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

September 2019

Electronic copies of this document can be found on CARB's website at http://www.arb.ca.gov/cc/sb375/sb375.htm.

This document has been reviewed by the staff of the California Air Resources Board and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the California Air Resources Board, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

Electronic copies of this document are available for download from the California Air Resources Board's internet site at: http://www.arb.ca.gov/cc/sb375/sb375.htm. In addition, written copies may be obtained from the Public Information Office, California Air Resources Board, 1001 I Street, 1st Floor, Visitors and Environmental Services Center, Sacramento, California 95814, (916) 322-2990.

For individuals with sensory disabilities, this document is available in Braille, large print, audiocassette, or computer disk. Please contact CARB's Disability Coordinator at (916) 323-4916 by voice or through the California Relay Services at 711, to place your request for disability services. If you are a person with limited English and would like to request interpreter services, please contact CARB's Bilingual Manager at (916) 323-7053.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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 (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 July 26, 2018, the Fresno Council of Governments (COG), which serves as the MPO for the Fresno County region, adopted their 2018 SCS. A complete submittal of the 2018 SCS and all necessary supporting information was provided to CARB for review on May 29, 2019. Fresno COG's 2018 SCS estimates a 5.3 percent and 10.7 percent decrease in GHG per capita emissions from light-duty passenger vehicles by 2020 and 2035 compared to 2005, respectively. The region's per capita GHG emissions reduction targets are 5 percent in 2020 and 10 percent in 2035, compared to 2005 levels. This report reflects CARB's technical evaluation of Fresno COG's 2018 SCS GHG quantification.

CARB DETERMINATION

ACCEPT

Based on a review of all available evidence, CARB accepts Fresno COG's determination that its 2018 SCS plan would meet the targets of a 5 percent reduction in GHG per capita emissions from light-duty passenger vehicles in 2020 and a 10 percent reduction in 2035, compared to 2005 levels, when fully implemented.

The 2018 SCS includes an increase in multi-family housing, commercial and residential development near transit, employee carpool and vanpool programs, as well as a significant increase in investment in active transportation projects. Fresno has also implemented Bus Rapid Transit (BRT) along the Kings Canyon Corridor, which was identified in its 2014 SCS. Fresno COG's 2018 SCS contains similar strategies as the first SCS, plus a new electric vehicle (EV) infrastructure strategy. In addition, for the 2018 SCS, Fresno COG incorporated modeling improvements and updated inputs and assumptions, including a decrease in population and housing and an increase in employment, as well as higher investment in active transportation.

With that said, in its SB 150 Report[1] CARB recently assessed on-the-ground progress since regions began developing SCSs and found that California was not on track to meet the GHG reductions expected under SB 375. As a result, the Fresno region may not realize the GHG reductions that the SCS projects and may not be on track to meet the 2020 or 2035 targets, if the plan is not fully implemented.

SCOPE AND METHODOLOGY

CARB examined Fresno COG'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 July 2011 document entitled *Description of Methodology for ARB Staff Review of Greenhouse Gas Reductions from Sustainable Communities Strategies Pursuant to SB 375*.[2]

In addition, as Fresno COG's 2018 SCS is an update to its adopted 2014 SCS, CARB also performed a qualitative review of Fresno COG's implementation actions over the past four years. CARB looked for evidence that Fresno COG has put in place enabling project investments, programs, incentives, or guidance to help support the implementation of the first SCS, and has established a foundation for continued implementation of policies and programs reflected in both their 2014 and 2018 plans.

CHANGES FROM THE REGION'S PREVIOUS SCS GHG QUANTIFICATION

The 2018 SCS retains all of the same strategies and tools as the previous plan with some modifications. Therefore, CARB focused its review on identifying and evaluating changes Fresno COG made between the current 2018 SCS and the previous 2014 SCS[3] with the potential to affect land use, transportation, and the SCS GHG emissions quantification. The 2018 SCS now includes a new electric vehicle infrastructure strategy. CARB staff reviewed changes made to demographic assumptions, the land use and transportation strategies included within the SCS, the model and off-model methods used to calculate passenger travel-related GHG emissions, as well as expected regional land use and transportation performance indicators. Table 1

---

[1] California Air Resources Board. 2018 Progress Report: California's Sustainable Communities and Climate Protection Act. November 2018. Available at: https://ww2.arb.ca.gov/sites/default/files/2018-11/Final2018Report_SB150_112618_02_Report.pdf.

[2] Available at: https://www.arb.ca.gov/cc/sb375/scs_review_methodology.pdf.

[3] CARB's acceptance and technical evaluation of Fresno COG's first SCS was completed in February 2015, and contains detailed information about the methods Fresno COG used to quantify GHG emissions. That information is still relevant for this technical evaluation and is available at: https://ww2.arb.ca.gov/fresno-council-governments-fcog

summarizes the changes in plan assumptions for demographics, land use, and transportation. Table 2 summarizes the changes in Fresno COG's model and off-model GHG emissions calculations.

LAND USE AND TRANSPORTATION STRATEGIES

Fresno COG's 2018 SCS maintains a set of land use and transportation strategies that are similar to those adopted in their previous 2014 SCS, with updates to assumptions used in the adopted scenario for land use and an increase in transportation investments, as further explained below. The adopted scenario was selected for its ability to meet GHG reductions targets while focusing growth in key corridors. It also significantly increased active transportation investments compared to the 2014 SCS and includes road projects that improve regional connectivity.

The 2018 SCS also incorporates updates to the region's forecasted population, employment, and housing growth. Table 1 summarizes these changes and provides CARB's assessment based on consistency with best available information and practice.

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

Action	CARB Assessment	Finding
Revised Regional Growth Forecast	Reasonable	Fresno COG revised population, housing, and employment growth estimates for its 2018 SCS. Projected population in the year 2035 is forecasted to be 3 percent lower in the 2018 SCS compared to the 2014 SCS. In the 2018 SCS, the projected housing units are forecasted to decline by 8 percent, while employment is forecasted to increase by 8 percent in 2035 compared to the 2014 SCS. Fresno County is the third highest-grossing agricultural county in the nation. This has a direct effect on agricultural employment as well as employment in sectors such as wholesale trade, manufacturing, services, finance, insurance and real estate. See Appendix A for more detail.
Updated Land Use Scenario	Reasonable	Fresno COG incorporated new demographic data and met with the region's 15 cities, the County of Fresno, staff from related local public agencies, the San Joaquin Valley Air Pollution Control District,

Action	CARB Assessment	Finding
		Caltrans, other state and federal agencies, and the public to update its land use scenario and local growth forecasts for population, housing, and employment growth. In addition, Fresno COG used parcel level land use data to update the land use scenario. See Appendix A for more detail.
Updated Revenue Projections and Transportation Project List	Reasonable	The 2018 SCS updates both transportation revenue projections and expenditures. Measure C, a local sales tax in Fresno County, is one source of transportation revenue. The breakdown of transportation investments includes 34 percent to road expansion, 40 percent to road maintenance, 18 percent to transit, and 8 percent to active transportation projects. See Appendix A for more detail about transportation investments.

MODEL AND OFF-MODEL CALCULATIONS

Fresno COG used updated modeling tools to evaluate its 2018 SCS with refined input data that slightly affect the quantification of model outputs of vehicle miles traveled (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. In the 2018 SCS, Fresno COG maintains a similar set of strategies quantified off-model, with one additional method added for GHG emissions reductions expected from its electric vehicle (EV) infrastructure program.

Table 2. Key Changes in Model and Off-Model Processes of FCOG's 2018 SCS

Modeling Component	CARB Assessment	Finding
Land Use Model	Reasonable	Fresno COG employed two land use modeling tools for this SCS: Envision Tomorrow and Cube Land. In addition to the Envision Tomorrow, which was used in the previous SCS, Fresno COG added Cube Land into its modeling tools, which includes economic parameters in its land use allocation.

Modeling Component	CARB Assessment	Finding
Travel Demand Model	Reasonable	Fresno COG used the VMIP 2 model for this SCS, which is an updated version of the MIP 1 model used in the previous SCS. The VMIP 2 model used updated data from the most recent Census, American Community Survey, California Household Travel Survey, and traffic counts.
Sensitivity Analysis	Reasonable *(see note)*	Fresno COG conducted one new sensitivity analysis to test the responsiveness of VMT to roadway capacity expansion in the Regional Travel Demand Model. The sensitivity analysis shows short-term induced demand. The model captures the input variable changes and falls within the range indicated by existing literature. Fresno COG also provided a Memo describing the Travel Demand Model changes and stated that the sensitivity analysis from the last SCS is still valid. See Appendix B for more detailed information regarding the sensitivity analysis. Note: Road expansion projects can result in long-term induced travel in the region. Currently, these impacts are not well accounted for in travel demand models or off-model assessments. Future SCSs should appropriately account for this impact, and will be taken into account in CARB's GHG determination.
Adjustment to EMFAC Outputs	Reasonable	Fresno COG followed the procedure demonstrated in CARB's memo titled "*Methodology to Calculate CO2 Adjustment to EMFAC Output for SB 375 Target Demonstrations.*" However, the EMFAC adjustment process was not specifically called out in the RTP/SCS.

Modeling Component	CARB Assessment	Finding
Off-Model Adjustments for Multiple Strategies	Somewhat Reasonable	Fresno COG included a series of off-model strategies in its 2018 SCS. In addition to the off-model strategies from the 2014 SCS, Fresno COG claimed a new off-model strategy, EV infrastructure, in its 2018 SCS. The calculation method for the new EV strategy is somewhat reasonable, since Fresno COG did not provide sufficient detailed information about the strategy and its funding commitment. For other strategies, Fresno COG applied the same methodologies with updated assumptions as the last SCS. See the Recommendations section for additional discussion.

REGIONAL LAND USE AND TRANSPORTATION PERFORMANCE INDICATORS

CARB also re-analyzed several land use and transportation modeled indicators against relationships expressed in the empirical literature between each metric, and VMT and/or GHG emissions to understand whether changes were consistent with forecasted GHG emissions reduction trends. Table 3 shows a summary of Fresno COG's 2018 SCS performance indicators. Data shown in this analysis came from Fresno COG's modeling data table, see Appendix C. Supporting data and charts for performance indicators are provided in Appendix D.

