APPENDIX M – SB 375 TECHNICAL METHODOLOGY

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STANISLAUS COUNCIL OF GOVERNMENTS TECHNICAL METHODOLOGY

SB 375 requires that the Metropolitan Planning Organization (MPO) submit to the Air Resources Board a description of the technological methodology that it intends to apply in the SCS, or APS if applicable.

The technical methodology described in this document satisfies the requirements of SB 375 and is consistent with the original Regional Targets Advisory Committee (RTAC) target setting process, as well as the ARB target revision process initiated in 2016. For the 2018 RTP/SCS, the Stanislaus Council of Governments (StanCOG) will be modeling 2005 as the base analysis year and 2020 and 2035 as the target analysis years for the purposes of SB 375. In addition, the RTP horizon year of 2042 will also be modeled.

1.0 SB 375 TARGETS

Current applicable SB 375 targets for each MPO in the San Joaquin Valley are a 5 percent per capita reduction in GHG emissions by the year 2020, and a 10 percent per capita reduction in GHG emissions by the year 2035 relative to 2005 levels. The Valley MPOs (along with other MPOs across the state) have been working with ARB staff to update these targets; however, new targets have yet to be finalized. In a December 2016 report to ARB, the Valley MPOs outlined the various SCS achievements that went beyond existing SCS commitments, as well outlined various challenges to GHG reductions that lie beyond an MPO's control (such as economic recovery and reduction in automobile operating costs). At the December 14, 2017 ARB meeting, ARB staff highlighted those challenges, and stated that their intention is to refocus the SB 375 process only towards those elements that an SCS can address. Per the ARB staff presentation, workshops have been initiated, and are still underway in early 2018, to reshape SB 375 target setting and the SCS evaluation. However, given the timing of 2018 RTP/SCS development, the Valley MPOs must proceed with the current applicable targets of a 5 percent per capita reduction in GHG emissions by the year 2020, and a 10 percent per capita reduction in GHG emissions by the year 2035. The Valley MPOs are excited to be working with ARB staff on a refocusing of target setting and SCS evaluation and will work directly with ARB staff to strive for success under SB 375 as the updates are finalized.

2.0 SCS DEVELOPMENT SUMMARY

Over the past three years, StanCOG, in collaboration with the other San Joaquin Valley MPOs, local jurisdictions and interested stakeholders, has been developing an RTP/SCS that seeks to meet SB 375 targets. The process began with updating the necessary modeling tools and developing underlying data and assumptions that would later become part of the scenario evaluation process. Consistent with the StanCOG public participation plan, a rigorous public involvement process was initiated to solicit input from the public and stakeholders on policies and strategies for the RTP/SCS, including those with potential to reduce GHG emissions, and associated metrics to measure plan performance. Four "scenarios" (packages of transportation investment strategies and land-use assumptions) were evaluated during the outreach process, resulting in a "preferred" set of foundational assumptions that are the basis for the draft 2018 RTP/SCS.

2.1 Scenario Modeling

The technical methodology to quantify GHG emissions for the 2018 RTP/SCS is based on the Valley Model Improvement Program 2 (VMIP2) model for the three-county (San Joaquin, Stanislaus, and Merced) area, ARB's EMFAC2014 emission factor model, and off-model adjustments, as necessary, for certain strategies that VMIP2 model does not capture.

The VMIP2 update was initiated in response to ARB feedback received during the technical evaluation of the Valley's first round of SCSs. SJV MPOs contracted with Fehr & Peers to update the travel models originally developed through the Model Improvement Program (MIP), funded by Proposition 84 funds, in 2012. The updated model will be used to estimate vehicle miles travelled (VMT) resulting from implementation of the SCS scenario and the alternatives.

In addition, StanCOG is using ARB's emission modeling software EMFAC2014 to complete SB 375-related emissions analyses.

2.2 Public Participation

The technical methodology as well as all other elements of the StanCOG SCS will be subject to Stanislaus Council of Government's public participation plan and outreach requirements, including a minimum 55-day review process, when the draft RTP/SCS is released in May of 2018.

The most recent version of the public participation plan was adopted by the StanCOG Board on March 18, 2015. The full text of the adopted public participation plan is available on StanCOG's website at http://www.stancog.org/public-participation-plan.shtm. The 2015 StanCOG Public Participation Plan is being updated: 1) to reflect new federal mandates, 2) to update the process by which Federal Transit Administration (FTA) funds are programmed in the Federal Transportation Improvement Program (FTIP); and 3) to make general administrative updates to the document.

