APPENDIX C *Transportation & Land Use*

Contents

Appendix C. Transportation and Land Use

Item 1. RTP Checklist

Regional Transportation Plan Checklist for MPOs
(Revised September 2023)

(To be completed electronically in Microsoft Word format by the MPO and submitted along with the draft and final RTP to Caltrans)

Name of MPO: Fresno Council of Governments

Date Draft RTP Completed: June 23, 2026

RTP Adoption Date: September 24, 2026

What is the Certification Date of the Environmental Document (ED)? September 24, 2026

Is the ED located in the RTP or is it a separate document? Separate document; referenced as Appendix A of the RTP

By completing this checklist, the MPO verifies the RTP addresses all of the following required information within the RTP, where applicable.

Regional Transportation Plan Contents

General	Yes/ No/ N/A	Page #
1. Does the RTP address no less than a 20-year planning horizon? (23 CFR 450.324(a))	Yes	Ch. 1, p. 1
2. Does the RTP include both long-range and short-range strategies/actions? (23 CFR 450.324(b))	Yes	Ch. 4, p. 3-10
3. Does the RTP address issues specified in the policy, action and financial elements identified in California Government Code Section 65080?	Yes	Ch. 4, Ch. 6
4. Does the RTP address the 10 issues specified in the Sustainable Communities Strategy (SCS) component as identified in Government Code Sections 65080(b)(2)(B) and 65584.04(i)(1)?	Yes	Ch. 5
a. Identify the general location of uses, residential densities, and building intensities within the region?	Yes	Ch. 5, p. 17
b. Identify areas within the region sufficient to house all the population of the region, including all economic segments of the population over the course of the planning period of the regional	Yes	Ch. 5, p. 18

transportation plan taking into account net migration into the region, population growth, household formation and employment growth?		
c. Identify areas within the region sufficient to house an eight-year projection of the regional housing need for the region pursuant to Government Code Section 65584?	Yes	Ch. 5, p. 18
d. Identify a transportation network to service the transportation needs of the region?	Yes	Ch. 3-6
e. Gather and consider the best practically available scientific information regarding resource areas and farmland in the region as defined in subdivisions (a) and (b) of Government Code Section 65080.01?	Yes	Ch. 5, p. 24-27
f. Consider the state housing goals specified in Sections 65580 and 65581?	Yes	Ch. 5, p. 23
g. Utilize the most recent planning assumptions, considering local general plans and other factors?	Yes	Ch. 5
h. Set forth a forecasted development pattern for the region, which, when integrated with the transportation network, and other transportation measures and policies, will reduce the greenhouse gas emissions from automobiles and light trucks to achieve, if there is a feasible way to do so, the greenhouse gas emission reduction targets approved by CARB?	Yes	Ch. 5
i. Provide consistency between the development pattern and allocation of housing units within the region (Government Code 65584.04(i)(1)?	Yes	Ch. 5, p 12-13
j. Allow the regional transportation plan to comply with Section 176 of the federal Clean Air Act (42 U.S.C. Section 7506)?	Yes	Ch. 1, p. 3
5. Does the RTP include Project Intent i.e. Plan Level Purpose and Need Statements?	Yes	Ch. 2, p. 2-9
6. Does the RTP specify how travel demand modeling methodology, results and key assumptions were developed as part of the RTP process? (Government Code 14522.2)	Yes	Ch. 1, p. 4-5, Ch. 5, p. 2, Appendix C
7. Does the RTP contain a System Performance Report? (23 CFR 450.324 (f))	Yes	Ch. 4, p. 10-12, Appendic C, Item 7
a. Does the report include a description of the performance measures and performance targets used in assessing the performance of the transportation system?	Yes	Ch. 4, p. 10-12, Appendic C, Item 7
b. Does the report show the progress towards achieving performance targets in comparison with the performance in previous reports?	Yes	Ch. 4, p. 10-12, Appendic C, Item 7
c. For MPOs that voluntarily elect to develop multiple scenarios, does the report include an evaluation of how the preferred scenario has improved conditions and performance, where applicable?	Yes	Ch. 4, p. 10-12, Appendic C, Item 7

d. Does the report include an evaluation of how local policies and investments have impacted costs necessary to achieve progress toward identified performance targets, where applicable?	Yes	Ch. 4, p. 10-12, Appendic C, Item 7

Consultation/Cooperation

	Yes/ No/ N/A	Page #
1. Does the RTP contain a public involvement program that meets the requirements of Title 23, CFR 450.316(a)?	Yes	Ch. 1, p. 7-13, Appendix D, Item 1
(i) Providing adequate public notice of public participation activities and time for public review and comment at key decision points, including a reasonable opportunity to comment on the proposed metropolitan transportation plan and the TIP;	Yes	Appendix D
(ii) Providing timely notice and reasonable access to information about transportation issues and processes;	Yes	Appendix D
(iii) Employing visualization techniques to describe metropolitan transportation plans and TIPs;	Yes	Ch. 5 and Appendix D
(iv) Making public information (technical information and meeting notices) available in electronically accessible formats and means, such as the World Wide Web;	Yes	PlanFresno.com and FresnoCOG.org
(v) Holding any public meetings at convenient and accessible locations and times;	Yes	Appendix D
(vi) Demonstrating explicit consideration and response to public input received during the development of the metropolitan transportation plan and the TIP;	Yes	Appendix D
(vii) Seeking out and considering the needs of those traditionally underserved by existing transportation systems, such as low-income and minority households, who may face challenges accessing employment and other services;	Yes	Appendix D
(viii) Providing an additional opportunity for public comment, if the final metropolitan transportation plan or TIP differs significantly from the version that was made available for public comment by the MPO and raises new material issues that interested parties could not reasonably have foreseen from the public involvement efforts;	N/A	N/A
(ix) Coordinating with the statewide transportation planning public involvement and consultation processes under subpart B of this part; and	Yes	Ch. 1 and Appendix D
(x) Periodically reviewing the effectiveness of the procedures and strategies contained in the participation plan to ensure a full and open participation process.	Yes	Appendix D, Item 1

		Yes/ No/ N/A	Page #
2.	Does the RTP contain a summary, analysis, and report on the disposition of significant written and oral comments received on the draft regional transportation plan as part of the final regional transportation plan and TIP that meets the requirements of 23 CFR 450.316(a)(2), as applicable?	Yes	Appendix D, Item 3
3.	Did the MPO/RTPA consult with the appropriate State and local representatives including representatives from environmental and economic communities; airport; transit; freight during the preparation of the RTP? (23 CFR 450.316(b))	Yes	Appendix D, Item 6
4.	Did the MPO/RTPA who has federal lands within its jurisdictional boundary involve the federal land management agencies during the preparation of the RTP? (23 CFR 450.316(d))	Yes	Ch. 1, p. 10-11
5.	Where does the RTP specify that the appropriate State and local agencies responsible for land use, natural resources, environmental protection, conservation and historic preservation consulted? (23 CFR 450.324(g))	Yes	Appendix D, Item 6
6.	Did the RTP include a comparison with the California State Wildlife Action Plan and (if available) inventories of natural and historic resources? (23 CFR 450.324(g)(1&2))	Yes	Appendix A, DEIR
7.	Did the MPO/RTPA who has a federally recognized Native American Tribal Government(s) and/or historical and sacred sites or subsistence resources of these Tribal Governments within its jurisdictional boundary address tribal concerns in the RTP and develop the RTP in consultation with the Tribal Government(s)? (23 CFR 450.316(c))	Yes	Ch. 1, p. 11-13
8.	Does the RTP address how the public and various specified groups were given a reasonable opportunity to comment on the plan using the participation plan developed under 23 CFR part 450.316(a)? (23 CFR 450.316(a)(i))	Yes	Ch. 1, p. 7-13, Appendix D
9.	Does the RTP contain a discussion describing the private sector involvement efforts that were used during the development of the plan? (23 CFR 450.316(a))	Yes	Ch.1, p. 7-8, Appendix D
10.	Does the RTP contain a discussion describing the coordination efforts with regional air quality planning authorities? (23 CFR 450.316(a)(2)) (MPO nonattainment and maintenance areas only)	Yes	Ch. 1
11.	Is the RTP coordinated and consistent with the Public Transit-Human Services Transportation Plan? (23 CFR 450.306(h))	Yes	N/A

12. Were the draft and adopted RTP posted on the Internet? (23 CFR 450.324(k))	Yes	FresnoCOG.org
13. Did the RTP explain how consultation occurred with locally elected officials? (Government Code 65080(D))	Yes	Ch. 1, p. 5-9
14. Did the RTP outline the public participation process for the sustainable communities strategy? (Government Code 65080(E))	Yes	Ch. 5, p. 2-6
15. Was the RTP adopted on the estimated date provided in writing to State Department of Housing and Community Development to determine the Regional Housing Need Allocation and planning period (start and end date) and align the local government housing element planning period (start and end date) and housing element adoption due date 18 months from RTP adoption date? (Government Code 65588(e)(5))	Yes	N/A

<u>Title VI and Environmental Justice</u>

1. Does the public participation plan describe how the MPO will seek out and consider the needs of those traditionally underserved by existing transportation system, such as low-income and minority households, who may face challenges accessing employment and other services? (23 CFR 450.316 (a)(1)(vii))	Yes	Appendix C
2. Has the MPO conducted a Title VI analysis that meets the legal requirements described in Section 4.2?	Yes	Ch. 7
3. Has the MPO conducted an Environmental Justice analysis that meets the legal requirements described in Section 4.2?	Yes	Ch. 7

<u>Modal Discussion</u>

	Yes/ No/ N/A	Page #
1. Does the RTP discuss intermodal and connectivity issues?	Yes	Ch. 3, p. 12-13
2. Does the RTP include a discussion of highways?	Yes	Ch. 3, p. 14-15
3. Does the RTP include a discussion of mass transportation?	Yes	Ch. 3, p. 16-21
4. Does the RTP include a discussion of the regional airport system?	Yes	Ch. 3, p. 22-26
5. Does the RTP include a discussion of regional pedestrian needs?	Yes	Ch. 3, p. 27-30, Ch. 4, p. 2-5
6. Does the RTP include a discussion of regional bicycle needs?	Yes	Ch. 3, p. 27-30, Ch. 4, p. 2-5

7. Does the RTP address the California Coastal Trail? (Government Code 65080.1) (For MPOs located along the coast only)	N/A	
8. Does the RTP include a discussion of rail transportation?	Yes	Ch. 3, p. 31-33
9. Does the RTP include a discussion of maritime transportation (if appropriate)?	N/A	
10. Does the RTP include a discussion of goods movement?	Yes	Ch. 4, p. 6-8

Programming/Operations	Yes/No/ N/A	Page #
1. Is the RTP consistent (to the maximum extent practicable) with the development of the regional ITS architecture? (23 CFR 450.306(g))	Yes	N/A
2. Does the RTP identify the objective criteria used for measuring the performance of the transportation system?	Yes	Appendix B
3. Does the RTP contain a list of un-constrained projects?	Yes	Appendix B

Financial	Yes/No/ N/A	Page #
1. Does the RTP include a financial plan that meets the requirements identified in 23 CFR part 450.324(f)(11)?	Yes	Ch. 5 and Appendix B
2. Does the RTP contain a consistency statement between the first 4 years of the fund estimate and the 4-year STIP fund estimate? (65080(b)(4)(A))	Yes	Ch. 6, p. 2-3
3. Do the projected revenues in the RTP reflect Fiscal Constraint? (23 CFR part 450.324(f)(11)(ii))	Yes	Ch. 6, p. 1-3 and Appendix B
4. Does the RTP contain a list of financially constrained projects? Any regionally significant projects should be identified. (Government Code 65080(4)(A))	Yes	Appendix B, Item 1
5. Do the cost estimates for implementing the projects identified in the RTP reflect "year of expenditure dollars" to reflect inflation rates? (23 CFR part 450.324(f)(11)(iv))	Yes	Appendix B, Item 5
6. After 12/11/07, does the RTP contain estimates of costs and revenue sources that are reasonably expected to be available to operate and maintain the freeways, highway and transit within the region? (23 CFR 450.324(f)(11)(i))	Yes	Appendix B, Item 4 and 5

7.	Does the RTP contain a statement regarding consistency between the projects in the RTP and the ITIP? (2016 STIP Guidelines Section 33)	Yes	Ch. 6, p. 2-3
8.	Does the RTP contain a statement regarding consistency between the projects in the RTP and the RTIP? (2016 STIP Guidelines Section 19)	Yes	Ch. 6, p. 2-3
9.	Does the RTP address the specific financial strategies required to ensure the identified TCMs from the SIP can be implemented? (23 CFR part 450.324(f)(11)(vi) (nonattainment and maintenance MPOs only)	Yes	2027 FTIP
	<u>Environmental</u>	Yes/No/ N/A	Page #
1.	Did the MPO/RTPA prepare an EIR or a program EIR for the RTP in accordance with CEQA guidelines?	Yes	Appendix A
2.	Does the RTP contain a list of projects specifically identified as TCMs, if applicable?	Yes	Conformity Analysis for the 2027 FTIP
3.	Does the RTP contain a discussion of SIP conformity, if applicable?	Yes	Ch.1, p. 5
4.	Does the RTP specify mitigation activities? (23 CFR part 450.324(f)(10))	Yes	Appendix A
5.	Where does the EIR address mitigation activities?	Yes	Appendix A
6.	Did the MPO/RTPA prepare a Negative Declaration or a Mitigated Negative Declaration for the RTP in accordance with CEQA guidelines?	No	Program Environmental Impact Report Prepared
7.	Does the RTP specify the TCMs to be implemented in the region? (federal nonattainment and maintenance areas only)	Yes	Conformity Analysis for the 2027 FTIP

I have reviewed the above information and certify that it is correct and complete.

Robert Phipps

(Must be signed by MPO Executive Director or designated representative)

June 23, 2026

Date

Robert Phipps

Print Name

Executive Director, Fresno COG

Title

Appendix C. Transportation and Land Use

Item 2. Valleywide Chapter

VALLEYWIDE CHAPTER

INTRODUCTION

The San Joaquin Valley is a unique region with diverse needs. The eight regions of the San Joaquin Valley work together to achieve common goals for a greater Valley. The Valleywide Chapter discusses these cooperative efforts across five sections.

Section 1. One Valley: The San Joaquin Valley Profile
This section describes the San Joaquin Valley's (SJV) regional characteristics to include geography, population, demographics, economy, and also discusses some information on why and how it's considered an economically distressed area.

Section 2. Valley Success in Partnering and Planning
This section provides insight into how the regional transportation planning agencies (RTPA) are coordinating together to improve air quality, develop sustainable communities' strategies, and through valleywide coordination, implement RTP/SCS initiatives and projects.

Section 3. Goods Movement
This section explains our current environment regarding new emerging technologies and systems. It also describes current goods movement studies and good movement projects that are taking place in the San Joaquin Valley and finally touches on the future of goods movement in the SJV.

Section 4. Valley Wide Planning Efforts
This section discusses the coordinated efforts between the RTPAs in the SJV. It provides information on the San Joaquin Valley Regional Policy Council, Valley Voice efforts and other collaborative planning efforts.

Section 5. Valley Success in Implementation
This section focuses on success stories in the SJV, including investments in passenger rail, SR 99, housing, and transit.

The Valleywide Chapter was developed in coordination with staff from each of the RTPA's. Staff from the San Joaquin Council of Governments, Stanislaus Council of Governments, Merced County Association of Governments, Madera County Transportation Commission, Fresno Council of Governments, Tulare County Association of Government, Kings County Associate of Governments, and the Kern Council of Governments, all contributed to this document.

1. ONE VALLEY: THE SAN JOAQUIN VALLEY PROFILE

GEOGRAPHY

The San Joaquin Valley (SJV) is the southern portion of the Great Central Valley of California [***Figure 6-1***]. The San Joaquin Valley stretches from the Tehachapi Mountains in the south to the San Joaquin Delta in the north, a distance of nearly 300 miles. The eastern boundary is the Sierra Nevada Mountains, which reaches elevations of over 14,000 feet, while the western boundary is the lower coastal ranges. The Valley floor is about 10,000 square miles in size.

Figure 6 - 1: San Joaquin Valley Topography

For the purposes of this chapter, the San Joaquin Valley is considered to include the entirety of the counties of San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, Tulare and Kern. The total area of the eight counties is 27,383 square miles, larger than West Virginia. Kern County straddles the Sierra Nevada Mountains and occupies a portion of the Mojave Desert. The desert portion of Kern County (about 3,650 square miles) is within the Southeastern Desert Air Basin, while the remainder of Kern County and the other counties are in the San Joaquin Valley Air Basin.

On the valley floor, the topography is generally flat to rolling, and the climate is characterized by long, very warm summers, and short, cool winters. Precipitation is related to latitude and elevation, with the northern portions of the valley receiving approximately 12-14 inches of rain a year, while the southern portion has an annual average of less than six inches. Snow rarely falls on the valley floor, but heavy winter accumulations are common in the Sierra Nevada Mountains.

The SJV occupies an area between the two largest metropolitan areas in California, San Francisco and Los Angeles. The major transportation facilities run generally north/south through the SJV and include State Route 99, Interstate 5, Union Pacific Railroad and Burlington Northern & Santa Fe (BNSF) Railway. Several highways and some rail lines cross the Valley east/west including State Routes 4, 58, 120, 152, 198 and the San Joaquin Valley Railroad among others. In addition, the Valley contains numerous oil and natural gas pipelines, a myriad of telecommunication facilities, distribution centers, the Port of Stockton, Fresno-Yosemite International Airport, and other key travel corridors.

POPULATION

While the SJV is largely rural in nature, it does contain several large cities and suburbs with a total population of over 4 million people (more than the population of 24 states). The eight San Joaquin Valley counties are a part of eight Metropolitan Statistical Areas (MSAs): Stockton-Lodi (San Joaquin County), Modesto (Stanislaus County), Merced, Madera, Fresno, Hanford-Corcoran (Kings County), Visalia-Porterville (Tulare County) and Bakersfield (Kern County). Most of the Valley's population resides along the State Route 99 corridor including four cities of over 150,000 people (Fresno, Bakersfield, Stockton and Modesto) *[**Figure 6-2**]*. Population growth has been sustained and significant *[**Figure 6-3**]*. In 1970, the eight San Joaquin Valley counties had a population of just over 1.6 million. By 2020, the population had increased 166% to over 4.3 million *[**Figure 6-4**] people.* The SJV continues to be one of the fastest growing regions in the state. The SJV accounted for 8.2% of California's total population in 1970 and has grown to account for 10.9% of California's total population today. By 2070, the Valley is projected to capture 12.1% of the state's population.

Figure 6 - 2: San Joaquin Valley Population Centers

Figure 6 - 3: San Joaquin Valley Total Population Projections, California Department of Finance

	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
Fresno County	1,007,099	1,027,337	1,040,540	1,056,039	1,070,345	1,080,179	1,082,708	1,075,804	1,060,905	1,040,827	1,016,151
Kern County	905,446	915,130	932,908	953,684	973,703	989,104	996,688	995,786	988,038	976,071	960,154
Kings County	152,408	153,897	157,102	156,651	154,076	149,311	142,401	133,510	122,983	111,444	99,024
Madera County	156,290	162,383	166,806	169,120	170,812	171,911	172,147	172,020	171,850	171,404	171,550
Merced County	281,206	292,448	300,479	309,351	319,674	329,887	338,013	343,647	347,608	351,208	354,900
San Joaquin County	779,717	803,086	835,773	886,170	937,725	986,917	1,030,808	1,069,645	1,104,909	1,138,501	1,172,384
Stanislaus County	553,102	552,985	558,563	566,643	576,148	585,339	592,048	595,422	595,679	594,960	595,331
Tulare County	472,440	484,220	493,219	495,938	495,243	489,344	478,030	462,031	443,030	422,140	398,839
San Joaquin Valley Total	4,307,708	4,391,486	4,485,390	4,593,596	4,697,726	4,781,992	4,832,843	4,847,865	4,835,002	4,806,555	4,768,333
California	39,535,726	39,299,708	39,651,187	40,105,580	40,468,122	40,729,125	40,819,078	40,701,927	40,410,637	40,004,477	39,537,598
SJV Population Percentage of California	10.9	11.2	11.3	11.5	11.6	11.7	11.8	11.9	12.0	12.0	12.1

Source: California Department of Finance. Demographic Research Unit.
Report P-2A: Total Population Projections, California Counties, 2020-2070 (Baseline 2024) Sacramento, California. October 2025

Figure 6 - 4:San Joaquin Valley Projected Population Growth as a Statewide Percentage

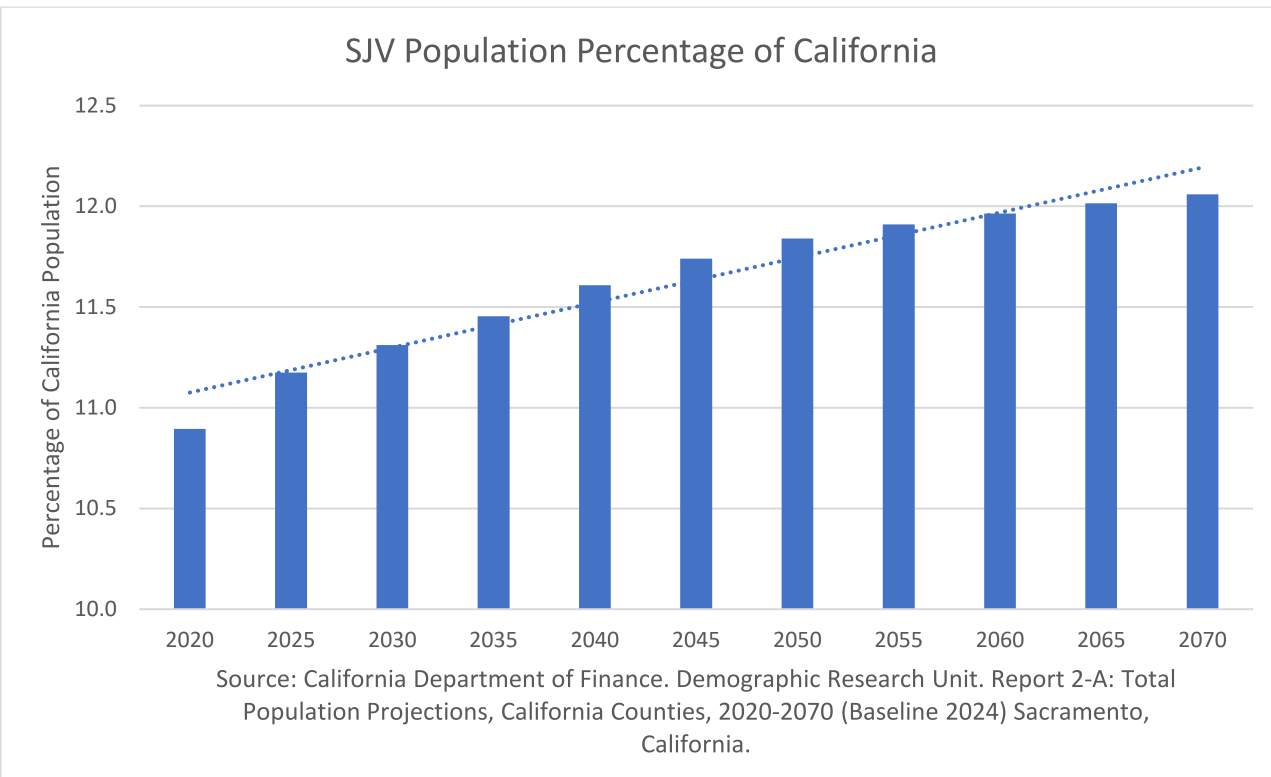
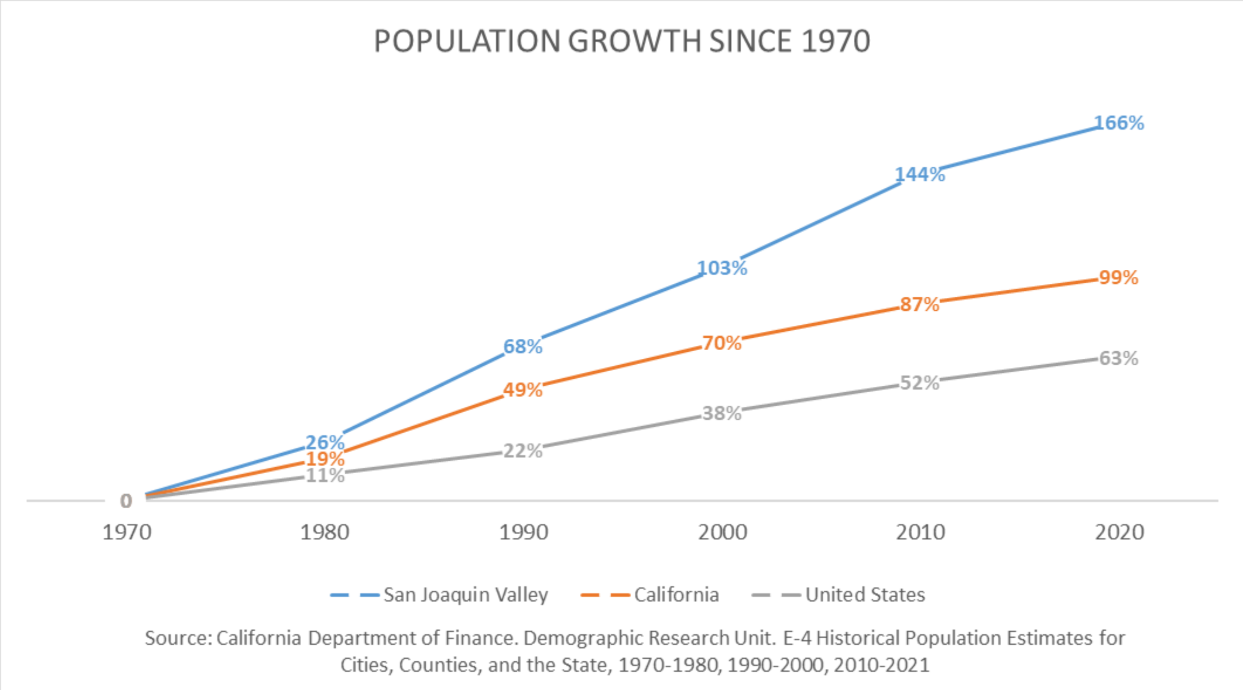


Figure 6 - 5: San Joaquin Valley Population Growth Relative to State and Federal Population Growth



Future population growth is also expected to be sustained and significant. Both ends of the SJV are under growth pressure from the neighboring metropolitan areas of Los Angeles and the San Francisco Bay Area, in addition to the natural growth rate. Population in the eight SJV counties is projected to reach just over 4.7 million by 2070, using growth projections from the California State Department of Finance (DOF) *[**Figure 6-3**]*. ***Figure 6.5*** demonstrates Valleywide population growth relative to California and the U.S. as a whole.

