TECHNICAL EVALUATION OF THE GREENHOUSE GAS EMISSIONS REDUCTION QUANTIFICATION FOR SAN JOAQUIN COUNCIL OF GOVERNMENTS' SB 375 2018 SUSTAINABLE COMMUNITIES STRATEGY

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CALIFORNIA
AIR RESOURCES BOARD

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Background

The Sustainable Communities and Climate Protection Act of 2008 (SB 375) is intended to support the State's broader climate goals by encouraging integrated regional transportation and land use planning that reduces greenhouse gas (GHG) emissions from passenger vehicle use. California's metropolitan planning organizations (MPO) develop regional Sustainable Communities Strategies (SCS) containing land use, housing, and transportation strategies that, when implemented, can meet the per capita passenger vehicle GHG emissions reductions targets for 2020 and 2035 set by the California Air Resources Board (CARB or Board). Once an MPO adopts an SCS, SB 375 directs CARB to accept or reject an MPO's determination that its SCS, when implemented, would meet the targets.

On June 28, 2018, the San Joaquin Council of Governments (SJCOG), which serves as the MPO for the San Joaquin County region, adopted its 2018 SCS.[1] A complete submittal of the 2018 SCS and all necessary supporting information were provided to CARB for review on May 8, 2020. SJCOG's 2018 SCS estimates an 8 percent and 15.7 percent decrease in GHG per capita emissions from light-duty passenger vehicles by 2020 and 2035, respectively, compared to 2005. The region's per capita GHG emissions reduction targets are 5 percent in 2020 and 10 percent in 2035, compared to 2005 levels, as adopted by the Board in 2010.[2] This report reflects CARB's technical evaluation of SJCOG's 2018 SCS GHG quantification.

CARB Determination

ACCEPT

Based on a review of all available evidence and in consideration of CARB's July 2011 document entitled *Description of Methodology for ARB Staff Review of Greenhouse Gas Reductions from Sustainable Communities Strategies Pursuant to SB 375* (2011 SCS Evaluation Methodology),[3] CARB accepts SJCOG's determination that the 2018 SCS plan would meet the San Joaquin regional targets of a 5 percent reduction in GHG per capita emissions from light-duty passenger vehicles by 2020 and a 10 percent reduction by 2035, compared to 2005 levels, when fully implemented.

SJCOG's 2018 SCS contains nearly the same strategies[4] and similar quantification methods and tools as SJCOG's first SCS,[5] which CARB reviewed and accepted as

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[1] SJCOG. 2018 Regional Transportation Plan/Sustainable Communities Strategy.
[2] CARB. Board Resolution 10-31 (September 23, 2010).
[3] CARB. 2011 methodology for CARB review of SCSs.
[4] See Appendix A: SJCOG 2018 SCS Strategy Table for a list of strategies included in the 2018 SCS and how they compare with the 2014 SCS.
[5] SJCOG. 2014 Regional Transportation Plan/Sustainable Communities Strategy.

meeting the targets in May 2015. Therefore, this evaluation incorporates the analysis from CARB's review of the 2014 SCS[6] and adds analysis of changes SJCOG made to the current 2018 SCS with the potential to affect land use, transportation, and the SCS GHG emissions quantification.

CARB staff reviewed SJCOG's 2018 SCS to verify that changes in the demographic assumptions, as well as the modeling methods used to calculate passenger travel-related GHG emissions, reflected the latest information and planning practices.[7] CARB staff also reviewed land use and transportation strategies included within the SCS to confirm that the 2018 SCS strategy commitments did not backslide from SJCOG's 2014 commitments. In addition, CARB staff reviewed SJCOG's reported regional land use and transportation performance indicators to confirm that they were trending in a direction that is consistent with forecasted GHG emissions and/or VMT reduction trends, as expressed in the empirical literature.

Based on these evaluations, CARB accepts SJCOG's determination that its 2018 SCS would meet the targets when implemented. CARB's analysis and assessment of changes to SJCOG's 2018 SCS and GHG quantification are documented in the "Changes from the Region's Previous SCS" section of this evaluation. Background information on the 2018 SCS changes, including demographic forecast, transportation investments, updates to the regional travel demand model, land use scenario modeling, and new strategies are documented in Appendix B: Discussion of 2018 SCS Changes.

CARB has identified issues with SJCOG's 2018 SCS that SJCOG will need to address in its upcoming third-round SCS development and documentation process based on the *Final Sustainable Communities Strategy Program and Evaluation Guidelines*[8] published in November 2019. Specifically, SJCOG's SCS submittal continues to lack data on a number of key performance indicators that further support its GHG emissions reduction calculations, and remains unclear about what specific actions, milestones, and enabling project investments are needed to support full implementation of its SCS policies and programs. These items are problematic given CARB's recent assessment of on-the-ground progress since regions began developing

[6] CARB's acceptance and technical evaluation of SJCOG's first SCS was completed in May 2015, and contains detailed information about the methods SJCOG used to quantify GHG emissions. See, CARB Technical Evaluation of SJCOG 2014 SCS.
[7] CARB examined modeling inputs and assumptions, model responsiveness to variable changes, model calibration and validation results, and performance indicators using the general method described in CARB's July 2011 methodology for reviewing SCSs.
[8] CARB. Final Sustainable Communities Strategy Program and Evaluation Guidelines. (November 2019).

SCSs,[9] which found that California was not on track to meet the GHG reductions expected under SB 375. As a result, the San Joaquin region may not realize the forecasted GHG reductions in the SCS for 2035, if the plan is not fully implemented. California needs strong commitments to implement vehicle miles traveled (VMT) reduction strategies to meet its SB 375 GHG commitments and support the statewide effort to successfully mitigate the worst forecasted impacts of climate change. CARB's concerns and suggested remedies are documented in the "Recommendations" section of this evaluation.

Changes from the Region's Previous SCS

The 2018 SCS retains the same strategies and tools as the 2014 SCS with some modifications. The following sections summarize changes made to the underlying 2018 SCS assumptions and strategies, quantification tools and methods, and resulting SCS performance indicator metrics, and CARB's assessment of the specified actions.

CARB examined SJCOG's modeling inputs and assumptions, model responsiveness to variable changes, model calibration and validation results, and performance indicators using the general method described in CARB's 2011 SCS Evaluation Methodology.

Land Use and Transportation Strategies

SJCOG's 2018 SCS maintains a set of land use and transportation strategies that are similar to those adopted in its previous 2014 SCS, with updates to assumptions for land use and an increase in transit and active transportation investments. The 2018 SCS also incorporates two new strategies, as well as updates to the region's growth forecast. Table 1 summarizes these changes and provides CARB's assessment based on consistency with best available information and practice.

[9] Prepared pursuant to Senate Bill (SB) 150 (Allen, Chapter 646, Statutes of 2017); CARB. 2018 Progress Report: California's Sustainable Communities and Climate Protection Act. (November 2018).

Table 1. Summary of Demographic, Land Use, and Transportation Changes in SJCOG's 2018 SCS Compared to the 2014 SCS

Action	CARB Assessment	Finding
Revised Regional Growth Forecast	Reasonable	SJCOG revised population, household, housing units, and employment growth estimates for its 2018 SCS. Forecasted population and housing in the year 2035 is forecasted to decrease by approximately 6 percent and 1 percent, respectively, while forecasted employment is anticipated to increase by approximately 6 percent when compared to the 2014 SCS. The changes in population and housing are due, in part, to changes in the countywide forecast from local jurisdictions on planned developments and building moratoria. The change in employment is based, in part, on updated employment trends and major land use projects not captured in past data. Per the 2011 Evaluation Guidelines, CARB reviewed these revisions and found them to be consistent with the 2014 DOF forecasts, which were the latest available at the time of plan development. See Appendix B: Discussion of 2018 SCS Changes for more detail.
Updated Land Use Scenario	Reasonable	SJCOG updated the SCS land use assumptions. Per the 2011 Evaluation Guidelines, CARB reviewed SJCOG's land use update process and found that it appropriately adjusted for total growth based on the region's latest growth forecast, as well as adjusted assumptions for where growth would occur based on latest local planning assumptions in consultation with its members. See Appendix B: Discussion of 2018 SCS Changes for more detail.