2.3 Scenario Selection

StanCOG's comprehensive community engagement process was designed to solicit input from stakeholders and community members on priorities for the region's long-term transportation future. The overall community engagement process is continuous, coordinated, and comprehensive, with public input for current and future RTPs being received through regular discussions. During development of the 2018 RTP/SCS, over 1,000 community members were engaged through a wide variety of venues, including informational presentations, booths at public events, via the internet through web based online engagement, public workshops, and community forums, including those specifically targeting traditionally underserved communities. Through this process, the foundational elements of the 2018 RTP/SCS – policies, projects, investment strategies, and land-use assumptions were evaluated according to the preferences and priorities for Stanislaus County citizens and stakeholders. Public opinion on the various scenarios of investment strategies were solicited using online polling, public comments and live workshop polling. Outreach to stakeholder groups, the public and elected officials will continue during the 55-day public review period for the 2018 RTP/SCS, which commenced on May 11, 2018 and will conclude on July 5, 2018.

In addition, two public hearings have been scheduled in June and July for the draft 2018 RTP/SCS which will be considered for adoption by the StanCOG Board in August of 2018.

The preferred 2018 RTP/SCS scenario analyzed by the environmental document is called "Scenario 2", also known as "Infill and Redevelopment". This scenario builds upon the previously selected scenario from the 2014 RTP/SCS known as "Moderate Change".

Additional information regarding the StanCOG 2018 RTP/SCS planning effort can be accessed via the following link: http://www.stancog.org/rtp.shtm

3.0 SOCIOECONOMIC DATA

A base year of 2015 is used in the modeling of the StanCOG 2018 RTP/SCS. The distribution of the 2015 population and household data was updated by StanCOG using both 2010 Census, 2015 American Community Survey, and California Department of Finance data. The 2015 employment data was updated by StanCOG using the U.S. Census Bureau Longitudinal Employer-Household Dynamics (LEHD) data set. The final 2015 base year data distribution was adjusted based on review of aerial photography, local knowledge, and meetings with local planning departments.

The University of the Pacific Center for Business & Policy Research developed population, housing and employment forecasts for the Stanislaus region to use in the 2018 RTP/SCS. The forecast methodology can be accessed at the StanCOG website here: http://www.stancog.org/pdf/rtp2018/appendix-j-regional-demographic-forecast.pdf. These forecasts were provided at the Census Designated Place (CDP) level to inform the distribution of the overall countywide forecasts. The forecasts were vetted with local jurisdictions in Stanislaus County and adjusted based on local knowledge of future development projects that may not have been accounted for in the initial forecasts.

The forecast numbers were provided from 2015 to 2042 in five-year increments. A summary of forecasts for Stanislaus County is provided below in Table 1:

Table 1: Summary of StanCOG Demographic Forecasts

StanCOG	2015	2020	2035	2040	2042
Total Population	540,794	571,139	674,019	707,554	720,568
Total Households	175,251	187,171	221,186	231,606	235,471
Total Employment	180,056	192,931	222,414	231,718	235,307

Source: 2016 Stanislaus County Forecast Summary (University of Pacific), July 7, 2016

4.0 MODELS AND TOOLS

StanCOG will utilize the following tools to estimate GHG emissions for the 2018 RTP/SCS, each of which are described in greater detail below:

(1) Scenario Planning/Land Use Model
(2) MIP Travel Model
(3) EMFAC 2014 Emissions Factor Model
(4) Off-Model Adjustments