Table 3. Summary of Performance Indicators

Performance Indicator	CARB Assessment	Finding
Land Use Indicators		
Residential Density	Consistent with reducing VMT/ GHG	Fresno COG's 2018 SCS projects an increase of 11 percent in residential density in 2035 compared to the base year of the plan (7.3 to 8.1 housing units per residential developed acre). It should be noted that Fresno COG updated its definition for total developed acres in this SCS, which is discussed in detail in Appendix D.
New Housing Mix	Consistent with reducing VMT/ GHG	Fresno COG's 2018 SCS projects that more new multi-family housing units will be built in Fresno in the future. The new multi-family housing unit rate will continuously increase to 31 percent in 2020 and 36 percent in 2035.
Housing Units near Transit	Consistent with reducing VMT/ GHG	Fresno COG's 2018 SCS projects a 150 percent increase in housing units within ½ mile of transit stations and stops in 2035 compared to the 2005 baseline, from 102,100 to 254,913 units.
Employment near Transit	Consistent with reducing VMT/ GHG	Fresno COG's 2018 SCS assumes a 104 percent increase in employment within ½ mile of transit stations and stops in 2035 compared to the 2005 baseline, from 162,000 to 329,782 jobs.
Transportation Indicators		
Per Capita Passenger VMT	Consistent with reducing VMT/ GHG	Fresno COG's 2018 SCS shows an 11 percent reduction of per capita VMT in 2035 compared to the 2005 baseline, from 17.4 to 15.5 miles per day.
Active Transportation Network	Consistent with reducing VMT/ GHG	Fresno COG's 2018 SCS shows that, additional bicycle and pedestrian related facilities will be built across the county, which can increase active transportation mode share and reduce GHG emissions and VMT.

IMPLEMENTATION OF FRESNO COG'S FIRST SCS

Fresno COG and its member local and regional agencies action over the past four years demonstrate support for implementing the first SCS and establishing a foundation for continued implementation of the policies and programs that are included in both the 2014 and 2018 SCSs.

Source: City of Fresno, Fulton Corridor Specific plan

The strategies of the 2014 and 2018 SCSs include focusing growth in key corridors, and increasing housing options, and travel choices. Since approval of the first SCS in 2014, the City of Fresno adopted the Fulton Corridor Specific Plan, which includes planned land use and transportation connections in the heart of downtown. In addition, the General Plan for the County of Fresno is undergoing updates and includes policies that support a variety of transportation and land use options. The plan supports development of a multi-modal transportation system, compact development, and adequate and affordable housing options. The City of Fresno also updated its General Plan, which calls for 50 percent of new growth in designated infill development areas and proposes no sphere of influence expansions through 2035, which will help rein in sprawl development. The General Plan also includes "complete neighborhood" elements, where residents have easier access to jobs, schools, and other services by a variety of transportation modes. Furthermore, in 2015, Fresno County and 12 of the 15 cities in Fresno County prepared a Multi-Jurisdictional Housing Element for the 2015-2023 housing element update. The primary objective of the project was to prepare a regional plan for addressing housing needs through a single certified housing element for all jurisdictions. This process informed land use assumptions in the RTP/SCS, which are used to estimate VMT and GHG emissions.

Additionally, the City of Fresno, the largest City in the County, has seen development including:

- The City of Fresno received funding from Fresno COG's Measure C Transit Oriented Development (TOD) program for the Fancher Creek Trail project to

provide a separated and accessible multi-modal connection between the affordable senior housing at Fancher Creek Town Center and the existing Fresno Areas Express (FAX) transit station and the future BRT station.

- The Kings Canyon Connectivity Project consists of a 135-unit affordable multi-family housing development in Southeast Fresno that is under construction. The project received funding from the Affordable Housing and Sustainable Communities (AHSC) program in Fiscal Year (FY) 15-16.
- The Park (formerly Phase 1 of South Stadium TOD project) received funding from AHSC. The project, which will soon be under construction, consists of a five-story mixed-use building that includes 51 units and approximately 10,000 square feet of retail/office in downtown Fresno. The infill project also includes streetscape improvements near the project site, including wider sidewalks, Class II and Class IV bike lanes, and additional pedestrian-oriented lighting and smart meters. It will also create a green alley along Home Run Alley and provides pedestrian and bicycle oriented wayfinding signage.
- The Blackstone & McKinley Transit Oriented Development project was approved and received funding from Fresno COG TOD program and AHSC to construct 88 units of affordable multi-family housing located near Fresno City College. It will be a mixed-use building located within ¼ mile of the City of Fresno Bus Rapid Transit Q line.

Enhancing Transportation Options

Fresno COG and its member agencies have delivered, or are nearing completion on a number of transportation projects to implement their 2014 SCS. Projects include:

- FAX Q Bus Rapid Transit Kings Canyon Corridor
- Drycreek Trailhead Multi-use Trail in the City of Clovis
- Fresno County Regional Transit Agency has a new Westside Transit link to provide access to rural residents.
- Fresno County Rural Transit Agency installed solar charging units at each of the 13 cities throughout Fresno County for electric vehicle charging through a collaboration between the Fresno County Rural Transit Agency, the California Energy Commission, CALSTART, CalTrans, San Joaquin Valley Air District, and Envision Solar.

Other innovative efforts include:

- In 2015, the City of Fresno was selected as a Bronze-level Bicycle Friendly Community by the League of American Bicyclists.

- The City of Fresno hosted Ciclovía and Park(ing) day events, which temporality closed certain streets or parking spaces to vehicles and allowed people to re-imagine the way streets are used. These events encouraged people to walk, ride bikes, dance, create open spaces, and hang out in the street.

Policy Guidance and Strategic Planning Documents

Fresno COG and its member jurisdictions have also prepared many transportation and transit-related regional and local planning documents that support implementation of the 2014 SCS. The following planning efforts were completed or have been underway since 2014:

- The City of Fresno published Fresno Area Express Fixed-Route System Restructure Study report, which identifies improvements they are planning to make to the FAX fixed-route transit system.
- The cities of Clovis, Coalinga, Fresno, and Selma approved active transportation plans and Fresno COG prepared a Regional Active Transportation Plan, which provide a vision for where active transportation investments should occur in these communities.
- Golden State Corridor, a multi-jurisdictional infrastructure improvement project, is in the early stages of design and engineering.
- Fresno COG prepared a Long-Range Transit Plan that will guide transit and multi-modal investments and services in the Fresno region through the year 2050.
- Fresno COG is in the process of preparing a Regional Electric Charging. Infrastructure Network Plan to identify and address deficiencies of the Fresno County region's public and transit electric vehicle (EV) charging infrastructure network and to inform the prioritization of deploying future infrastructure investment.
- Fresno COG has kicked off a Regional Transportation Network Vulnerability Assessment that will assess the vulnerability of the Fresno County region’s transportation network to potential impacts of climate change. It will identify strategies to address climate change impacts, which will provide valuable data for local jurisdictions to use and integrate within their general plans, as well as inform the next update of the Regional Transportation Plan.

OTHER FINDINGS AND RECOMMENDATIONS

CARB staff recommend that Fresno COG consider the following improvements to their model, data collection, analysis, and SCS strategies.

Interregional travel matters

External-External trips (XX), also known as through-trips or interregional trips are those that travel through the model region, but do not stop in the region. A trip from Los Angeles to Sacramento on Interstate 5 would be an interregional-trip for Fresno County. In the SCS submittal, Fresno COG did not provide XX trip VMT and GHG emissions data. Although interregional travel is not included in SB 375, appropriately accounting for each type of travel is important for GHG quantification. CARB staff recommend that Fresno COG report both VMT and GHG emissions from both regional and interregional trips in the future as reporting interregional VMT can inform MPO infrastructure coordination within the San Joaquin Valley and can assist Caltrans with strategic planning in the region.

Analyze induced demand (short-term and long-term) effects

Induced demand is demand that has been generated due to improvements made to transportation infrastructure. Increased capacity can lead to increased VMT in the short-term such as rerouting from congested roads to longer uncongested roads or shifting people from other modes to driving or drivers making more frequent trips. Longer-term effects may also occur if households and businesses move to more distant locations or if development patterns become more dispersed in response to the capacity increase. Induced demand is important to analyze as it can affect VMT and GHG emissions. Fresno COG has included road expansion projects in its 2018 SCS. Road expansion projects can lead to long-term induced travel in the region. Currently, long-term induced travel is not well-accounted for by the travel demand model and this may underestimate per capita GHG increases. Fresno COG should explore methods to better analyze the long-term induced demand from road expansion in future SCSs. There are tools available to help MPOs evaluate the effects of induced travel. Examples include, but are not limited to, University of California, Davis National Center

for Sustainable Transportation's Induced Travel Calculator[4] and Impact of Highway Capacity and Induced Travel on Passenger Vehicle Use and Greenhouse Gas Emissions.[5]

Improve off-model strategy calculation methods

In the event an MPO's travel demand model does not have sufficient resolution, nor is sufficiently robust, to characterize the effects of an MPO's RTP/SCS strategy, SB 375 allows for the use of off-model calculations and other approaches to characterize the effectiveness of an RTP/SCS strategy. Fresno COG included strategies that are quantified outside of their travel demand model. Fresno COG applied the same quantification method for most of the strategies with updated assumptions as in its first SCS. CARB staff determined that the quantification for certain strategies are only somewhat reasonable (see Appendix A for detail). Therefore, CARB staff recommends that if Fresno COG continues to quantify these off-model strategies in future SCSs, they should refer to the off-model evaluation framework described in the forthcoming SCS Evaluation Guidelines, which incorporates knowledge from the most recent literature, to better support Fresno COG's analysis for GHG emission reduction.

Meanwhile, Fresno COG should also try to collect more local data for off-model strategy calculation in the future. For example, Fresno COG applied the CalVans and the employer-based trip reduction programs as two off-model strategies to reduce regional VMT in the 2018 SCS. The current quantification methods for both CalVans and Rule 9410 strategies do not fully consider the market demand in the region, but only estimate trip frequencies based on funding projections. This is important to forecast utilization, which would therefore determine the potential reduction in vehicle trips and GHG emissions from these strategies. Fresno COG should develop an interagency process to collaborate with CalVans and the employer-base trip reduction programs in order to develop, validate, and monitor program projections in Fresno. Fresno COG should also provide clearer documentation related to methods and assumptions of individual off-model strategies to support their estimation. CARB staff recommend that Fresno COG develop methods that can track the participation and growth rates within the region for both strategies. CARB's forthcoming SCS Evaluation Guidelines will be a useful resource for Fresno COG to improve off-model analysis in future plan cycles.