ECONOMY

The San Joaquin Valley is famous for agricultural production. All eight counties rank within the top 12 of California's 58 counties *[**Figure 6-7**]*. In addition, if the SJV were a state, it would be the top agricultural producing state in the country. The SJV produced $39.9 billion in agricultural products in 2023. This amount is more than double the rest of California's agricultural production and just short of the next highest producing state, Iowa *[**Figure 6-8**]*.

Figure 6 - 6: Agriculture Production Value and Ranks of San Joaquin Valley Counties, 2019

Agriculture Production Value and Ranks of San Joaquin Valley Counties, 2023		
County	**Rank in California**	**Gross Value of Agricultre Production ($1,000s)**
Kern	1	$8,626,533
Fresno	2	$8,589,054
Tulare	3	$7,866,730
Merced	5	$4,223,546
Stanislaus	6	$3,351,480
San Joaquin	7	$3,218,497
Kings	9	$2,155,882
Madera	12	$1,859,366
San Joaquin Valley Total		$39,891,088
California Total		$59,443,765
Source: California Agricultural Statistics Review 2023-2024, California Department of Food & Agriculture		

Figure 6 - 7: California Gross Value of Agriculture Production

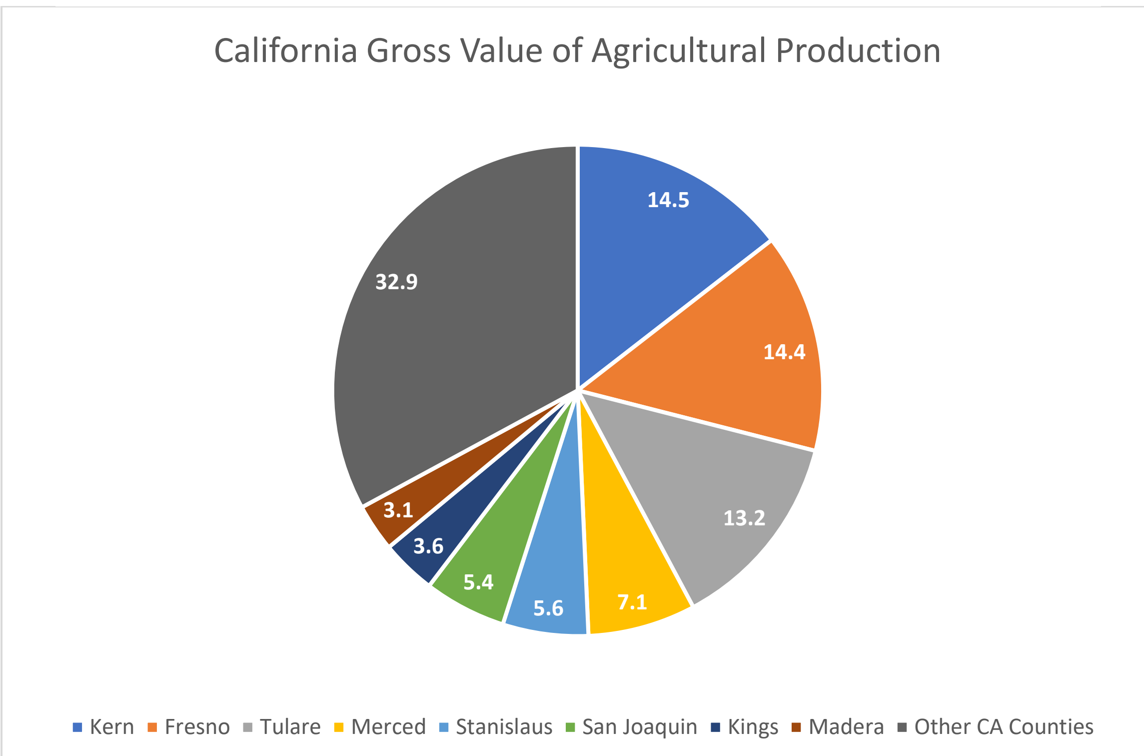
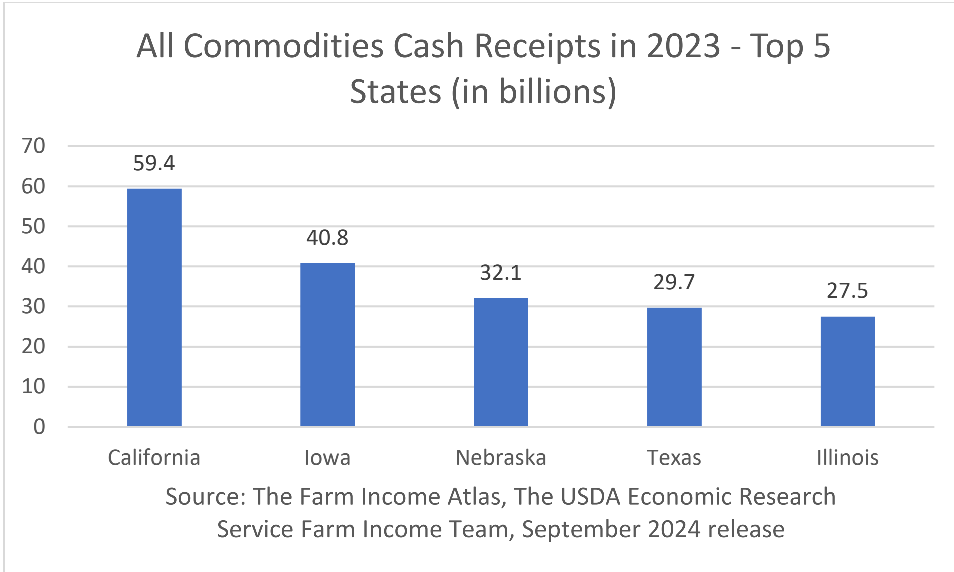


Figure 6 - 8: All Commodities Cash Receipts in 2023 of Leading States in the U.S.



Agriculture accounts for 12% of the Valley's jobs *[**Figure 6-9**]*. In comparison, only 2% of the state and nation's jobs are in agriculture *[**Figure 6-10**]*. Other major employment sectors in the Valley are education, health and social services (21.9%) and retail trade (10.9%).

Figure 6 - 9: San Joaquin Valley Employment by Industry

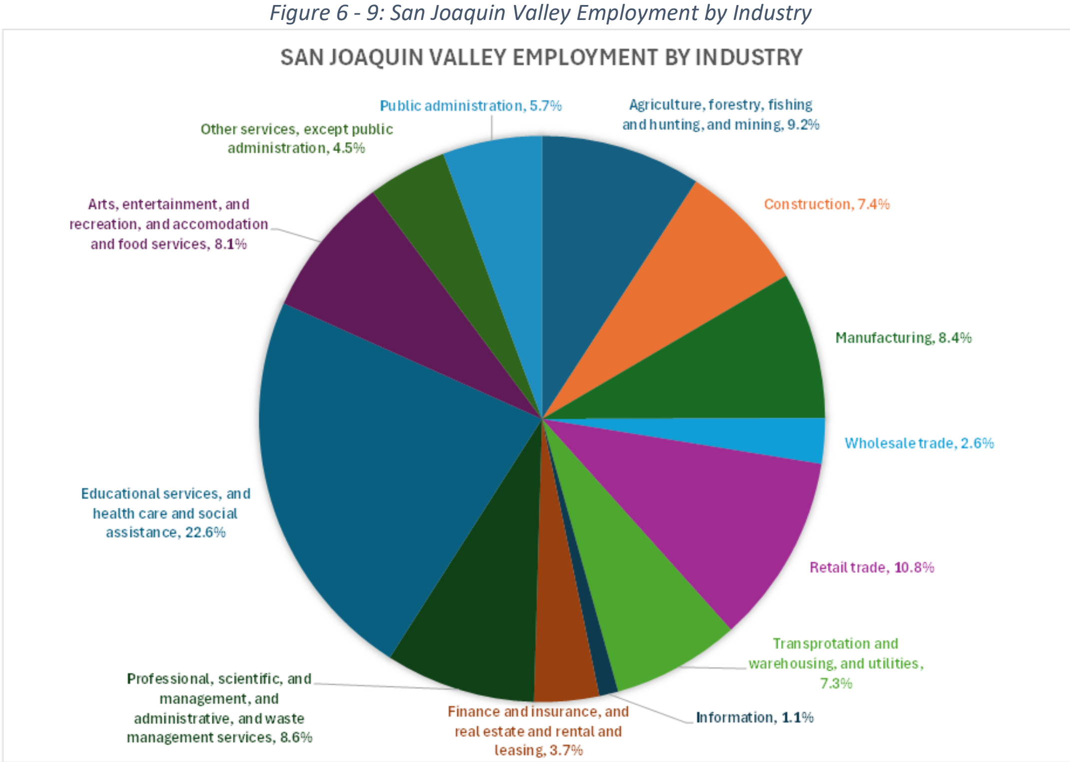


Figure 6 - 10: Employment by Industry, Comparing San Joaquin Valley with CA and the U.S.

Employment by industry, comparing San Joaquin Valley with California and the United States, 2023						
	San Joaquin Valley		California		United States	
	Estimate	Percent	Estimate	Percent	Estimate	Percent
Agriculture, forestry, fishing and hunting, and mining	164,134	9.2%	380,609	2.0%	2,552,148	1.6%
Construction	132,282	7.4%	1,253,773	6.7%	11,064,175	6.9%
Manufacturing	150,433	8.4%	1,665,814	8.9%	15,912,421	10.0%
Wholesale trade	46,509	2.6%	462,324	2.5%	3,678,210	2.3%
Retail trade	193,790	10.8%	1,893,259	10.1%	17,368,629	10.9%
Transprotation and warehousing, and utilities	130,790	7.3%	1,122,018	6.0%	9,373,191	5.9%
Information	19,437	1.1%	546,304	2.9%	2,998,298	1.9%
Finance and insurance, and real estate and rental and leasing	66,371	3.7%	1,066,811	5.7%	10,673,893	6.7%
Professional, scientific, and management, and administrative, and waste management services	153,784	8.6%	2,677,526	14.3%	19,763,960	12.4%
Educational services, and health care and social assistance	405,663	22.6%	4,062,424	21.7%	37,381,621	23.4%
Arts, entertainment, and recreation, and accomodation and food services	145,309	8.1%	1,781,368	9.5%	14,010,750	8.8%
Other services, except public administration	80,856	4.5%	904,454	4.8%	7,514,289	4.7%
Public administration	101,705	5.7%	883,539	4.7%	7,516,950	4.7%
Civilian Employed Population 16 years and over	1,791,063		18,700,223		159,808,535	
Source: Table DP03, 2024 American Community Survey 5-Year Estimates						

ECONOMICALLY DISTRESSED AREA

Educational levels for SJV residents lag behind those of California and the United States. Only 18.2% of persons 25 years of age and older have a bachelor's degree or higher, compared to 36.5% and 35% for the state and nation, respectively *[**Figure 6-11**].* The rate of those in the Valley who have an associate degree, or some college credits is slightly higher than the state or nation, however.

With the Valley's mix of employment types, high unemployment, and low educational attainment levels, the Valley suffers from a low median household income. As shown on ***Figure 6-12*** below, while the Valley's median household income of $73,258 has made progress towards the national median of $78,538, it is far below the state's median of $96,334.

Figure 6 - 11: Education Attainment San Joaquin Valley Population 25 Years of Age and Older

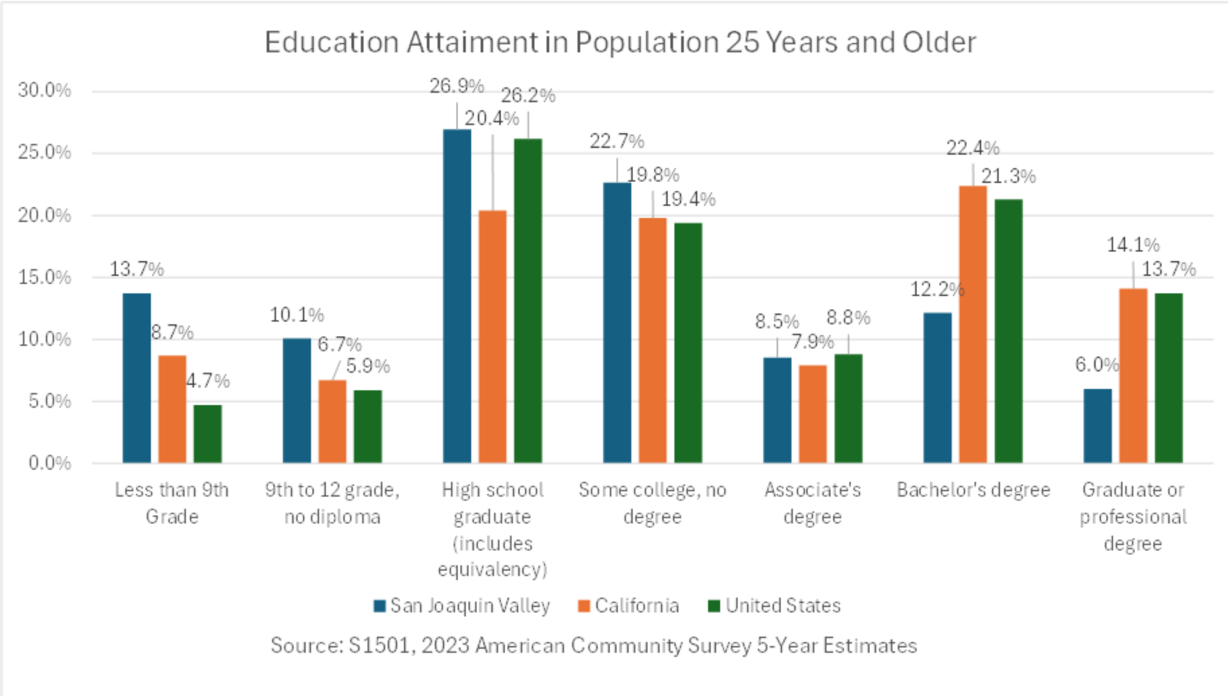
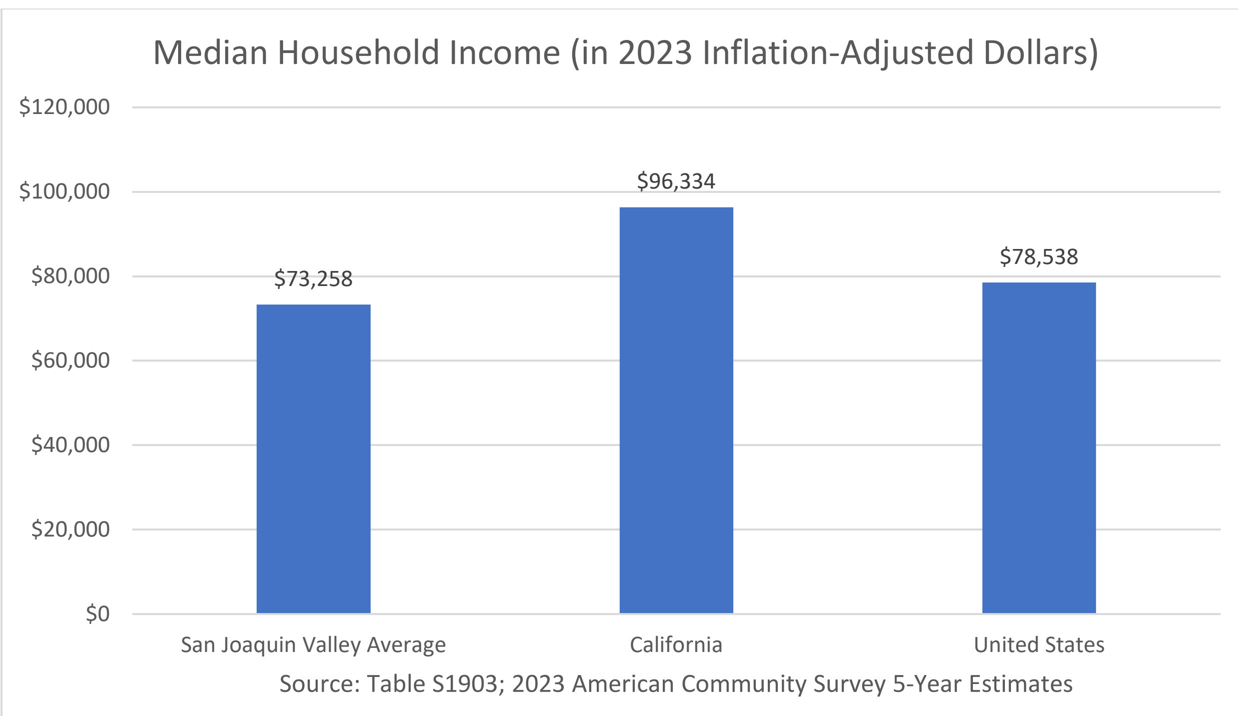


Figure 6 - 12: Median Household Income



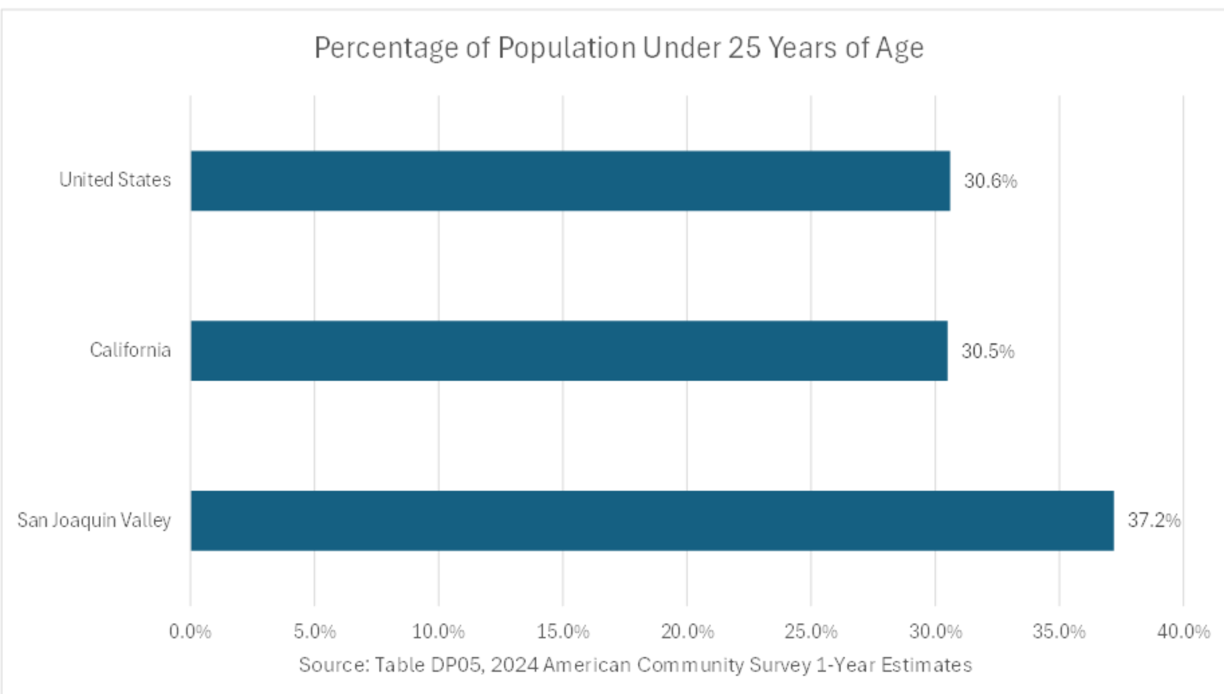
The economic plight of the San Joaquin Valley is starting to be recognized at a national level. The Congressional Research Service (CRS) completed a study in 2005 (California's San Joaquin Valley: A Region in Transition) comparing the economic conditions of the San Joaquin Valley to the Central Appalachian region, another severely economically distressed region. The Central Appalachian region (primarily eastern KY and parts of WV, TN and VA) is the most economically distressed sub-region within the Appalachian Regional Commission (ARC). ARC was created by Congress in 1965 in response to the persistent socioeconomic challenges in the Appalachian region. Economic conditions in the Valley were shown to be comparable to Central Appalachia and lagging far behind the state of California as a whole and the United States. For example, poverty rates in the Valley are similar to the poorest region of the Appalachians and are actually trending worse than the Central Appalachian region.

While being one of the most economically challenged regions in the country, the Valley has traditionally received far less federal assistance than other regions in the United States. The CRS study also showed that the Valley is lagging behind the Appalachian region, California and the United States in per capita federal expenditures.

DEMOGRAPHICS

The Valley has a younger population than California as a whole and the United States. In 2024, 37.2% of Valley residents were under the age of 25 compared to 30.5% for California and 30.6% for the United States *[**Figure 6-13**].*

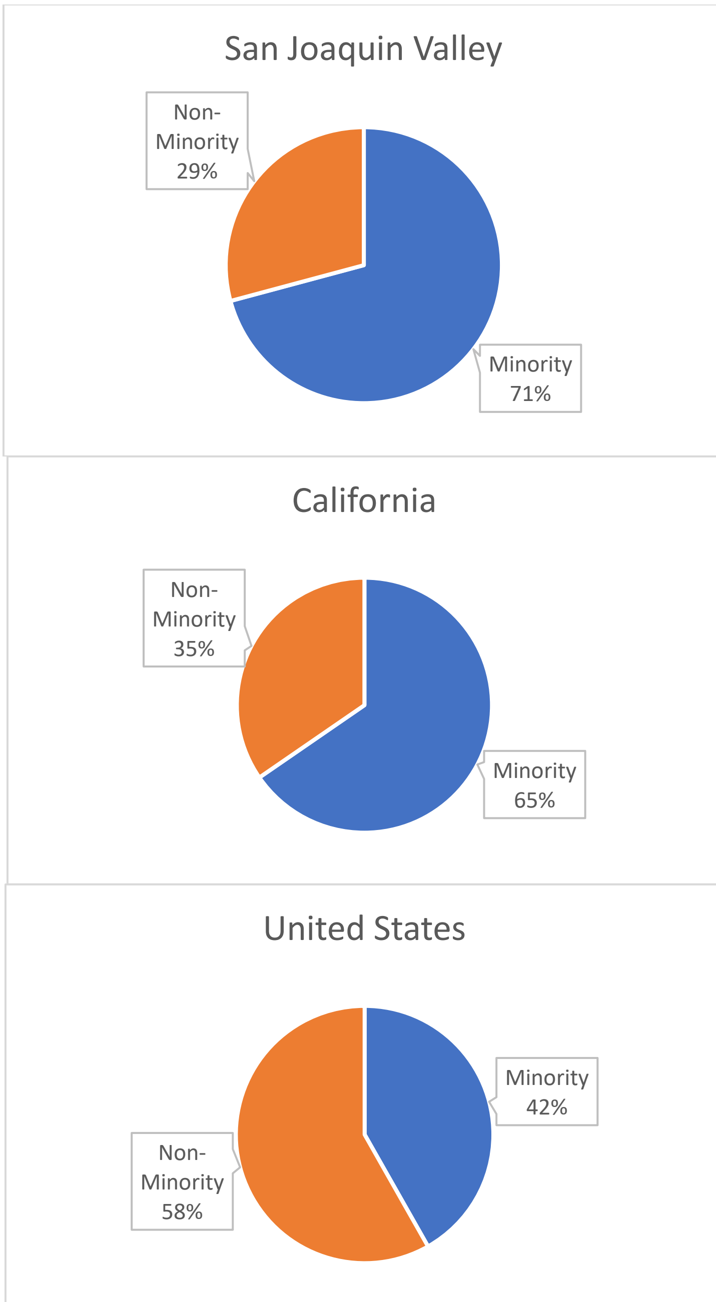
Figure 6 - 13: Percentage of Population Under 25 Years of Age



The residents of the Valley are more ethnically diverse than those of California and the United States. According to the 2023 American Community Survey, 70.8% of the Valley's inhabitants are minority (non-white), compared to 65.4% and 41.8% for the state and nation [***Figure 6-14***].

Figure 6-14: Percentage of Minority Population

Source: DP05, 2023 American Community Surveys 5-Year Estimates



2. VALLEY SUCCESS' IN PARTNERING AND PLANNING

The Valley's success' in partnering and planning has resulted in large improvements for the SJV's residents. This section provides detailed insight into valleywide coordinated efforts. It is broken down into the three subsections listed below.

- Air Quality
- Sustainable Community Strategies
- Valley-Wide RTP/SCS Coordination Efforts

AIR QUALITY

Background

The San Joaquin Valley is one of the largest and most challenging air quality nonattainment areas in the United States. The SJV nonattainment area includes eight counties from San Joaquin County to Kern County on the Western border of the Sierra Nevada range. These counties represent a diverse mixture of urban and rural characteristics yet are combined in a single nonattainment area that violates federal health standards for ozone and particulate matter. Air quality monitoring stations continue to indicate that the San Joaquin Valley is among the worst polluted regions in the country. Since the eight counties are combined into a single nonattainment area, there is a coordinated approach for compliance with the federal Clean Air Act. That coordinated approach is essential in meeting the San Joaquin Valley's goal to provide clean air to all residents.