Action	CARB Assessment	Finding
Updated Revenue Forecasts and Transportation Investments	Reasonable	The 2018 SCS updates both transportation revenue forecasts and investments. Per the 2011 Evaluation Guidelines, CARB reviewed overall changes to SJCOG's SCS transportation project investments and found them generally consistent with changes to anticipated resources. Compared to the 2014 SCS, total revenues and investments increase from $11 billion to $11.5 billion, or approximately 5 percent. The increase in funding is partially attributable to the available funding provided by the Road Repair and Accountability Act of 2017 (SB 1). Additional funding is provided by Measure K, a half-cent sales tax passed in 2006 by the voters of the San Joaquin region to fund needed transportation improvements, and SB 132, which provides funding for the Altamont Commuter Express (ACE) extension to Ceres and Merced. As a result, transportation investments are different from the previous plan with decreases in road expansion investments, which fell from 30 to 27 percent between plans. The portion of total investments in transit and active transportation remain nearly the same between plans at approximately 30 percent and 2 percent, respectively. See Appendix B: Discussion of 2018 SCS Changes for more detail.
New Strategies: ACE Rail Service and Technological Improvement Programs	Insufficient for evaluation	Although new strategies such as ACE passenger rail service, and various technological innovations (e.g., plug-in EV infrastructure readiness and autonomous vehicle programs) are discussed in SJCOG's 2018 SCS, SJCOG did not provide CARB with sufficient documentation to support its estimated GHG reduction quantification for these strategies.[10] See Appendix B: Discussion of 2018 SCS Changes for more detail.

[10] CARB did not include the reductions from these strategies in its determination.

Model Calculations

SJCOG used updated modeling tools to evaluate its 2018 SCS with updated 2005 base year input data that slightly affected the quantification of model outputs of VMT and GHG emissions compared to its 2014 SCS. Table 2 summarizes these changes along with CARB's assessment and findings based on consistency with best available information and modeling practice.

Table 2. Key Changes in SJCOG's 2018 SCS Modeling

Modeling Component	CARB Assessment	Finding
Travel Demand Model	Reasonable	SJCOG used the VMIP 2 model for the 2018 SCS, which is an updated version of the MIP 1 model used in the 2014 SCS. Per the 2011 Evaluation Guidelines, CARB reviewed SJCOG's updated model documentation and found that updates to incorporate data from the most recent Census, American Community Survey, California Household Travel Survey, and traffic counts improved the model's ability to represent current conditions, which are then reflected in travel forecasts used for GHG emissions quantification. For the 2018 SCS, SJCOG also updated its methodology and input data for the 2005 model year to address concerns CARB identified in the 2014 SCS review (e.g., auto operating cost and interregional travel). Further, SJCOG also updated the 2005 socioeconomic dataset using historical 2005 Census, American Community Survey, and Longitudinal Employer-Household Dynamics (LEHD) data, instead of using the back-cast methodology it employed for its 2014 SCS. These changes affected the distribution of socioeconomic data to the transportation analysis zones (TAZ) used by the travel demand model, and VMT estimates, which have led to less GHG reductions compared to the 2014 SCS. SJCOG's updated 2005 VMT estimates are also more closely aligned with Highway Performance Monitoring Data. See Appendix B: Discussion of 2018 SCS Changes for more detail.

Modeling Component	CARB Assessment	Finding
Adjustment to EMFAC Outputs	Reasonable	SJCOG used EMFAC 2014 to estimate GHG emissions. CARB reviewed SJCOG's calculations and found that they appropriately followed the procedure demonstrated in CARB's memo titled *Methodology to Calculate CO2 Adjustment to EMFAC Output for SB 375 Target Demonstrations.* See Appendix B: Discussion of 2018 SCS Changes for more detail.

Regional Land Use and Transportation Performance Indicators

To better understand whether SJCOG's key modeled land use and transportation performance indicators are trending in a direction consistent with forecasted GHG emissions and/or VMT reduction trends, CARB re-analyzed several of these indicators against relationships expressed in the empirical literature. Depending on what regional data were available, CARB compared changes in the metrics across either 2005 and the target years of 2020 and 2035 or the RTP/SCS plan base year of 2015 and target years 2020 and 2035.

Table 3 shows a summary of SJCOG's 2018 SCS land use performance indicators and Table 4 shows a summary of SJCOG's 2018 SCS transportation performance indicators. Data for this analysis came from SJCOG's SCS data table provided in Appendix C: Data Table. Supporting data and charts for performance indicators are provided in Appendix D: Performance Indicators.

Table 3. Summary of Land Use Performance Indicators

Performance Indicator	CARB Assessment	Finding
Residential Density	Consistent with reducing VMT/ GHG	SJCOG's 2018 SCS forecasts an increase from 2.0 to 2.3 housing units per developed acre, or a 14 percent increase in residential density by 2035 compared to 2015. Per the 2011 Evaluation Guidelines, CARB finds this trend supportive and consistent with the relationship shown in the empirical literature that increasing residential density helps to increase non-auto mode shares and reduce VMT and GHG emissions.

Performance Indicator	CARB Assessment	Finding
New Housing Mix	Consistent with reducing VMT/ GHG	SJCOG's 2018 SCS forecasts the proportion of total new housing units that are multi-family will increase to 24 percent in 2020 and 27 percent in 2035. Per the 2011 Evaluation Guidelines, CARB finds this trend supportive and consistent with the relationship shown in the empirical literature that increasing the proportion of new development that is multi-family units increases residential density and accessibility to destinations, and helps reduce VMT and GHG emissions.
Jobs and Housing near Transit	Consistent with reducing VMT/ GHG	SJCOG's 2018 SCS forcecasts that there will be more jobs and housing units near transit. Compared to the 2015 model base year (61,383 housing units and 95,448 jobs), the 2018 SCS shows an increasing trend in the numbers of jobs and housing units within one-half mile of transit stations or stops in 2035 (77,355 housing units and 107,709 jobs). Per the 2011 Evaluation Guidelines, CARB finds this trend supportive and consistent with the relationship shown in the empirical literature that increasing the proportion of new development near transit increases accessibility and helps reduce VMT and GHG emissions.

Table 4. Summary of Transportation Performance Indicators

Performance Indicator	CARB Assessment	Finding
Per Capita Passenger VMT	Consistent with reducing VMT/ GHG	SJCOG's 2018 SCS shows a reduction of per capita VMT in 2035 compared to the 2005 baseline, from 20.0 to 16.8 miles per day. Per the 2011 Evaluation Guidelines, CARB finds this trend supportive and consistent with the relationship shown in the empirical literature that per capita GHG emissions follow the same trend directionally as per capita VMT.

Recommendations

In reviewing SJCOG's 2018 SCS submittal, CARB staff identified what new information SJCOG will need to provide to CARB for its upcoming third-round SCS development

and documentation process based on the *Final Sustainable Communities Strategy Program and Evaluation Guidelines* published in November 2019.[11] The following sections provide information on what additional information will be needed in the MPO's third-round SCS evaluation submittal beyond what was shared with CARB in SJCOG's second-round SCS. For a complete understanding of what is needed for the third-round SCS evaluation submittal, please refer to the Guidelines document.

Trend Analysis

CARB staff currently uses land use and transportation system performance indicator trends to assess whether an SCS supports GHG emissions over time. This assessment will continue to be a part of CARB's third-round SCS evaluations. While SJCOG's submittal included some performance indicators that were directionally supportive of certain strategies and estimated GHG reductions, data provided to evaluate the performance of key strategies in the SCS were limited.

Given that SJCOG's third SCS must address new, more aggressive reduction targets, CARB staff will need SJCOG to quantify and report changes from its next SCS plan base year to the SCS target years for the eight performance metrics identified below. CARB will use these for the Trend Analysis determination in the third round, which includes checking whether the reported directionality for the following RTP/SCS performance indicators are trending as expected.[12] The metrics not provided by SJCOG for this evaluation are noted and italicized below.

1) *Household vehicle ownership: The average number of light-duty vehicles registered (i.e., LDA, LDT1, LDT2, and MDV vehicle categories) per household. (SJCOG did not provide this metric.)*
2) Mode split: The percentage of average daily trips by travel mode, including single-occupant vehicle, high-occupancy vehicle or carpool, transit, ride hailing or TNC, bike and walk.
3) Travel time by mode: The regional average travel time (minutes) by trip purpose (e.g., for commute and non-commute trips), by travel mode.
4) *Transit ridership: The total number of one-way linked or unlinked average daily transit passenger trip boardings on public transportation per day. (SJCOG did not provide this metric.)*
5) Average vehicle trip length: The regional average daily trip distance (miles/day) of driving.