---

[4] Available at: https://ncst.ucdavis.edu/research/tools/
[5] Available at: https://www.arb.ca.gov/cc/sb375/policies/hwycapacity/highway_capacity_brief.pdf

In addition, Fresno COG included a new Regional EV charging infrastructure program, and calculated its impacts on GHG emissions using a methodology developed by Metropolitan Transportation Commission (MTC) and San Diego Association of Governments (SANDAG)[6]. EV investment in the region are provided by a variety of sources including CARB, the San Joaquin Valley Air Pollution Control District, Measure C's New Technology program, etc. In future SCSs, Fresno COG should provide a breakdown of funding information to support the EV infrastructure projections. As part of this breakdown of funding sources, Fresno COG should clearly distinguish between local, regional, and state funding sources to fairly claim the GHG emission reduction benefits and to avoid any potential double-counting. Future SCSs may also consider the different activity patterns of different types of EVs. CARB's forthcoming SCS Evaluation Guidelines will be a useful resource for Fresno COG to improve EV-related analysis in future plan cycles, including quantification methods, data sources, and financial commitments . The SCS Evaluation Guidelines can provide a more comprehensive methodology and framework for Fresno COG to conduct future analysis.

SCS Strategy Tracking Implementation

Fresno COG should track implementation of all strategies, including off-model strategies, and provide data-supported metrics to better assess the extent to which the SCS is achieving the SB 375 GHG emission reduction targets. CARB's forthcoming SCS Evaluation Guidelines will be a useful resource for Fresno COG to track implementation in future plan cycles.

SCS Strategy Performance Indicators

Performance indicators are quantifiable measures of the outcomes of key land use and transportation system strategies. These performance indicators are important to assess trends that supports or hinder GHG emissions and VMT reductions over time. Fresno COG should consider including additional transportation performance indicators in order to gauge performance of RTP/SCS Strategies over time. For example, in the submittal provided, Fresno COG only provided BRT directional miles, which is not a direct indicator to assess the performance of the public transit system, including coverage, frequency and utilization. Instead, Fresno COG could include transit ridership, total operational miles or operational hours, and total transit daily vehicle service hours for all public transit modes, which are standard and more valuable performance indicators that

[6] In this methodology, SANDAG and MTC assumed eVMT will increase by 11 percent due to additional EV charging infrastructure. However, Fresno COG assumed a 5 percent increase in eVMT due to EV charging infrastructure.

can be used to demonstrate the growth in public transit and support the transit strategies in the SCS. Providing more meaningful performance indicators may require Fresno COG to update its travel demand model.

REFERENCES

California Air Resources Board. 2011. Description of Methodology for ARB Staff Review of Greenhouse Gas Reductions from Sustainable Communities Strategies (SCS) Pursuant to SB 375. Accessed June 2019 at: http://www.arb.ca.gov/cc/sb375/scs_review_methodology.pdf

California Air Resources Board. 2015. Technical Evaluation of the Greenhouse Gas Emission Reduction Quantification for the Fresno Council of Governments' SB 375 Sustainable Communities Strategy, Staff Report. February 2015. Accessed June 2019 at: https://www.arb.ca.gov/cc/sb375/fcog_technical_evaluation_final_corrected.pdf?_ga=2.197540911.1254818021.1549301214-2091559384.1546887270

California Department of Finance, Demographic Research Unit. 2018. Table P1: Total Estimated and Projected Population for California and Counties: July 1, 2010 to July 1, 2060 in 1-year Increments. Accessed February 2019 at: http://www.dof.ca.gov/Forecasting/Demographics/Projections/.

California Department of Transportation (Caltrans), Economic Analysis Branch Office of State Planning, prepared by The California Economic Forecast. California County-Level Economic Forecast 2015-2040. Accessed February 2019 at: http://dot.ca.gov/hq/tpp/offices/eab/docs/Full%20Report%202015.pdf.

California Employment Development Department. 2018. Long-Term Occupational Employment Projections. Accessed February 2019 at: https://data.edd.ca.gov/Employment-Projections/Long-Term-Occupational-Employment-Projections/4yzm-uyfq

Fresno Council of Governments. 2014. *2014 Regional Transportation Plan / Sustainable Communities Strategy*. Accessed in June 2019 at https://www.fresnocog.org/project/regional-transportation-plan-rtp/

Fresno Council Governments. 2018. *2018 Regional Transportation Plan / Sustainable Communities Strategy.* Accessed June 2019 at: https://www.fresnocog.org/project/regional-transportation-plan-rtp/

Fresno Council of Governments. 2018b. *Regional Transportation Plan / Sustainable Communities Strategy Appendix I: Sustainable Communities Strategy Reference Materials*. Accessed June 2019 at: https://www.fresnocog.org/wp-content/uploads/2017/02/2018-RTP_Appendix-I_FINAL.pdf

APPENDIX A: FURTHER DISCUSSION OF 2018 SCS CHANGES

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

Revised Population, Employment, and Housing Growth Forecast

Fresno COG updated the population, employment growth, and housing forecasts for its 2018 SCS using updated data and a new methodology. The forecasted employment growth was updated by estimating growth in the economic base export industries, particularly agriculture, multiplying that to other business-to-business secondary sectors, then adding in residential-serving employment based upon population estimates and health care employment using a method from the Economic Modeling Specialists Institute.[7] Population estimates for each of the 15 incorporated cities, and the unincorporated County, were forecasted independently using a population cohort survival method, with in- and out-migration rates calibrated against change between the 2010 decennial Census and 2015 estimates from the California Department of Finance.[8]

Table 4 below compares population, household, housing units, and employment estimates used in the 2014 and 2018 SCSs. The forecast for 2020 and 2035 include a stronger recovery in employment from the 2008 recession than in the previous SCS and slower growth in population, households, and housing units. Compared to the last plan, between 2005 and 2035, this plan expects 3 percent less population growth and 8 percent fewer housing units built, while also expecting 8 percent more employment growth.

[7] Fresno COG Regional Transportation Plan/ Sustainable Communities Strategy 2018-2042, page 1-9, and Appendix I.
[8] Fresno COG Regional Transportation Plan/ Sustainable Communities Strategy 2018-2042 page 1-10, and Appendix I.

Table 4. Comparison of Population, Household, Housing, and Employment Estimates in the Fresno COG 2014 and 2018 SCS

	Year	2014 SCS	2018 SCS	Difference
Population	2020	1,082,097	1,047,440	-3%
Population	2035	1,300,597	1,258,860	-3%
Households	2020	350,337	332,302	-5%
Households	2035	412,180	379,292	-8%
Housing units	2020	373,494	356,538	-5%
Housing units	2035	439,425	405,273	-8%
Employment	2020	363,581	398,050	9%
Employment	2035	427,728	460,100	8%

Source: Fresno 2014 and 2018 data tables

The final population projections are just slightly higher than the forecasts available from the California Department of Finance (DOF) Demographic Research Unit, with the gap growing in later years of the plan.[9] Compared to the DOF forecast from January 2019, Fresno COG's SCS expects the population to be 1 percent higher in 2020 and 5 percent higher in 2035 and 2042, the SCS horizon year. Between 2014 and 2035, Fresno COG's SCS expects 4 percent more population growth than the Department of Finance 2019 forecast over the same period. Note that the population projections were originally prepared and adjusted to DOF 2015 population estimates,[10] which is why the population estimates project higher growth than DOF's January 2019 forecast. Therefore, the forecasts utilized in the 2018 SCS are reasonable.

The two largest employment sectors in the region are federal, state, and local government (18.6 percent) and education and health services (16.8 percent).[11] Fresno County is the third highest-grossing agricultural county in the nation and agriculture accounts for 12.4 percent of Fresno County's jobs. Retail trade (10.1 percent) is another major employer. The employment projections sit within a range of forecasts

[9] California Department of Finance, Demographic Research Unit. January 2019. Table P1: Total Estimated and Projected Population for California and Counties: July 1, 2010 to July 1, 2060 in 1-year Increments. Accessed February 2019 at: http://www.dof.ca.gov/Forecasting/Demographics/Projections.
[10] Fresno COG Regional Transportation Plan/ Sustainable Communities Strategy 2018-2042 page 1-10, and Appendix I.
[11] Fresno COG Regional Transportation Plan/ Sustainable Communities Strategy 2018-2042, Chapter 1 page 1-5, and Appendix I.

created by State of California agencies.[12] Fresno COG's projection for 2035 is slightly higher (by approximately 2 percent) than that of the California Department of Transportation,[13] and is slightly lower than that of the California Employment Development Department.[14]

The MPO population and household projections in Fresno for this SCS are derived via a population cohort survival model developed by Applied Development Economics. Fresno COG then used both vacancy rates and replacement unit rates to conduct the analysis that projects the total number of future housing units.[15]

Revision in Transportation Funding Plan

For the 2018 SCS, Fresno COG updated the transportation expenditure plan. Total spending increased by nearly 60 percent, from approximately $4.4 billion to $6.9 billion.[16,17]The pattern of spending changed as well. The spending allocations by mode are shown in Figure 1.