Coordination

On-going coordination with federal, state, and local partners has been, is, and will continue to be critical to the meeting the goal of providing clean air to all San Joaquin Valley residents. As one of the few multi-jurisdictional planning areas in the country, the individual decisions and actions of each of the San Joaquin Valley Regional Planning Agencies (RPAs) have the potential to affect the entire the SJV. This coordination process is critical to documenting compliance with the Federal Clean Air Act, as well as enabling the expenditures that build and maintain transportation infrastructure; investments which provide valuable jobs to San Joaquin Valley residents.

Transportation Conformity

The primary goal of the transportation conformity process is to assure compliance with transportation conformity regulations with respect to the requirements for Regional Transportation Plans (RTPs), Federal Transportation Improvement Programs (FTIPs), amendments, compliance with the California Environmental Quality Act (CEQA), implementation of applicable transportation control measures (TCMs), and applicable State Implementation Plans (SIPs). In addition, FHWA has determined that the SJV RPA planning processes substantially meet the federal planning requirements.

Continued examples of the San Joaquin Valley RPA coordinated efforts with respect to transportation conformity include the following:

- Monitoring and testing of transportation model updates
- Continued documentation of latest planning assumptions and compliance with the transportation conformity rule and corresponding guidance documents
- Drafting of valley-wide procedures for RPA staff use, with detailed instructions from the execution of EMFAC to post-processing of emissions results consistent with applicable SIPS
- Preparation of boilerplate documentation, including draft public notices and adoption resolutions, as well as draft response to public comments

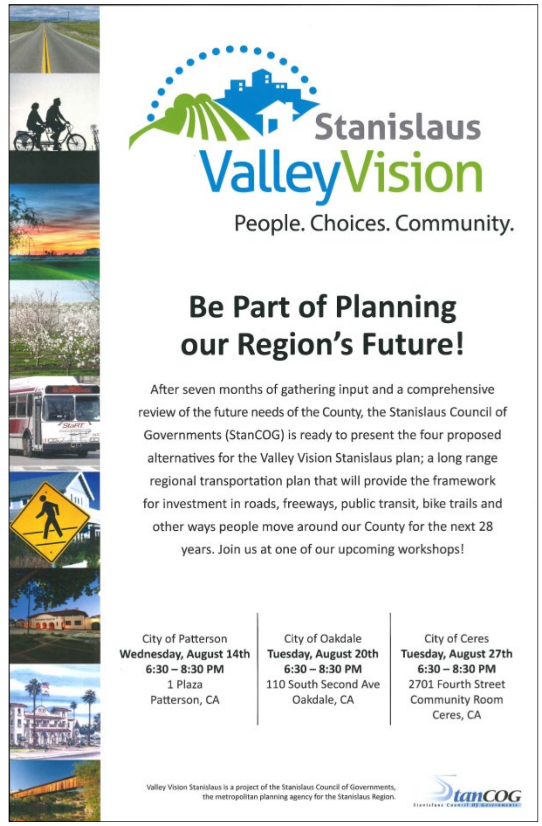
SUSTAINABLE COMMUNITIES STRATEGIES

California's Sustainable Communities and Climate Protection Act of 2008 (Sustainable Communities Act, SB 375, Chapter 728, Statutes of 2008) supports the State's climate action goals to reduce greenhouse gas (GHG) emissions through coordinated transportation and land use planning with the goal of more sustainable communities. Under the Sustainable Communities Act, the California Air Resources Board (ARB) sets regional targets for GHG emissions reductions from passenger vehicle use. In 2010, the ARB established these targets in the San Joaquin Valley as GHG reductions of 5% by 2020 and 10% by 2035. The ARB is currently in the process of setting the second round of targets for the regions. Under Senate Bill 375, each Metropolitan Planning Organization (MPO) in the State is required to develop a Sustainable Communities Strategy (SCS) as part of their Regional Transportation Plan (RTP) to demonstrate that, if implemented, the SCS will attain or exceed the greenhouse emission reduction targets. If the targets cannot be met, then an Alternative Planning Strategy (APS) needs to be developed. The SCS outlines the plan for integrating the transportation network and related strategies with an overall land use pattern that accounts for projected growth, housing needs, changing demographics, and forecasted transportation needs among all modes of travel.

For the San Joaquin Valley, each MPO is scheduled to approve their SCS as an element of their Regional Transportation (RTP/SCS) in 2026. Referred to as the RTP/SCS, each Valley COG has developed an investment strategy that outlines their region's transportation future through 2042. Each RTP/SCS in the Valley goes in-depth into the projects, policies, and strategies that will achieve compliance with state laws while delivering a financially constrained plan matching forecasted revenues with transportation demands. Some achievements of the collective RTP/SCS include:

- Provision of transportation and travel choices
- Improving safety, mobility, efficiency of the transportation system
- Maximizing economic competitiveness/economic vitality
- Facilitating goods movement
- Building healthy and active communities
- Improving the environment
- Providing a range of housing choices

Figure 6 - 15: Valley Vision



VALLEY WIDE COORDINATION ON RTP/SCS EFFORTS

Valley Visions

While SB 375 mandated individual development of the RTP/SCS, the eight MPOs in the San Joaquin Valley have had a history of collaboration in this process to share information, best practices, and foster consistent approaches to RTP/SCS development. The eight COGs participated in a joint grant proposal to the California Strategic Growth Council for Proposition 84 funding. The grant was funded and launched as "Valley Visions" in the 2014 RTP/SCS process

Valley Visions was implemented as a series of planning efforts underway throughout the San Joaquin Valley. It took a big picture look at how the Central Valley grows over time in a way that uses resources efficiently, protects existing communities, conserves farmland and open space, and supports the Central Valley economy, ultimately reducing future greenhouse gas emissions. The Valley Visions logo was provided to each COG to use and customize to their region if they wanted.

One of the tasks identified in the successful grant proposal was enhancement of the eight COG's individual public outreach efforts with a valleywide campaign. The project scope for this task included templates/written materials for customization, a media campaign to engage residents and publicize outreach efforts (social media, newspapers, radio and/or TV), and to assist with the development of SB 375 required workshops and hearings.

Of particular note was an informational video on the SCS process provided in three languages: English, Spanish, and Hmong and the media campaign that was active during the months of August, September, and October 2013. The videos were made available on YouTube, with links on the Valley Visions web page (www.valley-visions.org).

Valley Visions is yet another example showcasing the successes in valleywide collaboration. The eight counties of the San Joaquin Valley coordinated some aspects of these planning efforts and maximized resources, while each area's Metropolitan Planning Organization (MPO) developed a separate plan. This effort helped the Valley COGs brand a consistent message about sustainability.

3. GOODS MOVEMENT

In the Statewide Goods Movement Action Plan, Caltrans designated the Valley as one of the State's four major international trade corridors. The eight-county region is at the center of California's modern logistics system, moving a diverse mix of goods ranging from raw agricultural products to consumer goods. The Valley's critical role in the nation's food supply requires a goods movement system that is not only effective and reliable, but also responsive to global market demands.

While growth projections for the San Joaquin Valley, along with much of California, have trended downward in recent years, the demand on the goods movement system remains high. Continued pressure on costs and profits is leading shippers and receivers to continue to seek transportation efficiency gains. Within the SJV, that goal translates to continual fine-tuning of logistics chains, distribution locations, and transportation practices. Due to its central location, relatively inexpensive land, labor force, and multimodal transportation system, the SJV has emerged as a major hub for distribution for international trade. The SJV is also well positioned for the return of overseas manufacturing, offering proximity to western markets and relatively better water availability for processing compared to Southern California.

Many of the agricultural products that the San Joaquin Valley produces are exported through California's rail, marine and airport systems as well as using the highway and roadway systems to move commodities from farm—to processor/packer—to market. While Interstate 5 and State Route 99 are the two, primary north/south transportation arteries, SR 99 is the transportation backbone of the San Joaquin Valley and is served by many significant east-west corridors such as SR 58, SR 120, SR 180, I-580 to 205, SR 152, SR 198, and SR 46. The SJV is also served by the Port of Stockton, the inland terminus for Marine 580.

The San Joaquin Valley, as a region, needs to effectively plan for efficient goods movement and successfully partner with the private sector, state and federal

Figure 6 - 16: General Electric LNG Locomotive

Figure 6 – 17: Electric Hybrid Semi-Truck Technology

Figure 6 – 18: Federal Alt. Fuel Corridors

agencies to make necessary investments. Without coordinated planning and investment, the region risks worsening highway congestion and deterioration, diminished access to markets and economic opportunities, land use conflicts between logistics-oriented business and growing communities, and poor air quality due to diesel emissions. Emphasis on system-wide efficiency, alternative fuel technology and a comprehensive goods movement system have become key elements of competitive funding. It is anticipated these trends will continue to shape transportation policy and that future funding may emulate the approach of the state’s Trade and Congested Corridor Programs funded through Senate Bill 1.

Figure 6 - 19: Emerging Clearer Medium/Long-Haul Semi-Truck Fleet Technology

Graphic adapted from: https://seekingalpha.com/article/4127262-tesla-semi-revisited

EMERGING TECHNOLOGIES/SYSTEMS

In addition to new clean trucking technologies, ***Figure 6-20*** illustrates battery-powered, autonomous-rail vehicle technology. This emerging technology promises to be an energy-efficient, zero-emission solution developed by a Southern California start-up, Parallel Systems, initially intended to serve short-haul rail routes less than 500 miles. The firm has a pilot project in Georgia expected to begin commercial operations in 2026 with the parent company to the San Joaquin Valley Railroad (SJVR), hauling containers on existing rail and SJVR is interested in expanding the pilot to the Valley. The technology uses safe, wireless charging buried beneath the tracks between the railroad ties, and the vehicles can stop in one-tenth the distance of a normal train.

The San Joaquin Valley will continue to coordinate with Caltrans, CARB, and SJVAPCD to explore the possibility of developing a zero-emissions freight corridor along SR 99/I-5 or the parallel railroad corridors that connects SJV distribution and shipping with the Ports of L.A./Long Beach, Oakland and all points East**. *Figure 6-21*** illustrates potential rail corridors connecting a conceptual network of inland rail ports in the Valley to the seaports. In recent years, the success of Blue Diamond Almond Company shipping by rail from the Sacramento area to the ports of L.A./Long Beach has resulted in diverting hundreds of trucks per year to rail. A $50M

CalSTA grant to the Castle Logistics Center near Merced has opened up a new intermodal ramp near Merced and has seen their usage triple. Wonderful Company in Shafter near Bakersfield is constructing a $100M rail yard expansion to be served by BNSF with pricing that is competitive with trucking. Scheduled to begin operations in 2026 includes a container truck depot similar to one in Lathrop near Stockton that enables container trucks to perform "street-turns," allowing them to be shipped both directions full reducing shipping costs by as much as 40% while eliminating deadheading trips. These early projects demonstrate the viability of similar projects throughout the Valley. Combining these projects with emerging technologies such as blockchain container shipping/tracking and autonomous vehicle technology can lead to a more efficient use of resources, possibly enabling more "street turns" for trucks and rail freight, there by significantly reducing emissions.[1] The Kern Area Regional Goods Movement Operations Study includes a proposal to use I-5 as an autonomous truck testing corridor for California.

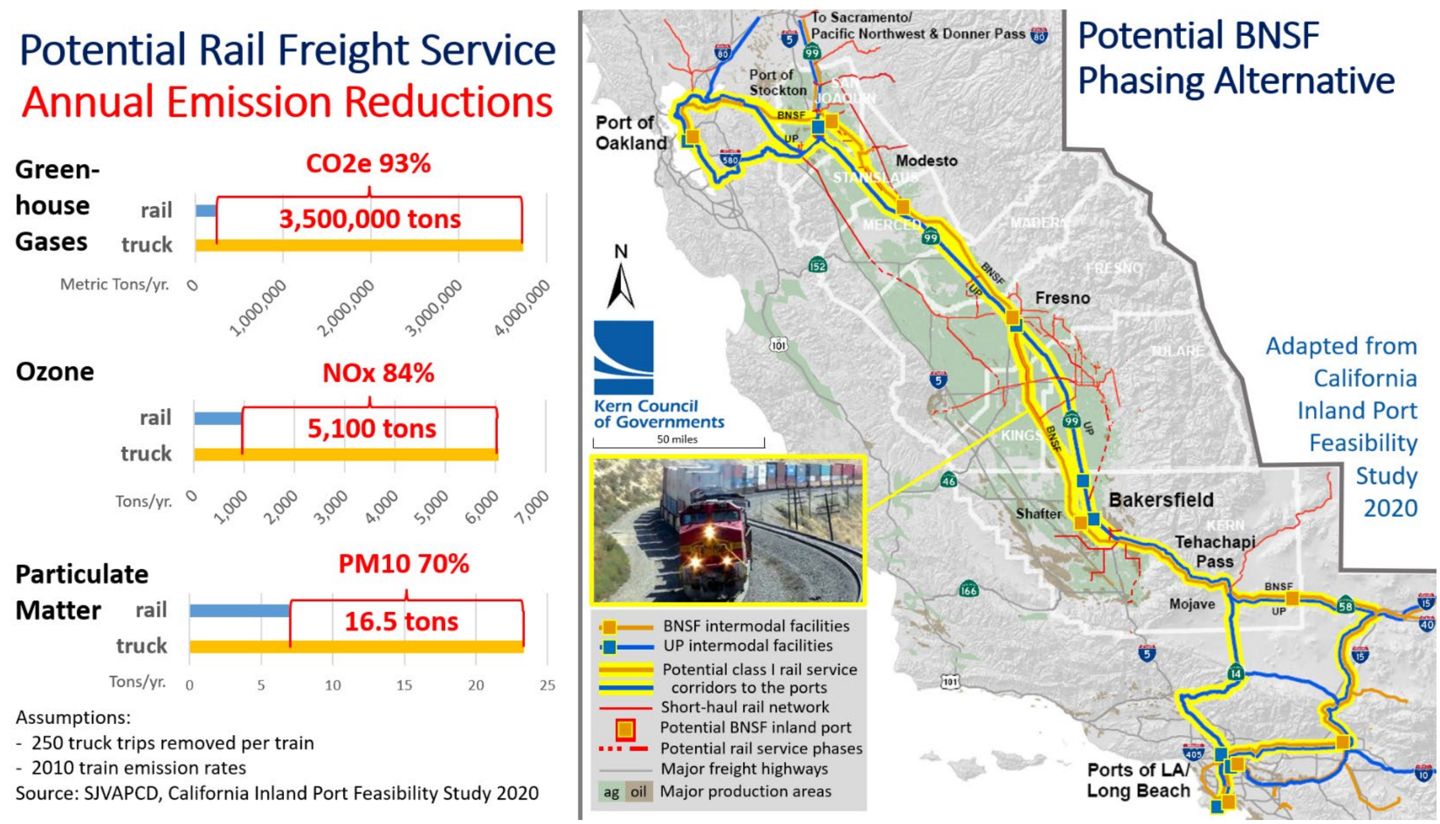
Note that the emission savings in ***Figure 6-21*** are based on the older diesel truck standards and may not be as beneficial for combating Ozone and Particulate matter according to a draft CARB study.[2] However, rail remains 10 times more energy efficient and less carbon emitting than trucking, while providing a significant benefit to roadway maintenance and safety. It is also important to note that the California High Speed Rail when implemented would free up capacity on the BNSF mainline for freight currently being used by Amtrak.

[1] Hapag-Lloyd, Blockchain in Shipping, 2023, ttps://www.hapag-lloyd.com/en/online-business/digital-insights-dock/insights/2023/11/blockchain-in-shipping.html?msockid=397c2d0772ff63c215923b75734e6216#benefits-blockchain

[2] CARB, Draft Truck vs. Train Emission Analysis, 2020, https://ww2.arb.ca.gov/resources/fact-sheets/draft-truck-vs-train-emissions-analysis

Figure 6 - 20: Parallel Systems Electric Intermodal Rail Technology

Figure 6 - 21: Potential Benefits of a California Inland Port Network for Rail Freight Shipments



BACKGROUND/ GOODS MOVEMENT STUDIES

Since 2007 the SJV region has coordinated on development of Goods Movement plans, and identified freight flows for the region, including development of the San Joaquin Valley Truck Model tool and scenario testing. Since that time, a number of goods movement studies have been completed that build on the previous work efforts and further refined the criteria and decision-making process while identifying vital goods movement networks for the multi-county region.

Previous and ongoing goods movement studies for the Valley:

- Valley Transport Resiliency Advancement for Neighborhoods Sustainable Freight Movement (V-TRANSFRM) – underway (2027)
- TradePort California Site Selection Feasibility Study (2026)
- Kern Area Regional Goods Movement Operations (KARGO) Sustainability Study – Phases 1-3 (2021,2023,2026)
- California Inland Port Study – Phase 2 (2023)
- I-5 Freight Zero Emissions Route Operations (ZERO) Sustainability Study (2022)
- California Inland Port Feasibility Analysis – Phase 1 (2020)
- San Joaquin Valley I-5/SR99 Goods Movement Corridor Study (2017)
- San Joaquin Valley Goods Movement Sustainable Implementation Plan (2017)
- San Joaquin Valley Interregional Goods Movement Plan (2013)
- Updated State Route 99 Business Plan (2013)
- SR 223, 166, 119, 46 and 65 Truck Origin and Destination Studies (2011)
- East Side Business Plan (Short Haul Rail), Tulare County (2010)
- SR 58 Origin and Destination Truck Study (2009)
- Interstate 5 and State Route 99 Origin and Destination Study (2009)
- Draft San Joaquin Valley Regional Goods Movement Action Plan (2008)
- San Joaquin Valley Regional Goods Movement Action Plan (2007)
- California Interregional Intermodal System (CIRIS) Implementation Plan (2006)

Some of the recent goods movement studies are summarized below.

Valley Transport Resiliency Advancement for Neighborhoods Sustainable Freight Movement (V-TRANSFRM) (2027)

In a study led by Tulare County Association of Governments (TCAG) in partnership with the eight San Joaquin Valley COGs, V-TRANSFRM is a study that provides updated truck route maps for each region, identification of climate resiliency needs for these routes as well as 30% conceptual design and cost estimation. In 2026 Kern completed the third phase of the Kern Area Regional Goods Movement Operations (KARGO) study which the V-TRANSFRM study was based on.

TradePort California Site Selection Feasibility Study (2026)

The recent study Identified two optimal sites in Fresno County, and involves input from the ports of Oakland, Stockton, Long Beach, and the Air District. The study proposes sequential development of inland ports throughout the San Joquin Valley.

California Inland Port Feasibility Analysis (2020)

In a study led by the San Joaquin Valley Air Pollution Control District, a logistics consultant looked at the market for rail service between a system of inland ports and the ports in L.A./Long Beach and Oakland. The service envisioned a container unit train(s) that would travel the 500-mile route between the two seaports, make one or more stops in the San Joaquin Valley *[Figure 6-21].* The study showed enough freight to support 2 to 10 trains per week with 250 containers per train, with the highest number of trains traveling between the North Valley and the L.A./Long Beach Ports. The study also showed a potential market for transporting containers between the South Valley to the Port of Oakland, creating the potential for hauling containers in both directions in a service that travels between both seaports.

Key Findings of the Market and Operating Cost Analysis:

- The current shipping market is quite robust, larger than most in the industry realized
- There are relatively balanced volumes for inbound and outbound cargos
- The northern portion of the Market Shed is very large
- The Preliminary Business Model suggests that a California inland port rail system can be feasible; but it is important to note that this is dependent on a range of critical factors and assumptions
- A significant number of issues need to be addressed for the project to advance and this needs to be reviewed in the context of a Developed Business Model
- The project requires close collaboration with the railroad companies and close coordination with the State of California
- The Inland Port would produce significant public policy benefits: 1) increased economic competitiveness, especially in the Central Valley region, 2) significantly reduced greenhouse gas air emissions, and 3) reductions in congestion and wear and tear of roadways
- The Inland Port will require public policy leadership from State government, air quality districts, counties and cities and seaports

- In the end, the Inland Port project would have a range of rather substantial economic and environmental impacts for markets and populations throughout the State.

By taking a certain portion of trucks off the road from this region, significant emissions reductions can be realized. Based upon the analysis done for this study, NOx emissions would be reduced by up to 83% while greenhouse gas emissions would be reduced by up to 93%. Moving large quantities of freight via rail provides significant benefits to the air quality of the region, as shown by the emissions reduction analysis section of this report. Additionally, by taking some of these trucks off the road, congestion on key transportation corridors such as I-5, 99 and 101 would be reduced, thereby improving the flow of traffic and the safety of the roadways in these regions *[**Figure 6-21**]*.

Connector Needs and Strategies

Performance metric data collected for select connectors revealed multiple needs that could improve safety and efficiency on connectors throughout the region. Examples include:

- Improved signage for both passenger and commercial vehicle traffic.
- Safety analysis and improvement.
- Signal coordination on truck routes.
- Pavement quality improvements.
- Exploring design standards for heavy truck routes and connectors.

Truck Parking Recommendations

After reviewing previous reports and discussing the issue with public agencies, truck stop operators and truck drivers, several factors were identified that contribute to the truck parking problem in the San Joaquin Valley. The following recommendations to improve conditions should be considered:

- Planning and Funding
  - Improve data collection and analysis to have a better understanding of short-term and long-term parking demand.
  - Work with law enforcement to educate and train them about improved use of safe and available parking spaces.
  - Update plans and investment programs to include truck parking solutions, both for facilities and technology for truck parking information services.
  - MPOs should consider ways to incentivize land use decisions to facilitate private-sector expansion of existing facilities or opening of new ones.
  - Surplus public properties can be converted to truck stops.
  - Funding provided by FAST could be used to construct or expand truck parking facilities and deploy tools for commercial motor vehicle drivers to find safe, available places to park and rest.

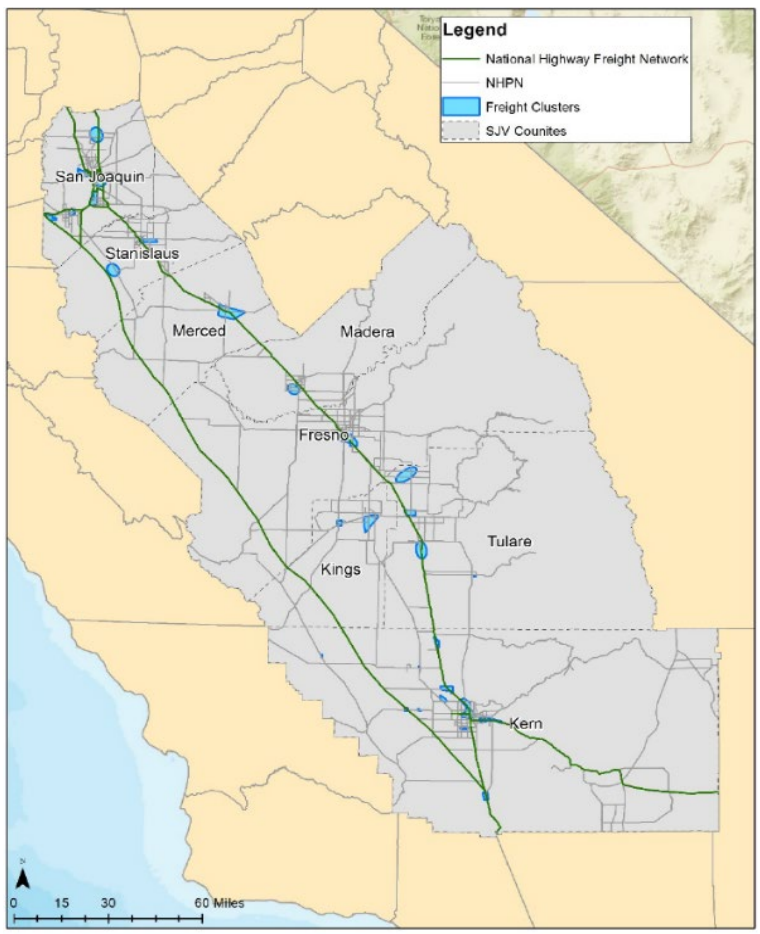
- Demand Control
    - Policies that incentivize off-peak deliveries can reduce demand for long-term parking spaces.
    - Truck circulation is a problem in some older parking facilities that are not designed for larger trucks.
    - Shippers/receivers often demand that drivers leave the facility immediately after delivery.

Recommended Next Steps

The SJV Sustainable Implementation Plan has identified a system of truck corridors and connectors and recommendations for how to proceed with improvements on these roadways to address identified needs. In order to move forward with these recommendations, implementation actions should be taken in four key areas:

1. Taking steps to secure funding for near-term opportunities;
2. Conduct additional local analysis to prioritize corridor improvements, including truck parking;
3. Establish a process for regular input on connectors, priority corridors and truck routes; and
4. Work with Caltrans to adapt the statewide freight model for Valley applications.

Figure 6-22: SJV Freight Clusters



San Joaquin Valley I-5/SR99 Goods Movement Corridor Study (2017)

Interstate 5 (I-5) and State Route 99 (SR 99) play critical and unique roles as the major goods movement facilities in the San Joaquin Valley. At present, 92 percent of goods in the SJV are carried by truck, and this is not expected to change in the near future. I-5 and SR 99 carry the highest volumes of trucks in the SJV and in some locations, among the highest volumes in the state. This is a reflection of the traditional north-south orientation of freight flows in the SJV, associated with the through routing of trucks to connect the major coastal urban areas to the north and south of the SJV, the north-south orientation of the Valley's major urban centers, and the need to access major east-west interstate connections north and south of the San Joaquin Valley itself.

I-5 is the route that is favored for long-haul movements. It carries higher levels for through traffic and there has traditionally been less development along this route. However, new developments in warehousing and distribution centers and manufacturing are taking advantage of access to I-5. Increasing traffic that is being generated within the San Joaquin Valley uses I-5 for national connections. SR 99 runs through each of the urban areas in the SJV and includes truck traffic distributing goods to/from these areas. It also provides connections to east-west routes that support the farm-to-market traffic and connections between farms and food processing that characterize the agricultural supply chain. It is the backbone of the intra-Valley goods movement and a major route for commuters who share the road with trucks in the urban centers.