[11] CARB. Final Sustainable Communities Strategy Program and Evaluation Guidelines. (November 2019).
[12] For expected directionality of performance indicators for the Trend Analysis, see CARB Final Sustainable Communities Strategy Program and Evaluation Guidelines, Table 4 at page 39.

6) *Seat utilization: The average daily percentage of occupied vehicle seats on the roadway network, including for passenger vehicles and transit buses. (SJCOG did not provide this metric.)*
7) *Household VMT: The average daily light-duty vehicle VMT from each household within the MPO, excluding group quarters and visitors. (SJCOG did not provide this metric.)*
8) GHG per capita: The average daily CO2 emissions within the MPO from light-duty vehicles per person.

Policy and Investment Analysis

For all third-round SCSs, CARB is shifting its evaluation focus to assess whether SCS strategies for GHG emissions reduction are likely to be implemented, and are therefore reasonable for inclusion and credit toward target achievement. To assess this, CARB staff needs MPOs to provide clear descriptions of each SCS strategy with regard to applicable geographic scope, with specific locations if known; implementation timeframes; and what key supporting actions the MPO and its member agencies will undertake to support and track strategy implementation. [13]

Key supporting actions should correspond to each individual strategy, and in general, actions should be measurable, and should include identification of the region's specific investment commitments; policy and/or financial incentives; technical assistance; and if legislative action is needed, partnership activities to advance needed statutory changes. Each action should be clear about its scope, who will be involved, and anticipated timeline. For example, SJCOG's 2018 SCS includes a policy to maximize mobility and accessibility. That policy, "Strategy 6," seeks to facilitate transit-oriented development to maximize existing transit investments. For the third-round SCS, SJCOG will need to identify what key supporting actions it is committing to in order to help implement this strategy. This could include identifying specific funding or other incentive programs the region will have to reward local jurisdictions that are investing in these SCS preferred growth areas, including any actions SJCOG plans to take to improve local connectivity to transit and influence development patterns around key transit areas across the region.

For the third-round SCS, CARB staff will also be evaluating how transportation investments are dispersed throughout the region and whether these investments support or put at risk the GHG reduction benefits of the SCS. To assess this, CARB staff needs SJCOG to provide the complete list of transportation projects identified in the second- and third-round SCSs. Projects need to be tabulated by project type (road expansion, road maintenance, active transportation, transit, or other), cost, funding source (if known), project time period (e.g., base year through 2020, 2020

[13] For more information on the Policy Analysis, see CARB Final Sustainable Communities Strategy Program and Evaluation Guidelines, at pages 40-42.

through 2035, or beyond 2035), and location including jurisdiction, intersections, and roadway segments (if available).

Tracking Implementation and Plan Adjustment

In the third-round SCS evaluation, CARB staff will look at how an MPO's previous SCS strategies and actions are performing, in compliance with SB 150, and what MPOs are doing in the third-round SCS, if the previous plans are not performing as expected, as directed by the Board.[14, 15] CARB's *2018 Progress Report: California's Sustainable Communities and Climate Protection Act* provides some information in this area based on the latest observed statewide data and trends. For the next SCS, CARB staff needs MPOs to compare available observed data to the development pattern and travel assumptions used in their previous SCS to achieve its targets. If the observed data do not align with the plan assumptions, an MPO should document what priority adjustments and changes it is making in the third-round SCS to get the region on track to achieve its SB 375 targets.

CARB staff needs SJCOG to clearly document how they are using data to track implementation progress of their SCS, as well as justify any adjustments they make to the underlying baseline assumptions. In particular, CARB encourages SJCOG to gather more detailed land use, transit, and active transportation data to help better assess the effectiveness of the land use and transit service expansion strategies in the SCS. This data (e.g., ACE ridership) could also inform SJCOG's methodology to estimate GHG reductions for strategies outside the travel demand model.

Analyze Induced Travel (Short-Term and Long-Term) Effects

Induced travel is the increase in VMT due to roadway capacity expansion. Roadway expansion projects can lead to increases in travel due to changes in the number of trips and trip distances (destination changes); shifts in travel modes, the time-of-day travel occurs, and routes; as well as changes in residence and workplace locations. Induced travel is important to analyze as it can affect VMT and GHG emissions.

CARB staff recommends SJCOG explore methods for better analyzing the short- and long-term induced travel from roadway expansion projects in future SCS cycles. SJCOG included roadway expansion projects in the 2018 SCS that can lead to short- and long-term induced travel in the region. Currently, long-term induced travel is not well accounted for by SJCOG's travel demand model and may underestimate per capita GHG emissions. CARB staff has identified available tools to help SJCOG

[14] See, CARB Final Sustainable Communities Strategy Program and Evaluation Guidelines, at pages 37-38 and 43-44.
[15] Gov. Code § 65080 (b)(2)(J)(iv); CARB Board Resolution 18-12 (March 22, 2018).

evaluate the effects of induced travel.[16] Examples include, but are not limited to, University of California, Davis National Center for Sustainable Transportation's Induced Travel Calculator[17] and Impact of Highway Capacity and Induced Travel on Passenger Vehicle Use and Greenhouse Gas Emissions.[18]

Improve Strategy Calculation Methods

SJCOG discussed a number of strategies intended to reduce VMT and GHG emissions in the 2018 SCS that could not be captured by its model. These included the ACE passenger rail service extension, technological improvement programs, increasing investment in bicycle and pedestrian projects, and reducing investment in roadway capacity projects. As a result, SJCOG did not analyze the VMT and GHG impacts of these strategies and these were not credited toward achievement of its targets.

If SJCOG plans to include these strategies in future SCSs for credit toward its targets, it needs to provide further information to substantiate GHG emissions reductions. For the third-round SCS evaluation, the following additional documentation is needed, for each strategy that is quantified off-model, before GHG emissions reduction credit can be received: [19]

- A more comprehensive description of all off-model strategies, including the scope of the strategies, the target users, the timeline of implementation, and current status of the strategies;
- Detailed quantification methods and assumptions for each strategy that document the step-by-step analysis of the strategy benefits;
- Identification of funding commitments or local policies that support implementation of each strategy; and
- The efforts to collect local data and monitor implementation.

Conduct Modeling Sensitivity Analysis

CARB understands that MPOs periodically update travel models with newer input data and methods to keep the model compatible and consistent with socioeconomic trends and changes to the transportation network. If SJCOG makes significant changes to its travel model that can affect its sensitivity to RTP/SCS strategies, CARB staff recommends SJCOG conduct a sensitivity analysis of the model. The analysis is

[16] For more information on the Transportation Policy Analysis where induced travel is discussed, see CARB Final Sustainable Communities Strategy Program and Evaluation Guidelines, at pages 40-41.
[17] See, University of California at Davis. NCST tool.
[18] CARB. Highway Capacity Brief.
[19] For more information on quantifying GHG emissions off model, see CARB Final Sustainable Communities Strategy Program and Evaluation Guidelines, Appendix E.

important for validating and calibrating the model so that outputs can be compared against observed data. The analysis also helps to explain how the modeling outputs used to estimate GHG per capita and total VMT may change in response to land use and transportation strategies.

Appendix A: SJCOG 2018 SCS Strategy Table

This appendix summarizes the 2018 SCS strategies provided by SJCOG to CARB as part of its SCS submittal, the quantification method used, whether the strategy existed in its previous 2014 SCS or is new, and descriptive comments.[20]

SCS Strategy	ON/OFF Model	Carryover from Last SCS or New?	Comments
Higher density residential and employment uses, in addition to mixed-use designations, at a city's core and along major transportation corridors.	On Model	Carryover from last SCS w/ updates	Compared to 2014 plan, 2018 plan includes more growth in key corridors due to updates in local general and specific plans, as well as updated jurisdiction-specific demographic growth forecasts.
More compact, mixed-use and infill development as compared to General Plan/Business as Usual Scenario	On Model	Carryover from last SCS w/ updates	As compared to Business as Usual Scenario (Scenario 1), which used the local jurisdiction's general plans as a baseline.
Greater investment in multi-family versus single-family residential development, especially in downtown areas.	On Model	Carryover from last SCS w/ updates	The increased focus on multi-family housing in the 2018 RTP/SCS preferred scenario (Scenario 2), as well as a relative emphasis on smaller-lot, single-family homes over large-lot, single-family homes, means that the residential densities associated with new development are generally greater than those listed in the local agency general plans.