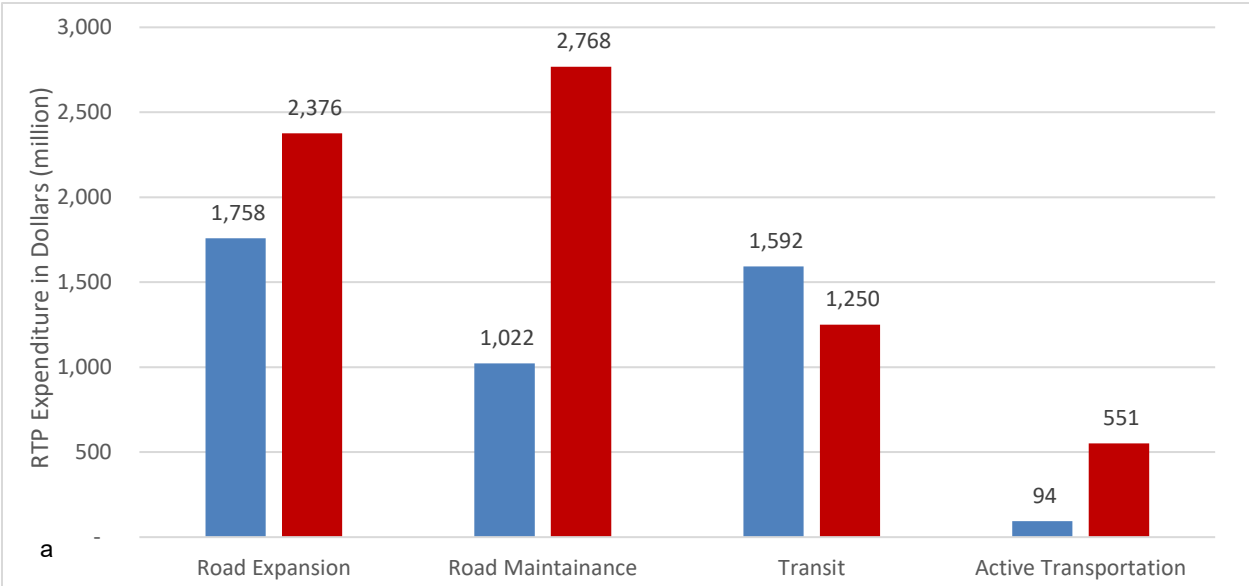
The largest increase in investment occurred in the category of maintenance and operations, which grew from 23 to 40 percent. The portion of the plan devoted to transit fell from 36 to 18 percent. The category of active transportation increased from 2 to 8 percent. The total amount of investment for roadway expansion also increased (as shown in figure 1); however, compared with the 2014 SCS, the portion of the plan devoted to roads and highway expansion decreased from 39 to 34 percent, due to the

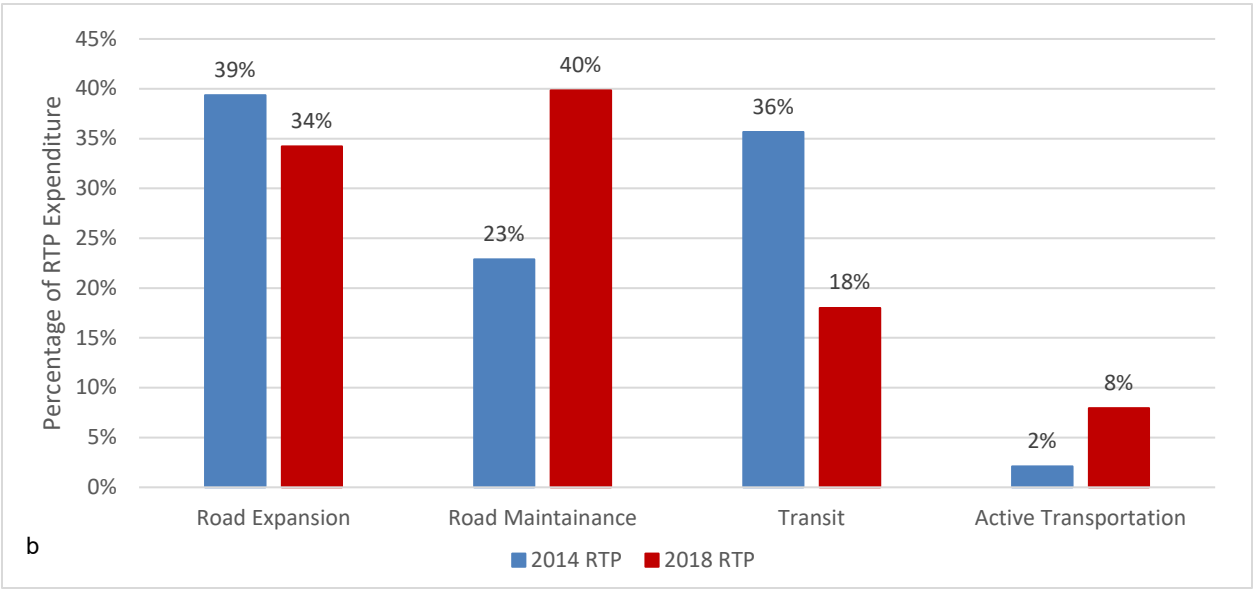
[12] The population projections of the Department of Finance and the employment projections of Caltrans are derived using different methodologies and thus would not be expected to align. The fact that the SCS is higher than one source and lower than another says as much about those two distinct external data sources as it does about the SCS and is not considered to be an inconsistency.
[13] California Department of Transportation (Caltrans), Economic Analysis Branch Office of State Planning, prepared by The California Economic Forecast. 2015. California County-Level Economic Forecast 2015-2040. Accessed February 2019 at: http://dot.ca.gov/hq/tpp/offices/eab/docs/Full%20Report%202015.pdf.
[14] CARB reviewed information from the Employment Development Department (EDD) for 2014 to 2024. This forecast expects employment in the region to grow by a little over 12 percent by 2024, which if extended to 2035, would be a growth rate of 26 to 28 percent depending upon the method used. The SCS expects employment to grow by 26 percent from 2014 to 2035. The EDD estimate also begins from a larger baseline, putting all estimates above those of Fresno COG. Source: Employment Development Department. July 26, 2018. Long-Term Occupational Employment Projections. https://data.edd.ca.gov/Employment-Projections/Long-Term-Occupational-Employment-Projections/4yzm-uyfq. Accessed February 2019.
[15] Fresno County 2050 Growth Projections, May 2017, https://www.fresnocog.org/wp-content/uploads/publications/Demographics/Fresno_COG_2050_Projections_Final_Report_050417.pdf
[16] All figures represent escalated Year of Expenditure dollar values.
[17] Fresno COG's 2014 RTP/SCS constrained project list included $4.4 billion in project programming. However, the projected revenue for the 2014 RTP/SCS was $6.5 billion. Fresno COG's 2018 RTP/SCS now has enough projects to spend $6.9 billion.

overall increase in the total planned transportation expenditure. It is also important to note that many road maintenance and operations projects also include funding for bicycle and pedestrian elements.[18]

[18] Project descriptions can be seen in Appendix C of Fresno COG's 2018 RTP/ SCS: https://www.fresnocog.org/wp-content/uploads/2017/02/2018-RTP_Appendix-C_FINAL.pdf.

Figure 1.Fresno COG Planned SCS Transportation Expenditures by Mode (2014 vs. 2018 Plans)





Sources: FCOG's SB 150 Data Submittal to CARB (2014 SCS Funding),
RTP/SCS Table 5-1: Total Expenditures by Project Type (2018 SCS Funding).
All dollar values used in calculations are in Year of Expenditure.

Notes: Figure 1 (a) describes the total amount and (b) describes the percentage of expenditure by type. Neither the 2014 RTP nor the 2018 RTP included any funding for the CA high-speed rail projects. The 2018 RTP included an improved methodology for estimating the cost of transit projects. In the four-year period between the two plans, the Fresno bus rapid transit (BRT) project was completed, which represented a significant share of the transit funding reported in the 2014 plan.

Land Use Model

Fresno COG used Cube Land in addition to Envision Tomorrow for its land use allocation methodology. The deployment of Cube Land allowed the land use modeling process to consider the impacts of the economy on land use changes, in addition to the policies and land use planning assumptions. Fresno COG applied the projected growth from Cube Land as the control totals for Envision Tomorrow, which is a land-use scenario development tool used by Fresno COG in both the previous and current SCS.

Travel Demand Model

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

The main structure of the VMPI2 is the same as VMIP1 used from Fresno COG's previous 2014 SCS. Updating from VMIP1, the VMIP2 incorporated the most recent Census, American Community Survey, and California Household Travel Survey data, so that the modeling results are more up-to-date. The VMIP2 also enhanced the model structure of VMIP1. Key enhancements include land use changes, socio-economic changes, interregional travel, and modified assumptions in employment density, intersection density, and accessibility, according to Fresno COG.

Off-Model Adjustments

Fresno COG relied on several off-model adjustments for various strategies to demonstrate their regional SB 375 targets, including regional EV charging infrastructure programs, active transportation projects, vanpool program, rideshare programs, Rule 9410 Employer Trip Reductions, intelligent transportation systems (ITS), and other transportation system management (TSM) projects. The adjustment methods for most strategies (e.g., active transportation, vanpool, rideshare, employer trip reduction program, and ITS strategies) were consistent with the methods used in their 2014 SCS, with updated assumptions and methodologies. Fresno COG has provided a Memo to CARB describing the key updates, assumptions, and supporting documentation of all strategies used in their 2014 SCS. Fresno COG included one new off-model strategy in their 2018 SCS, regional EV charging infrastructure programs.

Fresno COG updated the off-model calculation methods for vanpool programs and the employer-based trip reduction program (i.e., Rule 9410 Employer Based Trip Reduction or eTrip), and increased the VMT reduction estimates for these corresponding strategies. Fresno COG estimated that the vanpool project is expected to reduce regional VMT by 2.4 percent, and the Rule 9410 is expected to reduce regional VMT by

2.5 percent. These estimated reductions are almost doubled compared to the last SCS. CARB staff reviewed the updated calculation methods, assumptions, and supporting documents and found that the increased estimations are reasonably appropriate. The analyses for individual off-model strategies are discussed in the following sub-sections.

Vanpool program expansion

CalVans is receiving funding from multiple Federal and State sources, including an AHSC Grant, local funding from Fresno County Measure C, and local funding from the San Joaquin Valley Air Pollution Control District "REMOVE II" Program.[19] Meanwhile, CalVans' staff has been working with individuals and companies in various industries, including government, farm workers, growers, and the private sector to expand the program. The employment growth in distribution facilities within Fresno such as Amazon and Ulta Beauty, which recently opened in 2018, may also increase CalVans' ridership. With the funding commitment and the growth projections in CalVans users, CARB staff conclude that it is somewhat reasonable that Fresno COG's 2018 SCS increased the projection for CalVans growth in the target years and the associated numbers in VMT and GHG emission reductions. However, Fresno COG should collect local data to assess region-specific demand for the CalVans program in order to improve the accuracy of the quantification method.