A major effort and focus of this study involved identifying major truck generators in the San Joaquin Valley. This study identified seventeen major freight clusters responsible for a large percentage of truck trips within the SJV and to and from other regions in California *[Figure 6-22].* Each of these clusters consists of some combination of intermodal facilities, distribution centers, and/or large manufacturing firms. The clusters are distributed throughout the San Joaquin Valley, with four located in San Joaquin County, two in Stanislaus County, one each in Merced and Madera counties, one in Fresno County, one in Kings County, three in Tulare County, and four in Kern County.

The San Joaquin Valley I-5/SR99 Goods Movement Corridor Study is divided into seven tasks, of which the Final Report incorporates Tasks 1, 2, 3, 4, and 7. Tasks 5 and 6 covered coordination in support of the other tasks. The Tasks covered in the Final Report are:

- Establish the need for streamlining goods movement.
- Name specific "pain points" and priorities for mitigation.
- Identify mitigating projects and programs.
- Identify mitigating projects and programs.
- Evaluate the feasibility of implementing projects and programs.
- Analyze potential for technical demonstration of specified technology.

GOODS MOVEMENT PROJECTS

The three key basis for selection of the projects are as follows: 1) they are located on I-5 or SR 99 corridors and would improve economic efficiency and productivity, alleviate mobility and safety related goods movement issues, as well as support the growth of agricultural and industrial land uses; 2) they are located on connectors between I-5 and SR 99 corridors and would meaningfully increase network redundancy and alleviate congestion on the SR 99 corridor, along which a majority of freight clusters are located; and/or 3) they are located on key ingress/egress routes of the San Joaquin Valley region and would likely enhance its economic opportunities of handling trade and logistics for the ports and large populations in the Bay Area and Southern California.

Information collected for the projects includes: 1) location and route, 2) project ID, 3) project title and description, 4) project type, 5) project cost, 6) timeline for implementation, and 7) source of project information. The following provides information about projects planned along I-5 and SR 99, as well as along some major east/west or north/south connectors between I-5 and SR 99 that may alleviate SR 99 congestion.

The projects with an implementation timeline of 0-5 years in each San Joaquin Valley County, including local updates since the 2017 Goods Movement Corridor Study, are as follows:

Fresno

- California High-Speed Rail Project-SR 99 Re-Alignment
- Mountain View and SR 99 Overcrossing: Widen Overcrossing and Improve Ramps
- NB SR 99 Herndon Off Ramp: Signalize & Widen Ramp
- Widen I-5 between Kings County and Merced County lines
- Widen SR 99 from 6 to 8 lanes from Central Ave to Bullard Ave.

Kern

- SR46: I-5 to Lost Hills Disadvantaged Community Safety Improvements/Gap Closure - Phase 4
- SR58, 46, 99, 14, 395, I-5 Federal Clean Transportation EV Charging/Alt. Fuel Corridors
- SR58 Centennial Corridor Gap Connector—Out of Direction Travel/VMT Reduction Project
- SR58 Tehachapi Grade Safety Improvements, Truck Climbing/Passing Lanes; HSR Realignment
- SR58 Safety Conversion of Expressway Segments to Freeway at SR 223 & California City Blvd
- Intermodal Rail Inland Port “Last-Mile” Connector Improvements (SR99, 43, 7^{th} Standard Rd)
- Metropolitan Bakersfield Railroad Separation-of-Grade Safety Program

Madera

- SR99: North Madera 6 Lane (Avenue 17 to 21)
- SR99: Reconstruct SR 99 and SR 233/Avenue 26 Interchange
- SR99: South Madera 6 Lane (Avenue 7 to 12)

Merced

- Highway 99: Livingston Widening Northbound
- Highway 99: Livingston Widening Southbound
- Widen SR 152 between SR 99 and US 101 (in Merced County)

San Joaquin

- I-5 at Louise Avenue Interchange
- I-5 at Roth Road Interchange
- Widen I-5 between SR 120 and I-205
- Widen I-5 from 1 mile north of SR 12 to SR 120
- Widen SR 99 from French Camp Rd to Mariposa Rd 6 to 8 lanes, with new interchange
- SR 99 at Austin Road Interchange
- SR 99 at Eight Mile Road Interchange
- SR 99 at Gateway Boulevard Interchange
- SR 99 at Main Street/UPRR Interchange (Ripon)
- SR 99 at Morada Interchange
- SR 99 at Raymus Expressway Interchange
- SR 99 at Turner Road Interchange Operational Improvements
- Widen SR 12 between I-5 and SR 99
- Widen SR 120 between I-5 and SR 99, with new interchange at SR 99

Stanislaus

- SR 99 Interchange Ramp and Auxiliary Lane Improvements
- SR 99 & Hammett Rd
- SR 99 & Briggsmore Interchange
- SR 99 Reconstruct Interchange at Fulkerth Road
- SR 99 Reconstruct to 8-lane Interchange - Phase II
- I-5 to Rogers Road: Interchange Improvements and Widen Sperry Ave
- Widen SR 99 from 6 to 8 lanes in Stanislaus County
- Widen SR 132 connecting SR 99 and I-580

Tulare

- State Route 99/Betty Drive Interchange

Kings County did not have any projects with an implementation timeline of 0-5 years.

Strategic Goals, Objectives, I-5/SR 99 Strategic Program

The study identified seven strategic goals with related objectives for the SJV region based on various state and regional transportation planning documents.

Strategic Goals, Objectives

- Improve Economic Competitiveness:
    - Vitalize/Revitalize commercial vehicle corridors.
    - Increase transportation choices for freight uses.
    - Improve access to key economic centers.
    - Reduce the cost of exporting products from the region, thereby increasing demand for those products and related processing/manufacturing jobs.
- Preserve Infrastructure:

  - Conduct preventative maintenance and rehabilitation on freight transportation system.
  - Maximize utilization of available supply for freight uses.
  - Manage freight demand within existing supply.
  - Preserve land for future freight uses.
- Improve Mobility and Travel Time Reliability:
  - Integrate multiple modes for freight uses.
  - Minimize congestion and increase operational efficiency for freight uses.
  - Increase network redundancy for freight uses.
- Improve Safety and Security:
  - Minimize crashes and damages for freight uses.
  - Improve operations on freight transportation system.
  - Improve incident management and network resiliency on freight transportation system.
  - Stay informed about the current level of threat to security on freight transportation system.
- Improve Environment:
  - Stay informed about the current commercial vehicle environmental laws and regulations and improve their enforcement.
  - Conserve energy and natural resources for freight uses.
  - Minimize commercial vehicle emissions.
  - Improve development and implementation of mitigation measures for freight investments.
  - Improving environmental justice for freight investments.
- Use Innovative Technology and Practices:
  - Develop commercial vehicle alternate fuel technology and fueling infrastructure.
  - Develop new commercial vehicle to commercial vehicle communications technology applications.
  - Develop new commercial vehicle operator information systems.
  - Develop institutional arrangements and business relationships to optimize freight transportation system usage and costs.
- Plan and Collaborate to Fund Investments:
  - Develop freight projects list, timeline for implementation and public funding gap information.
  - Conduct studies to evaluate benefits of key freight transportation system investments.
  - Coordinate with other public agencies and private sector for freight project or service development and associated land use planning.

CONCLUSIONS/THE FUTURE OF GOODS MOVEMENT IN THE SAN JOAQUIN VALLEY

The most recent statewide, regional, and local transportation plans were used to compile a master list of goods movement related projects and programs on I-5 and SR 99 corridors in the San Joaquin Valley region. These included projects on I-5 and SR 99, key connectors between the two corridors and key ingress/egress routes of the region that connect to I-80 via Sacramento Valley, San Francisco Bay Area, Central Coast, Southern California and I-40/I-15 corridors via Tehachapi Pass.

County level analysis of truck volume and peak period travel speed data on I-5 and SR 99 showed critical mobility and reliability issues on segments and critical freight access interchanges. County level analysis of truck involved crash severity data on I-5 and SR 99 showed critical safety and reliability issues on segments and critical freight access interchanges.

The literature review on ITS solutions for truck parking showed options for real-time parking detection technologies, compared their physical and operational capabilities, and summarized past tested public-private-partnership opportunities for truck parking.

The California Inland Ports Feasibility Analysis has identified a potential business case for container rail service between the state's major seaports and the San Joaquin Valley with as many as 10 trains per week between the Northern San Joaquin Valley to the Ports of L.A. at 30 percent market saturation. The ability to divert truck trips to rail improves GHG emissions, reduces wear and tear on the highways, improves highway safety, and delays the need for interregional goods movement related highway capacity improvements. Fresno COG is leading phase 2 of the California Inland Port Study being funded by Caltrans. One of the recommendations of the Phase 1 study was the need to form a statewide inland port authority with representatives from the seaports, the inland port interests, affected state agencies, shippers, receivers, and the railroads.

Through the cooperative efforts of the San Joaquin Valley eight-county coalition and the goods movement planning efforts, the SJV is seriously looking at all the existing conditions, growth implications and environmental impacts on our communities to develop a strategic and comprehensive understanding and strategies for implementing an efficient goods movement system.

Throughout the goods movement planning process, public and private stakeholders have met and discussed the criteria and metrics for evaluating projects to enhance the socioeconomic status of the San Joaquin Valley via improvements in our transportation systems, especially the status of disadvantaged communities. During the planning process the regional planning agencies worked with regional freight stakeholders from throughout the SJV to understand the issues, challenges, bottlenecks, and opportunities of the Valley's multi-modal goods movement system, including a three-tiered stakeholder outreach process to public, private, and other freight system stakeholders.

The supply chain and logistics trends of key industries, their current needs, and how they will impact goods movement in the future based on travel modeling, as well as creating simplified supply chain diagrams to illustrate the transportation system needs of industries should be expanded.

The goods movement planning processes provide the eight-county region with data-driven, multimodal project lists that reflect the combined goods movement vision of the entire of the region.

4. VALLEY WIDE PLANNING EFFORTS

SAN JOAQUIN VALLEY REGIONAL POLICY COUNCIL

The eight valley Regional Transportation Planning Agencies have a long history of successfully coordinating and collaborating to address issues of regional significance in the San Joaquin Valley. This approach was formalized with the voluntary creation of the San Joaquin Valley Regional Policy Council (Regional Policy Council). This Council was established in 2006 to discuss and build regional consensus on issues of SJV importance. In 2009 the San Joaquin Valley Air Pollution Control District was added as a member, and in 2021 the San Joaquin Joint Powers Authority was added, resulting in ten member agencies. The Council consists of two elected officials and one alternate appointed from each of the eight regional planning agencies' governing boards in the San Joaquin Valley. This body provides a forum for our Valley to communicate and coordinate easily and effectively on issues that impact the region such as:

- Intercity Passenger Rail
- State Route 99
- Goods Movement
- Short Haul Rail
- Air Quality/Transportation Planning
- Valleywide Model Improvement Plan
- AB 32, SB 375 Implementation
- Regional Energy Planning
- Regional Transportation Plans
- Annual Policy Conference
- Accessory Dwelling Unites
- Regional Early Action Planning (REAP) Program

In addition, the Regional Policy Council also fosters and supports the development of relationships between the San Joaquin Valley and the California Transportation Commission, the California Air Resources Board, the California Partnership for the San Joaquin Valley, Caltrans, Federal Highway Administration, and other state and federal agencies.

VALLEY VOICE

Valley Voice is a valley-wide advocacy program which consists of annual trips to Washington, D.C. and Sacramento.

The goals of the Valley Voice program are to:

- Communicate the Valley's legislative priorities.
- Obtain more state and federal funding for regional priorities.
- Advocate for legislation or changes to existing legislation that will benefit the valley.

The Valley Voice delegation is comprised of representatives from the San Joaquin Valley Regional Policy Council. Each year, the RTPAs develop state and federal legislative platforms that are reviewed and approved by the Regional Policy Council. The Washington, DC trip is typically scheduled in September, and the Sacramento trip is typically scheduled for February/March.

VALLEY VOICE SACRAMENTO 2025 – ISSUES

Pragmatically Address Air Quality, Equity, and Mobility Goals Through Operational Improvements

- Support stable, equitable, and environmentally conscious state funding of alternatives to petroleum fuel sources to expand infrastructure and incentives for conversion to electric vehicles to reduce greenhouse gas emissions.
- Prioritize feasible implementation strategies for State and regional climate goals to improve air quality and mobility.
- Extend the Cap-and-Trade Program beyond 2030.
- Pursue Innovative Solutions to Address Climate and Mobility Goals.
- Monitor activities on conversations regarding the jobs-housing imbalance and the impact on vehicle miles traveled.
- Monitor the implementation of SB 743, AB 285, and discussion on amending SB 375 and protect the ability to continue addressing congestion.

Leveraging State Funding to Address Safety, Goods Movement, and Mobility

- Aggressively pursue funds through the State Budget, California Transportation Commission (CTC) allocation process or any other state sources to address safety, congestion management, and goods movement.
- Advocate for a successor source to the gas tax to ensure stability and predictability of funding.
- Ensure that CSIS allows investments to enhance safety and goods movement on state highway system.

Access Transit Funding

- Support potential changes to the Transportation Development Act that will assist local public transportation systems with funding eligibility.

- Stabilize and increase transit funding levels.
- Protect and augment existing programs to encourage mode-shift.

Enhance Passenger Rail Infrastructure and Service

- Provide enhanced passenger rail service connecting the San Joaquin Valley to the Bay Area and Southern California.
- Maintain and increase funding for commuter and intercity passenger rail.

VALLEY VOICE WASHINGTON DC 2025– ISSUES

State Route 99

State Route 99 – due to its central location in California – is a major goods movement state highway connecting southern and northern California through the major cities of the San Joaquin Valley. SR 99 is on the National Primary Freight Network and has high truck volumes. Lack of capacity for SR 99 results in congestion, fatal accidents, and poor air quality. The Valley Voice delegation encourages Congress and the Administration to support robust federal investments for this critical corridor.

Reauthorization Policy Principles

Valley Voice supports prioritize the distribution of federal funds to the local level, specifically to Metropolitan Planning Organizations (MPOs). We encourage lawmakers to direct dollars through key formula programs rather than discretionary or competitive programs. Formula programs provide reliable and predictable resources to the Valley on an annual basis – and these dollars are more accessible to smaller agencies that struggle with the capacity to apply for competitive or discretionary programs. Understanding that Congress considers legislation to succeed the Infrastructure Investment and Jobs Act (IIJA), the Policy Council asks lawmakers to prioritize the distribution of federal funds to the local level, we urge members of our congressional delegation to advance the following policy priorities and secure additional federal resources for our local needs:

- Addressing Demand for Investment in Bridges and Rural Goods Movement
- Robust investments in emissions reduction such as the Congestion Mitigation and Air Quality Improvement Program (CMAQ) and Surface Transportation Block Grant (STBG) Program.
- Address air quality challenges in the region, with eligibility for more efficient, innovative vehicles and equipment, as well as clean air technologies.
- Legislative and regulatory solutions that seek to further streamline project permitting efforts and reduce administrative burdens and project delays associated with National Environmental Policy Act (NEPA) reviews.

Support Pending Federal Grant Applications

The Valley Voice delegation encourages Congress and the Administration's support for the following projects seeking federal grant assistance through programs administered by the U.S. Department of Transportation:

- I-205 Managed Lanes---Highway Infrastructure Programs
- SR 43/7th Standard Rd Roundabout Last-Mile Truck-Rail Access Safety Project ---Highway Infrastructure Programs
- Modesto & Empire Terminal Railroad Positive Train Control Installation---Consolidated Rail Infrastructure and Safety Improvements

U.S. Department of Housing and Urban Development

- *Kern County: Centennial Corridor SB 99 to WB 58 Connector*
- *Tulare County: Riggin Avenue Widening and Streetscaping*

VALLEYWIDE WORKING GROUPS

Valley Legislative Affairs Committee (VLAC)

A regional policy and advocacy group that brings together representatives from the eight San Joaquin Valley regional planning agencies (metropolitan planning organizations and councils of governments).
Its main purpose is to:

- Coordinate on **federal and state legislative issues** that affect the San Joaquin Valley.
- Advocate for **funding, transportation, air quality, water, and other regional priorities**.
- Provide a unified voice for the Valley to strengthen legislative impact in Sacramento and Washington, D.C.
- Monitor and recommend **legislation, policy changes, and regulatory actions**.

VLAC typically reports to the **San Joaquin Valley Regional Policy Council**, which is made up of elected officials from each of the Valley's COGs.

Travel Modelers Group

The **Travel Modelers Group (TMG)** in the San Joaquin Valley is a **technical working group** made up of travel demand modelers and planners from the eight Valley Metropolitan Planning Organizations (MPOs) / Councils of Governments.
Purpose

- Provide a **forum for coordination and consistency** in travel demand modeling across the San Joaquin Valley.
- Ensure modeling practices align with **federal and state requirements** (e.g., for air quality conformity, SB 375, and long-range transportation plans).

- Share **data, tools, and methodologies** to maintain consistency in regional and Valleywide planning efforts.
- Support interagency consultation with **Caltrans, CARB, FHWA, FTA, and ARB** when modeling inputs or assumptions affect air quality or transportation conformity.
- Advise the **Model Improvement Program (MIP)** for the Valley, including updates to the Valleywide travel demand model platform.

Membership

- Technical staff from each of the eight Valley MPOs/COGs.
- Caltrans District and Headquarters staff.
- Other partners (e.g., consultants, ARB staff) participate as needed.

Reporting

- Provides technical recommendations to the **San Joaquin Valley Regional Planning Agencies' Directors Committee**.
- Plays a key role in supporting Valleywide efforts such as the **Sustainable Communities Strategies (SCS)**, **Regional Transportation Plans (RTPs)**, and **air quality conformity analyses**.

SJV Swap Meet Programmers Group

- The purpose of the group is for Valley MPOs/COGs to exchange information on programming needs, funding swaps, and project delivery strategies. The group is essentially a staff-level coordination meeting to keep project funding flexible across the Valley. The group convenes once a month.

Valley Wide House Committee

- The Valley Wide Housing and Land Use Committee is one of many collaborative forums for San Joaquin Valley MPO staff to discuss and navigate similar challenge. The purpose is to exchange the development of technical land use tools for scenario development for the Sustainable Communities Strategy and the Regional Housing Needs Assessment consistency, updates to Regional Early Action Planning, housing policy and land use legislation as imposed by the State and Federal government.

Rail, Transit, and Transit-Oriented Development Working Group

- With the purpose of developing, promoting, and helping implement a vision for passenger rail, transit, and land use around public transportation in the San Joaquin Valley, the Rail, Transit, and Transit-Oriented Development (TOD) Working Group was formed in 2023 and is led by the San Joaquin Joint Powers Authority (SJJPA) staff. Each of the eight San Joaquin Valley Regional Transportation Planning Authorities have assigned at least one senior staff member to this Working Group, and meetings are typically held bi-monthly. Recent activities of the Rail, Transit, and TOD Working Group have included the development of maps and a one-pager for use at the SJV Policy Conference and on lobbying trips to Sacramento and DC, as well as the development of a letter to US DOT Secretary Sean Duffy on the importance of keeping federal grants on the California High-Speed Rail project. The Working Group has also been in discussions with SJV Policy Council members on the upcoming extension of the Cap-and-Trade, now called Cap-and-Invest program, in order to secure long-term funding for the high-speed rail project as well as continued funding for the Transit and Intercity Rail Capital Program (TIRCP) which has been an important source of capital funding for transit and rail projects throughout the Valley. Key activities and accomplishments of the Rail, Transit, and TOD Working Group include:

- Valleywide and County-Level Vision Documents in Partnership with The California High-Speed Rail Authority
- San Joaquin Valley Network Integration and Transit-Oriented Development Action Plan (Plan)
- Valley Voice Support for Sacramento and DC Lobby Days
- San Joaquin Valley Passenger Rail, Transit, and Land Use Planning Studies led by Partner Agencies

TRANSPORTATION PLANNING EFFORTS AND STUDIES

Transportation planning agencies in the San Joaquin Valley have led the way on efforts to bring innovative transportation planning concepts and projects to the residents of the San Joaquin Valley. These efforts are especially aimed at improving mobility in rural and disadvantaged communities. Some examples of the planning efforts in the San Joaquin Valley include:

Valley Wide Efforts

Valley Transport Resiliency Advancement for Neighborhoods Sustainable Freight Movement (V-TRNSFRM)

The aim of the V-TRNSFRM study is to help us assess climate change vulnerabilities and identify solutions that will strengthen the resilience of transportation infrastructure in the San Joaquin Valley. The study will analyze the vulnerabilities of I-5, SR-99, and their key connectors, including parallel routes that support freight movement and regional connectivity, identifying infrastructure deficiencies and prioritizing climate adaptation strategies. This valley-wide effort is being managed by TCAG.

Fresno Council of Governments

Fresno County Mobility Hub Feasibility Study

Sponsored by FCOG and its local transit agencies, including Fresno Area Express, Clovis Transit, and Fresno County Regional Transit Agency, the study is looking to find feasible locations for the placement of mobility hubs. A mobility hub is a central spot where people can access at least two types of transportation alternatives other than driving alone. Mobility hubs are designed to help people get around without needing a car and can include distinctive amenities depending on the needs of people in the area. They could include things like bus routes, on-demand shuttle stops, bike lanes and bike parking areas, rideshares like Uber or Lyft, sidewalks, and electric car charging stations. Additional amenities can include coffee shops, daycare facilities, and convenience stores.

San Joaquin Council of Governments

Stockton Mobility Collective

The Stockton Mobility Collective project improved transportation options to help residents travel to jobs, schools, health care, grocery stores and other key destinations vital to everyday life. The project launched Stockton's first nonprofit electric bike sharing and carsharing programs, enhanced the Vamos app with new features, and piloted new programs for workforce development and mobility incentives to help pay for transportation costs for qualifying residents. The project grant was completed in December 2024, though several programs will continue to operate and expand into 2025 and beyond.

Tulare County Association of Governments

Equity-Based Zero Emission Regional Transportation Study (EB-ZERTS)

This effort is currently underway and aims to expand opportunities for electric vehicle (EV) charging and alternative fuel stations, enhancing both local and interregional mobility as well as the movement of goods within Tulare County. More specifically, the study is looking for ways to: better accommodate existing alternative fuel users; improve access and effectiveness for increasing future alternative fuel usage; and increase funding opportunities for TCAG and its member agencies to equitably expand the EV and Alternative Fuel networks throughout the Tulare County region.

Merced County Association of Governments

Merced Regional Multimodal Access Plan (MRMAP)

The MRMAP aims to improve access to the future Merced Integrated Intermodal Rail Station through a comprehensive approach that includes creating illustrative materials, identifying key trip generators in the county, and recommending effective multimodal transportation investments. By focusing on the needs and priorities of local communities, the plan emphasizes economic growth, equity, air quality, and access, with a strong commitment to enhancing biking, walking, and transit infrastructure to access the future High Speed Rail station in downtown Merced.

Madera County Transportation Commission

Zero-Emission Vehicle Readiness and Implementation Plan

In 2023, MCTC prepared the Zero-Emission Vehicle Readiness and Implementation Plan. The plan assesses the existing zero emission vehicle infrastructure environment, recommends infrastructure improvements and investments, identifies implementation strategies and policies to promote ZEV infrastructure adoption in the short- and long-term, identifies key community challenges and barriers to advancement, and provides stakeholders with tools to procure, site and install various ZEV infrastructure. This plan primarily addresses conventional ZEVs including battery electric vehicles (BEVs) and fuel cell electric vehicles (FCEVs).

5. VALLEY SUCCESS IN IMPLEMENTATION

PASSENGER RAIL IN THE SAN JOAQUIN VALLEY

Passenger rail service has been an area of extensive activity for the San Joaquin Valley with two existing services currently operating and the first segment of the California High-Speed Rail System under construction, which began in Fresno in 2015. The two existing passenger rail services include the Amtrak Gold Runner (formerly the San Joaquins) route that runs the length of the San Joaquin Valley and the Altamont Corridor Express (ACE) that connects the northern San Joaquin Valley with the San Francisco Bay Area.

Figure 6 - 23: Amtrak San Joaquins Route

The Amtrak Gold Runner route provides service from the San Francisco Bay Area and Sacramento through the SJV to Bakersfield. The Gold Runner runs multiple times daily between the San Francisco Bay Area (or Sacramento) and Bakersfield, where Amtrak Thruway buses connect to Southern California destinations. Other stops along the way include Stockton, Modesto, Merced, Martinez, and Fresno. Thruway bus connections to San Francisco are made at Emeryville.

Figure 6 – 24: Altamont Corridor Express (ACE) Route

The Altamont Corridor Express (ACE) is a commuter rail service that connects Stockton to San Jose. The ACE service is named for the Altamont Pass, through which it runs. The 86- mile (138 km) route includes ten stops, with travel time of about 2 hours and 12 minutes end-to-end. ACE runs four round trips daily with annual ridership of 1.5 million passengers. ACE trains depart Stockton in the morning with return departures from San Jose in the afternoon. ACE service has ten stations through San Joaquin, Alameda, and Santa Clara County with bus connections to other transit including Bay Area Rapid Transit (BART) in Pleasanton.

After breaking ground in 2015, construction of the California High-Speed Rail is well underway in the San Joaquin Valley. The California High-Speed Rail System will be the first 200+ mph high-speed rail system in the nation. The California High-Speed Rail Authority ("Authority") is proposing an Initial Operating Section (IOS) from Merced to Bakersfield. The Merced to Fresno Project Section is part of the first phase of the high-speed rail system. The Authority plans to begin operations of service in 2032, at which time Merced will become the southern terminus for Gold Runner Amtrak rail service. This project section is approximately 171-miles and generally parallels the BNSF Railway tracks, Union Pacific Railroad (UPRR) tracks and State Route 99 between Merced and Bakersfield with stations in downtown Merced, Madera, Fresno, Hanford and Bakersfield. The system will eventually extend to San Francisco, Sacramento and San Diego, totaling 800 miles with up to 24 stations. In addition, the Authority is working with regional partners to implement a statewide rail modernization plan that will invest billions of dollars in local and regional rail lines to meet the state's 21st century transportation needs.