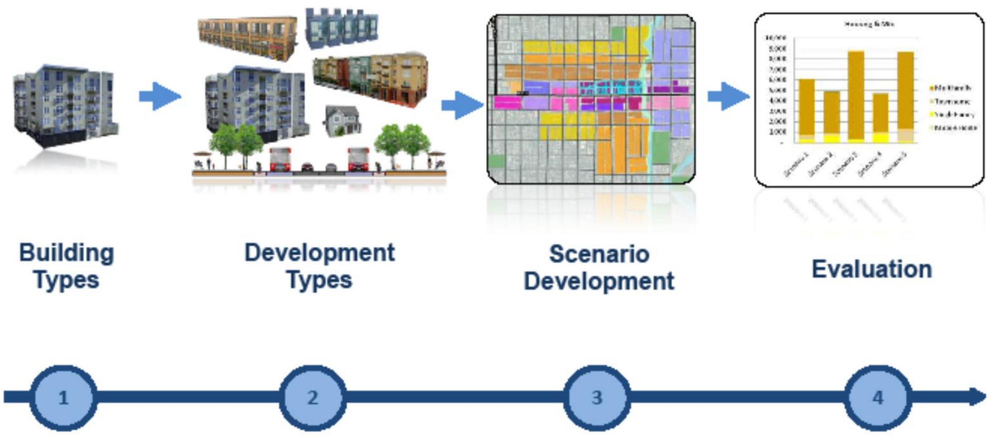
Off model emission reductions will be quantified if deemed appropriate in the final 2018 RTP/SCS considered for adoption.

4.1 Scenario Planning/ Land Use Model

Scenario modeling allows evaluation of the impacts of the RTP/SCS policies on regional land use. In particular, the scenario planning approach is a way to explore what it would take to achieve the revised SB 375 per capita emissions targets. Scenario modeling tools use building blocks that describe the different types of land uses that exist within the metropolitan area or are planned for the future. The output of the scenario modeling tools forms the fundamental input to the MIP transportation model.

Envision Tomorrow

Figure 1 – Envision Tomorrow



Envision Tomorrow is a suite of scenario planning tools that tests different land-use and transportation options. The primary tool is a Scenario Builder which is used to develop land use scenarios for evaluation.

The Scenario Builder is a Geographic Information Systems (GIS) based application that lets the user "paint the landscape" by allocating various, created development types across a study area to create unique land use scenarios. The tool then allows real-time evaluation of each scenario through a set of user-defined indicators. The indicators measure such things as the scenario's impact on land use, housing, sustainability, transportation and economic conditions. General plans, specific plans, community plans, zoning maps, Assessor's parcel data information, and environmental constraints, if any, are all inputs into the Scenario Builder tool. The growth forecast is allocated by the user into various locations as desired in this tool.

Once the coordinated land use/transportation scenario is developed, the output of that process is converted into transportation model inputs and run through the MPO travel demand model to estimate vehicle miles traveled attributable to the MPO scenarios.

It is important to note that the output of the scenario planning tool does not yield VMT estimates. As described in the MIP Travel Model section below, the MIP process created standardized land-use input categories across all eight San Joaquin Valley MPOs. These standardized categories ensure consistent transportation modeling of household and employment types across all eight MPOs to generate an accurate process to estimate vehicle miles traveled (VMT).

4.2 Model Improvement Program (MIP) Travel Demand Model

Beginning in 2010, the eight MPOs began a joint process to improve their travel demand modeling capabilities to help meet SB 375 requirements. This process, known as the San Joaquin Valley Model Improvement Program (MIP) was funded by a $2.5 million Strategic Growth Council Proposition 84 grant. Between 2010 and 2012, staff from each of the eight MPOs participated in monthly meetings with a team of technical consultants to upgrade the models and modeling processes. To enhance coordination efforts, staff from the Air Resources Board and the University of California Berkeley listened in on the monthly MIP meetings of the MPOs and technical consultants.

The MIP effort resulted in the delivery of substantially upgraded and standardized travel demand models to the MPOs in the summer of 2012. The new travel models were designed to better evaluate the types of land-use and transportation policies likely to be considered in the RTP/SCS. Sensitivity to changes in land use and travel estimates was enhanced compared to previous models by – (i) refining each models' traffic analysis zone (TAZ) system to better capture mixed-use and transit oriented development; (ii) incorporating additional socioeconomic variables such as housing units by building type, household income, housing density, employee by sector type, and employment density; and (iii) adding a vehicle ownership component and improved sensitivity to travel characteristics.

In addition, the MIP resulted in the standardization of model software, inputs, and methodologies between the eight MPOs. The new models employ a common software package called CUBE, which enhances the MPOs' ability to share data and resources with each other, as well as coordinate on model improvement and training efforts.

Improvements made to the model input data and each of the key components of the travel demand models (see Figure 2) including: vehicle ownership, trip generation, trip distribution, mode choice, and trip assignment, are discussed in greater detail in the following section.