Rule 9410 Employer Trip Reductions

For Rule 9410, Fresno COG applied the average commute trip lengths (i.e., home-based work (HBW) trip lengths) reported by their travel demand model. The average HBW trip lengths increased from around 8.9 miles in the 2014 SCS to around 14.6 miles in the 2018 SCS. According to Fresno COG's Memo, the differences are mainly due to the travel demand model updates that occurred in 2017, which replaced VMIP1 with VMIP2. The updated model improved HBW trip length calibration to better fit the trip length reported by the 2012 California Household Travel Survey (CHTS). CARB staff analyzed the CHTS data and found that the average HBW trip length in Fresno County is 12.6 miles per trip, which is closer to the trip length reported in VMIP2. Therefore, CARB staff concludes that it is somewhat reasonable that Fresno COG's 2018 SCS increased the projection for VMT reductions from Rule 9410. CARB staff

[19] Fresno COG, Response to CARB, May 2019.

recommend that Fresno COG continue to monitor and validate trip lengths in the future round of SCSs.

Rideshare programs

Fresno COG's 2018 SCS included a car sharing strategy (i.e., Valleyrides carpool incentive program). The program reported 58,527 daily commute carpool VMT in year 2015/16. By encouraging increased pooling, the program reduced about 0.3 percent of the regional VMT. Fresno COG projects that a similar trend will continue in the future. The Valleyrides carpool program is fully funded by Fresno County's ½ cent sales tax, Measure C, and administrated by Fresno COG staff. CARB staff concludes that the methods and the estimated numbers for VMT and GHG emission reductions from this strategy are reasonable.

Active transportation, ITS and other TSM projects

Fresno COG also claimed multiple intelligent transportation systems (ITS), transportation systems management (TSM), and active transportation strategies in the region, and used the Moving Cooler tool to quantify the cumulative effects in VMT and GHG emission reductions. The methods and the claimed reductions are consistent with the previous SCS.

Regional EV charging infrastructure programs

The newly included EV charging infrastructure strategy quantifies the GHG emissions benefits from the multiple funding programs from Fresno Rural Transit Agency, PG&E, Electrify America, and other sources. The investment includes funding for charging station installation projects in the region. For example, Fresno COG's Measure C New Tech Program awards funding for EV infrastructure and other new tech projects. There was $5.7 million available in 2018, and about $3 million is estimated to be available every two years for this program. The San Joaquin Valley Air Pollution Control District also provides funding through its Charge Up! Program for public agencies, businesses, and property owners of multi-unit dwellings to install EV chargers. According to Fresno COG's 2018 SCS and supporting documentation, 7,508 additional EV charging stations will be installed in the region, including residential, workplace, and public chargers. The number of chargers will continue to increase to 9,695 by 2050.

Based on the EV charging infrastructure projections, Fresno COG utilized the method created by SANDAG to estimate the associated increase in eVMT, which

will in turn reduce fossil fuel consumption and carbon dioxide (CO_2) emissions. However, the level of detail for this strategy and its funding commitment are not specific. Therefore, CARB staff determined that the overall analysis and the amount of claimed benefits are conservative and somewhat reasonable.

Adjustment to EMFAC Outputs

The EMFAC adjustment factor for Fresno COG is -5.7 percent in 2020 and -7.1 percent in 2035. Since the 2014 SCS, Fresno COG used different versions of CARB's EMFAC model in quantifying the GHG emissions for its 2014 and 2018 SCSs. To allow an "apple to apples" comparison of the first and second round of SCSs, CARB developed a methodology to calculate a CO_2 adjustment factor for SB 375 target demonstrations to allow MPOs to adjust the calculation of percent reduction in per capita CO_2 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 their targets, regardless of the version of EMFAC used for the second SCS. Fresno COG followed the methodology and their CO_2 per capita reduction results were adjusted accordingly.

APPENDIX B: TRAVEL DEMAND MODEL SENSITIVITY ANALYSES

This appendix describes in more detail the travel demand model sensitivity analysis conducted by Fresno COG. Sensitivity analysis tests the responsiveness of the travel demand model to changes in selected input variables. The responsiveness, or sensitivity, of the model to changes in key inputs indicates whether the model can reasonably estimate the anticipated change in VMT and associated GHG emissions resulting from the policies in the SCS. This analysis usually assumes one input variable change at a time and examines the range of output changes.

Fresno COG submitted a Sensitivity Test Memo stating that the sensitivity analyses conducted for the VMIP1 model, including Auto Operating Cost, Transit Frequency, Residential Density, Proximity to Transit, and Household Income Distribution, are still valid for VMIP2. According to the Memo, the VMIP2 model structure as a whole, including the majority of the modeling scripts and the inherent four-step travel demand model framework, remain the same as VMIP1. In other words, sensitivity of VMIP2 to various inputs and SCS strategies are similar to VMIP1. Therefore, repeating the sensitivity tests using VMIP 2 conducted in VMIP1 is redundant and not necessary.

Fresno COG submitted a roadway capacity expansion sensitivity analysis using VMIP2, which was not conducted using VMIP1. With regard to this new sensitivity analysis, the modeled VMT changed in the expected direction and fell within the expected range.

ROAD CAPACITY EXPANSION

To determine the responsiveness of the Fresno COG model, a section of State Route (SR) 41, between downtown Fresno and Herndon Avenue, was modeled with a different number of freeway-through lanes, in addition to the existing 3 lanes in each direction configuration in the 2014 base case. Figure 2 shows the location of SR 41. Two alternative roadway configurations were tested: 2 through lanes in each direction (representing a 33 percent reduction in capacity) and 4 through lanes in each direction (representing a 33 percent increase in capacity from the base case).

CARB staff analyzed whether or not the results of the sensitivity test demonstrate that the model is showing output changes (i.e., VMT) that are within the range of values published in relevant empirical literature. Table 5 shows that the modeled VMT from Fresno COG's sensitivity tests changed in the expected direction and fell within the expected range. Therefore, CARB staff concluded that the model is sensitive to roadway expansion and its associated short-term induced travel. It should also be noted that the current model cannot capture the impacts of roadway expansion on long-term induced travel.

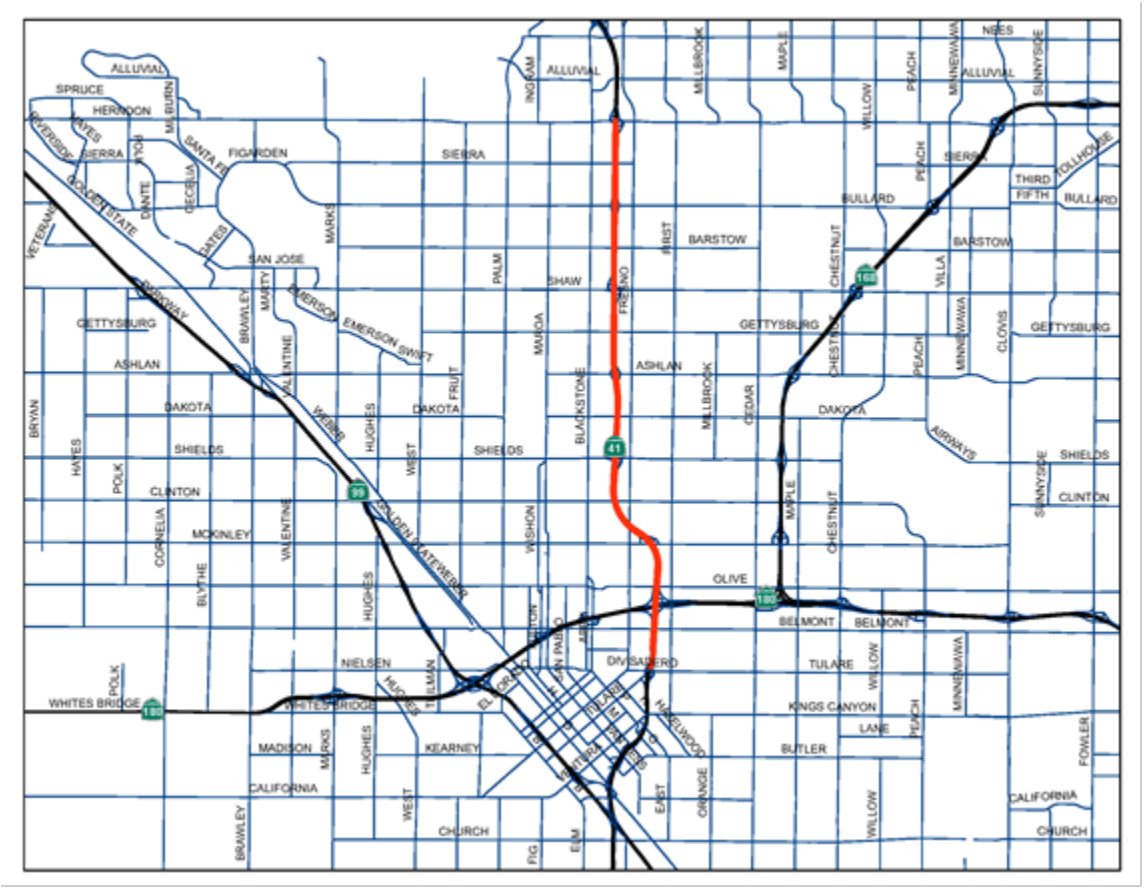
Table 5. Roadway Expansion Sensitivity Model Performance

Scenario	Total Modeled Lane Miles	Delta of Lane Miles	Total Regional VMT	Delta of Regional VMT	Expected VMT Change from Literature[20]
33% decrease in capacity on a urban section of SR41	6,607	-15	23,511,502	-45,076	-5,340 – -53,360
2014 base	6,622	NA	23,556,578	NA	NA
33% increase in capacity on a urban section SR41	6,635	13	23,565,986	9,408	4,620 – 46,245

Source: Fresno COG RTP/SCS Model Sensitivity Tests Memo, March 2019.

[20] *Impact of Highway Capacity and Induced Travel on Passenger Vehicle Use and Greenhouse Gas Emissions Policy Brief*, Susan Handy and Marlon G. Boarnet, September 2014; https://www.arb.ca.gov/cc/sb375/policies/hwycapacity/highway_capacity_brief.pdf

Figure 2. Area of SR-41 Sensitivity Test



Source: Fresno COG, May 2019.