San Joaquin Joint Powers Authority

A short-term goal for the service outlined in the 2021 SJJPA Business Plan is to increase to nine daily round trips and double trips from Stockton to Sacramento from two to four daily trips. With the passage of Assembly Bill (AB) 1779 in August 2012, regional government agencies were authorized to form the San Joaquin Joint Powers Authority (SJJPA) to take over the administration and management of the existing Amtrak Gold Runner Rail Service from the state. The SJJPA was established in March 2013 and is comprised of ten Member Agencies that make up the SJJPA Board including: Alameda County, Contra Costa Transportation Authority, Fresno Council of Governments, Kings County Association of Governments, Madera County Transportation Commission, Merced County Association of Governments, Sacramento Regional Transit, San Joaquin Regional Rail Commission, Stanislaus Council of Governments and Tulare County Association of Governments. An Interagency Transfer Agreement between the SJJPA and the State was signed on June 29, 2015. Under the provisions of AB 1779, the state will continue to provide the funding necessary for service operations, administration and marketing. Furthermore, Caltrans Division of Rail will remain responsible for the development of the Statewide Rail Plan and the coordination and integration between the three state-supported intercity passenger rail services.

The primary role of SJJPA is the day-to-day management of the Gold Runner Amtrak System. The SJJPA will be responsible for managing the High-Speed Rail IOS for the Merced to Bakersfield Segment. Recent activities of the SJJPA have included focusing on short-term service improvements, pre of the High-Speed Rail Authority (HSRA) in the implementation of high-speed rail through the Central Valley and the San Joaquin Valley Joint Powers Authority (SJPPA) in support of enhanced Gold Runner Amtrak service. These activities have involved:

- Supporting Amtrak service expansion to 9 daily round trips in the San Joaquin Valley
- Expanding through-way bus services with a variety of transit services providers
- Advancing renewable diesel engine initiative for commuter rail emission reduction
- Relocation of the Madera Amtrak Station
- Reducing overall run times between Bakersfield and Norther California destinations
- Launching Merced to San Jose Thruway Bus Route Pilot Program
- Strategic Integration with High-Speed Rail service
- Merced Intermodal Track Connector (MITC) Project
- Stockton Diamond Grade Separation Project

Looking Forward

Senate Bill 132 was adopted in April 2017, assigning $400 million for the purpose of extending the Altamont Corridor Express into Ceres and Merced by the year 2027. Senate Bill 132 aligns with the San Joaquin Regional Rail Commission (SJRRC) Valley Rail Ceres-Merced Extensions planning effort, which supports both the enhancement of exiting ACE service between Stockton and San Jose as well as extend ACE service to Manteca, Modesto, Turlock and Merced. The San Joaquin Valley transportation partners will also continue to work with the California HSRA to support the implementation of high-speed rail within the SJV as the initial operating phases are complete and services are initiated.

Figure 6 – 26: ACEforward Proposed Service

The Valley Rail Sacramento Extension Project would expand Amtrak Gold Runner and Altamont Corridor Express (ACE) passenger rail services to the greater Sacramento area through the construction of six new rail stations and track improvements along the Union Pacific Railroad (UPRR) Sacramento Subdivision train tracks. The Project includes the potential implementation of two new roundtrips of Gold Runner service operating on the Sacramento, Fresno, and BNSF Stockton Subdivisions, as well as an extension of existing ACE service to the proposed Natomas Station. The Project also includes service from the proposed Natomas Station to the Ceres ACE Station included in the ACE Extension Lathrop to Ceres/Merced project. The six new stations would be constructed in the following locations: Lodi, south Sacramento (to be named the "North Elk Grove" station), City College, Midtown Sacramento, Old North Sacramento, and Natomas/Sacramento Airport (with a shuttle connection to and from the Sacramento International Airport).

Other planned passenger rail services in the San Joaquin Valley include Valley Link, Cross Valley Corridor (CVC), and Fresno Regional Rail. Valley Link is a 42-mile passenger rail service over the Altamont Pass, providing a new, zero-emission transit alternative to congested Interstate 580. The 22-mile initial operating phase, which could break ground as early as 2025, will provide all-day, bi-directional service between the Dublin/Pleasanton BART Station in the San Francisco Bay Area and a new Valley Link station in Mountain House in San Joaquin County. Service will ultimately extend to the North Lathrop Transfer Station, where it will connect with ACE service. The planned Cross Valley Corridor (CVC) passenger rail service will utilize an existing freight rail corridor from Huron to Porterville, roughly paralleling state routes 198 and 65. Destinations along the corridor include Naval Air Station (NAS) Lemoore, Hanford, the HSR Kings/Tulare Station, Visalia, and Porterville, with additional transit connections to Corcoran, Tulare, Dinuba, and Woodlake. Initially, the CVC will be served by expanded and improved express buses connecting key markets along the corridor to the Kings/Tulare HSR Station. Planning will be initiated for a new passenger rail service that utilizes existing freight rail corridors in Fresno County between Firebaugh, San Joaquin, Dinuba, Kingsburg, and Fresno. Regional service would connect with the Fresno HSR Station and to future light rail service being planned for downtown Fresno.

Longer-distance Thruway buses will continue to bring San Joaquin Valley travelers to destinations throughout California. At the Bakersfield HSR Station, these buses will meet every HSR round-trip for connections to major travel markets in Southern California, as well as Las Vegas. Local transit and on-demand services will also link to HSR, Valley Rail, Valley Link, Cross Valley Corridor, and Fresno Regional Rail, allowing car-free travel to destinations within and outside San Joaquin Valley.

PROPOSITION 1B AND SENATE BILL 1

The State Route 99 Business Plan has focused mainly on major facility improvements that would typically be funded through the State Transportation Improvement Program (STIP) or similar federally funded programs. The Business Plan establishes a strategic approach to achieving the functional goals for the corridor predicated on the Interregional Transportation Strategic Plan, Transportation Concept Reports, Corridor System Management Plans, and Regional Transportation Plans. The most significant obstacle to improving State Route 99 has been insufficient funding. Neither the STIP nor the SHOPP have had funding levels adequate to maintain—much less improve—State Route 99.

California's Proposition 1B Transportation Bond Measure of 2006 contained nearly $20 billion in funding for transportation projects. Of that, approximately $1 billion was set aside for State Route 99. In March 2025, the California Transportation Commission (CTC) reported that a total of 26 projects received $992 million of Proposition 1B funds. Some projects were constructed in stages, resulting in a total of 34 construction contracts being administered. Of these, 30 contracts have been completed, and there four remain active with $40.9 million in Proposition 1B funds.

Proposition 1B By the Numbers

Statewide	$20b
SR 99	$1b
SR 99 Projects Funded	34
SR 99 Projects Completed	30
SR 99 Projects Still Active	4

Even with the substantial investments, Proposition 1B made a small dent in the nearly $6 billion in immediate needs identified in Caltrans' 2020 State Route 99 Business Plan. Far greater funding is needed to bring the "Main Street" and the primary goods movement corridor of the San Joaquin Valley up to a full six lanes from Bakersfield to Sacramento. Widening to at least six lanes has been a long-term goal of the Valley and is necessary to accommodate the forecasted growth and avoid major congestion problems along the State Route 99 corridor in the future.

In anticipation of the expiration of Proposition 1B, Senate Bill 1 the "Road Repair and

Accountability Act of 2017" (SB 1) was signed into law in 2017. The SB 1 package augmented the SHOPP and the STIP funds and contained statewide grants. While the SHOPP was most greatly reinforced by SB 1, the impact to the STIP was not as significant. SB 1's impact to the funding controlled by regions in the STIP was mostly to remove the dramatic ups and downs created by the "Fuel Tax Swap." Before SB 1, the CTC famously cut and delayed $1.5 billion in STIP projects due to lack of funding, including State Route 99 projects identified in the Business Plan. With the passage of SB 1, the volatility of the STIP has stabilized.

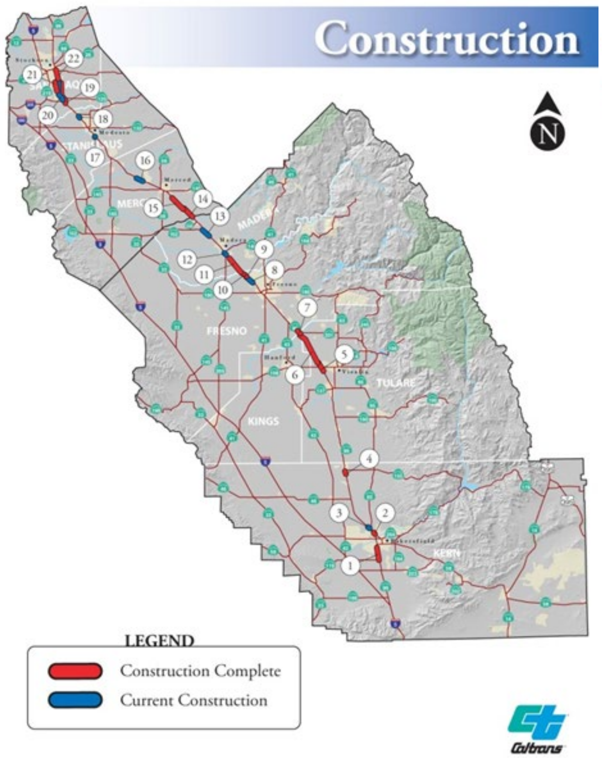
Grant programming in the SB 1 package includes the Trade Corridor Enhancement Program (TCEP) that distributes approximately $400 million annually for projects related to transportation infrastructure vital to California's trade and freight economy. Some $99 million in projects on State Route 99 have been successful at securing TCEP funding in cycles 1-4.

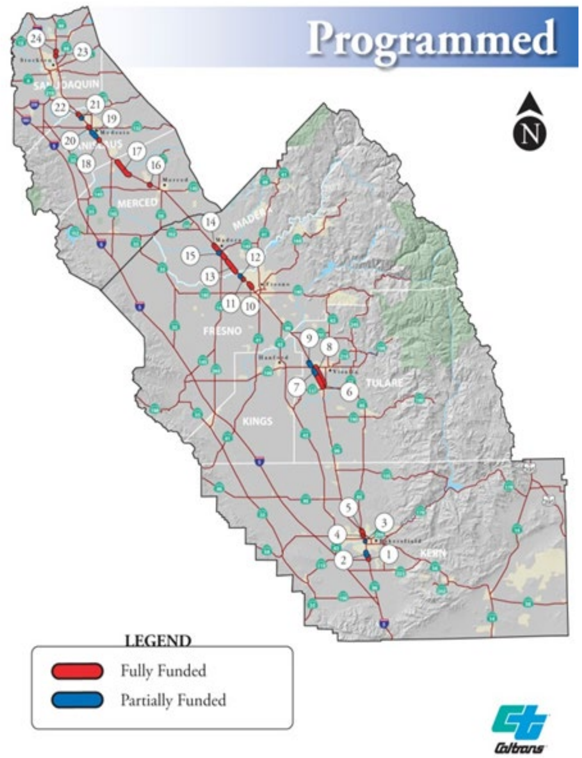
SB 1 TCEP By the Numbers

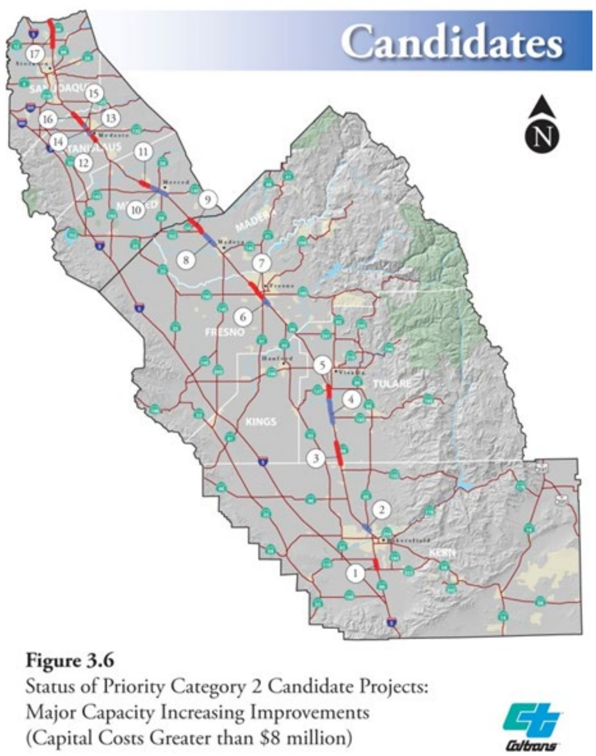
Statewide per Year	$400m
SR 99 Funding (Cycles 1-4, 2018-2024)	$99m

SB 1 is forecasted to add $54 billion in funding over 10 years to the state's transportation budget. Caltrans will receive half of SB 1 revenue: $26 billion. The other half will go to local roads, transit agencies, and an expansion of the state's network of pedestrian and bicycle routes. Over 10 years, SB 1 will allocate $15 billion to improve the condition of the state highway system, with an additional $4 billion to fix or replace bridges and culverts. The revenue from SB 1 gives Caltrans a massive boost in addressing safety projects, deficiencies, and deferred maintenance.

Figure 6 – 27: State Route 99 Business Plan







In 2013, Caltrans and the 8 Valley MPOs completed the second update to the 99 Business Plan. Here are the highlights:

- $1Billion funded by Proposition 1B
- Construction/Complete - 20 Projects - $1.3 Billion funded
- Programed/Partially Funded - 24 Projects - $1.4 Billion funded
- Candidates Remaining - 19 Major Projects - $3.5 Billion unfunded
- New Emphasis on operational improvements including: carpool facilities / ramp metering, reduced truck congestion , 511 Travel Info System, CalVans public vanpool service, privately subsidized express bus service saving 1.4M VMT/yr, new park & ride lots.

SR 99 COMPREHENSIVE MULTIMODAL CORRIDOR PLAN (CMCP)

The California Department of Transportation (Caltrans) and its partner agencies have developed a Comprehensive Multimodal Corridor Plan (CMCP) for the State Route (SR) 99 Corridor, from Interstate 5 (I-5) in southern Kern County to United States (US) Highway 50 (US 50) in the heart of Sacramento. SR 99 was formerly part of US Route 99 and was a main north-south route between Mexico, the US, and Canada on the West Coast until the construction of I-5. SR 99 and the parallel rail corridors are the backbone of the San Joaquin Valley, providing major and primary access to northern and southern California and linking major cities including Sacramento, Stockton, Modesto, Merced, Madera, Fresno, Visalia, and Bakersfield, and many other cities and communities in between. The SR 99 CMCP was crafted in partnership with local and regional agencies and partners as well as through engagement with the public. This document builds upon statewide, regional, and local efforts, along with the coordinated efforts of Caltrans Districts 3, 6, and 10, to create a comprehensive strategy that sets a foundation to enhance multimodal connectivity and accessibility for the communities of the SR 99 corridor.

The SR 99 CMCP built on and update the prior vision of past efforts, including the SR 99 Business Plan, while identifying a range of multimodal opportunities for improving and enhancing the SR 99 corridor and will align with statewide plans such as the California Transportation Agency's Climate Action Plan for Transportation Infrastructure (CAPTI), the California Transportation Plan (CTP) 2050, and Caltrans System Investment Strategy (CSIS).

The objective of the SR 99 CMCP is to develop a shared vision and implementation plan for the SR 99 corridor that aligns with state goals and policies while meeting the needs of agency partners, stakeholders, and the traveling public. The CMCP addresses needs while analyzing impacts on all modes of transportation based on future land use growth along the SR 99 corridor.

The goals for the SR 99 CMCP are drawn from local, regional, and statewide planning documents, as well as Caltrans' vision, mission, core values, and goals, to address the complex needs of the corridor and its residents, workers, and visitors. The goals call for a balanced multimodal transportation system that improves safety, air quality, and affordability while supporting the communities of the southern Sacramento and San Joaquin Valleys.

SR 99 CMCP Study Goals

The Draft SR 99 CMCP was released for public review on August 22, 2025, with comments due on September 5, 2025. The CMCP was approved in late October 2025.

2022-2025 SAN JOAQUIN VALLEY BLUEPRINT AWARDS

In 2006, the eight RTPAs joined together to develop a coordinated vision known as the San Joaquin Valley Regional Blueprint, guiding development throughout the SJV to the year 2050. In an effort to recognize plans, policies, and projects that are "Blueprint friendly," as well as the people who guide those projects, the RTPAs formed an awards program across a number of categories. Each year, these awards are presented as part of the San Joaquin Valley Regional Policy Conference. Below are examples of awards from the past few years.

2022

- Residential Development Project – Sequioa Commons, Self-Help Enterprises
- Transportation Enhancement Project – The "Q", City of Fresno FAX Rapid Transit
- Planning Project – City of Kerman's 2040 General Pan & EIR
- Darrel Hildebrand Blueprint Leadership Award – Ted Smalley, Executive Director, City of Modesto
- Outstanding Local Elected Official – Jenny Kenoyer, City Council Member, City of Modesto

2023

- Residential Development Project (excellence) – Victory Gardens, Stockton. SJ Housing Authority
- (merit) – Sugar Pine Village, Madera. Self Help Enterprises
- Commercial Development – Merced County Castle Development, Merced County
- Transportation Enhancement Project – Griggs Neighborhood Improvement Project, Dinuba

- Planning Project – Accessory Dwelling Unit Program, Kerman
- Darrel Hildebrand Blueprint Award – Benjamin Kimball, Deputy Director, TCAG
- Outstanding Locally Elected Official – Supervisor Robert Poythress, Madera County

2024

- Residential Development Project (Award of Excellence) – Grand View Village Apartments, Visionary Home Builders of California
- Residential Development Project (Award of Merit) – Merced Preapproved ADU, Duplex and Triplex Program, City of Merced, Planning Department
- Commercial Development (Award of Excellence) – Kerman Animal Shelter, City of Kerman
- Downtown Revitalization Project (Award of Excellence) – The Lofts at Fort Visalia, Self-Help Enterprises
- Transportation Enhancement Project (Award of Excellence) – Modesto Transit Center, City of Modesto
- Transportation Enhancement Project (Award of Merit) – Caltrans Walk Assessment Program, Caltrans District 6 Office of Multimodal Transportation Planning
- Planning Project (Award of Excellence) – Water Supply Study for the San Joaquin Valley REAP Program, Rincon Consultants
- Planning Project (Award of Merit) – Mendota Safe Routes to School Master Plan, City of Mendota
- Darrel Hildebrand Blueprint Leadership Award – Tony Boren, Executive Director, Fresno Council of Governments
- Jenny Kenoyer Outstanding Local Official – Vito Chiesa, Supervisor, Stanislaus County
- Jenny Kenoyer Outstanding Local Official – Cherylee Wegman, Mayor, City of Wasco

2025

- Residential Development (Award of Excellence) – Crossroads Village, Fresno County, Paul Halajian Architects
- Commercial Development (Award of Excellence) – Mercantile Row Shopping Center Revitalization, City of Dinuba
- Mixed Use Development (Award of Excellence) – Los Arroyos Housing Project & Farmersville Transit Center, City of Farmersville
- Downtown Revitalization (Award of Excellence) – City of Merced Downtown Revitalization Initiative, City of Merced
- Transportation Enhancement (Award of Excellence) – Farmersville Transit Center, City of Farmersville
- Planning Project/Program Category (Award of Excellence) – The Villages at Almond Grove Specific Plan, City of Madera

- Planning Project/Program Category (Award of Merit) – Small Lot Planning Study for the San Joaquin Valley, SJV Regional Early Action Program (REAP) and Fresno Council of Governments
- Residential Development (Award of Merit) – Sonoma Square, San Joaquin County, Delta Community Developers Corporation
- Commercial Development (Award of Merit) – Whitesbridge Horizontal Mixed-Use Project, City of Kerman
- Historic Revitalization (Award of Excellence) – State Route 99 Plainsburg-Arboleda Columbian Mammoth Silhouettes, Caltrans District 10
- Downtown Revitalization (Award of Merit) – J Street and Seventh Street Parking Lot Rehabilitation Proj3ect, City of Los Banos
- Transportation Enhancement (Award of Merit) – Alta/Kamm Roundabout, City of Dinuba
- Planning Project/Program Category (Award of Excellence) – South of Tule River (SoTu) District Master Plan, City of Porterville
- Darrel Hildebrand Blueprint Leadership Award – Patricia Taylor, Executive Director, Madera County Transportation Commission (MCTC)
- Jenny Kenoyer Outstanding Local Elected Official – Daron McDaniel, Supervisor, Merced County

HOUSING

As part of the San Joaquin Valley's regional housing coordination, the eight regional planning agencies have built on the collaboration initiated through REAP 1.0.

Under REAP 1.0, Valley planners met monthly to coordinate on major work areas, including:

- RHNA (Regional Housing Needs Assessments): developing an improved methodology for the distribution of the sixth-cycle RHNA and supporting housing element implementation.
- Suballocations to jurisdictions: providing grants to accelerate housing production in alignment with state priorities for housing, transportation, equity, and climate goals.
- Valleywide efforts: conducting a comprehensive housing report, regional planning and coordination, program implementation, technical assistance, and other activities, along with administering the REAP application, agreements, consultants, outreach, and program management duties.

Building on this foundation, the Valleywide Housing Committee was established following the conclusion of REAP 1.0 meetings. This committee provides an ongoing forum for planners from all eight agencies to share best practices, track emerging housing and land use policies, and coordinate on shared housing challenges and opportunities.

This Valleywide coordination is especially important for the RTP/SCS process, as it strengthens the integration of housing and transportation planning. Regular collaboration ensures that regional housing strategies are better aligned with long-range transportation investments, supports compliance with state housing and climate mandates, and fosters a consistent, coordinated approach to planning for growth across jurisdictions throughout the Valley.

TRANSIT INITIATIVES

Ridesharing has been a game-changer for mobility in the State of California and the San Joaquin Valley. Commercial ridesharing services like Uber and Lyft were introduced in the San Joaquin Valley in 2015. Since then, their popularity has skyrocketed. However, not everyone can afford the sometimes-exorbitant costs associated with these commercial based services. As an alternative, transit agencies began offering ridesharing or micro transit services which have proven to be more affordable and convenient for rural and disadvantaged community residents in the Valley. In addition to micro transit, car sharing and mobile ticketing and fare payments system services found in the San Joaquin Valley are discussed.

Miocar

Miocar is a car sharing service that is currently available in Stockton, and in parts of Tulare County and Kern County. It is a membership-based program that is available to anyone 21 years of age and over with a valid driving license and relatively clean driving record. It also requires the driver to have a valid credit or debit card. Miocar offers a fleet of zero emission electric vehicles for personal use. Riders can reserve their vehicle in advance via the Miocar mobile app or website. Costs start at $4 per hour or $35 per day.

Vamos-EZHub

Vamos-EZHub is a cashless mobile ticketing and fare payment system, available in the Vamos Mobility App. The app makes using public transit safer and easier to access and pay for throughout San Joaquin County region. Riders can use the Vamos Mobility app to plan their journeys and purchase tickets for any of the seven participating transit systems. Riders using services provided by San Joaquin RTD, Manteca Transit, Tracer, eTrans, GrapeLine and City of Ripon can use EZHub to purchase tickets via the Vamos Mobility app wherever, whenever and ride across all seven transit networks. This will cover the regional bus and rail transit services throughout San Joaquin County and local bus transit service in the cities of Stockton, Lodi, Manteca, Ripon, Tracy, and Escalon.

Visalia CONNECT

Launched in June 2025, Visalia CONNECT is a new on-demand Micro Transit service provided by Visalia Transit. Riders are able to request a ride anywhere within the service zone for just $5 per trip, per person. Operating hours are the same as Visalia Transit's fixed-route service. The city has reported extremely positive response to the service, surpassing all expectations.

Appendix C. Transportation and Land Use

Item 3. Transportation and Land Use

I. Overview of Existing Conditions

a. Notable Changes to Existing Regional or Local Planning Contexts

Based on recent population estimates, Fresno region is experiencing a quick population recovering from COVID-19 pandemic as a higher than usual net migration was observed in 2023.

The unemployment rate and total employment have recovered to the pre-pandemic level since fall of 2022. A stable employment growth assumption was applied in the projection.

Unemployment Rate Monthly Trend in Freno County, 2014-2025, U.S. BLS via FRED

In September 2024, the California Department of Finance (DOF), Demographic Research Unit released the Population Projections, 2020-2070 that incorporated the latest historical population, birth, death, and migration data available as of July 2023, and are informed by the 2020 Census data products. Compared to the Vintage 2019 release, the 2023 Baseline (Vintage 2024) release projected that Fresno County would have 7% less population in 2035, 9% less population in 2050, and 53% less population growth from 2020 to 2035, 45% less population growth from 2020 to 2050. Please refer to Section III for more detailed information about the socio-economic forecast updates. The decreased population growth projection brings a challenge to achieving the per capita based GHG reduction target. Although the regional total GHG emission would decrease because of the smaller projected population, the region will have less housing units that can be planned as higher density housing development, which has otherwise proven to be an effective strategy to reduce per capita GHG emission.

With the implementation of Sustainable Groundwater Management ACT (SGMA), the Public Policy Institute of California (PPIC) study estimated a loss of close to 1 million acres of farmland in the San Joaquin Valley by 2040. Around 25% of Fresno County's employment is related to ag production. It is anticipated that the SGMA will have a profound social economic impact on Fresno County in areas such as employment, air quality, housing affordability, rural poverty, etc.