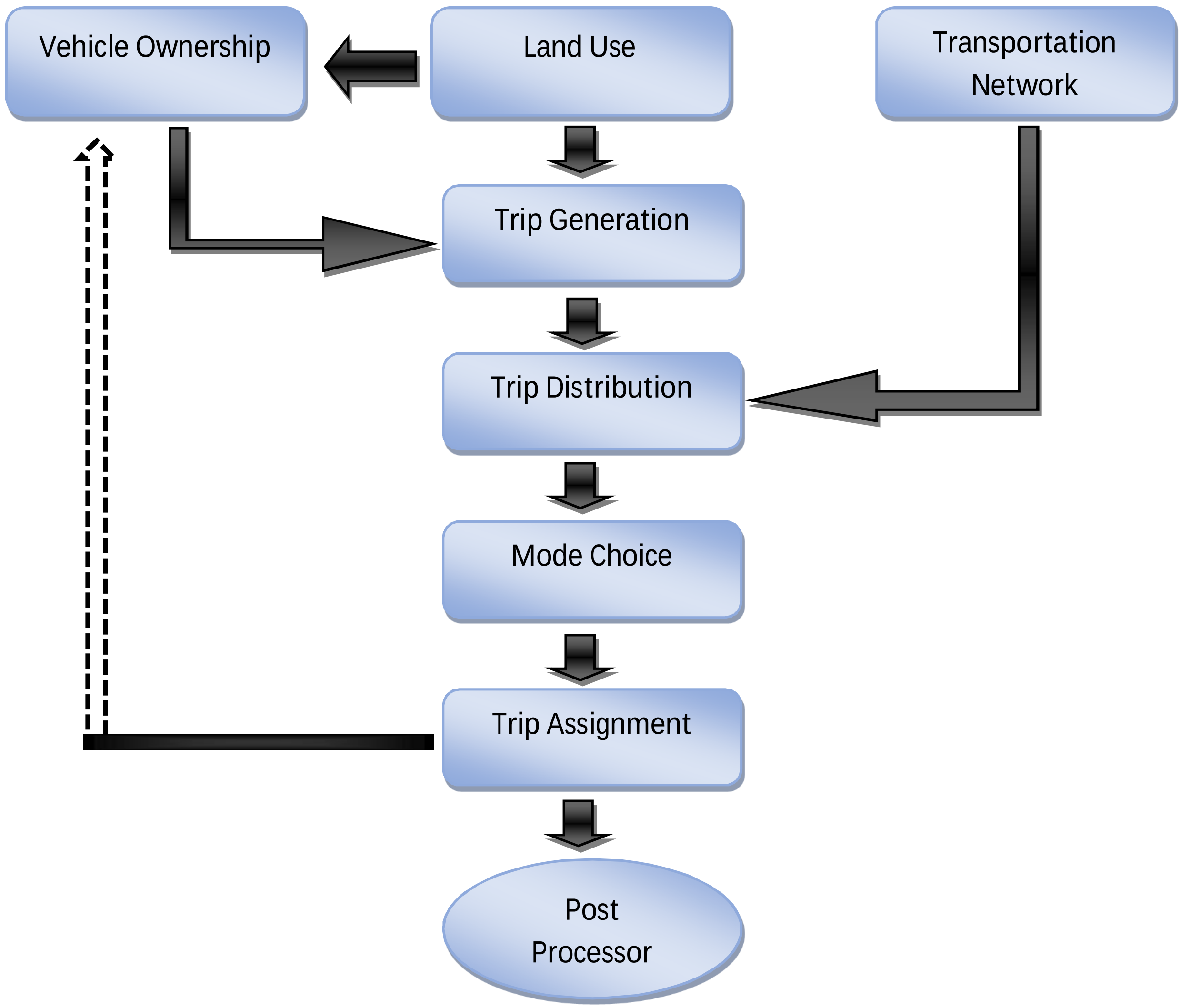
Subsequently, in 2014, a minor update to the models developed in 2012 began, known as VMIP 2. VMIP2 takes advantage of the 2010 Census, the most recent American Community Survey and the 2012-2013 California Household Travel Survey data to enhance the model structure developed as part of the VMIP1. In addition to the updated data, VMIP2 implements changes to the model structure based on ARB feedback received. Model improvements that specifically address ARB's comments include the following:

- Auto ownership was updated to account for land use accessibility (auto, transit, walk, bike) and commute cost as a percentage of household income.
- Trip generation rates were revised depending on area type and accounting for the accessibility of land uses. Area type is recalculated with each model run to account for land use changes between scenarios.
- Trip distribution was updated to include a correlation between household income and job salary for home-work trips.
- Mode choice was updated based on demographics from the latest household travel survey data (household size, income, autos owned) and incorporates average vehicle occupancy by purpose.
- In addition to counts and VMT, the model peak period congested locations were compared to observed NPMRDS data provided by FHWA.