APPENDIX C: DATA TABLE

Modeling Parameters	2005	2014 (base year)	2020		2035		2042		Data Source(s)
			With Project[1]	Without Project[2]	With Project	Without Project	With Project	Without Project	
DEMOGRAPHICS									
Total population	872,569	957,916	1,047,440	1,047,440	1,258,860	1,258,860	1,347,000	1,347,000	Census, FCOG Demographic Forecast
Group quarters population	17,827	17,624	18,690	18,690	22,750	22,750	24,340	24,340	Census, FCOG Demographic Forecast
Total employment (employees)	335,159	366,205	398,050	398,050	460,100	460,100	482,600	482,600	Census, FCOG Demographic Forecast
Average unemployment rate (%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total number of households	274,129	297,993	332,302	332,302	379,292	379,292	399,382	399,382	Census, FCOG Demographic Forecast
Persons per household	3.12	3.16	3.1	3.1	3.26	3.26	3.31	3.31	Calculated
Auto ownership per household	1.773	1.585	1.573	1.573	1.552	1.552	1.551	1.551	VMIP model
Mean household income	N/A	$63,045	$67,593	$67,593	$82,122	$82,122	$87,102	$87,102	Census, FCOG Demographic Forecast
LAND USE									
Total acres within MPO	3,847,339	3,847,339	3,847,339	3,847,339	3,847,339	3,847,339	3,847,339	3,847,339	GIS

Modeling Parameters	2005	2014 (base year)	2020		2035		2042		Data Source(s)
			With Project[1]	Without Project[2]	With Project	Without Project	With Project	Without Project	
Total resource area acres (CA GC Section 65080.01)	N/A	3,232,720	3,230,332	3,230,332	3,228,276	3,228,276	3,227,907	3,227,907	FMMP 2012, FEMA floodzones, Critical Habitat Areas, General Plan data, etc.
Total farmland acres (CA GC Section 65080.01)	N/A	1,139,652	1,139,643	1,139,643	1,139,625	1,139,625	1,139,625	1,139,625	FMMP 2012
Total developed acres	N/A	95,552	101,128	101,128	107,074	107,074	107,912	107,912	COG SCS Data
Total commercial developed acres	N/A	51,471	53,287	53,287	56,765	56,765	57,457	57,457	"
Total residential developed acres	N/A	44,081	47,841	47,841	50,309	50,309	50,455	50,455	"
Total housing units	294,155	321,281	356,538	356,538	405,273	405,273	426,174	426,174	"
Total housing unit growth (against 2005)	0	27,126	62,383	62,383	111,118	111,118	132,019	132,019	"
Housing vacancy rate (%)	6.80%	7.20%	6.80%	6.80%	6.40%	6.40%	6.30%	6.30%	"
Total single-family detached housing units	192,643	211,568	233,198	233,198	258,199	258,199	268,440	268,440	"
Total small-lot single-family detached housing units (5,500 sq. ft. lots and smaller)	N/A	20,363	30,129	30,129	45,933	45,933	51,754	51,754	"
Total conventional-lot single-family detached units (between 5,500 and 10,900 sq. ft. lots)	N/A	139,330	144,532	144,532	149,813	149,813	152,772	152,772	"
Total large-lot single-family detached units (10,900 sq ft. lots and larger)	N/A	51,875	58,538	58,538	62,453	62,453	63,914	63,914	"

Modeling Parameters	2005	2014 (base year)	2020		2035		2042		Data Source(s)
			With Project[1]	Without Project[2]	With Project	Without Project	With Project	Without Project	
Total single-family attached housing units	10,823	11,529	13,550	13,550	16,491	16,491	17,547	17,547	"
Total multi-family housing units	75,757	82,944	94,566	94,566	115,484	115,484	125,129	125,129	"
Total mobile home units & other	14,932	15,240	15,223	15,223	15,098	15,098	15,058	15,058	"
Total infill housing units	241,197	263,504	290,054	290,054	302,569	302,569	303,587	303,587	"
Total mixed-use buildings	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	79,500	165,796	182,087	182,087	192,129	192,129	193,388	193,388	"
Total housing units within 1/2 mile of transit stations and stops	102,100	218,492	239,393	239,393	254,913	254,913	257,008	257,008	"
Total employment within 1/4 mile of transit stations and stops	139,100	226,801	251,118	251,118	280,194	280,194	285,539	285,539	"
Total employment within 1/2 mile of transit stations and stops	162,000	264,045	290,869	290,869	329,782	329,782	336,164	336,164	"
TRANSPORTATION SYSTEM									
Freeway general purpose lanes – mixed flow lane miles	650.45	681.07	685.4	685.4	690.58	685.4	690.58	685.4	VMIP model
Highway (lane miles)	691.97	759.72	791.12	785.01	857.45	785.01	862.05	785.01	VMIP model
Expressway (lane miles)	616.53	664.68	690.76	674.21	800	674.21	808.18	674.21	VMIP model

Modeling Parameters	2005	2014 (base year)	2020		2035		2042		Data Source(s)
			With Project[1]	Without Project[2]	With Project	Without Project	With Project	Without Project	
HOV (lane miles)	0	0	0	0	0	0	0	0	VMIP model
Arterial (lane miles)	2148.57	2179.1	2228.09	2198.6	2386.71	2198.6	2394.32	2198.6	VMIP model
Collector (lane miles)	2191.49	2204.52	2227.65	2206.73	2355.81	2206.73	2358.27	2206.73	VMIP model
Local (lane miles)	11.4	11.01	11.01	11.01	10.5	11.01	10.5	11.01	VMIP model
Freeway/Freeway (lane miles)	20.19	33.74	33.74	33.74	33.74	33.74	33.74	33.74	VMIP model
Local, express bus, and neighborhood shuttle operation miles	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Bus rapid transit bus directional route miles	0	0	32.3	32.3	84.4	32.3	84.4	32.3	VMIP model
Passenger rail operation miles	0	0	0	0	0	0	0	0	
Transit total daily vehicle service hours	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	
Vanpool (total riders per weekday)	N/A	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	350,331	251,098	276,922	280,597	314,876	319,729	332,058	336,941	VMIP model
Home-based shop	246,415	559,389	625,280	625,294	716,195	716,396	756,529	756,761	VMIP model
Home-based other	616,798	818,174	888,790	902,490	985,748	1,029,149	1,034,538	1,079,351	VMIP model

Modeling Parameters	2005	2014 (base year)	2020		2035		2042		Data Source(s)
			With Project[1]	Without Project[2]	With Project	Without Project	With Project	Without Project	
Home-based school	224,164	139,997	150,074	150,075	175,985	175,970	183,839	183,819	VMIP model
Home-based university	61,207	99,424	107,059	107,061	125,696	125,642	131,061	131,004	VMIP model
Non-home-based work	95,026	171,722	176,402	180,514	195,258	207,735	201,395	214,620	VMIP model
Non-home-based other	388,487	527,015	575,510	588,106	675,628	691,619	703,314	719,830	VMIP model
Average weekday trip length by trip purpose (miles)									
Home-based work	N/A	14.4	14.4	14.5	14.6	14.5	14.6	14.5	VMIP model
Home-based shop	N/A	4.8	4.9	4.9	5	5	5.1	5.1	VMIP model
Home-based other	N/A	10.1	10.2	10.2	10.4	10.4	10.4	10.4	VMIP model
Home-based school	N/A	8.8	8.7	8.7	8.6	8.7	8.6	8.7	VMIP model
Home-based university	N/A	15.1	15	15	14.8	14.8	14.7	14.6	VMIP model
Non-home-based work	N/A	9.9	10	10	10.6	10.2	10.6	10.3	VMIP model
Non-home-based other	N/A	9.1	9.1	9.3	9.6	9.7	9.8	9.8	VMIP model
MODE SHARE									
Vehicle Mode Share (HBW)									
SOV (% of trips)	82.30%	80.80%	80.00%	79.90%	78.20%	80.10%	78.40%	80.20%	VMIP model
HOV (% of trips)	13.10%	11.90%	11.90%	12.00%	11.90%	12.00%	12.00%	12.20%	VMIP model
Transit (% of trips)	1.40%	1.70%	2.00%	2.00%	2.80%	1.90%	2.70%	1.80%	VMIP model
Non-motorized (% of trips)	3.10%	5.50%	6.10%	6.10%	7.10%	6.00%	6.90%	5.80%	VMIP model

Modeling Parameters	2005	2014 (base year)	2020		2035		2042		Data Source(s)
			With Project[1]	Without Project[2]	With Project	Without Project	With Project	Without Project	
Vehicle Mode Share (Whole Day)									
SOV (% of trips)	38.80%	37.00%	36.70%	36.60%	36.30%	36.70%	36.30%	36.70%	VMIP model
HOV (% of trips)	53.00%	44.90%	44.80%	44.70%	44.30%	45.00%	44.50%	45.20%	VMIP model
Transit (% of trips)	1.60%	3.10%	3.30%	3.30%	3.40%	3.10%	3.40%	3.00%	VMIP model
Non-motorized (% of trips)	6.60%	14.90%	15.20%	15.40%	16.00%	15.20%	15.80%	15.10%	VMIP model
Average weekday trip length (miles)									
SOV	12.3	10.2	10.2	10.3	10.5	10.4	10.5	10.4	VMIP model
HOV	12.1	8.7	8.7	8.8	9	9	9	9.1	VMIP model
Transit	4.9	9.8	9.6	9.5	9.9	9.5	9.8	9.4	VMIP model
Walk	2.6	2.5	2.5	2.5	2.6	2.5	2.7	2.6	VMIP model
Bike	4.9	4.9	5	5	5.4	5.2	5.4	5.2	VMIP model
TRAVEL MEASURES									
Total VMT per weekday for passenger vehicles[3] (miles), excluding XX trips	14,868,490	15,894,020	16,668,566	16,892,535	19,125,509	19,618,111	19,989,391	20,506,325	EMFAC11/14
Total II (Internal) VMT per weekday for passenger vehicles (miles)	13,311,032	13,507,664	14,185,750	14,334,458	16,211,702	16,598,803	16,938,348	17,342,332	EMFAC (estimated based on VMT)
Total IX/XI VMT per weekday for passenger vehicles (miles)	1,557,458	2,386,356	2,482,816	2,558,077	2,913,807	3,019,308	3,051,043	3,163,993	EMFAC (estimated based on VMT)
Total XX VMT per weekday for passenger vehicles (miles)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Modeling Parameters	2005	2014 (base year)	2020		2035		2042		Data Source(s)
			With Project[1]	Without Project[2]	With Project	Without Project	With Project	Without Project	
Congested Peak Hour VMT on freeways (Lane Miles, V/C ratios >0.75)	2509090.87 (daily)	854,560	1,085,537	1,079,403	1,683,836	1,790,909	2,262,158	2,214,045	VMIP model
Congested Peak VMT on all other roadways (Lane Miles, V/C ratios >0.75)	669742.73 (daily)	408,621	490,939	604,711	848,429	1,091,375	1,016,986	1,359,460	VMIP model
CO_2 Emissions [4]									
Total CO_2 emissions per weekday for passenger vehicles [3] (tons), excluding XX trips	6,870	7,278	7,407	7,504	8,284	8,503	8,652	8,887	EMFAC11/14
Total II (Internal) CO_2 emissions per weekday for passenger vehicles (tons)	6,151	6,186	6,304	6,367	7,022	7,195	7,332	7,516	EMFAC (estimated based on VMT)
Total IX / XI trip CO_2 emissions per weekday for passenger vehicles (tons)	720	1,093	1,103	1,136	1,262	1,309	1,321	1,371	EMFAC (estimated based on VMT)
Total XX trip CO_2 emissions per weekday for passenger vehicles (tons)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
EMFAC ADJUSTMENT [5]									
% change in per capita GHG due to EMFAC 2011 to EMFAC2014 adjustment (%)	N/A	N/A	-5.71%	-5.71%	-7.07%	-7.07%	-7.11%	-7.11%	