SB 743 is another legislation that has a significant impact on how growth will be shaped in the region. After the initial study of VMT mitigation program in 2023, the Fresno COG is now working on establishing VMT mitigation programs in 2026/27, which are expected to lead to VMT mitigation fees that developments will have the option of paying into if the projects have significant VMT impacts. The city of Fresno is implementing their VMT mitigation program early 2026. SB 743 is expected to have more impact on the small cities and the rural areas in the County, where residents tend to make longer daily commutes than people living in the Metro area. Fresno COG's land use model takes into consideration the low VMT areas in the County in various scenarios.

Several large distribution centers have started operation in south Fresno since 2020. Alta and Amazon brought close to 3000 jobs to the region. The City of Selma has three major development projects facilitated by the sewer infrastructure construction, which will provide 2,000 – 2,500 construction jobs. T-Mobile opened its call center in Kingsburg in 2022, which provided 1,000+ new jobs. The first BRT line in Fresno that started its operation in 2018 had been enjoying steady ridership until March 2020. Starting April 2020, the BRT as well as the other transit routes in the region had been operating at about 50% ridership compared to its pre-COVID level. However, by late 2024, the ridership is up at 90% compared to pre-COVID level. Fresno Area Express (FAX) also realigned a few routes such as Route 3, Route 12, Route 20, Route 45, and Route 58 to better serve the riders. FAX also has increased the frequency on some routes like Route 28 and Route 39. In addition, FAX launched a new route 29 operating along Church Avenue in August 2025. Fresno COG, in partnership with Fresno County Rural Transit Agency (FCRTA), has secured a grant from Caltrans to assess the feasibility of regional rail corridors connecting rural and suburban cities to Fresno. Also, Fresno COG will be working with FAX on the feasibility assessment of Light Rail Transit (LRT) connecting north Fresno and airport to the high-speed rail station. The city of Fresno has streamlined its planning process for development in the downtown and the BRT corridor, both of which are the infill development areas, and updated its zoning ordinances to facilitate the implementation of the updated general plan. It's the City of Fresno's policy to "Emphasize infill development and a revitalized central core area as the primary activity center for Fresno and the region by locating substantial growth near the Downtown core and along the corridors leading to the Downtown."

The City of Clovis created the award winning “Cottage Home Program”, which was originally created to encourage residential infill development in the Clovis Old Town area, but due to its popularity, has been expanded citywide. The City of Coalinga applied for a SB 2 Planning Grant to develop a similar cottage home program, and many other local governments are also considering such a program.

Several small cities have also gone through general plan updates. The City of Kerman and City of Sanger adopted their General Plan Updates in 2020. The Cities of Fowler adopted its General Plan updates in 2023. And the County of Fresno adopted its General Plan in 2024. In April of 2019, the City of Clovis expanded their sphere of influence by 1,035 acres. Clovis’ General Plan identified this area for significant job generation, designating over 500 acres for jobs, 225 acres of open space, and 325 acres for residential uses. The cities of Reedley, Huron, and Kerman have also recently updated their spheres of influence, mostly to accommodate residential development and public facilities. All annexations are reviewed by Fresno LAFCo to ensure orderly development. In 2023 and 2024, all jurisdictions in Fresno County updated their 2023-2031 Housing Elements. A growing number of jurisdictions in Fresno County have adopted general plans, housing elements, and zoning ordinances that promote strategies such as infill development, mixed-use types, transit-oriented development, increased density, conservation of farmland and other resource areas, etc.

Fresno COG completed a Transportation Network Vulnerability Assessment in 2020. The Transportation Network Vulnerability Assessment provides local jurisdictions information regarding local climate risks and strategies to increase the resiliency of the transportation network. This information will be useful for local jurisdictions as they update their Safety Elements to incorporate climate adaptation. Fresno COG is continuing to help plan and prepare for climate resiliency for the region. We recently completed the Fresno County Climate Resiliency Plan, which is a subsequent plan to the Transportation Network Vulnerability Assessment. The Climate Resiliency Plan will identify specific transportation improvement projects for the most vulnerable transportation assets identified in the vulnerability assessment and conduct climate risk assessments for the projects. We are working with other San Joaquin valley MPOs in assessing the climate change vulnerabilities of the SJV corridor and resiliency connectors. This study is scheduled to be completed in 2027. These plans and recommended transportation improvement projects will help inform the jurisdictions' project submittals and the COG submittal process for future RTPs and call-for-projects. Climate adaptation will be added as a project scoring criteria to the 2026 RTP/SCS to incentivize the local governments to consider climate adaptation in project submittal. In addition, an EV Readiness Plan has been completed, which provides guidance for the development of EV infrastructure in the Fresno region. The Comprehensive Climate Action Plan (CCAP) identifies GHG emissions and sinks throughout the County from various sectors which include but are not limited to: transportation, waste/wastewater management, residential/commercial buildings, energy generation, and agriculture. This plan will help the agencies acquire critical funding to embark on mitigation measures and strategies in construction or policy implementation.

The TradePort California project envisions an inter-modal goods movement system linked by inland ports (or trade ports) located in the Central Valley. The cargo will be shipped from the ports via rail into the trade ports in the Central Valley as opposed to by medium and heavy-duty diesel trucks. The goods will then be transported by clean energy fueled trucks (hydrogen/electric). The trade ports will serve as logistics hubs that will house distribution centers in Fresno County and other counties in the Central Valley. The project scope embraces a system with clean transportation, technology, and innovation that will reduce GHG emissions and other criteria pollution from State Route 99, one of the most heavily utilized freight corridors in the State (ranked 3rd in California).

The Fresno County Mobility Hub Feasibility Study conducted in partnership with the three transit agencies (FCRTA, FAX, and Clovis Transit) will identify four mobility hub sites in Fresno County. Each site will have different characteristics but regardless will advance mobility and contribute to a more sustainable and connected transportation network that will provide seamless connections among various transportation modes.

Assembly Bill 101 (2018) established the Regional Early Action Planning (REAP) program to assist in developing an improved methodology for sixth-cycle Regional Housing Needs Assessment (RHNA) process and to further housing production efforts throughout the state. The eight-county San Joaquin Valley was one of two regions in the state granted additional funds to work together toward mega regional solutions to the housing crisis. In 2021, REAP 2.0 was established and sought to accelerate progress towards state housing goals and climate commitments through a strengthened partnerships among the state, its regions, and local entities to accelerate infill development, housing, and VMT reductions in ways that advance equity. Fresno COG received $13.6 million in funding for projects in the region that meet REAP 2.0 objectives

In 2023, Fresno COG finalized the Regional Vehicle Miles Traveled (VMT) Mitigation Program Feasibility Study that explored options that would be most effective in providing the pathways for VMT reduction in the Fresno region. Several different frameworks for VMT mitigation were evaluated, including a VMT mitigation bank, VMT mitigation exchange, and a regional VMT impact fee. As a follow-up
to the feasibility study, staff are moving forward with a Regional VMT Mitigation Program Implementation Plan which seeks to establish a regional VMT mitigation program in Fresno County.

In January 2025, Fresno COG began the Fresno-Clovis Metropolitan Area Managed Lane Study by releasing the Request for Proposal (RFP) with an expected completion date of June 2026. This study will help determine if current and future travel demand in the Fresno-Clovis area would deem managed lanes to be an effective solution to reduce congestion and reduce VMT. The study will recommend alternatives for managed lanes locations, and a timeline for phased implementation. Managed lanes provide a solution to managing traffic congestion and improving safety on urban freeway networks and are utilized widely throughout the state. Managed lanes are consistent with the RTP/SCS goals for VMT/GHG reduction and will further the state's climate goals and the other overarching goals such as safety and efficiency in the California Transportation Plan.

b. Key Regional Issues Influencing RTP/SCS Policy Framework and Discussions

The key issues that have influenced the 2026 RTP/SCS policy discussion include, but not limited to: transit ridership post COVID; job growth especially distribution center jobs, which leads to goods movement infrastructure needs; how to promote infill/redevelopment given that cost for such development is more expensive and rent structure in Fresno does not support such higher cost development; social equity issue given that a large percent of our population live in disadvantaged communities; air quality and public health continue to be serious challenges in the region; how to preserve important farmland; safety issues on our transportation system; how to help our existing rural communities continue to support themselves and thrive, etc.

II. Demographic Forecast

Fresno COG has updated the population and employment projection for the 2026 RTP/SCS. The update incorporates the post COVID-19 pandemic conditions, as well as the new planning context mentioned in section II. The methodology mirrors that of the forecast that was applied in the 2022 RTP/SCS with notable changes coming primarily from updates in observed data and trends.

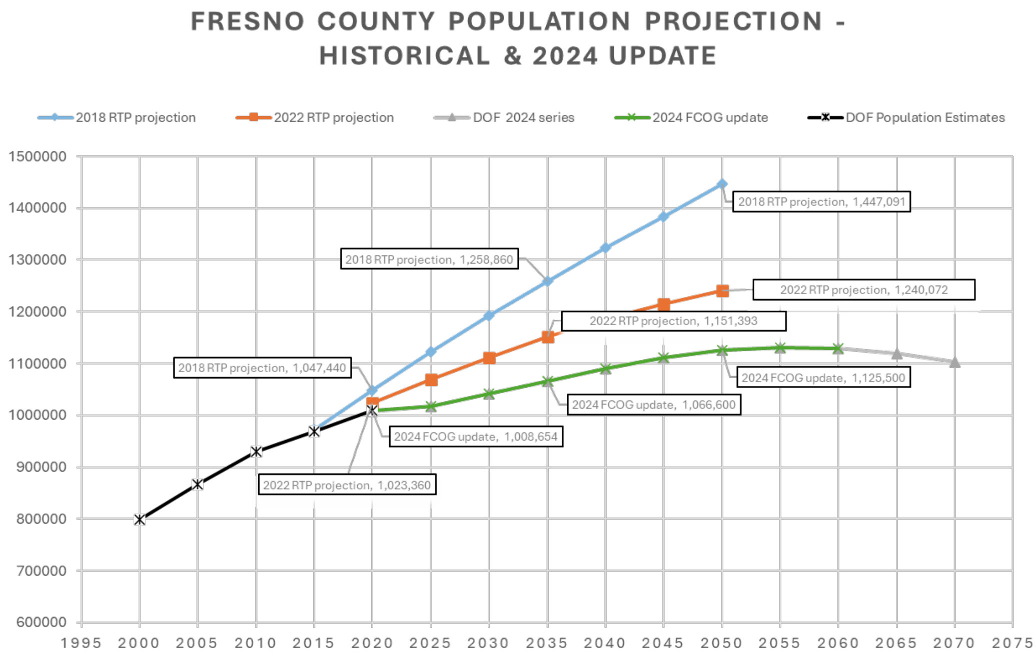
Table 2: Demographic Forecast Changes

	2023	2035 (2018 SCS)	2035 (2022 SCS)	2035 (2026 SCS)
Population	1,012,524	1,258,860	1,151,390	1,066,610
Households	328,642	375,290	359,090	351,580
Employment	415,596	460,100	444,800	442,660

As demonstrated in Table 2, population projection have been reduced significantly compared to the last plan. This downward adjustment is mainly attributed to the 2020 decennial Census results used as new benchmark, impact of COVID-19, declining fertility, and an aging population.

Fresno COG updated Fresno County Growth Projections in 2024 with 2020 Decennial Census, the latest demographic and employment statistics, and consultation with local jurisdictions. The report is published on Fresno COG Demographic Data webpage (https://www.fresnocog.org/project/demographic-data/). This report updates the growth projections for Fresno County and the spheres of influence of each of its cities previously published in 2020. The new projections utilize a base year of 2022.

In September 2024, the DOF Demographic Research Unit released the Population Projections, 2020-2070, indicating slower growth compared to earlier projections. The 2023 Baseline release (September 23, 2024) indicates that Fresno County's population is projected to be approximately 7 percent lower in 2035 and 9 percent lower in 2050 than projected in the 2019 DOF release (used in FCOG 2022 RTP). FCOG staff have calibrated the county-level population projection to align with DOF’s most recent release available at the time this report was completed. The resulting countywide population projections are within ±1.5 percent of DOF’s projections.



Population: The primary method used for population projection is the cohort component projection method, which calculates the population by previous population plus births minus the deaths, plus the net migration. This process is applied to each age cohort and race ethnicity group.

The base demographic inputs used in the cohort-component projection include:

(1) 2022 population estimation by jurisdiction sphere of influence (SOI);
(2) 2020 Census data on age by race at 1-year intervals by jurisdictions;
(3) Birth rates by race from California Department of Public Health; and
(4) Death rates by age, sex, and race from CDC WONDER (Wide-ranging ONline Data for Epidemiologic Research) database.

Annual Fresno County population totals from the DOF Population Projections (September 23, 2024 release) were used as countywide control totals to calibrate the projection.

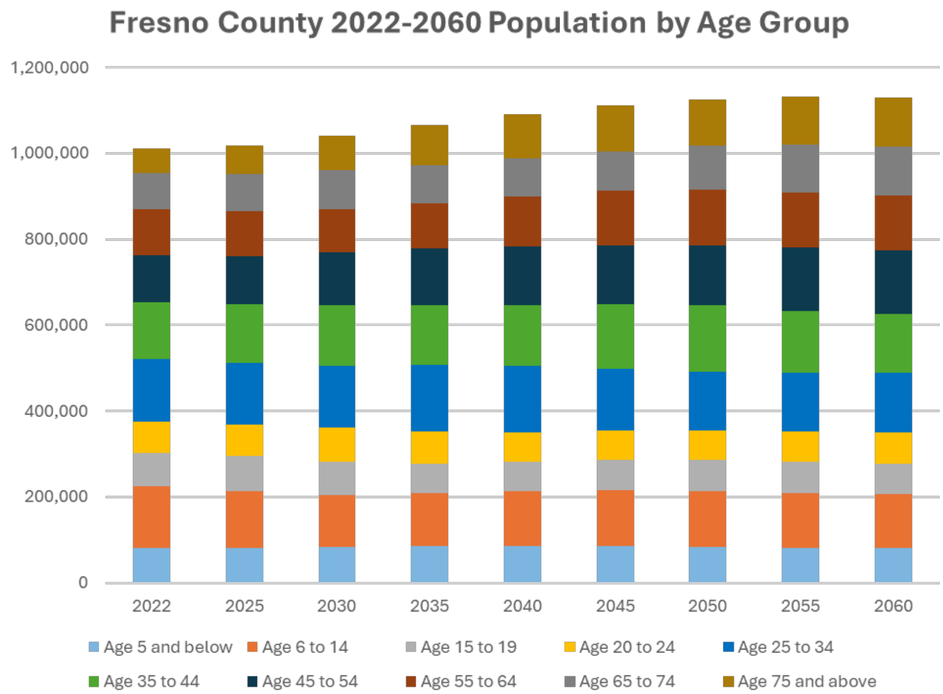
A gravity model was applied to allocate countywide population growth to each SOI. For the 2022–2025 period, allocation factors are based on DOF E-5 data for the 2022–2024 period. For SOIs that exhibited negative growth, a minimum allocation factor of 0.001 was applied, and the remaining SOIs were prorated to sum to 100 percent. This technical adjustment was applied to avoid the projections showing continued negative growth and also because the E-5 data shows continuous negative growth for the unincorporated areas, probably driven to some extent by annexations. The 2026-2030 period is based on DOF E-5 figures for the 2015-2024 period. A similar convention was used as above for the few jurisdictions that had negative growth during this longer period. The third period, 2031-2040, uses the average of the first two allocation periods combined with the existing 2022 population distribution. This approach gradually redistributes growth toward smaller SOIs and the unincorporated area while maintaining consistency with countywide controls. The final two projection periods retain this same distribution.

For each projection year, the model reconciles the annual demographic growth with the topline county growth and the gravity model growth factors of the appropriate time periods for each SOI. Differences are ascribed to net migration.

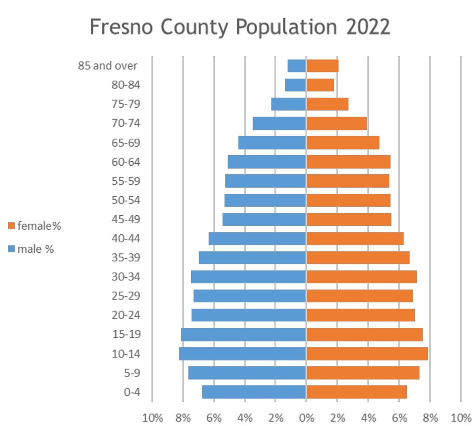
DOF P-4 projections were used to derive jurisdiction-level factors distinguishing household population from group quarters population, allowing calculation of household population for each jurisdiction.

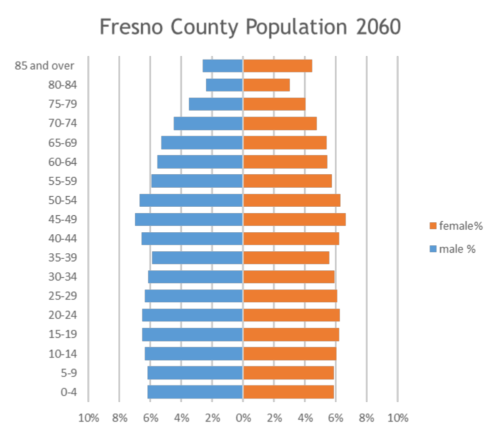
One significant contributor to the downward revision in projected population growth is declining fertility. Birth rates have been decreasing since approximately 2000, preceding the COVID-19 pandemic. With updated birth rate data incorporated, projected population growth is lower than in prior forecasts.

As growth slows, the Fresno region is projected to experience population aging. Older age cohorts, particularly those aged 45 and above, are projected to grow more rapidly, with the population aged 65 and over increasing from 13.9 percent today to approximately 20.0 percent by 2060. In contrast, younger age groups between 6 and 34 years are projected to decline.



The current population structure resembles a stationary population pyramid, while the 2060 projection exhibits a constrictive pyramid shape, characterized by a narrower base and a larger share of older adults. This shift reflects sustained fertility decline and increasing longevity and is consistent with statewide demographic trends identified in recent DOF projections.





Employment: The 2022 baseline employment data by jurisdiction sphere of influence (SOI) were developed by FCOG staff using confidential Quarterly Census of Employment and Wages (QCEW) data from California Employment Development Department, and Fresno County Business data from Data Axle. Employment was categorized using EDD job sector classifications, mapped to FCOG model categories and NAICS sectors as shown in Table below:

Table 3: Employment by job sector for Fresno County

EDD Job Sector Categories	FCOG Model Categories	NAICS Sector
Farm	Other	11
Natural Resources and Mining	Other	21
Manufacturing	Industrial	31-33
Trans, Warehousing	Industrial	48-49
Wholesale Trade	Industrial	42
Utilities	Industrial	22
Construction	Other	23
Retail Trade	Retail	44-45
Information	Office	51
Financial Activities	Office	52, 53
Professional & Business Services	Office	54,55,56
Educational Services	Educational Services	61
Health Care & Social Assistance	Health/Medical	62
Arts, Entertainment, and Recreation	Services	71
Accommodation & Food Service	Food	72
Other Services	Services	81
Government	Government	92

Employment projections grouped sectors into two categories:

1. Economic base sectors (Farm; Natural Resources and Mining; Manufacturing; Transportation and Warehousing; Wholesale Trade), and
2. Non-basic sectors (Utilities; Construction; Retail Trade; Information; Financial Activities; Professional and Business Services; Educational Services; Health Care and Social Assistance; Arts, Entertainment, and Recreation; Accommodation and Food Services; Other Services; and Government).

Annual growth rates for economic base sectors were derived from Woods & Poole (W&P) projections and applied to project economic base employment. For non-basic sectors, the job figures are calculated with Business to Business (B2B) multipliers and population multipliers.

At the SOI level, the economic base sectors, Industrial and Other, were projected based on each jurisdiction's 2022 sectoral share, with flexibility to vary assumptions across three time periods: 2022–2025, 2026–2035, and 2036–2060. Aggregate non-basic employment growth was allocated using a formula attributing 25 percent of growth to economic base employment growth and 75 percent to population growth. This allocation reflects observed relationships between population growth and service-sector employment in Fresno County and is consistent with prior FCOG modeling practice.

Component non-basic sectors were projected using county-level growth rates adjusted for SOI-specific non-basic growth. Office employment was treated as a remainder sector to ensure sector totals matched non-basic employment totals for each SOI. The unincorporated area was treated as a remainder jurisdiction to ensure countywide control totals were maintained.

Final employment projections were summarized at five-year intervals by sector for use in the FCOG land use and travel demand models.

Household size: The base year household size by jurisdiction was derived from California Department of Finance E-5 reports. Then it calculates projected household sizes for 2025-2060 based on Woods & Poole (W&P) county projections. W&P Persons per Household (PPH) is only available at County level, though its advantage is the specific projections for various years in the future. DOF city-to-county relationships were used to calibrate W&P for each jurisdiction and each future year.

Household income: Base year average household income was sourced from Census Bureau American Community Survey 2022 1-year estimates for Fresno County. The growth rates were calculated from Woods & Poole (W&P) Average Household Income projections for Fresno County.

Housing units: 2022 Vacancy rates and housing units from DOF E-5 report are used as base year 2022 data. The Target Healthy Vacancy Rates for each jurisdiction were calculated using the following approach: Jurisdiction overcrowding rate - average for comparable regions (4.37%, identified by HCD, 6th cycle RHNA) + Vacancy rate (if vacancy rate <5%, use standard 5% by HCD, 6th cycle RHNA). The dwelling unit growth then is calculated based on vacancy rates plus a DU replacement factor of 0.5%, also taken from HCD's RHNA methodology. It should be noted that the resulting vacancy factor increases the projections of housing units in relation to household growth. Also, the household projections do not account for any increased households due to less overcrowding.

Future single-family and multi-family housing splits were estimated using HCD pipeline data (2018–2022) and historical trends (2014–2024) for the 2023–2030 period. For later periods, jurisdiction General Plan land use assumptions were incorporated where available. In addition, the factors are averaged over time to simulate a smooth trend toward the long-term General Plan housing distribution.

Household and housing unit projections in this report should not be directly compared to the 6th Cycle RHNA allocation for the 2023–2031 period, as this analysis incorporates updated DOF population projections reflecting slower growth. Under the updated population assumptions, the population level underlying the 6th Cycle RHNA is not projected to be reached until approximately 2049–2050. While the time horizons differ, the projection methodology generally follows RHNA assumptions. When evaluated at an equivalent population level, the model estimates approximately 54,916 additional housing units; when combined with the RHNA Cost Burden Adjustment of 3,505 units, this yields a total of approximately 58,421 units, which is broadly consistent with the 6th Cycle RHNA requirement of 58,298 units.

School Enrollment: K–12 school enrollment was calculated at five-year intervals. School participation rates through 2045 were derived from DOF's California Public K–12 Graded Enrollment and High School Graduate Projections by County — 2023 Series. For years beyond 2045, participation rates were assumed to remain constant at 2040–2045 levels. These rates were applied to projected populations aged 5–18 to estimate school enrollment through 2060.

After completion of the draft projections, Fresno COG staff consulted with planning staff from each jurisdiction and made minor adjustments based on updated development pipelines and local planning assumptions.

III. Modeling Approaches

Fresno ABM: Fresno COG will apply an updated version of the activity- based model in the 2026 RTP/SCS development. It runs on Daysim and has a bike/ped component. The Fresno COG activity-based model system uses micro-zones, which are based on census blocks, as the fundamental spatial unit for generating travel demand. Use of micro-zones improves the sensitivity of the model system to land use, fine-grained urban form and accessibility attributes. The model system is capable of addressing policies such as compact and mixed-use development, active transportation, transit, and pricing. The model is credible for forecasting demand for highway alternatives such as new river crossings and corridor improvements, and appropriately sensitive to land-use changes such as new planned developments and provide useful information for traffic impact studies.

The updated ABM has a base year of 2023. The model inputs such as socioeconomic datasets, Auto Operating Cost (AOC), and interregional trips were updated. The interregional trip estimation has been updated, adopting the hybrid approach. California Statewide Travel Demand Model (CSTDM) was utilized to establish the interregional trips for base year 2023. The model years, 2020 and 2040 from the State model was used for the subarea analysis in the Fresno County and was interpolated for 2023. For the future years, the population growth rate was applied on the base year trip tables. The Central California Travel Survey conducted in 2022/23 was used to calibrate the model. Along with the inputs, a few model enhancements including managed lanes, TNC, telecommute, and truck restriction modules were also incorporated. Please refer to the model documentation for the details of the update.

Telecommute Strategy: In 2020, telecommute became unplanned reality due to COVID pandemic. According to the 2023 American Community Survey (ACS) and American Time Use Survey (ATUS) data, there is a decline in the telecommute or work from home workers from 2020, but their share continued to be maintained at a high level. While the telecommute strategy was handled off-model in last SCS, it will be analyzed within the model for 2026 SCS.

The updated model includes a telecommute sub-model which allows resident workers to make the choice to telecommute (different from working from home and having no out-of-home work location). This was calibrated using the 2022-23 Central California Travel Survey (CCTS), which was collected within San Joaquin Valley (SJV) with Fresno COG's lead. SJV consists of eight counties, Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare. The CCTS sampling plan was based on the 2015-2019 American Community Survey (ACS) 5-year estimates, and the survey was expanded (weighted) to the 2019 ACS Public Use Microdata Sample (PUMS) 1-year data to match the survey data to key household and person demographic variables. To support the 2023 base year model update, targeted refinements were applied to the CCTS survey weights of Fresno households to better represent 2023 travel conditions, and the survey data was reformatted to support the calibration efforts. Please refer to the model documentation for the CCTS data formatting and calibration used to setup a Telecommute model.

To capture the emerging "new normal" telecommute trend for future years, Fresno COG will monitor and analyze the results from US Survey of Working

Arrangement and Attitudes[i] (SWAA, https://wfhresearch.com/data/) to estimate the work from home rate after the pandemic. The SWAA survey is an ongoing monthly survey run jointly by the University of Chicago, ITAM, MIT, and Stanford University. The survey result is available by month from May 2020. Fresno COG staff plans to use the general telework decline trend at national level and base year telecommute rate and frequency observed by local household travel survey, to estimate future telecommute acceptance and feasibility in Fresno region.