Other key enhancements to model sensitivity and usability include:

- Land Use: simplified residential and employment categories
- Socio-economic: employee salary and household income relationship for home-work trips
- Interregional Travel: updated based on the newly released California Statewide Transportation Demand Model, and based on place and purpose, rather than having internal and interregional travel combined and distributed based on time/cost of travel
- Modified Assumptions: adjustments to employment density, intersection density, and access to jobs and houses

Figure 2 – San Joaquin Valley Model Improvement Program: Model Components



Data Input: The MIP models feature improved TAZ systems, socioeconomic data, land use and travel network characteristics. Improvements to the TAZ systems are designed to help capture more detailed travel movements throughout the region, which allows for more precise analysis of land use and smart growth effects. An updated version of the trip based Caltrans statewide traffic model was developed to help forecast interregional and intraregional trips. Improvements to socioeconomic, land use and transportation network data in the models better account for differences in vehicle ownership and trip generation factors, as well as standardize categories across the eight SJV MPOs.

Vehicle Ownership: The MIP model calculates the number of motor vehicles in a region based on demographic characteristics, auto operating cost, and accessibility. The output of this component is a critical input to the trip generation step, helping to capture the economic characteristics of each household. For VMIP 2, the vehicle operating cost was updated to include maintenance and operations costs based on feedback from ARB.

Trip Generation: The trip generation component estimates the number of person-trips for each activity, such as traveling to-and-from work, school, shops, and social/recreational events. The new models estimate person trips based on demographic and employment characteristics, increasing their capability to analyze the effect of socioeconomic factors on trip rates. Further, the new models increase the number of trip purposes from the typical three or five to eleven1. This change allows distinguishing the potential for alternative modes such as school and college trips. The new models also improve the trip generation step by allowing trip rates to vary by income, household size, the number of workers in a household, drivers, and vehicle ownership. This provides better information about regional travel patterns. For VMIP2, trip generation factors were updated to reflect the built environment and area type factors, and home-work trips were grouped by income range.

Trip Distribution: Trip distribution estimates the number of trips from one travel zone to each of the other travel zones in the county. The new models improve the sensitivity of changes to land use on trip distribution by better reflecting the attributes that influence a person's decision to travel. The MIP model provides the capability to consider additional factors such as trip purpose, person travel time by all modes, travel cost, congestion, and vehicle ownership. For VMIP2, trip distribution was updated to match household income and job salary and to better reflect interregional travel at a local scale.

Mode Choice: The Three-County MIP has an inbuilt mode choice model. This component is used to predict the probability of selecting a travel mode (e.g., auto, transit, bike and walk) for each trip in the region based on the income of the trip maker, the travel cost, time and accessibility of other modes, and improves the travel models' responsiveness to socioeconomic characteristics, land use, pricing and parking strategies. The mode choice model includes seven travel mode choices for vehicle travel with a separate mode choice for walk and bike. The seven vehicle mode choices are work, school, escort, personal business, shopping, meal, and social/recreation.

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[1] The additional trip purposes includes home-based K-12, home-based college, highway commercial, trucks-small, trucks-medium, and truck-heavy. The original 5 trip purposes were home-based work, home based shop, home based social, home based other, and non-home based.

Trip Assignment: The trip assignment component estimates traffic volumes and travel times for each roadway in the network. The new models enhance the trip assignment component by including a new feedback mechanism between the trip assignment and the number of autos to enhance the ability to address induced travel demand. The feedback mechanism inputs congested travel times into the model, which helps to account for travelers who change their travel route and mode in response to congestion.

Model Calibration and Validation: Model calibration is the method of adjusting model parameters to obtain replication of observed data in a particular base year. In model calibration, each component of the model is calibrated to ensure that it produces accurate forecasts. Calibration is an iterative process where model settings are adjusted so the output of the model matches observed travel patterns.