Modeling Parameters	2005	2014 (base year)	2020		2035		2042		Data Source(s)
			With Project[1]	Without Project[2]	With Project	Without Project	With Project	Without Project	
INVESTMENT (Billions)									
Total RTP Expenditure (Year XXXX $)	N/A	N/A	N/A	N/A	N/A	N/A	$6,945,236,300	N/A	
Highway Capacity expansion ($)	N/A	N/A	N/A	N/A	N/A	N/A	$2,376,021,000	N/A	
Other road capacity expansion ($)	N/A	N/A	N/A	N/A	N/A	N/A		N/A	
Roadway maintenance ($1000)	N/A	N/A	N/A	N/A	N/A	N/A	$2,767,824,300	N/A	
BRT projects ($)	N/A	N/A	N/A	N/A	N/A	N/A	$596,500,000	N/A	
Transit capacity expansion ($)	N/A	N/A	N/A	N/A	N/A	N/A	$653,755,000	N/A	
Transit operations ($)	N/A	N/A	N/A	N/A	N/A	N/A		N/A	
Bike and pedestrian projects ($)	N/A	N/A	N/A	N/A	N/A	N/A	$551,136,000	N/A	
TRANSPORTATION USER COSTS									
Vehicle operating costs (Year XXXX $ per mile)	2000 $0.155	2010 $0.2236	2010 $0.2368	2010 $0.2368	2010 $0.2207	2010 $0.2207	2010 $0.2319	2010 $0.2319	VMIP model
Gasoline price (Year XXXX $ per gallon)	2009 $2.67	N/A	2010 $4.06	2010 $4.06	2010 $4.81	2010 $4.81	2010 $5.21	2010 $5.21	VMIP model
Average transit fare (Year XXXX $)	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	VMIP model

Modeling Parameters	2005	2014 (base year)	2020		2035		2042		Data Source(s)
			With Project[1]	Without Project[2]	With Project	Without Project	With Project	Without Project	
Parking cost (Year XXXX $)	2008 $3.00/$0.70	2008 $3.00/$0.70	2008 $3.00/$0.70	2008 $3.00/$0.70	2008 $3.00/$0.70	2008 $3.00/$0.70	2008 $3.00/$0.70	2008 $3.00/$0.70	VA1:J113MIP model, $3 for downtown Fresno, $0.7 for college campuses

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

[2] "Without Project" scenarios correspond to "No Project" scenarios analyzed in the RTP PEIR document. "No Project" scenarios reflect base year conditions plus any programmed projects that could be built in the first two years of the latest Federal Transportation Improvement Program (FTIP), in other words, projects scheduled for opening in years 2018 and 2019. "No Project" scenarios also assume that growth and development (through to the year 2042) would occur in a fashion consistent with the adopted general plans of each local jurisdictions.

[3] Passenger vehicles includes (1) passenger cars (LDA), (2) light-duty trucks whose GVWR <6000 lbs and 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 are 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 indicators with Fresno COG's modeled GHG emissions reductions, as well as the general relationships between those indicators and GHG emissions reductions, based on the empirical literature. The SCS performance indicators evaluated include: housing and employment near transit, residential density, per capita VMT, and the development of active transportation infrastructure.

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 Fresno COG's land use strategies and forecasted GHG emissions forecast: total households and employment near transit, residential density, and multi-family housing units.

Housing and Employment near Transit

As shown in Figure 3, Fresno COG estimates that the number of housing units near transit (i.e., within ½ mile of transit stations and stops) will increase by 152,813 dwelling units, or 150 percent, from 2005 to 2035. FCOG also estimates that employment near transit (i.e., within ½ mile of transit stations and stops) will increase by 167,782 jobs, or 104 percent, from 2005 to 2035. Both housing units and employment will continue to increase by 2042. These metrics support Fresno COG's 2018 SCS strategy and its GHG emissions reduction targets.

Figure 3. Total Housing Units and Employment within 1/2 Mile of Transit Stations and Stops

Residential Density

Figure 4 shows that the residential density in Fresno COG will increase by 11 percent from 2014 to 2035, and continue to increase to 16 percent in 2042 due to changes in the definition of "total developed acres". Residential density can help reduce auto trip length and household VMT. Therefore, the increased residential density is directionally supportive of Fresno COG's GHG emissions reduction targets. The total developed acres (which includes total residential developed acres and total commercial developed acres) decreased by almost half compared to the 2014 SCS. According to Fresno COG staff, the change is due to new data received from the cities within the region, which provided clearer parcel-level data that was reflected in their model.

Figure 4. Residential Density Forecast in Fresno COG

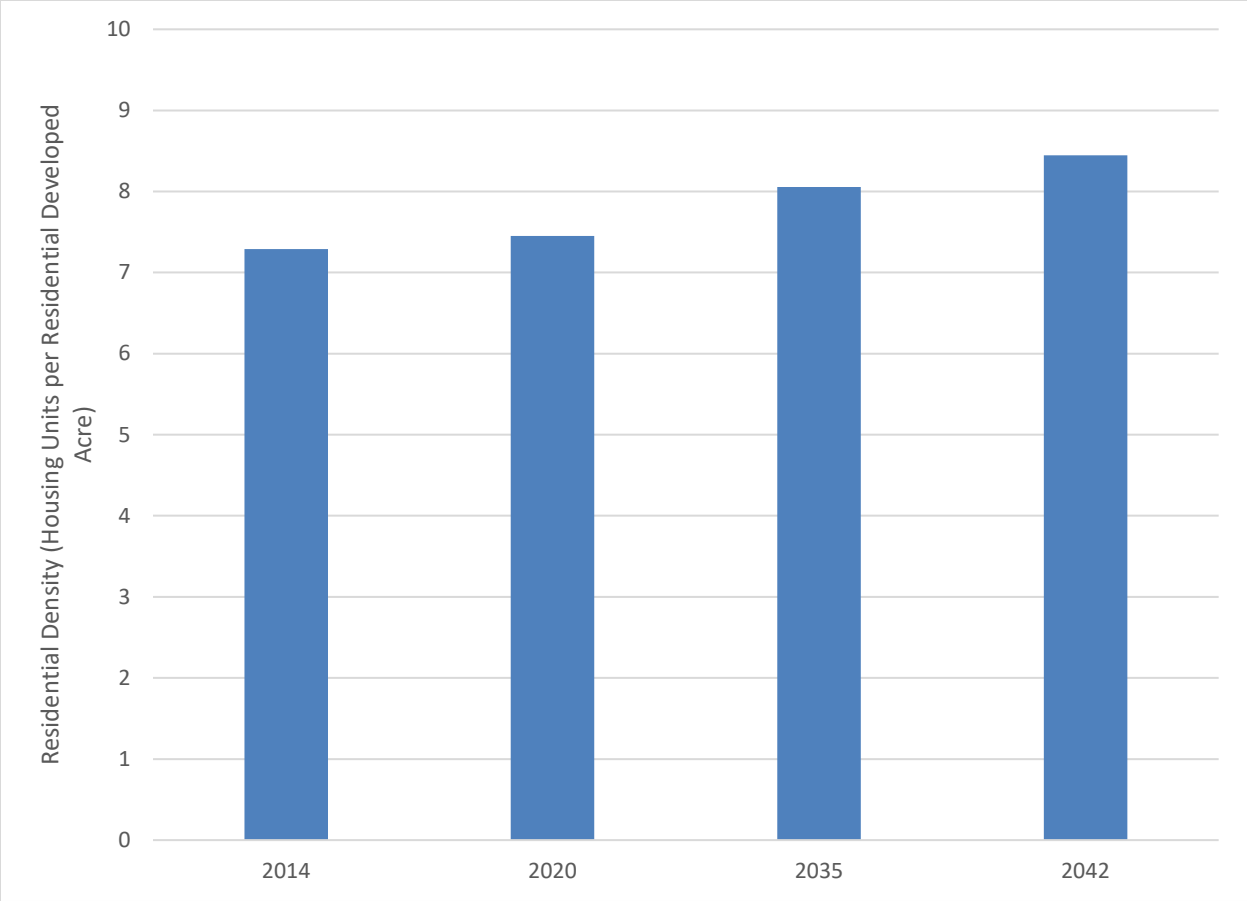


Figure 5 further shows that among all housing units built after 2014, multi-family housing units will account for 36 percent in 2035 and 37 percent in 2042, which are higher than the baseline multi-family housing unit rate of 31 percent in the region. Building more multi-family housing units can help increase housing density and accessibility, which may reduce auto trip lengths and household VMT. Therefore, the increased share of new multi-family housing units is directionally supportive of Fresno COG's GHG emissions reduction targets.