[20] SJCOG provided CARB with a Policy Matrix (May 5, 2020) showing the strategies: increasing spending on bicycle/pedestrian improvements and decreasing spending on roadway capacity as accounted for "On Model". In follow up correspondence between CARB and SJCOG staff, SJCOG stated that these strategies were incorrectly categorized and should have been categorized as "Not Analyzed". CARB has reflected this change here in Appendix A.

SCS Strategy	ON/OFF Model	Carryover from Last SCS or New?	Comments
Increases spending on bicycle/pedestrian improvements as compared to Business as Usual Scenario	Not Analyzed	Carryover from last SCS w/ updates	Consistent with having more infill development for housing and jobs in downtown areas and along major transportation corridors, Scenario 2 increases spending on bicycle/pedestrian improvements over Scenario 1, the Business as Usual Scenario.
Reduces the amount of relative spending on new roadway capacity as compared to Business as Usual Scenario	Not Analyzed	Carryover from last SCS w/ updates	As compared to Business as Usual Scenario (Scenario 1), which used the local jurisdiction's general plans as a baseline.
Commitment to technological improvements for improved mobility	Not Analyzed	New	The 2018 RTP/SCS adds a "Technological Innovations" chapter (chapter 7), outlining existing initiatives as well as next steps.
Expansion of ACE service	Not Analyzed	Carryover from last SCS w/ updates	SJCOG's analysis based on the San Joaquin Regional Rail Commission's (SJRRC's) phased improvement plan (ACE Forward), which identified the planned service expansion, station enhancements and track improvements for extending ACE service to the cities of Manteca, Modesto, Ceres, Turlock and Merced to support the analysis. Due to a $500M TIRCP grant, ACE will also expand north into Sacramento.

Appendix B: Discussion of 2018 SCS Changes

This appendix describes changes in the 2018 SCS compared to the 2014 SCS in more technical detail, including the demographic forecast, transportation investments, updates to the regional travel demand model, and new strategies.

Revised Regional Growth Forecast

SJCOG updated the population, employment growth, and housing forecasts for its 2018 SCS (see, 2018 SCS Appendix R). The University of Pacific (UOP) Center for Business & Policy Research developed and completed forecasts for the San Joaquin region in 2016. SJCOG's updated forecasts less growth than what SJCOG forecasted in the 2014 SCS, and tracks closely with DOF population forecasts for the San Joaquin region in 2014, which was the latest available at the time of preparation. The 2018 SCS includes the same planning assumptions with regard to housing needs as the 2014 SCS because the Regional Housing Needs Assessment (RHNA) is conducted every eight years while the SCS cycle is every four years. The 2022 SCS will include updated housing assumptions since it will incorporate a new RHNA and growth forecast.

Table 5. Comparison of Population, Household, and Employment Estimates between SJCOG's 2014 and 2018 SCSs below compares population, household, and employment estimates used in the 2014 and 2018 SCSs. The forecast for 2020 and 2035 indicate less population, housing, and employment than in the previous SCS. Compared to the 2014 SCS, between 2005 and 2035, SJCOG expects 6 percent less population growth and 1 percent fewer households, while also expecting a 6 percent increase in employment growth.

Table 5. Comparison of Population, Household, and Employment Estimates between SJCOG's 2014 and 2018 SCSs

	Year	2014 SCS	2018 SCS	Difference
Population	2020	807,099	775,819	- 4%
Population	2035	1,003,843	947,835	- 6%
Households	2020	249,764	246,715	- 1%
Households	2035	302,258	299,495	- 1%
Employment	2020	234,235	256,022	9%
Employment	2035	282,613	299,919	6%

Updated Land Use Scenario

The land use scenario adopted in the 2018 SCS was developed based on the principles adopted as part of the 2006 San Joaquin Valley Blueprint and builds on the 2014 SCS by including land use and transportation project updates in the interim. SJCOG collaborated with planning staff at San Joaquin County and each member city

in 2017. The development of the 2018 SCS land use scenario was informed by member input that provided a better understanding of where growth had occurred since the 2014 SCS, adjusted the future growth distribution to reflect new development projects and projects that were no longer active, and allowed for changes to assumptions for on-going projects.

SJCOG developed four scenarios that varied in terms of overall development pattern, housing options, growth location/intensity, and transportation investments. SJCOG workshopped each scenario to solicit public input, which culminated in a final scenario (Scenario 2A) focused on increasing alternative to vehicular travel, expanding public transit, and providing more funding to active transportation projects. SJCOG stated that Scenario 2A directs transportation investments to complement strategies that promote compact growth while minimizing impacts on surrounding agricultural lands. SJCOG also stated that these regional planning principles include 93 percent higher overall residential density per acre compared to the existing land use pattern of development, emphasize funding operations for local, intercity, and interregional bus services and enhancing the ACE transit system, and increase investments to support active transit modes.

Revenue Forecasts and Transportation Investments

For the 2018 SCS, SJCOG updated its transportation revenue forecasts and investments. Total revenues increased from approximately 5 percent, from $11 billion to $11.5 billion. The pattern of spending changed as well. The change in investments by mode between the 2014 and 2018 plans by total amount are shown in Figure 1, while the change in percent of total expenditures between plans is shown in Figure 2.

The largest increase in investment occurred in the category of roadway maintenance, which grew from $3.9 billion to $4.5 billion, reflecting an 18 percent increase. The portion of the plan devoted to road expansion fell from $3.3 billion to $3.1 billion, which is a 6 percent decrease. The category of active transportation increased from $282 million to 320 million, a 13 percent increase. The total amount of investment for transit remained about the same from the 2014 to 2018 SCSs.

Figure 1. SJCOG Planned SCS Transportation Expenditures Between the 2014 SCS and 2018 SCS (Total Amount)