Model validation is the process where the model is tested to ensure that the model output matches available traffic counts and roadway speeds. Ideally, model output should be as close as possible to observed data. As part of the validation process, elements of trip generation, trip distribution and traffic assignment modules may be adjusted.

StanCOG, as part of the three county model performed calibration for each component of the model, following the Federal Highway Administration and Caltrans guidelines, to ensure that the models produce reasonable forecasts. Additional calibration was done on the regional VMT total output from the three county travel demand model.

Model validation, a critical step in the development of any regional travel demand model, establishes the credibility of the model to predict future travel behavior. The MPOs performed validation on the model, as recommended by Federal Highway Administration guidelines, to include trip generation rates, trip length frequency by purpose, average travel time by purpose, mode split by purpose, traffic assignment by facility, and mode choice.

Modeling Interregional Trips: The California Statewide Travel Demand Model (Statewide Model) was designed to capture the interactions of land use plans all across the State as they affect interregional travel. The model operates at a scale coarser than the SJV-MIP models. Its value is in placing local and regional travel in the context of total statewide activity. For the VMIP 2 update, interregional travel was updated to reflect the 2010 Statewide Model version. However, due to timing of the Statewide Model update, it does not incorporate the latest land-use from 2014 SJV RTPs.

For the VMIP2 model, AirSage data was used to evaluate county-to-county traffic volumes for the 8 SJV MPOs and aggregated volumes for counties outside of the San Joaquin Valley focusing exclusively on long distance trips. The Statewide Model was used to compare the magnitude of county-to-county traffic flows to AirSage. Once the magnitudes were determined to be comparable, the Statewide Model was used to develop through trips and station weights by purpose for each gateway. A process of interpolating or extrapolating, as appropriate, was implemented using the base and future year from the Statewide Model for multiple years. The Statewide Model was also used to determine the weighted average trip distance for external gateways to represent travel beyond the model area.

For the purpose of preparing the GHG emissions analysis for the 2018 RTP/SCSs, all emissions from through trips (trips without an origin and a destination in the MPO region) are excluded. In addition, the portion of VMT attributable to trips that either begin or end within the region but travel to/from neighboring regions (IX/XI) has been included for all portions of the trip within the MPO region.
Accounting for interregional travel, or travel that crosses MPO boundaries, continues to be a key issue for SB-375 implementation across the state. The issue is especially important when considering the area covered by SJV MPOs, which in aggregate experience a higher proportion of through traffic relative to other regions (as a percent of total vehicle miles traveled). Statewide discussions to determine how to account for interregional travel across the state are still ongoing.

Base Year Update: The update of the VMIP2's 2015 base year was discussed in the previous *Socio-Economic Data* section of this document. Data sources for the distribution of 2015 households and employment were:

- 2010 U.S. Census Block Level Data for Total Households
- 2015 5yr U.S. Census American Community Survey (ACS) Block Group Level Data for Housing Type Distribution
- 2013 5yr U.S. Census ACS Block Group Level Data for Near Term Household Growth Areas
- 2011 to 2015 1yr ACS for Trends in Countywide Household Growth
- 2015 Census Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics (LODES) Block Level Data for Employment Data by NAICS sector

Additionally, as part of the VMIP2 model update process for the 2018 RTP/SCS, StanCOG (in partnership with SJCOG and MCAG) updated the SB 375 base year to 2005. For the 2014 RTP/SCS, a "back-cast" of the 2008 base year to 2005 was developed. When this process was originally completed, the depth of and recovery from the recession was speculative; thus, appropriate growth rates to use for the back-cast by TAZ were difficult to determine. When updating the 2015 base year, full availability of 2010 block level Census data and 2015 ACS data at the block group level greatly enhanced the 2015 base year over the previous 2008 base year. For this reason, StanCOG, as part of the three county partnership, took the step to examine available 2005 Census ACS and LEHD data sets for 2005 to construct a 2005 set based on historical data as opposed to the back-cast methodology previously employed. While this change in methodology does not significantly change overall county totals for households and employment, it does affect the distribution of socio-economic data to the TAZs, and thus VMT calculations slightly. Overall, technical corrections to the new 2005 SB375 base year resulted in modeled 2005 VMT that was closer to the 2005 Caltrans Highway Performance Monitoring System (HPMS) VMT. Data sources for the distribution of 2005 households and employment were as follows:

- 2010 U.S. Census Block Level Data for Households (Overall & Units in Structure)
- 2000 U.S. Census Block Group Level Data for Households (Overall & Units in Structure)
- 2005 to 2009 1yr ACS data for Tends in Countywide Household Growth

- 2005 LEHD/LODES Block Level Data for Employment by NAICS sector

4.3 EMFAC 2014 Emissions Factor Model

StanCOG is using the latest version of ARB's emissions modeling software EMFAC2014 to complete GHG emissions estimates for the SCS scenario and the alternatives.

