles	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Transit total daily vehicle service hours	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Bicycle and pedestrian trail/lane miles	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Vanpool (total riders per weekday)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
TRIP DATA								
Number of trips by trip purpose	-	-	-	-	-	-	-	
Home-based work	80,582	86,557	86,556	115,834	115,824	121,773	121,784	
Home-based other	210,482	261,446	261,521	308,398	308,506	324,206	324,388	
Non-home-based work	11,810	14,981	14,981	18,918	18,917	20,308	20,308	
Non-home-based other	150,805	191,338	191,342	238,603	238,605	254,702	254,711	

MODE SHARE								
Vehicle Mode Share (Peak Period)	-	-	-	-	-	-	-	-
SOV (% of trips)	36.86%	35.49%	35.49%	36.21%	36.22%	36.14%	36.15%	
HOV (% of trips)	53.28%	54.13%	54.13%	53.68%	53.69%	53.74%	53.75%	
Transit (% of trips)	1.73%	1.77%	1.76%	1.51%	1.50%	1.49%	1.48%	
Non-motorized (% of trips)	8.12%	8.62%	8.62%	8.60%	8.59%	8.64%	8.62%	
Vehicle Mode Share (Whole Day)								
SOV (% of trips)	39.1%	37.0%	37.0%	38.1%	38.1%	38.0%	38.0%	
HOV (% of trips)	45.7%	46.5%	46.5%	46.0%	46.0%	46.0%	46.0%	
Transit (% of trips)	2.6%	2.8%	2.7%	2.3%	2.3%	2.3%	2.3%	
Non-motorized (% of trips)	12.6%	13.8%	13.8%	13.6%	13.6%	13.7%	13.7%	
Average weekday trip length (miles)	-	-	-	-	-	-	-	
SOV	7.34	6.86	6.86	6.18	6.19	6.13	6.13	
HOV	4.91	5.23	5.23	4.42	4.42	4.40	4.40	
Transit	4.70	3.31	3.15	2.93	2.8	2.84	2.72	
Walk	1.14	1.18	1.18	1.18	1.18	1.18	1.18	
Bike	2.35	2.40	2.41	2.38	2.38	2.39	2.39	
Average weekday travel time (minutes)	-	-	-	-	-	-	-	
SOV	11.43	11.44	11.44	10.70	10.69	10.70	10.70	
HOV	8.80	9.85	9.85	8.70	8.70	8.74	8.74	
Transit	8.04	6.58	6.44	6.20	6.08	6.11	6.00	
Walk	4.28	4.53	4.53	4.55	4.55	4.59	4.59	
Bike	5.94	6.43	6.43	6.56	6.56	6.65	6.64	

TRAVEL MEASURES								
SB 375 VMT per weekday for passenger vehicles (ARB vehicle classes of LDA, LDT1, LDT2 and MDV) (miles)	1533585	1821864	1822544	2074412	2075296	2184536	2185664	MIP/EMFAC2011
Total II (Internal) VMT per weekday for passenger vehicles (miles)	889479	1220649	1221104	1306880	1307436	1398103	1398825	MIP/EMFAC2011
Total IX/XI VMTper weekday for passenger vehicles (miles)	644106	601215	601439	767533	767859	786433	786839	MIP/EMFAC2011
Total XX VMT per weekday for passenger vehicles (miles)	1058173	1439273	1439810	1866971	1867766	2009773	2010811	MIP/EMFAC2011
Congested Peak Hour VMT on freeways (Lane Miles, V/C ratios >0.75)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Congested Peak VMT on all other roadways (Lane Miles, V/C ratios >0.75)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
CO2 EMISSIONS								
SB 375 CO2 emissions per weekday for passenger vehicles (ARB vehicle classes LDA, LDT1, LDT2, and MDV) (tons)	760.11	902.60	902.92	1031.29	1031.85	1087.84	1088.53	EMFAC2011
Total II (Internal) CO2 emissions per weekday for passenger vehicles (tons)	440.86	604.74	604.96	649.71	650.07	696.22	696.66	EMFAC2011
Total IX / XI trip CO2 emissions per weekday for passenger vehicles (tons)	319.25	297.86	297.96	381.58	381.78	391.62	391.87	EMFAC2011
Total XX trip CO2 emissions per weekday for passenger vehicles (tons)	524.48	713.05	713.31	928.16	928.67	1000.81	1001.45	EMFAC2011