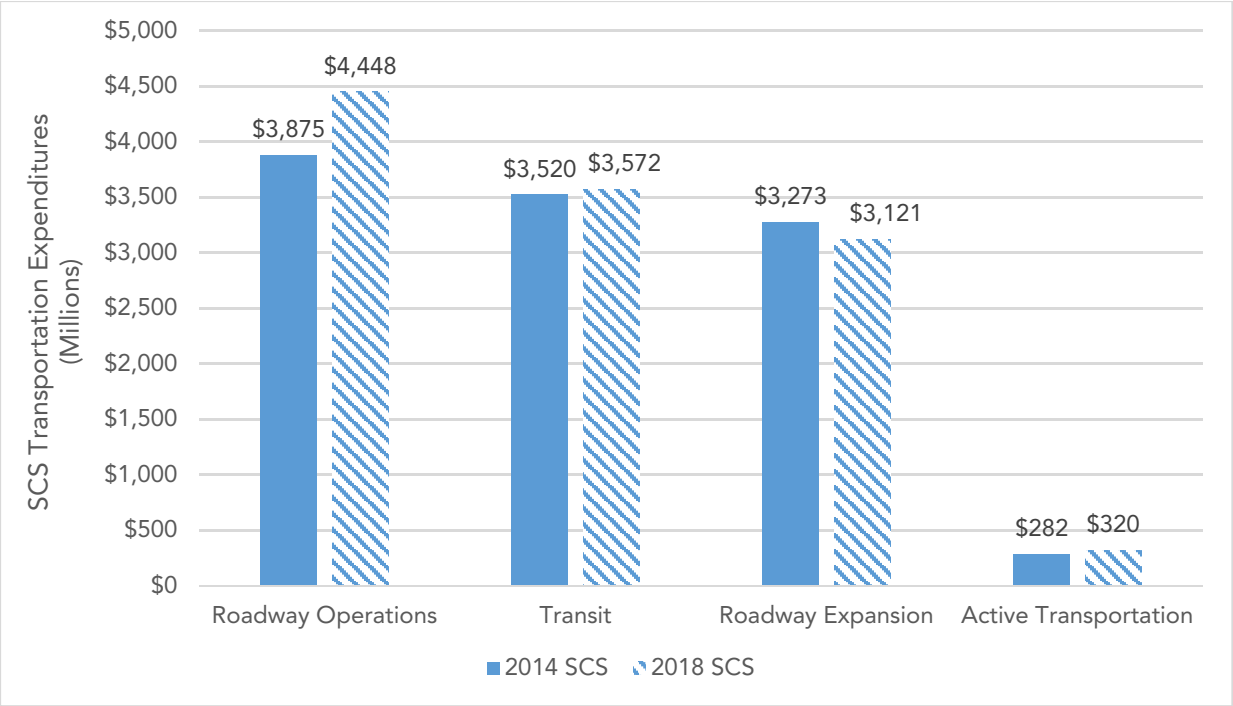
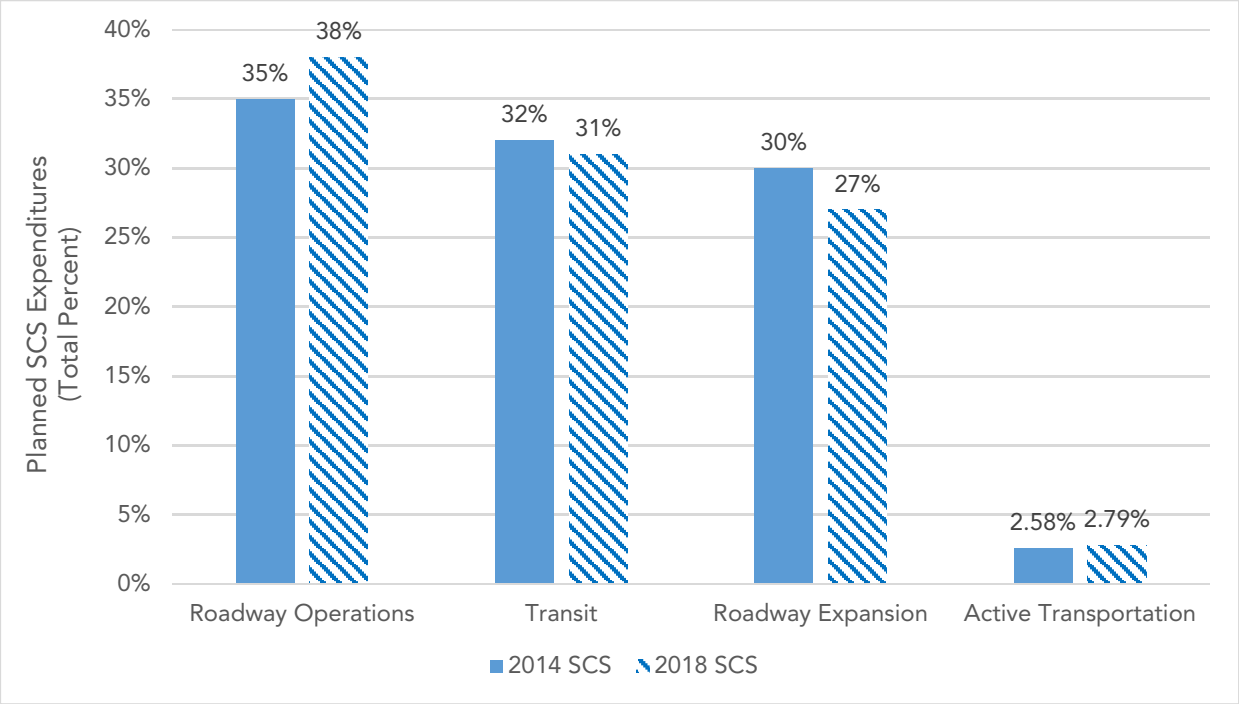


Figure 2. SJCOG Planned SCS Transportation Expenditures Between the 2014 SCS and 2018 SCS (Percent of Total Expenditure)



New and Carryover Strategies Not Analyzed: ACE Rail Service, Technological Improvements Programs, Increased Investment in Bike and Pedestrian Projects, and Reduced Investment in Roadway Capacity Projects

SJCOG's SCS submittal claims that the 2018 SCS includes two new strategies: ACE Rail Service and Technological Improvements Programs (e.g., plug-in EV infrastructure readiness program, autonomous vehicles, etc.). SJCOG also claims that the 2018 SCS includes carryover strategies that were not analyzed: increasing investment in bicycle and pedestrian projects, and reducing investment in roadway capacity projects. However, SJCOG chose not to provide CARB with supporting documentation since SJCOG determined the region may meet the SB 375 targets without quantifying the GHG reductions from those strategies.

Land Use Model

SJCOG used *Envision Tomorrow* for its scenario planning and land use allocation. *Envision Tomorrow* is a regional planning tool that forecasts future land use changes using a bottom-up approach. The land use planning process in *Envision Tomorrow* starts with allocating and forecasting the building types (e.g., office building, single-family house, commercial building) and development types (e.g., residential, mixed-use, industrial) in individual communities based on regional and local policies. Next, region-wide land use scenarios are then developed based on the combination of different community-level development types. Based on the regional growth forecast and local land use policies, SJCOG developed different land use scenarios for evaluation and comparison. The land use information corresponding to SJCOG's preferred scenario served as an input in to SJCOG's travel demand model.

Travel Demand Model

The primary travel demand model that SJCOG utilized is a trip-based model, VMIP2, which was updated from the VMIP1 model developed by the San Joaquin Valley Model Improvement Program (MIP) beginning in 2010.

The main structure of the VMIP2 is the same as VMIP1 used from SJCOG's 2014 SCS. VMIP2 incorporates the most recent Census, American Community Survey, and California Household Travel Survey data, so that the modeling results are more precise. The VMIP2 also enhances interregional travel, land use, auto ownership, trip generation rates, trip distribution, and mode choice, compared to VMIP 1, with updates in data sources. For example, interregional travel is updated based on the newly released California Statewide Transportation Demand Model and based on place and purpose. Mode choice is updated based on demographic data from the latest California Household Travel Survey and incorporates average vehicle occupancy. Auto ownership is updated based on the land use accessibility to different

transportation modes (e.g., auto, bike, and transit) and household income. Considering the modeling structure of VMIP2 is still largely the same as VMIP1 used for SJCOG's 2014 SCS, and SJCOG's 2018 SCS did not include additional strategies quantified through the travel demand model, CARB staff finds it acceptable that SJCOG did not conduct any additional sensitivity analysis for this round.

In the 2018 SCS, SJCOG also revised its 2005 SB 375 base year data. SJCOG applied a new approach, which constructs a 2005 profile based on available 2005 Census, American Community Survey (ACS), and Longitudinal Employer-Household Dynamics (LEHD) datasets. This differs from the previous approach in the 2014 SCS, in which the 2005 profile was a "back-cast" of the 2008 model base year. While this change in methodology does not significantly change overall county totals for number of households and employment, it does affect the distribution of socioeconomic data to the TAZs, and thus VMT calculations in the travel demand model. The 2005 base year adjustment has led SJCOG to estimate a lower baseline VMT and GHG emissions in 2005 that is closer to the 2005 Caltrans Highway Performance Monitoring System VMT data. With this adjustment, the 2018 SCS reports less GHG reductions in the region between 2005 and the SB 375 target years.

Adjustment to EMFAC Outputs

The EMFAC adjustment factor for SJCOG is 0.4 percent in 2020 and 0.6 percent in 2035. Since the 2014 SCS, SJCOG used different versions of CARB's EMFAC model in quantifying the GHG emissions for its 2014 and 2018 SCSs. To allow an "apples to apples" comparison of the first- and second-round SCSs, CARB developed a methodology to adjust the calculation of percent reduction in per capita CO2 emissions when using different versions of EMFAC. This adjustment factor neutralizes the changes in fleet average emission rates between the version of EMFAC used for the 2014 SCS (EMFAC 2011) and the version used for the 2018 SCS (EMFAC 2014). The goal of the methodology is to hold each MPO to the same level of stringency in achieving its targets, regardless of the version of EMFAC used for its second SCS. SJCOG followed the methodology and its CO2 per capita reduction results were adjusted accordingly.