The telework rate declined sharply before 2022 and has since entered a relatively stable plateau. A preliminary projection through 2035 suggests that there will be around 19% telework which is similar to base year 2023 assumption.

Data sources:

US Survey of Working Arrangement and Attitudes (SWAA) is used to estimate the decline trend of work from home rate. 2022-2023 Central California Travel Survey is the data source for calibrating the telecommute module in Fresno ABM, like work from home rate and frequency by area, industry, and income level .

Quantification method:

Fresno COG will use the following steps to calculate the emission reductions from the telecommute strategy:

Step 1: Estimate the national work from home trend

(1) Based on 65 monthly points of work from home rate by SWAA from May 2020 to September 2025, staff built an Exponential decay with floor

Model:

$$Y_t = C + (K - C)\, e^{-\lambda t}$$

(t = months since May-2020; Y in percent, not proportion)

Table 4: Telecommute projection modeling parameters

Symbol	Description	Value
C	floor (long-run minimum)	27
K	ceiling	57.87891666
Lamda	decay	0.119214109
SSE	Sum of Squared Errors	190.6227099

R^2		0.938943082

(2) Predict the 2035 work from home rate using the model above

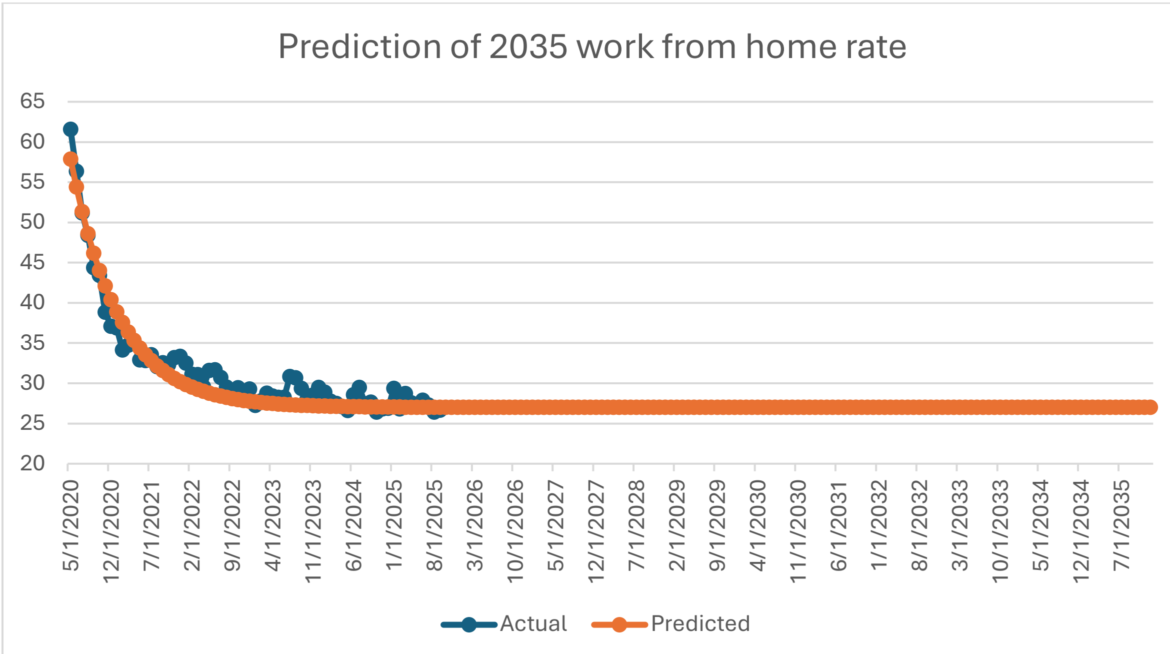


Figure 1: National telecommute trend projection through 2035

Step 2: Calculate Fresno region telecommute rate

(1) WFH decline rate 2022 to 2035 = 2035 average projected national rate / 2022 average projected national rate
(2) Fresno 2035 = WFH decline rate 2022 to 2035 * Fresno 2022 WFH rate = 27/28.61 * 26.2

Year	SWAA	Fresno Target
2022	28.6	26.2
2035	27	24.7

(3) 2022 Fresno region's work from home rate is 5.1%. Assuming the Work from Home rate in Fresno Region keep consistent through 2035, the telecommute work rate in 2035 = 24.7% - 5.1% = 19.6%

Step 3: Apply the 2035 work from home/ telecommute rate to Fresno ABM

Please find the details in Fresno ABM documentation. As the telecommute module was calibrated with Fresno region's travel survey data, the model is designed to reflect the rebound effect of additional non work trips generated by workers on their telecommute day or work from home. The day pattern model within ABM predicts whether a person makes at least one tour for each of the seven home-based tour purposes (excluding work-based tours), and whether the person makes any intermediate stops on these tours. The model includes variables for work-from-home workers and telecommuters to capture their travel behavior, which includes a lower likelihood of making tours and a higher likelihood of making non-work tours compared to all other workers, i.e., out-of-home workers.

Induced Demand: As mentioned in Section I, Fresno COG ABM is sensitive to short term induced demand due to increased transportation network capacity. Such short-term latent demand includes mode switching, route changing, time of day switching, destination change and new trips. In order to address longer term induced travel demand generated from land use changes due to added capacity on the transportation system, Fresno COG will continue to use the hybrid approach that was employed in the 2022 SCS. The hybrid approach uses the National Center for Sustainable Transportation (NCST) calculator in tandem with the ABM to estimate the long-term induced demand. Although Fresno COG tested an iterative methodology for creating feedback between the land use growth allocation tool and the ABM to allow for induced demand feedback between the two models, it was not ready to be used in this SCS cycle.

<u>Methodology</u>
Fresno COG performed sensitivity tests to capture ABM's reaction to network capacity changes. The resulting elasticity represents the short-term induced demand. This portion of the induced demand reaction is built into the ABM model, therefore it is considered in-model calculation. The long-term induced VMT that is caused by land use and socioeconomic changes is captured by employing NCST calculator. In the process the elasticity results provided by NCST calculator coalesced with ABM elasticity results and ensure no double-counting of the short-term induced demand.

Key assumptions:
Due to the fact that induced travel demand includes VMT made by all vehicle classes, and SB 375 is only concerned about passenger cars and light duty trucks, it is appropriate to adjust the total VMT input through the EMFAC instead of simply applying a post-processing off-model GHG adjustment.

Data sources:
Fresno COG used the NCST Induced Travel Calculator, which is available on-line at: NCST Tool.

Quantification method:
Freson COG conducted base year model sensitivity analyses, in which general purpose lanes were reduced and increased to respective roadway sections. The resulted elasticities were used as short-term induced demand response from the model. The NCST calculator is applied to facilities with Federal Highway Administration (FHWA) functional classifications of 1, 2 or 3. That corresponds to interstate highways (class 1), other freeways and expressways (class 2), and other principal arterials (class 3). The elasticities from the NCST include both short term and long term induced demand.

Long-term induced demand calculation involves tallying capacity increasing projects by lane miles increased, by year, and by road categories. The long-term induced VMT elasticity is calculated by deducting short-term elasticity from the model from the reported NCST elasticity. And subsequently, the long-term induced VMT is calculated by multiplying the increased lane miles by facility types by the respective elasticities. The resulting induced VMT is then added to the model-reported VMT and fed into the EMFAC model for GHG emission calculation.

PopulationSim: Fresno COG uses the PopulationSim to generate synthetic population for the ABM. Regional controls for the synthetic population include household counts by micro zone, households by income, size, number of workers, marital status, presence of children, unit type, and age of householder; household population and group quarters population by age, gender and minority status; and workers by occupation. Demographic distributions come from PUMS and are adjusted to conform to projected forecasts.

External Trips: As mentioned in the Introduction section, Fresno COG used the existing California Statewide Travel Demand Model (CSTDM), to estimate the inter-regional trips for the base year 2023. Fresno COG also looked into the latest version of CSTDM released by Caltrans in early 2026 but discovered some potential volume issues in the highway network. Caltrans was made aware of this issue and had no clear direction on the potential fix as well as the timeline. Hence Fresno COG decided to use the available version of CSTDM with a base year 2015. The California Statewide Model system includes a highway network, peak-hour demand by time-period, vehicle and trip type, and other inputs necessary for running highway assignment. In order to generate demand specific to the Fresno region, a sub-area analysis with the statewide model will be created using a sub-area network developed for the Fresno model region. To disaggregate the statewide OD matrices into the Fresno zones, the future year land use will be used. Although the model shows the reasonable growth in IX (internal-external)/XI (external-internal) trips and VMT, the XX (external-external) trips and VMT for 2035 went down compared to 2023. So, a hybrid approach has been utilized to compute the external demand tables. The population growth factors have been derived from the 2025 DOF forecasts for external trips. While Fresno and surrounding counties (Tulare, Kings, Madera, Monterey) were considered for the IX/XI growth, overall growth in California was used for the XX growth. This is because the IX and XI trips happen between Fresno and the neighboring counties and are determined by the change in population within these areas. However, for the XX trips, all the people within the State can travel on the two major highways of Fresno County i.e. I-5 and SR-99, and are not restricted within the surrounding counties. Although we looked at the household growth along with the population, the population growth seemed more reasonable for this effort as people make trips and changes in trips are determined by the changes in the people living in those areas. The population growth factors were applied on the base year trip tables to compute the external trip tables for all the future years, as shown in Table 5 below.

Table 5: Growth factors for External Trip Tables

	HH Growth from 2023			Population Growth from 2023		
Year	Fresno	Surr+Fresno	California	Fresno	Surr+Fresno	California
2023	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2027	4.82%	4.29%	3.04%	1.64%	1.66%	0.82%
2029	6.32%	5.63%	4.25%	1.97%	2.17%	1.16%
2031	7.76%	6.85%	5.29%	2.61%	2.78%	1.56%
2032	8.54%	7.48%	5.79%	2.92%	3.06%	1.80%
2035	10.78%	9.24%	7.19%	3.82%	3.79%	2.51%
2037	12.20%	10.33%	8.06%	4.42%	4.23%	2.92%
2046	20.22%	16.85%	13.26%	6.32%	5.01%	4.19%
2049	23.34%	19.43%	15.31%	6.47%	4.70%	4.33%

Sensitivity Test: When the ABM was updated to a new base year, the sensitivity test was conducted for the auto operation cost, transit fares, new transit service and new employment centers, similar to the last base year. In addition, the transit frequency test was also incorporated. The test results can be found in Chapter 4 of the Fresno COG ABM Report. Sensitivity testing assesses the model's sensitivity to changing model inputs like fuel prices, transit fares, varying transit frequencies and services, new land uses, or new infrastructure. For each test, shadow pricing is either turned on or off depending on the expected effect of the project. For example, small changes in the highway or transit network are not expected to have large effects on work and school location choice. For these types of tests, stable shadow prices from the base run are used. For cases where there are very broad changes in the travel system like changes in auto-operating costs, the shadow pricing loop is turned on to generate shadow prices for the new scenario. The 'model setup' section in each test description will indicate whether or not shadow prices are re-calculated.

Land Use Growth Allocation: Fresno COG has developed an application for future growth allocation that estimates each parcel's development suitability and uses that value to meet growth targets for each jurisdiction's sphere of influence. The suitability score considered several factors, detailed in Table 5. Fresno COG may add or remove parameters throughout the modeling process to capture new planning assumptions or generate more realistic growth patterns.

Growth totals are controlled at the regional and jurisdictional (i.e. spheres of influence) levels, with the growth allocation tool affecting the growth pattern within each jurisdiction. To summarize the characteristic differences in growth patterns across scenarios, COG will report regional and jurisdictional growth totals, as well as by the following regional growth areas:

- Corridor/Center Communities (within downtowns, or within a half-mile of BRT)
- Established Communities (within contiguous city limits and rural community planning boundaries)
- Developing Areas (within city spheres of influence)
- Rural Growth

The characteristics of new growth for applicable parcels are based on Fresno COG's Envision Tomorrow model, which designates development types based on region-specific urban form as well as the general and specific plans in the region. Certain high-quality parcels may be assigned higher density development types, depending on model parameters, that are still consistent with planned land use designations but represent densities that are on the aspirational side.

Table 5: Growth Model Parameters

Parameter	Description
Cube Land Factor	How much weight is given to the TAZ-level growth totals allocated by the Cube Land model

High Density Factor	The percentage of new growth that represents “high density” growth, i.e. densities at the higher range of planned land use designations
Minimum Redevelopment Density	Minimum net density gain between existing and proposed land uses for a parcel to be considered for new growth potential
Infill Index	The normalized, inverse distance of a parcel from a city limit or rural community boundary
Conservation Index	The percentage of a parcel’s land that is not covered by a conservation layer (e.g. important farmland, groundwater recharge areas, etc.)
Density Index	The net density of a developed or redeveloped parcel, normalized for the region
VMT Index	Whether the parcel falls within a low-, moderate-, or high-VMT area for SB 743 purposes
Accessibility Indexes, by Mode	Cumulative opportunities (job) accessible based on skim results from Fresno ABM, by mode (SOV, bike, ped, transit)
Calibration Factors	A set of coefficients used to calibrate regional growth characteristics such as infill development, mixed-use share, residential density, unit share by type, redevelopment share, etc.

REMI. Fresno COG has partnered with MTC/ABAG to access the REMI economic forecasting model. This tool will be used to estimate many of the exogenous model variables referenced, as well as the results of various strategies and policies within the purview of the SCS scenarios.

EMFAC. Fresno COG is using CARB's emissions modeling software EMFAC2014 to complete the on-model GHG emissions estimates for the SCS. The latest version of the emission model, EMFAC 2021, will be applied in the GHG quantification process for the off-model strategies.
EMFAC was designed and developed by the CARB to specifically calculate emission inventories from motor vehicles operating on roadways in California. EMFAC is regularly updated by the CARB to reflect the latest planning assumptions (such as vehicle fleet mix) and emission factors. In addition, SB 375 legislation indicates that MPOs may not take credits for GHG reductions from state programs such as improved vehicle emission standards, fuel efficiency and other state programs such as the Advanced Clean Cars (ACC)

and the Low Carbon Fuel Standards (LCFS). Therefore, an EMFAC adjustment methodology was developed by the CARB to normalize the effect of the different versions of EMFAC. Fresno COG will apply the adjustment factors to the EMFAC 2014 results based on the methodology recommended in the SCS Review Guideline adopted in 2019 by the CARB.

IV. Modeling Assumptions:

The exogenous variables in the ABM are outlined in Table 6. These variables may be altered or updated as new data becomes available throughout the modeling process.

Table 6: Exogenous Variables

	Source(s)	2023	2035
Total Population	Fresno COG Demographic Forecast	1,012,524	1,066,610
Total Jobs	Fresno COG Demographic Forecast	415,596	442,660
Auto-Operation Cost (2019$)	2025 AOC Forecast Update by Trinity	27.26 (cents/mile)	27.26 (cents/mile)
HH by Size	PUMS, Fresno COG Demographic Forecast	3.0(mean)	3.0 (mean)
HH by Income (2022$)	PUMS, Fresno COG Demographic Forecast	$93,576 (mean)	$102,970 (mean)
HH by Presence of Children	PUMS	35.6% w/children	35.6% w/children
HH by Number of Workers	PUMS	1.28 (mean)	1.28 (mean)
School Enrollment	Fresno COG Demographic Forecast	202,610	185,207
Workers by Occupation	Fresno COG Demographic Forecast	41% population in workforce	41% population in workforce

Auto Operation Cost (AOC). As part of the San Joaquin Valley Auto Operation Cost (AOC) update for the 2026 RTP/SCS, Fresno COG worked with Trinity consultant to update the AOC assumption used in the modeling by incorporating the latest fuel forecast, fuel efficiency, and various taxes in California. Auto operating costs were updated for the 2026 RTP/SCS consistent with CARB's SCS Program and Evaluation Guidelines' Appendix D[1] to account for operation costs associated with both petroleum-fueled (e.g., gasoline and diesel) and alternative fuel vehicles (e.g., electric and plug-in hybrids). The underlying assumptions related to petroleum fuel price forecast and vehicle fuel efficiency were updated as detailed below.

The 2023 Annual Energy Outlook (AEO) data[2] was used to update future gasoline and diesel fuel price projections from 2023 to 2049. Specifically, the average projections between high and low oil scenarios of the AEO were used to develop fuel forecast factors that were then applied to 2023 California average retail fuel prices as reported by the EIA. Electricity costs were based on 2023 Transportation Energy Demand Forecast[3] published by the California Energy Commission (CEC) and linearly forecasted between 2035 through 2049 since CEC data was not available post 2035.

Non-fuel costs associated with vehicle maintenance were updated based on 2023 "Your Driving Costs" report[4] from AAA depending on vehicle type and extrapolated through 2049, assuming 2% increase per year. All costs were then converted to 2019 dollars consistent with the travel model validation year.

Fuel efficiency inputs for gasoline, diesel, and plug in hybrid vehicles were obtained from EMFAC2021. Fuel efficiency for electric vehicles was obtained from CARB's Auto Operating Cost Calculator[5]. The resulting values for years ranging from 2010 to 2049 for Fresno COG are shown in Appendix A.

Quantification of GHG reduction. Fresno COG plans to use both the traffic model and off-model tools to quantify the GHG reductions from the SCS strategies. CARB's recommended methodology for off-model GHG quantification will be referenced and considered in the process. Table 7 provides a preliminary list of strategies with the planned quantification approach.

Table 7: RTP/SCS Strategies

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[1] Final Sustainable Communities Strategy Appendices (ca.gov).
[2] U.S. Energy Information Administration - EIA - Independent Statistics and Analysis
[3] CA_Planning_Library_2022_IEPR_Fuel_Price_Forecast_ada.xlsx.
[4] https://newsroom.aaa.com/wp-content/uploads/2023/08/YDC-Brochure_2023-FINAL-8.30.23-.pdf.
[5] CARB AOC tool can be downloaded from SCS Evaluation Resources | California Air Resources Board.

Strategy	Category	Quantification Approach	Status
Infill, compact development, transit-oriented development, mixed-uses and allocation of growth along transportation corridors	Land use	Traffic model	Present in last plan*
ADUs	Land use	Traffic model	Present in last plan*
Allocation of growth in low-VMT areas	Land use	Traffic model	Present in last plan*
Allocation of growth in areas with higher access to bike, ped, and transit	Land use	Traffic model	Present in last plan*
Transit capital projects, bike projects	Transportation	Traffic model	Present in last plan*
Pedestrian infrastructure improvement, operational improvements (Transportation System Management), ITS	Transportation	Off model	Present in last plan*
Carpool, vanpool	Travel Demand Management (TDM)	Off model	Present in last plan*
Telecommute	Transportation	Traffic model	Present in last plan*
Employer- based trip-reduction programs (Rule 9410)	Travel Demand Management (TDM)	Off model	Present in last plan*
Additional regional/local EV infrastructure (charger & micro-grid system) program	Technical improvement	Off model	Present in last plan*
Car Sharing	Travel Demand Management (TDM)	Off model	Present in last plan*

Local EV Incentive program	Technical improvement	Off model	Newly added in this plan

** Some carry-over strategies may be further emphasized compared to the last plan*

[i] *Barrero, Jose Maria, Nicholas Bloom, and Steven J. Davis, 2021. "Why working from home will stick," National Bureau of Economic Research Working Paper 28731.*

Appendix C. Transportation and Land Use

Item 4. Fresno Activity Based Model

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FRESNO COUNCIL OF GOVERNMENTS ACTIVITY-BASED MODEL UPDATE

June 2026 | Fresno Council of Governments

FRESNO COUNCIL OF GOVERNMENTS

FRESNO COUNCIL OF GOVERNMENTS ACTIVITY-BASED MODEL UPDATE

Fresno AB Model Update Report:

Fresno Council of Governments Activity-Based Model Update

Report Prepared by:

RSG

Report Prepared for:

Fresno Council of Governments

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1.0 INTRODUCTION

This report describes updates to the Fresno Council of Governments (Fresno COG) activity-based travel demand model (ABM) to meet existing and evolving transportation planning needs. The new model system is capable of addressing policies such as changes in telecommuting shares, peak hour and daily tolling, TNC modes, and truck restrictions.

The report describes the updated ABM system in detail and also serves as a user's guide for the model system. The ABM uses the DaySim activity-based model platform[1] for resident travel demand integrated with Bentley Cube software[2], which is primarily used for network models (skimming and assignment) and auxiliary demand models (truck model). The ABM is calibrated to a new base year (2023) using the 2022-2023 Central California Travel Survey (subsequently referred to as the 2023 CCTS). The model system is also validated against 2023 observed data for traffic counts, vehicle miles traveled (VMT), and transit ridership.

This project undertook the following key tasks to update the Fresno activity-based model:

- Implemented the latest version of DaySim activity-based model platform
- Updated input external auto and truck trip tables using the California Statewide Travel Demand Model (CSTDM)
- Developed inputs for a new base year (2023)
- Updated the time and cost parameters in the DaySim tour mode choice model to make the derived value of time by purpose more reasonable
- Activated telecommuting model functionality in DaySim[3]
- Processed the 2023 CCTS to develop calibration targets
- Calibrated and validated key submodels in the base year model
- Updated the model GitHub repository with the latest model setup[4]

The rest of this report refers to the ABM system as "Fresno ABM" and is organized as follows. The next chapter, Chapter 2, presents an overview of the ABM system. Chapter 3 presents various summaries of outputs from the calibrated and validated model. Chapter 4 discusses the tests examining model sensitivities to land-use and network changes. Chapter 5 provides

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[1] https://github.com/RSGInc/DaySim
[2] https://docs.bentley.com/LiveContent/web/OpenPaths%20Help-v1/en/GUID-912A4C66-0CA7-4F87-BCEE-61A08366389D.html
[3] https://github.com/RSGInc/DaySim/wiki/Telecommute-Model
[4] Fresno ABM GitHub repository maintained by RSG (private and requires RSG permission): https://github.com/RSGInc/FresnoABM/tree/FresnoABM_2023_update

instructions to run the model system. The appendices (A-F) at the end of the report provide supplemental information about various tasks performed during this project.

2.0 MODEL DESIGN

This model update includes updating the model base year from 2019 to 2023 and adding model feature enhancements. As such, the 2023 model design and structure are identical to the 2019 model (except for the enhancements).

Prior to the full model run, if the PopulationSim has not been run before for a new land use or horizon year scenario, it needs to be run as a standalone script first. PopulationSim is currently set up to run in an Anaconda 3 environment using the latest PopulationSim python package. This differs from the Anaconda 2 environment used by the rest of the model. It is recommended to update the python packages and settings used for both PopulationSim and the full model run so both can be run with a single run command. The PopulationSim step can be found inside the 'DaySimInputPrep' module described immediately below to facilitate future integration. The steps for updating the synthetic population controls and targets are outlined in Appendix B.

2.1 OVERVIEW

Figure 1 presents the structure of the new Fresno ABM system showing relationships among different sub-model components.

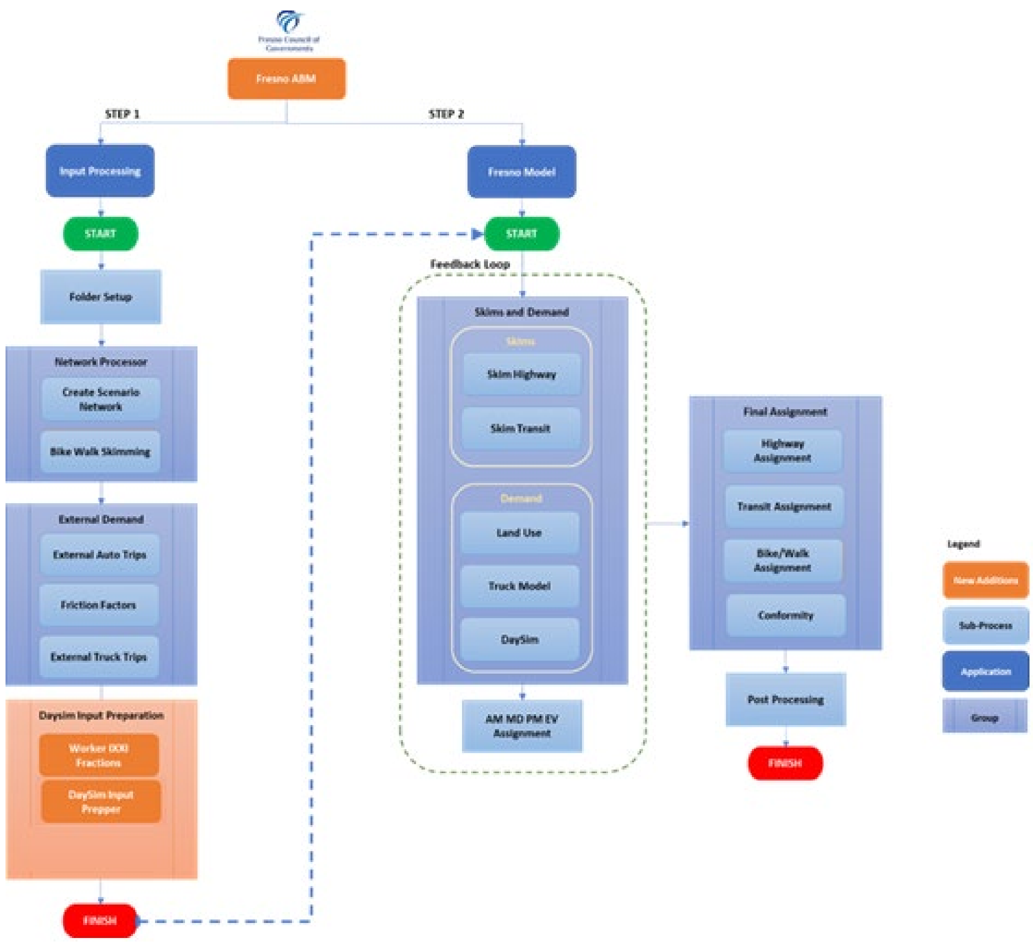

FIGURE 1: MODEL PROCESS FLOW

The ABM consists of two sequential steps: Input Processing and SJV Model. These steps can be launched with a single run command from the Cube catalog. The first step, Input Processing, processes the model network and creates inputs required in the second step, SJV Model, which performs network skimming, demand generation, and assignment in three feedback loops.