The latest EMFAC update includes an "SB 375 Emission Analysis" mode that estimates and reports CO2 emissions in tons per day from appropriate light-duty vehicle classes (LDA, LDT1, LDT2 and MDV). In order to ensure a coordinated approach and reduce potential for user errors, EMFAC2014 modeling instructions and an EMFAC output post-processing worksheet have been developed for the SJV MPOs in consultation with ARB. The approach uses Transportation Data Templates that convert VMIP2 travel model outputs into EMFAC2014 inputs including VMT and speed distributions specific to the region. Per RTAC recommendation, the VMT modeled for SB 375 purposes does not include through trips. The EMFAC output post-processing worksheet calculates per capita CO_2 reductions from 2005 base year for 2020, 2035, and RTP horizon year 2042 using CO_2 emissions modeled with EMFAC2014 and the latest population projections for the region.

In addition, the 2018 RTP/SCS emissions modeling approach incorporates ARB's "Methodology to Calculate CO_2 Adjustment to EMFAC Output for SB 375 Target Demonstration." The emissions methodology adjusts 2020 and 2035 target performance to account for fleet mix and emission factor updates between EMFAC2011 used for the 2014 RTP/SCS and EMFAC2014. The EMFAC output post-processing worksheet calculates per capita CO_2 reductions from 2005 base year for 2020, 2035, and RTP horizon year 2042 using CO_2 emissions modeled with EMFAC2014 and the latest population projections for the region. The spreadsheet also incorporates the ARB CO2 Adjustment Methodology by applying the difference between CO_2 per capita reductions modeled with EMFAC2011 and EMFAC2014 using 2014 RTP activity data to reductions achieved by the 2018 RTP/SCS using EMFAC2014. Note that ARB has indicated that this target demonstration approach is separate from the SB 375 target setting methodology and is not directly comparable to the target recommendations StanCOG has provided to ARB.

4.4 Off-Model Adjustments

Similar to other traditional four-step travel demand models, the three-county model is not sensitive to the impacts of Transportation Demand Management/Transportation Systems Management (TDM/TSM) projects such as Intelligent Transportation Systems (ITS), bike and pedestrian projects, and rideshare programs, nor electrical vehicle penetration. In these instances, StanCOG will rely on "off-model" adjustments using methodologies commonly used in literature, previously approved or cited by ARB, and consistent with the other MPOs. Specifically, the following off-model adjustments were performed for quantification of VMT reduction benefits:

1. Active transportation projects (Tier I Bike Improvements)

An off model analysis was performed to quantify the benefits of active transportation projects based on NCHRP 552 Methodology analysis on the mode shift of commuters in the region as a result of new bicycle infrastructure improvements identified in StanCOG's Tier 1 list of financially constrained improvements to be built within Stanislaus County.

2. Vanpool program expansion (introduction of CalVans Program in Stanislaus County)

An off model analysis was performed to quantify the benefits of the projected number of in-service vans and historic demand response in other areas of the state where CalVans provides service relative to an assumed passenger market capture and travel distance within Stanislaus County.

3. Transit enhancements (not captured in MIP) (ACE Forward – passenger rail service extension to Modesto and Ceres)

An off model analysis was also performed to quantify the benefits of anticipated in-service capacity and projected daily ridership relative to an assumed passenger market capture and travel distance within Stanislaus County.

4. Rule 9410 Employer Trip Reduction (which includes various strategies facilitated by DIBS)

An off model analysis was performed to quantify the benefits of Rule 9410 Employer Trip Reduction based on a dual assessment using TRIMMS software relative to Sierra Research's analysis performed for ARB.

StanCOG's RTP/SCS will document these analyses and VMT reduction results as a separate document (Appendix W in the technical appendices of the 2018 RTP/SCS).

StanCOG passes and meets current SB375 GHG reduction targets using a combined approach of off model adjustments and the ARB CO_2 adjustment methodology.