Appendix C: Data Table

Modeling Parameters	2005	2015 (base year)	2020 With Project (1)	2020 W/out Project (2)	2035 With Project	2035 W/out Project	2042 With Project	2042 W/out Project	Data Sources
Total population	652,339	726,106	775,819	775,819	947,835	947,835	1,050,218	1,050,218	University of the Pacific
Group quarters population	17,118	15,893	N/A	N/A	N/A	N/A	N/A	N/A	DOF.ca.gov/Forecasting/Demographics/Estimates/E-5/
Total employment (employees)	221,017	234,969	256,022	256,022	299,919	299,919	319,949	319,949	University of the Pacific
Average unemployment rate (percent)	7.9%	8.9%	5.3%	5.3%	N/A	N/A	N/A	N/A	University of the Pacific
Total number of households	205,497	223,062	246,715	246,715	299,495	299,495	330,095	330,095	University of the Pacific
Persons per household	3.09	3.18	3.04	3.04	3.10	3.10	3.11	3.11	Calculation
Auto ownership per household	1.8	1.78	1.76	1.76	1.77	1.78	1.8	1.78	VMIP2
Mean household income	$49,391	$55,775	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total acres within metropolitan planning organization	912,640	912,640	912,640	912,640	912,640	912,640	912,640	912,640	US Census

Modeling Parameters	2005	2015 (base year)	2020 With Project (1)	2020 W/out Project (2)	2035 With Project	2035 W/out Project	2042 With Project	2042 W/out Project	Data Sources
Total resource area acres (California Government Code Section 65080.01)	N/A	24,819	24,818	24,815	24,815	24,804	24,814	24,798	N/A
Total farmland acres (California Government Code Section 65080.01)	501,923	492,735	492,648	492,355	492,079	491,204	491,871	490,681	N/A
Total developed acres	N/A	118,850	123,591	127,384	137,824	153,132	144,449	164,934	N/A
Total commercial developed acres	N/A	70,384	73,134	74,139	76,456	75,183	78,565	76,859	N/A
Total residential developed acres	N/A	48,466	50,457	53,245	61,368	77,949	65,884	88,075	N/A
Total housing units	217,090	238,626	259,051	259,051	314,470	314,470	346,600	346,600	University of the Pacific
Housing vacancy rate (percent)	5.34%	6.52%	4.76%	4.76%	4.76%	4.76%	4.76%	4.76%	University of the Pacific
Total single-family detached housing units	165,965	175,870	188,244	192,020	220,129	236,129	251,863	256,916	VMIP2
Total small-lot single-family detached housing units (5,000 sq. ft. lots and smaller)	N/A	16,983	23,435	21,483	40,881	34,498	31,355	28,744	N/A

Modeling Parameters	2005	2015 (base year)	2020 With Project (1)	2020 W/out Project (2)	2035 With Project	2035 W/out Project	2042 With Project	2042 W/out Project	Data Sources
Total conventional-lot single-family detached units (between 5,001 and 7,000 sq. ft. lots)	N/A	97,408	102,459	102,866	116,354	116,917	137,086	137,631	N/A
Total large-lot single-family detached units (7,001 sq ft. lots and larger)	N/A	61,480	62,350	67,671	62,894	84,714	83,422	90,541	N/A
Total single-family attached housing units	Included in MF	Included in MF	Included in MF	Included in MF	Included in MF	Included in MF	Included in MF	Included in MF	N/A
Total multi-family housing units	49,240	54,692	62,740	58,731	84,907	69,520	83,943	78,579	VMIP2
Total mobile home units & other	7,850	8,064	8,067	8,300	9,434	8,821	10,793	11,105	N/A
Total infill housing units	N/A	N/A	4,533	648	22,013	3,145	N/A	N/A	N/A
Total mixed-use buildings	N/A	N/A	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	N/A	N/A

Modeling Parameters	2005	2015 (base year)	2020 With Project (1)	2020 W/out Project (2)	2035 With Project	2035 W/out Project	2042 With Project	2042 W/out Project	Data Sources
Total housing units within 1/2 mile of transit stations and stops	N/A	61,383	65,376	64,027	77,355	73,852	82,945	75,659	2018 RTP/SCS EJ Analysis
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	N/A	N/A
Total employment within 1/2 mile of transit stations and stops	N/A	95,448	100,914	97,731	117,310	107,709	124,952	107,778	N/A
Freeway general purpose lanes – mixed flow lane miles	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Freeway (lane miles)	703	760	760	760	803	803	840	840	VMIP2
Expressway (lane miles)	416	416	416	416	416	416	416	416	VMIP2
Arterial (lane miles)	1,440	1,489	1,529	1,529	1,742	1,742	1,759	1,759	VMIP2
Collector (lane miles)	1,571	1,572	1,584	1,584	1,643	1,643	1,643	1,643	VMIP2
Local (lane miles)	655	658	658	658	748	748	1748	748	VMIP2

Modeling Parameters	2005	2015 (base year)	2020 With Project (1)	2020 W/out Project (2)	2035 With Project	2035 W/out Project	2042 With Project	2042 W/out Project	Data Sources
Local, express bus, and neighborhood shuttle operation miles	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bus rapid transit bus directional route miles	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Passenger rail operation miles	92	92	224	224	224	224	224	224	Altamont Corridor Express
Transit total daily vehicle service hours	N/A	N/A	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	N/A	N/A
Vanpool (total riders per weekday)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Home-Work	475,152	506,414	552,713	553,587	664,744	651,566	684,856	685,562	VMIP2
Home-Shop	730,044	780,648	844,388	847,316	1,024,858	1,016,365	1,120,460	1,127,046	VMIP2
Home-Other	873,578	910,304	970,443	968,831	11,113,054	1,090,616	1,188,292	1,170,687	VMIP2
Work-Other	179,442	182,497	193,996	193,241	229,253	224,351	243,164	237,049	VMIP2
Other-Other	637,200	681,805	722,828	722,587	815,583	814,952	859,058	856,997	VMIP2
Average weekday trip length by trip purpose (miles)	N/A	N/A	N/A	N/A	N/A	N/A	4,095,830	N/A	VMIP2
Home-Work	25.5	24.1	23.6	23.8	22.0	21.4	18.1	18.3	VMIP2
Home-Shop	8.1	8.0	7.6	7.8	7.3	7.5	7.4	7.6	VMIP2

Modeling Parameters	2005	2015 (base year)	2020 With Project (1)	2020 W/out Project (2)	2035 With Project	2035 W/out Project	2042 With Project	2042 W/out Project	Data Sources
Home-Other	20.8	19.6	18.9	19.1	18.5	18.4	18.4	18.4	VMIP2
Work-Other	12.3	11.0	10.2	10.3	10.7	10.8	10.7	10.8	VMIP2
Other-Other	9.3	9.1	9.2	9.2	9.2	9.1	9.5	9.2	VMIP2
Single Occupant Vechiles (percent of trips)	39.8%	39.9%	39.7%	39.7%	39.6%	40.1%	39.1%	39.4%	VMIP2
Hight Occupant Vehciles (percent of trips	55.6%	55.2%	55.1%	55.3%	55.1%	54.5%	55.6%	55.5%	VMIP2
Transit (percent of trips)	0.8%	0.7%	0.8%	0.7%	0.7%	0.7%	0.8%	0.7%	VMIP2
Non-motorized (percent of trips)	3.9%	4.2%	4.3%	4.3%	4.5%	4.3%	4.6%	4.5%	VMIP2
Single Occupant Vechiles (percent of trips)	39.5%	39.6%	39.4%	39.4%	39.3%	39.8%	38.8%	39.1%	VMIP2
Hight Occupant Vehciles (percent of trips	55.21%	54.8%	54.7%	54.8%	54.7%	56.2%	55.1%	55.0%	VMIP2
Transit (percent of trips)	0.8%	0.7%	0.8%	0.7%	0.8%	0.7%	0.7%	0.6%	VMIP2
Non-motorized (percent of trips)	4.5%	4.9%	5.1%	5.0%	4.5%	5.0%	5.4%	5.2%	VMIP2
Single Occupant Vechiles	18.7	17.6	17.2	17.3	16.4	16.2	14.8	14.9	VMIP2
Shared ride 2	16.6	15.9	15.3	15.5	14.8	14.6	14.6	14.7	VMIP2
Shared Ride 3+	12.0	11.6	11.5	15.5	11.4	11.3	11.6	11.4	VMIP2