Figure 5. Split of New Single- and Multi-Family Housing Units

Note: Single-family housing unit includes both single-family detached and single-family attached housing units.

TRANSPORTATION INDICATORS

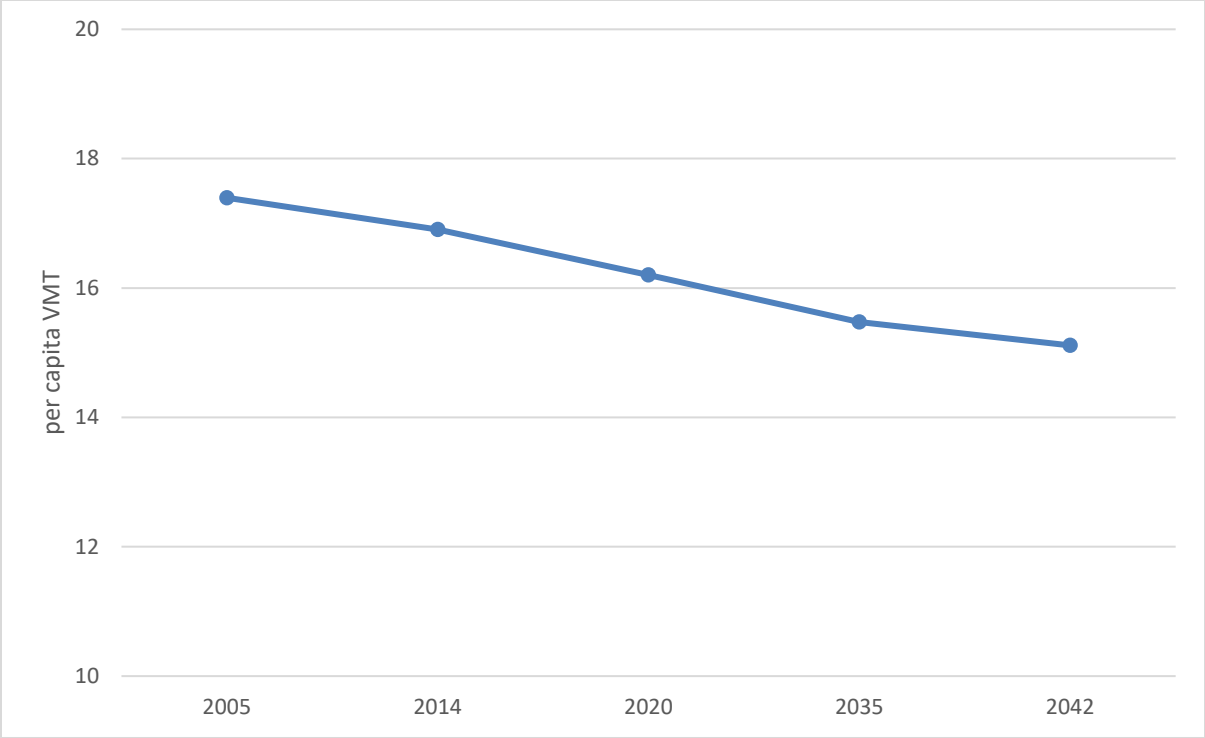
CARB staff evaluated two transportation-related performance indicators, per capita VMT and active transportation, to determine whether the trends support Fresno COG's transportation strategies and the reported GHG emissions reductions. Other transportation-related performance indicators were not reported here because Fresno COG's travel demand model is only partially sensitive to other transportation changes, and therefore the effects of most transportation strategies were not well captured by the travel demand model. CARB staff recommend that Fresno COG continue to improve its model performance in the future, update the quantification methods for off-model strategies to complement model results, and consider including additional transportation performance indicators in the data table in order to gauge performance of RTP/SCS strategies over time.

Per Capita VMT

The Fresno COG's 2018 SCS shows a consistent 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 7 percent from 2005 to 2020, and by 11 percent from 2005 to 2035. It should be noted that the projected VMT changes shown here include VMT reductions contributed by ridesharing, vanpooling, and employer trip reduction programs, which are not captured by the travel demand model. Furthermore, the per capita VMT reported here does not account for the impacts of other off-model strategies not quantified by Fresno COG such as active transportation, ITS, and other TSM strategies. CARB staff therefore found that the passenger vehicle VMT reduction is consistent with Fresno COG's claimed GHG emissions reductions. Despite the VMT reduction trends projected by Fresno COG's 2018 SCS, the observed statewide VMT data and other data-supported metrics specific to Fresno COG has indicated actual GHG emissions and VMT per capita have not declined as forecasted for 2020. CARB's SB 150 Report[21] explores these trends in more detail.

[21] California Air Resources Board. 2018 Progress Report: California's Sustainable Communities and Climate Protection Act. November 2018. Available at: https://ww2.arb.ca.gov/sites/default/files/2018-11/Final2018Report_SB150_112618_02_Report.pdf.

Figure 6. Per Capita Passenger VMT

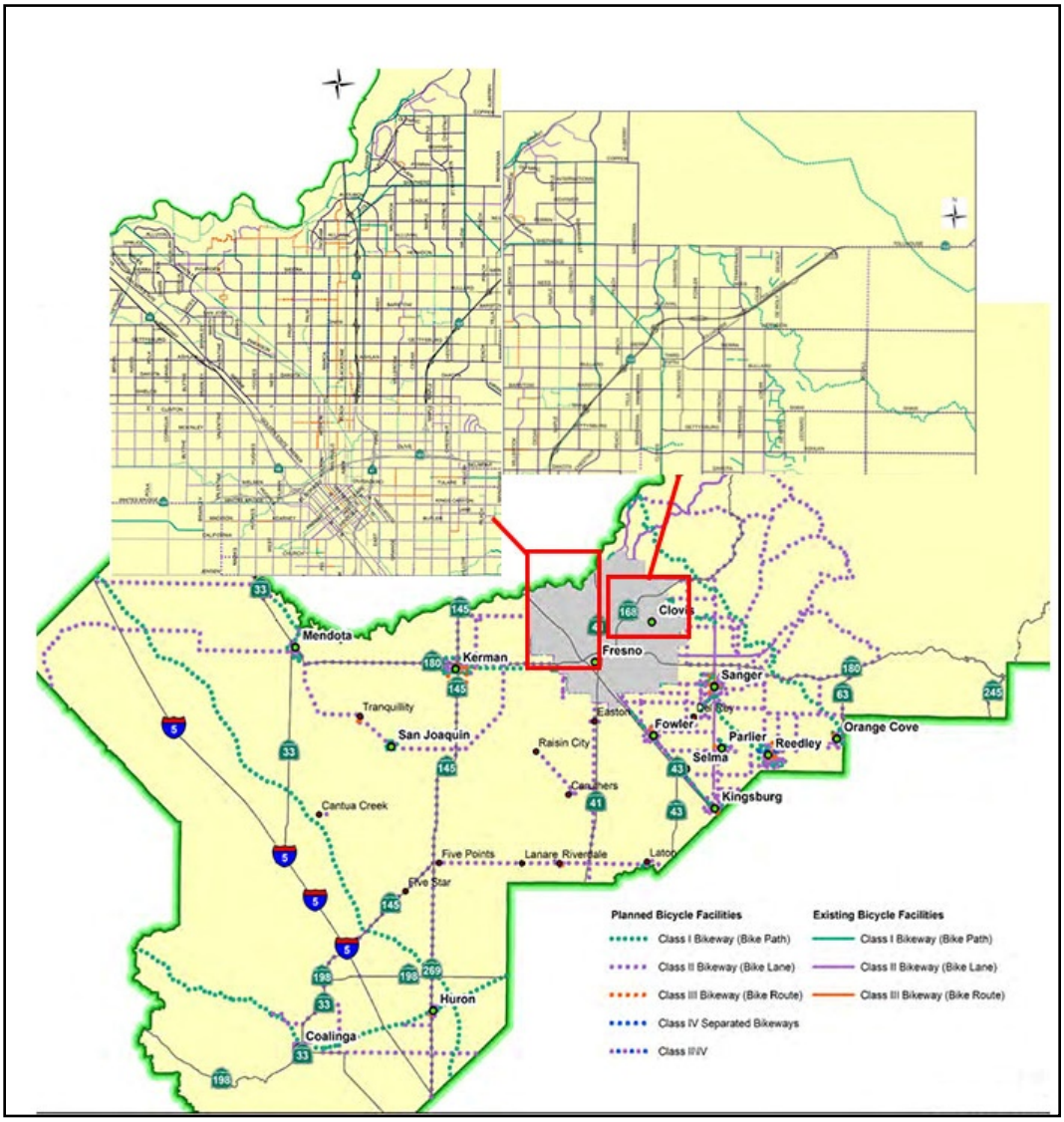


Active Transportation

Active transportation refers to a variety of modes of travel that are generally human powered, such as bicycling and walking. In most cases, when a person chooses to replace a car trip with a bike or walk trip to a destination, passenger vehicle VMT is reduced, along with GHG emissions. Fresno COG's 2018 SCS supports the expansion of the existing network of bicycle and pedestrian facilities that can connect adjoining communities, provide better access to transit facilities, maintain the existing active transportation facilities, and create a safer and more secure active transportation system. Within Fresno's 2007/08 – 2026/27 Measure C Expenditure Plan, 4 percent of funding is allocated to pedestrian/trails/bicycle facilities subprograms. The Final Measure C Extension Expenditure Plan includes additional requirements applying to all streets, roads, and highways using either regional or local allocation funds. For example, every highway, expressway, super-arterial, arterial, or collector built or reconstructed with Measure C Extension funds must include accommodations for

bicycle travel either by a shared roadway or by bike lane. Figure 7[22] illustrates the existing and planned bike network in the Fresno COG region. In the 2018 SCS, Fresno COG extended bike and pedestrian-related projects from downtown areas to broader areas across the county.

Figure 7. Existing and Planned Bicycle Facilities in Fresno COG's 2018 SCS



Source: Fresno COG, Regional Transportation Plan/ Sustainable Communities Strategy 2018-2042

[22] Source: Fresno COG Regional Transportation Plan/ Sustainable Communities Strategy 2018-2042, Chapter 4, Figures 4-13a, 4-13b, and 4-14.