<table>
<tr><td colspan="9">INVESTMENT (Millions)</td></tr>
<tr><td>Total RTP Expenditure (YOE)</td><td>445.11</td><td>94.30</td><td>92.40</td><td>N/A</td><td>N/A</td><td>377.20</td><td>369.61</td><td>2005 data from 2004 RTP</td></tr>
<tr><td>Highway capacity expansion ($)</td><td>135.50</td><td rowspan="2">$19.40</td><td rowspan="2">23.99</td><td>N/A</td><td>N/A</td><td rowspan="2">77.60</td><td rowspan="2">95.95</td><td>all other data from 2014 RTP/SCS</td></tr>
<tr><td>Other road capacity expansion ($)</td><td>23.00</td><td>N/A</td><td>N/A</td><td></td></tr>
<tr><td>Roadway maintenance ($)</td><td>263.05</td><td>56.18</td><td>53.29</td><td>N/A</td><td>N/A</td><td>224.72</td><td>213.17</td><td></td></tr>
<tr><td>BRT projects ($)</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td></td></tr>
<tr><td>Transit capacity expansion ($)</td><td rowspan="2">14.86</td><td rowspan="2">16.50</td><td rowspan="2">14.81</td><td>N/A</td><td>N/A</td><td rowspan="2">66.00</td><td rowspan="2">59.23</td><td></td></tr>
<tr><td>Transit operations ($)</td><td>N/A</td><td>N/A</td><td></td></tr>
<tr><td>Bike and pedestrian projects ($)</td><td>8.70</td><td>2.22</td><td>0.31</td><td>N/A</td><td>N/A</td><td>8.88</td><td>1.26</td><td></td></tr>
<tr><td colspan="9">TRANSPORTATION USER COSTS</td></tr>
<tr><td>Vehicle operating costs (Year 2000 $ per mile)</td><td>0.11</td><td>0.18</td><td>0.18</td><td>0.19</td><td>0.19</td><td>0.19</td><td>0.19</td><td>MTC 2009 RTP Analysis</td></tr>
<tr><td>Gasoline price (Year 2000 $ per gallon)</td><td>2.24</td><td>4.46</td><td>4.46</td><td>6.06</td><td>6.06</td><td>N/A</td><td>N/A</td><td></td></tr>
<tr><td>Average transit fare (Year XXXX $)</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td></td></tr>
<tr><td>Parking cost (Year XXXX $)</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td></td></tr>
</table>

**Total expenditures from 2004 RTP

APPENDIX B. 2010 CTC RTP Guidelines Addressed in KCAG's RTP/SCS

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

Requirements

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

Recommendations

- The use of three-step models can continue for the next few years. The models should be run to a reasonable convergence towards equilibrium.
- The models should account for the effects of land use characteristics on travel, either by incorporating effects into the model process or by post-processing.
- During the development period of more sophisticated/detailed models, there may be a need to augment current models with other methods to achieve reasonable levels of sensitivity. Post-processing should be applied to adjust model outputs where the models lack capability, or are insensitive to a particular policy or factor. The most commonly referred to post-processor is a "D's" post-processor, but postprocessors could be developed for other non-D factors and policies, too. (See Section 3.6, Reference 3, for additional guidance)
- The models should address changes in regional demographic patterns.
- Geographic Information Systems (GIS) capabilities should be developed in these counties, leading to simple land use models in a few years.
- All natural resources data should be entered into the GIS.

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