Modeling Parameters	2005	2015 (base year)	2020 With Project (1)	2020 W/out Project (2)	2035 With Project	2035 W/out Project	2042 With Project	2042 W/out Project	Data Sources
Transit	9.2	9.3	8.8	9.2	8.9	9.6	9.0	9.6	VMIP2
Walk/Bike	2.6	2.6	2.7	2.7	2.7	2.8	2.8	2.8	VMIP2
Total VMT per weekday for passenger vehicles (ARB vehicle classes of LDA, LDT1, LDT2 and MDV) (miles) (3)	14,600,612	N/A	16,962,943	17,043,025	19,809,491	19,887,811	21,004,259	21,147,029	VMIP2/EMFAC2014
Total II (Internal) VMT per weekday for passenger vehicles (miles)	6,764,027	N/A	7,493,247	7,583,952	8,802,616	8,882,373	9,488,738	9,614,160	VMIP2/EMFAC2014
Total IX/XI VMT per weekday for passenger vehicles (miles)	5,926,143	N/A	6,579,705	6,571,937	7,082,991	7,089,811	7,123,022	7,151,619	VMIP2/EMFAC2014
Total XX VMT per weekday for passenger vehicles (miles)	1,910,442	N/A	2,889,992	2,887,136	3,923,884	3,915,627	4,392,499	4,381,249	VMIP2/EMFAC2014
Congested AM Peak Hour VMT all roadway (Lane Miles, V/C ratios >0.75)	N/A	1,561,567	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Modeling Parameters	2005	2015 (base year)	2020 With Project (1)	2020 W/out Project (2)	2035 With Project	2035 W/out Project	2042 With Project	2042 W/out Project	Data Sources
Uncongested AM Peak VMT on all roadways	N/A	2,684,467	N/A	N/A	N/A	N/A	N/A	N/A	N/A
(Lane Miles, V/C ratios >0.75)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total carbon dioxide emissions per weekday for passenger vehicles (ARB vehicle classes LDA, LDT1, LDT2, and MDV) (tons) (4)	6,945	N/A	7,994	8,023	9,282	9,318	9,762	9,856	EMFAC2014
Total II (Internal) carbon dioxide emissions per weekday for passenger vehicles (tons) (4)	3,217	N/A	3,531	3,570	4,125	4,162	4,410	4,481	EMFAC2014
Total IX / XI trip carbon dioxide emissions per weekday for passenger vehicles (tons) (4)	2,819	N/A	3,101	3,094	3,319	3,322	3,310	3,333	EMFAC2014

Modeling Parameters	2005	2015 (base year)	2020 With Project (1)	2020 W/out Project (2)	2035 With Project	2035 W/out Project	2042 With Project	2042 W/out Project	Data Sources
Total XX trip carbon dioxide emissions per weekday for passenger vehicles (tons) (4)	909	N/A	1,362	1,359	1,839	1,835	2,041	2,042	EMFAC2014
Percent change in per capita greenhouse gas emissions due to EMFAC 2011 to EMFAC2014 adjustment (5)	N/A	N/A	0.4	0.4	0.6	0.6	0.7	0.7	CARB SCS Adjustment Methodology/ EMFAC2011/ EMFAC2014
Total RTP Expenditure (Dollars)	N/A	N/A	N/A	N/A	N/A	N/A	11.40	11.33	2018 RTP/SCS
Highway capacity expansion (Dollars)	N/A	N/A	N/A	N/A	N/A	N/A	2.16	2.25	2018 RTP/SCS
Other road capacity expansion (Dollars)	N/A	N/A	N/A	N/A	N/A	N/A	0.84	0.84	2018 RTP/SCS
Roadway maintenance (Dollars)	N/A	N/A	N/A	N/A	N/A	N/A	4.45	4.53	2018 RTP/SCS
BRT projects (Dollars)	N/A	N/A	N/A	N/A	N/A	N/A	1.01	0.99	2018 RTP/SCS

Modeling Parameters	2005	2015 (base year)	2020 With Project (1)	2020 W/out Project (2)	2035 With Project	2035 W/out Project	2042 With Project	2042 W/out Project	Data Sources
Transit capacity expansion (Dollars)	N/A	N/A	N/A	N/A	N/A	N/A	0.63	0.59	2018 RTP/SCS
Transit operations (Dollars)	N/A	N/A	N/A	N/A	N/A	N/A	1.87	1.76	2018 RTP/SCS
Bike and pedestrian projects (Dollars)	N/A	N/A	N/A	N/A	N/A	N/A	0.31	0.27	2018 RTP/SCS
Vehicle operating costs (Dollars per mile)	19.56	22.58	24.45	24.45	22.54	22.54	23.66	23.66	VMIP2
Gasoline price (Dollars per gallon)	2.82	3.45	4.08	4.08	4.83	4.83	5.23	5.23	VMIP2
Average transit fare (Dollars)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Parking cost (Dollars)	None	None	None	None	None	None	None	None	N/A

(1) This scenario includes modeling of all planned and programmed projects in RTP/SCS for respective calendar year.

(2) This scenario reflects the MPO's Business as Usual scenario, which for most is what would happen under the MPO's previously adopted RTP for the respective calendar year.

(3) Passenger vehicles includes (1) passenger cars (LDA), (2) light-duty trucks whose gross vehicle weight rating (GVWR) <6000 lbs and equivalent test weight (ETW) <= 3750 lbs (LDT1), (3) light-duty trucks whose GVWR <6000 lbs and ETW between 3751 and 5750 lbs (LDT2), and (4) medium-duty vehicles whose GVWR between 6000 and 8500 lbs (MDV). In the CARB vehicle category, these four categories of vehicles are referred to as of LDA, LDT1, LDT2, and MDV, respectively.

(4) Data in this section are estimated using EMFAC model. The associated EMFAC Input and Output files are provided separately to CARB.

(5) Information regarding EMFAC adjustment is provided separately to CARB. XX VMT and GHG were excluded to ensure consistency with EMFAC GHG reporting and SB 375 rules, which require that MPOs exclude XX trips from GHG calculations.

Appendix D: Performance Indicators

This appendix describes in more detail changes in key non-GHG indicators that describe SCS performance. These indicators are examined to determine if they can provide qualitative and quantitative evidence that the SCS, when implemented, could meet its GHG targets. The evaluation looked at directional consistency of the performance indicators with SJCOG's modeled GHG emissions reductions, as well as the general relationships between those indicators and GHG emissions reductions, based on the empirical literature. The 2018 SCS performance indicators evaluated include: residential density, new housing mix, jobs and housing near transit, and per capita VMT.

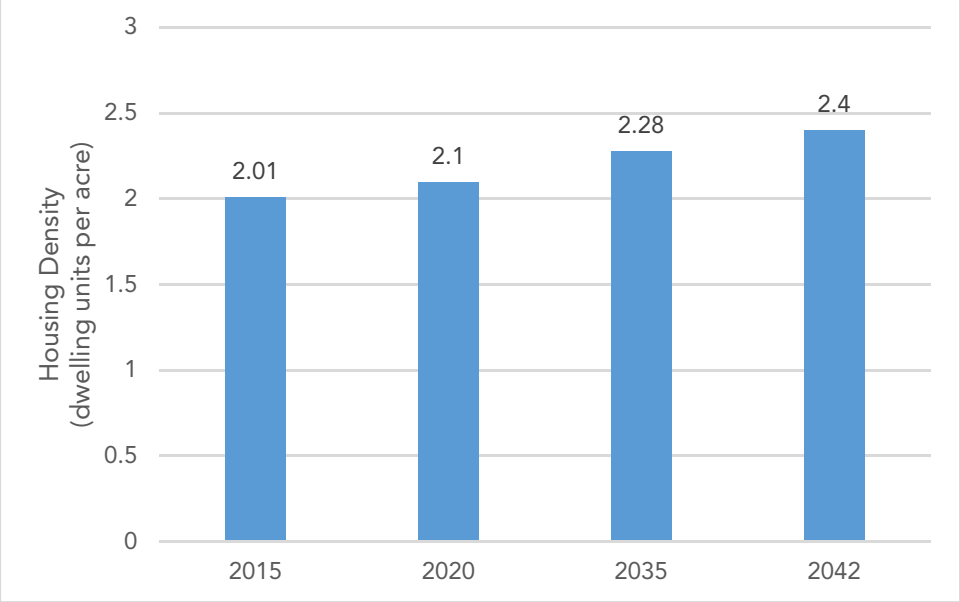
Land Use Indicators

Land use influences the travel behavior of residents including both mode choice and trip length. The evaluation focused on three land use-related performance indicators to determine whether they support SJCOG's land use strategies and forecasted GHG emissions forecast: residential density, mix of housing types, and jobs and housing near transit.

Residential Density

Figure 3 shows that the residential density in SJCOG will increase from 2.0 to 2.1 dwelling units per acre, or 4.4 percent from 2015 to 2020. The residential density continues to increase to 2.3 and 2.4 dwelling units per acre in 2035 and 2042, respectively. Residential density can help reduce auto trip length and household VMT, which is supportive and consistent with SJCOG's GHG emissions reduction quantification.

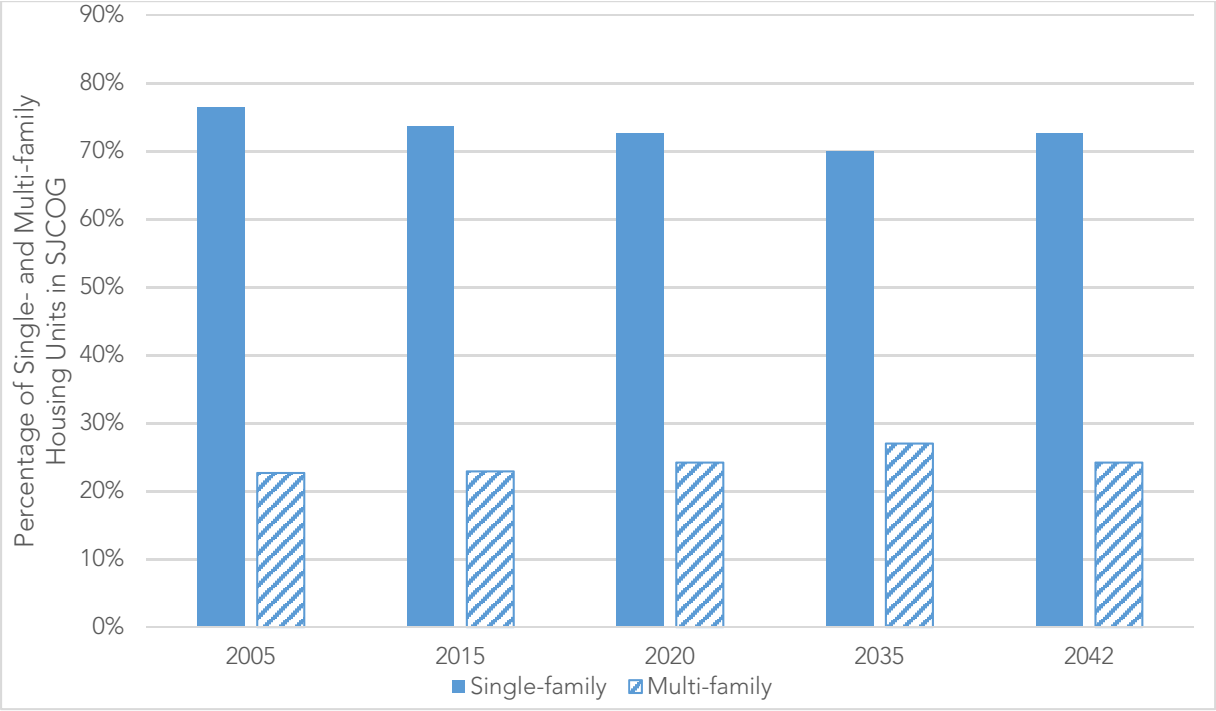
Figure 3. Residential Density Forecast in San Joaquin County



Mix of Housing Types

Figure 4 shows that the mix of housing types in the region is forecasted to shift increasingly towards multi-family housing units. Multi-family housing units will account for 24 percent of total housing units in 2020, 27 percent in 2035, and 24 percent of total housing units in the region in 2042, which are higher than the 2005 baseline multi-family housing unit rate of 23 percent. However, CARB staff noticed that the multi-family housing units will decrease in 2042 compared to 2035, which is not explained in SJCOG's SCS. Building more multi-family housing units can help increase housing density and accessibility to destinations, which may reduce auto trip lengths and household VMT, and thus GHG emissions. Therefore, the increased share of new multi-family housing units is supportive and consistent with SJCOG's GHG emissions reduction quantification.

Figure 4. Split of Total Single- and Multi-Family Housing Units

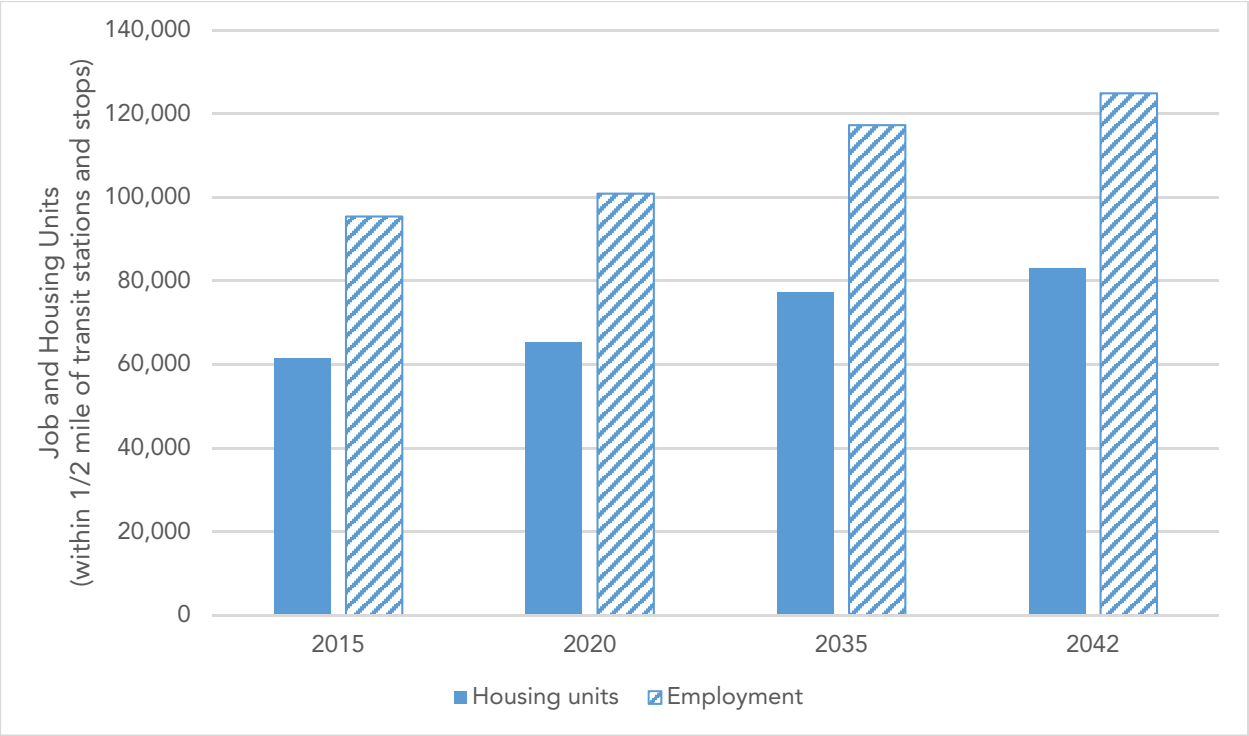


Jobs and Housing near Transit

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

Figure 5 summarizes the number of jobs and housing units projected to be within a half-mile of transit stations or stops based on SJCOG's 2018 SCS. Compared to the 2015 model base year, the 2018 SCS shows an increasing trend in the numbers of jobs and housing units near transit in future. This trend is supportive and consistent with SJCOG's GHG emissions reduction quantification.

Figure 5. Jobs and Housing Units near Transit Stations and Stops



Transportation Indicators

CARB staff evaluated per capita VMT as a performance indicator to determine whether the trends support SJCOG's transportation strategies and the reported GHG emissions reductions.

Per Capita VMT

SJCOG's 2018 SCS shows a declining trend in per capita passenger vehicle VMT in 2020, 2035, and 2042, compared to 2005. As shown in Figure 6, per capita VMT is modeled to decrease by 9 percent from 2005 to 2020, and by 16.1 percent from 2005 to 2035, and 20.8 percent from 2005 to 2042. CARB staff determined that the passenger vehicle VMT reduction is consistent with SJCOG's claimed GHG emissions reductions. Despite the VMT reduction trends forecasted by SJCOG's 2018 SCS, the observed statewide VMT data and other data-supported metrics specific to SJCOG have indicated actual GHG emissions and VMT per capita have not declined as forecasted for 2020. CARB's SB 150 Report explores these trends in more detail and suggests that accelerated action is crucial for public health, economic, equity, and climate success.

Figure 6. Per Capita Passenger VMT