The Input Processing step first converts the input CUBE network into scenario specific CUBE network formats (highway, transit, and non-motorized) for network skimming and assignment procedures. As non-motorized assignments are not capacity constrained, re-skimming of bike and walk are not required in every feedback loop. Therefore, an initial set of bike and walk skims are generated to use in every feedback loop. Similarly, this step formats external demand matrices (auto and truck) which are kept static across all feedback loops. Other static inputs specific to DaySim are prepared in the new DaySim Input Preparation Module.

After the networks are prepared in the required format, the second step, SJV Model, runs three feedback loops. Each feedback loop starts with generating highway and transit skims to use in demand models. A set of demand models produces demand for two travel markets in the Fresno County region: resident travel and truck travel. The resident travel demand is generated by DaySim, whereas the truck demand is produced by the truck model, which is retained from the Valley Model Improvement Plan Version 2 (VMIP2) model. The two sets of travel demand, along with the external demand (auto and truck) generated in the first step, input processing, are combined into four time-period specific highway demand matrices with each having OD demand by multiple highway classes based on vehicle type and value of time. Similarly, the transit demand from DaySim is also prepared into four time-period specific transit demand matrices with each having multiple transit assignment classes based on transit sub-mode and access mode. The non-motorized (bike and walk) demand comes from the DaySim model and the corresponding matrices represent daily demand. After the demand matrices are constructed, four highway assignments are run: AM-peak (AM), off-peak (MD), PM-peak (PM), and night (EV). Note that transit and non-motorized assignments are run only once, in the final assignment step after the feedback loops. The link flows from the four highway assignments then inform new link travel times for the next feedback loop.

After the model system runs three feedback loops of skimming, demand, and assignment, a final assignment step runs assignment for all network systems (highway, transit, and non-motorized). The final highway assignment is run for four time periods (AM, MD, PM, and EV) and the transit assignment is performed for peak and off-peak periods. The non-motorized assignments are run for daily demand. After the network assignments, the last step of the model system summarizes the assignment results and produces files/reports to use for analysis.

Note that before running DaySim, a utility called “Buffer Tool” generates a buffered micro-zone file (land-use and accessibility measure for micro-zones) to use in DaySim. Also, a python tool called “population sampler” updates the input synthetic population to oversample households by a factor of 3.0 to reduce the Monte Carlo variance for an individual DaySim model run. If shadow pricing is turned on, the first iteration of the feedback loop will run the DaySim model four times; the first three runs of DaySim produce stable shadow prices that are used as an input for the fourth run, and for the subsequent DaySim runs in iterations two and three.

The Fresno ABM system process is comprised of the following key elements: input preparation, network skimming, demand generation, assignment preparation, assignment preparation, assignment, feedback loop, and reporting. The following sections discuss these processes in more detail.

2.2 INPUT PREPARATION

The first step of the model system, Input Processing, performs all necessary calculations and conversions to prepare networks and other inputs for processes in the second step, Fresno

ABM, of the model system. This input preparation process undertakes the following primary tasks that are completed sequentially:

- Setup scenario directory
- Create scenario networks
- Generate non-motorized skims
- Generate external demand
- Generate transit stops file
- Generate intersection density file
- Generate truck model socio-economic (SE) file
- Generate internal-external worker fractions (Optional)
- Generate synthetic population (Optional)

Setup Scenario Directory

When the input processing step is started, it first creates a scenario directory with all necessary sub-folders required at any step of the model system.

Create Scenario Networks

After setting up a scenario directory, the process reads the input all-street highway network in Cube format and transit network from the text-based ".lin" file and processes them to convert into scenario networks. In addition to generating necessary fields, this step filters out minor streets to create a coarser auto network for use in skimming and assignment.

Note that the process of creating the CUBE format highway network does not check for connectivity. The accuracy of the output network is entirely dependent on how well the attributes that are used in the street filtering process are coded in the all-street network. Additionally, a coarser network may miss some streets with substantial traffic, thus causing, on some links, higher model flows than observed traffic counts. A substantial effort was made to track down and resolve such network dysconnectivity and missing link issues during the model validation phase of this project.

Generate Non-Motorized Skims

Since non-motorized network models are not constrained by capacity, non-motorized networks are skimmed only once, during network preparation, and non-motorized assignment is run once during the final assignment step after all feedback loops have completed.

The non-motorized skimming procedures use the all-street network and generate distance skims for MAZ OD pairs[5]. The input preparation step creates a separate non-motorized network from the input all-street network and generates one distance skim for each of the two non-motorized modes. The distance skims are generated using a Cube-based shortest path method. The walk distances are based on a distance-based shortest path, whereas the bike distances are based on a shortest path minimizing a generalized cost function that is calculated as equivalent minutes weighted by bike facility class. As shown in Table 1, eight bike facility classes are available in the all-street network. The weights[6] in bike generalized cost are applied by more aggregated bike facility classes as presented in Table 2.

TABLE 1: BIKE FACILITY TYPE IN ALL-STREET NETWORK

BIKE_FACTYPE	DESCRIPTION
0	Shared Roadway (No Bikeway Designation).
1	Class I Bikeway (Bike Path). Provides a completely separated right of way for the exclusive use of bicycles and pedestrians with crossflow by motorists minimized.
2	Class II Bikeway (Bike Lane). Provides a striped lane for one-way bike travel on a street or highway.
3	Class III Bikeway (Bike Route). Provides for shared use with pedestrian or motor vehicle traffic.
4	Class IV Separated Bikeway (cycle tracks). On-street bicycle facilities that include a vertical physical barrier between the bikeway and moving traffic.
5	Separate highway overcrossings
6	Unpaved Multipurpose Trails
9	Freeways and Ramps (bicycling not permitted)

[5] Auto trips are significantly longer and calculating impedances at a finer detail (MAZ) than TAZ would not be worth adding substantial run time to the model system.
[6] The parameters are borrowed from SANDAG route choice model, converted from utiles per mile to minutes per mile.

TABLE 2: PARAMETERS BY BIKE FACILITY TYPE

BIKE FACILITY	WEIGHT (MINS PER MILE) *
No bike facility	6.0
Bike trail	2.0
Bike lane	3.1
Bike route	4.9

*Note: initial parameters were borrowed from SANDAG bike route choice model

The skimming process first strips out all freeway facilities from the all-street network and then calculates a bike generalized cost (BIKE_MINMILE) for each link in the network. As Cube expects skim zones (nodes) to be numbered from 1, the node ids in the resulting non-motorized network are updated to bring MAZ centroids in the beginning and the rest of the nodes start after them. This was done by subtracting 100,000 if node id is greater than 100,000 (MAZ centroids) and adding 100,000 otherwise (street nodes). Both node and link files were updated to reflect the new node id numbering scheme. Now, this updated network is used to generate bike and walk skims using a Cube utility (BUILDPATH) that, for every OD pair, summarizes an attribute on a shortest path based on a user provided cost function, which is the distance for both walk and bike.

Generate External Demand

The Activity-Based Model (ABM) system incorporates two distinct sets of external demand: auto demand and truck demand. These external trip tables were developed prior to the model run using the California Statewide Travel Demand Model (CSTDM) and are provided as static inputs to the system. The auto external trip tables are stratified across four model time periods, whereas the truck external trip table is provided as a daily matrix.

Figure 2 illustrates the process for generating these external trip tables for the Fresno model region. To develop the necessary datasets, this process is executed for the 2020 and 2040 scenario years within the Statewide Model. The base year (2023) trip tables are then developed by interpolating between the 2020 and 2040 external matrices.

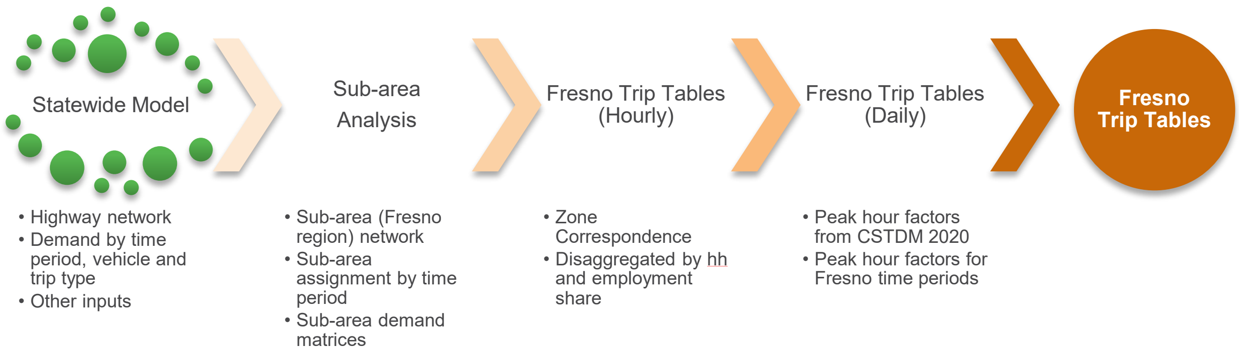

FIGURE 2: EXTERNAL TRIP TABLE GENERATION PROCESS

The California Statewide Model system comprises a highway network, peak-hour demand segmented by time period, vehicle type, and trip type, alongside other inputs requisite for highway assignment. To generate demand matrices specific to the Fresno region, a sub-area analysis was conducted within the Statewide Model using a sub-area network delineated for the Fresno model boundary.

Each assignment iteration produced a sub-area demand matrix containing travel demand indexed by CSTDM zones falling within the Fresno sub-area network. These matrices captured all four regional travel components: internal-internal (I-I), internal-external (I-E), external-internal (E-I), and external-external (E-E). However, because these matrices were formatted by CSTDM zones rather than Fresno ABM zones, a spatial transformation was required.

Converting the demand data into the Fresno ABM zone structure involved a disaggregation (and, in some instances, aggregation) process governed by a zone-to-zone correspondence lookup table. The process factored[7] the demand based on the relative share of employment, population, or a combination of both within the Fresno ABM zones relative to the CSTDM zones.

Because the converted trip tables originally represented peak-hour demand for specific time intervals, Peak Hour Factors (PHF) were applied to scale the matrices to represent the full duration of the Fresno model time periods. These peak hour factors were derived by adjusting the original CSTM factors to compensate for the differences in time-period definitions between the two modeling platforms.

[7] Factors are utilized for zones internal to the Fresno region and are applied at both the origin and destination ends. At the origin end, household share is applied during the AM and MD periods, while employment share is applied during the PM and NT periods. Conversely, at the destination end, household share is applied during the PM and NT periods, while employment share is applied during the AM and MD periods.

Ultimately, these tables were processed into six auto matrices (representing four model time periods and two peak-hour sub-periods) and one daily truck matrix. The auto trip tables isolate vehicle trips by three occupancy classes: drive-alone, shared-ride 2, and shared-ride 3+. The truck tables segment demand by two vehicle weight classes: medium duty and heavy duty. These finalized, adjusted trip tables serve as static inputs to the Fresno ABM system.

Future-year external trip tables are generated by applying growth factors—segmented by trip type: Internal-External (I-E), External-Internal (E-I), and External-External (E-E)—to the base-year matrices. These growth factors are derived from demographic trends published in the California Department of Finance (DOF) population projections. Specifically, population growth rates within Fresno County and its neighboring counties are utilized to determine growth factors for I-E and E-I trips, while the statewide population growth rate for California is applied to scale E-E trips.

Generate Transit Stops File

The transit stops file is created using the input transit network and is now automated in the input processing step of the model. The module “Scenario Prepper” inside the ‘DaySimInputPrep’ module contains the process to generate this file. It is run after the network processor. First, the highway network is exported to shapefiles as links and nodes. Next, a python script reads the node shapefile and processes the transit line file to read all the stop nodes with their associated transit mode. This information is joined to the coordinate data of the nodes and exported in the format shown in Figure 3.

The stops file is in the following format:

id	mode	xcoord_p	ycoord_p
1	1	6309142	2167872
2	1	6309117	2166434
3	1	6309112	2165240
4	1	6307677	2165242
5	1	6306517	2165245
6	1	6306529	2166560
7	1	6306503	2167889
8	1	6309149	2169329
9	1	6309154	2170526
10	1	6309171	2171830
11	1	6307831	2173200
12	1	6306543	2173215
13	1	6305216	2173227
14	1	6303896	2173225
15	1	6303887	2174830

FIGURE 3: TRANSIT STOPS FILE FORMAT

Generate Intersection Density File

The intersection file provides the number of roads (links) at an intersection (node). The all-street network in the model is a dual road network where a two-way street is represented as one link for each direction. A two-way road is represented by two links representing to and from direction. Therefore, the all-street network cannot simply be used to calculate number of links at an intersection. First, we need to simplify the network and then process to create the intersection file.

This step in the input prepper reads the exported link file that was created at the beginning of the DaySim Input Prep step and uses a python script to pare the network down to single roadway links. The python script joins this to the node layer and the intersection link counts are saved in the appropriate format as described in section 5.5.

Generate Truck Model Socio-economic File

The truck model requires a socio-economic (SE) data file at the TAZ level with employment categories filled. This data is already available in the MAZ land use data file that is used as an input to DaySim. This step simply aggregates the data to the TAZ level and saves it in the appropriate format for the truck model. This step simplifies the model input preparation as now changes to land use need to be made only in the MAZ land use data file. The employment categories used in the truck model are slightly different than those available in the MAZ land use file. So, a crosswalk, shown in Table 3, is used to reformat these categories.

TABLE 3: DAYSIM TO TRUCK MODEL EMPLOYMENT CATEGORY CROSSWALK

MAZ FIELD (DAYSIM)	TAZ FIELD (TRUCK)
empgov_p	EMPGOV
empind_p	EMPIND
empmed_p	EMPMED
empofc_p	EMPOFC
empret_p	EMPRET
empsvc_p	EMPOTH
empoth_p	EMPAGR
emptot_p	TOTEMP

Generate Internal-External (IXXI) Worker Fractions

The IXXI (internal-external and external-internal) worker fractions are zonal share of resident workers working outside Fresno County and zonal share of employment occupied by non-resident workers. These are input into the DaySim model and are generated by summarizing Longitudinal Employer Household Dynamics (LEHD) worker flow data, the latest year available at the time of the model update. This model input only needs to be updated when the base year of the model is changed, or new data is available. This step is optional in the CUBE catalog and can be set to run using the CUBE key “Run_WorkerFrac”.

2.3 NETWORK SKIMMING

The model system generates impedances (skims) for three sets of networks: highway, transit, and non-motorized. The highway and transit skims are (re)generated at the beginning of each feedback loop. The non-motorized skims are generated one-time in the Input Processing step, before the feedback loops.

Highway

The highway skimming process generates 12 skim matrices for four time periods (AM, MD, PM, EV) and three auto modes (drive-alone (DA), shared-ride 2 (SR2), and shared-ride 3+ (SR3)). Each highway skim matrix contains the following impedances in three value of time categories:

- Generalized time (mins)
- Time (mins)
- Distance (miles)
- Cost (dollars)

Note that the highway system reads auto operating cost (AOC) from an input CSV file that contains AOC by scenario years, which is based on 2019 dollars.. To maintain consistency between demand and supply models, before each run, the DaySim configuration file is updated dynamically to reflect the same auto operating cost. This model update included the following features to implement tolling and truck restrictions:

- Network Attributes:
  - Additional network attributes to facilitate tolls and restrictions are summarized in Table 4
- Skimming:
  - Skimming within the feedback loop includes all four time periods
  - Skimmed costs use toll values specific to each time period
  - Each skimming class accommodates the new restrictions for HOV and Truck restricted facilities
- Assignment:
  - Assignment within the feedback loop includes assignment for all four time periods
  - Assignment class definition accommodates the new restrictions for HOV and Truck restricted facilities
  - Each assignment reads in the period-specific toll values as the toll cost (AM sees TOLL_AM, MD sees TOLL_MD, etc.)
  - Final assignment step includes the same improvements as the assignment in the feedback loop

TABLE 4: NETWORK ATTRIBUTES FOR TOLLING AND RESTRICTIONS

NETWORK ATTRIBUTE	VALUE	DESCRIPTION
USE (BASE_USE, IMP1_USE, IMP2_USE)	0	Not used by any vehicle classes
	1	A general purpose lane that can be used by any assignment class
	2	An HOV2+ facility in which only vehicles with occupancy 2 or more are allowed
	3	An HOV3+ facility in which only vehicles with occupancy of 3 or more are allowed
	4	An HOV2+ facility but only in the peak (AM, PM) assignment periods. Will operate as a general-purpose lane in the off-peak (MD, EV) assignment periods
TOLL_{AM, MD, PM, NT}	Dollar value	Toll Value on the link[8]
TRK_USE	0	Not used by any vehicle classes
	1	Trucks (light, medium, and heavy) are restricted from using the link at all times
	2	Trucks (light, medium, and heavy) are restricted from using the link in the peak periods only (AM, PM)

Transit

The transit skimming process generates 16 skim matrices for two time periods (peak and off-peak), four transit sub-modes (local bus, BRT, light rail and commuter rail), and two access modes (walk and drive). Each transit skim matrix contains the following impedances:

- Transit in-vehicle time (mins)

[8] The dollar value of the toll is per link. This allows flexibility in coding: for distance based pricing, format the dollar value as price per mile multiplied by link length. For fixed price between ramps, choose one link on the path and set the toll amount.

- Walk access time (mins)
- Walk egress time (mins)
- Transfer walk time (mins)
- Initial wait time (mins)
- Transfer wait time (mins)
- Fare (dollars)
- Boardings
- Transit in-vehicle time for local bus (mins)
- Transit in-vehicle time for express bus (mins)
- Transit in-vehicle time for BRT (mins)

The transit system uses two sets of fare systems: fixed fare and zone-based fare. The fixed fare of $1 is applied to Fresno Area Express (FAX) and $0 (free) for Clovis Transit bus routes[9], whereas the zone-based fare ($0.75 - $6.00) is applied to the Fresno County inter-city buses operated by Fresno County Rural Transit Agency (FCRTA)[10].

The non-motorized skimming process generates two Cube matrices for bike and walk distances by MAZ OD pairs. The walk distances are produced in a text format as well for use in the DaySim buffer tool[11].

2.4 TRAVEL DEMAND

The model system encompasses three sets of travel demand: resident travel, truck travel, and auxiliary travel. DaySim simulates the internal travel for the Fresno residents. Truck travel within the region is produced by the truck model. Auxiliary demand such as external travel (auto and truck) are provided as inputs in the form of trip tables to the model system.

Resident Model (DaySim)

DaySim is an activity-based (AB) travel demand model. DaySim simulates 24-hour itineraries for individuals with parcel-level spatial resolution and minute-level temporal resolution. DaySim can generate outputs at the level of resolution required as input to dynamic traffic simulation. DaySim's forecasts in all dimensions (activity and travel generation, tours and trip-chaining, destinations, modes, and timing) are sensitive to travel times and costs that vary by mode,

[9] This is provided in "1_inputs\4_Transit\FC_BASE_TRAN_FAR.FAR"
[10] This is provided in "1_Inputs\4_Transit\fareMatrix.txt"
[11] A DaySim input preparation tool that generates a buffered micro-zone file that contains several land-use and accessibility variables.

origin–destination path, and time of day. As a result, DaySim uses the improved network travel costs and times output from a dynamic traffic simulator as inputs. DaySim captures the effects of travel time and cost upon activity and travel choices. These effects are balanced across modes and times of day and are consistent with the econometric theory of nested choice models. DaySim can be used in a distributed manner by running different partitions of the study area population on separate processors and then merging the results.

DaySim comprises several subcomponents and is structured as a series of hierarchical or nested choice models. DaySim's hierarchy places the long-term models at the top of the choice hierarchy and places the short-term models at successively lower levels in the hierarchy. The detailed hierarchy and flow through the model are illustrated in Figure 4.

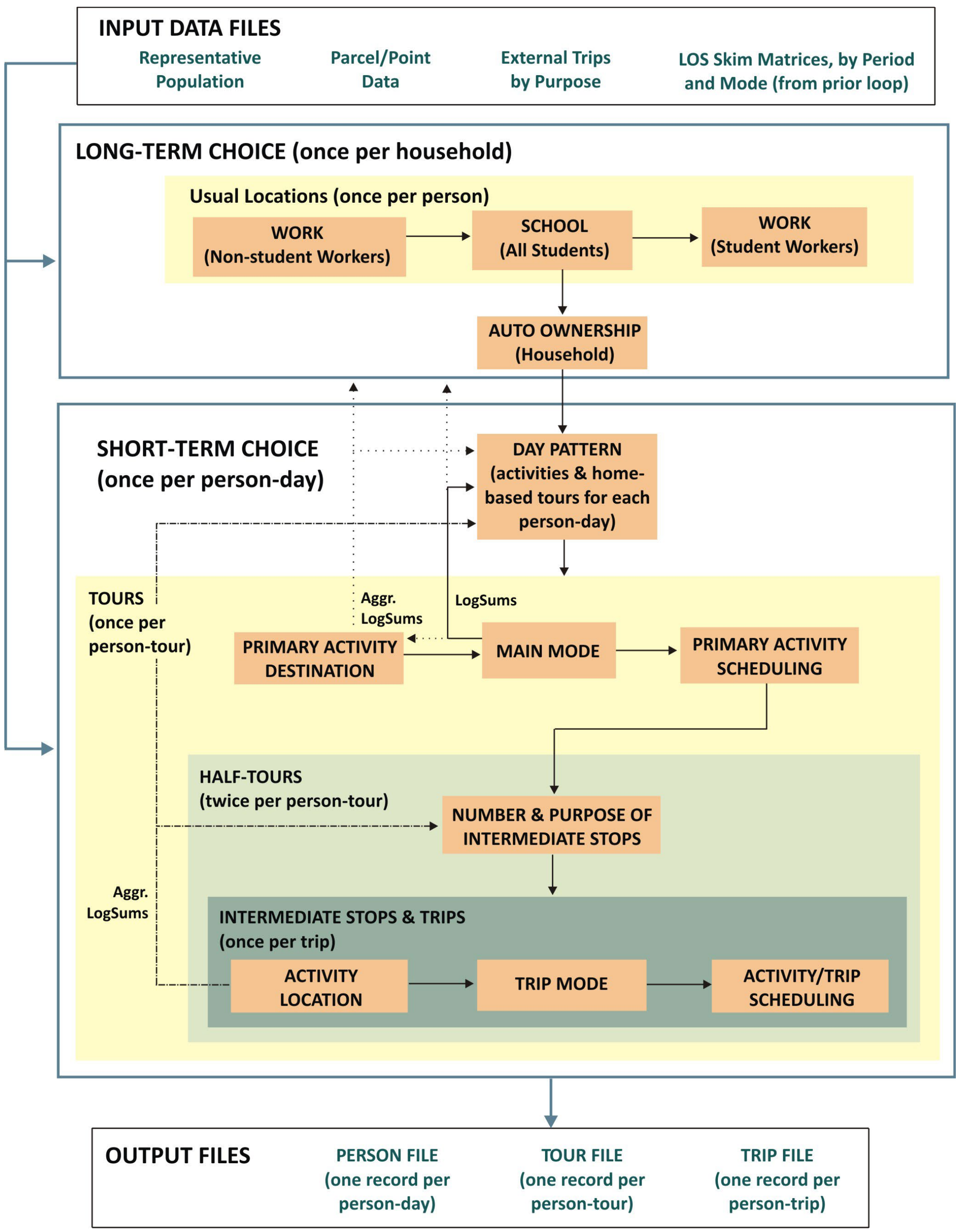

FIGURE 4: DAYSIM SUB-MODELS

The flow generally proceeds in a linear fashion from the long-term models to the short-term models. The choices made in the long-term models influence or constrain the choices made in the lower-level models. For example, household auto ownership affects both day pattern and tour (and trip) mode choice by including auto ownership variables in those component models. In addition to these direct influences, utilities from lower-level models flow upward to higher-level models. “Logsums” (expected utilities) from tour destination and tour mode choice models affect other short-term models as well as upper-level, longer-term models. Some of the logsums from lower-level models are aggregated for use in the long-term models in order to reduce the computational time required to use fully detailed disaggregate logsums in a complex nesting structure.

This model update included updates to the DaySim code to allow for paid ride share modes such as Uber/Lyft services, which may also be toggled to allow these services to be provided by automated vehicles (AVs). Additionally, the new DaySim code also includes a telecommute sub-model which allows resident workers to make the choice to telecommute (different from working from home and having no out-of-home work location). More details on these parameters can be found in Appendix D.

Buffering and Transit Access Preparation

In DaySim, it is important to have measures not only within a particular micro-zone, but also for the area immediately surrounding each micro-zone. These measures are created by defining a “buffer” area around each micro-zone and counting what lies inside the buffer. These variables can then be used in DaySim, similar to how zonal land use and density variables are used in TAZ-based models, with the advantage that the buffer is defined in exactly the same way for each micro-zone. The buffer variables that DaySim uses include:

- The number of households in the buffer;
- Employment (number of jobs) in the buffer in various employment sectors;
- Enrollment in schools in the buffer, segmented by grade schools and colleges;
- The number of spaces and average price of paid off-street parking in the buffer;
- The number of transit stops within the buffer (segmented by sub-mode, if relevant);
- The number of street intersections in the buffer, segmented by 1-node (dead-end or cul-de-sac), 3-node (T-junction), and 4+node intersections; and

In addition, DaySim also uses the distance from the micro-zone centroid to the nearest transit stop (by transit sub-mode, if relevant), as well as the distance to the nearest open space area while simulating models.

DaySim Buffering Tool

A tool, Buffer Tool, to perform the buffer calculations is implemented in the DaySim component of the model system. This tool calculates all the buffer and transit access variables that DaySim needs, using the following inputs:

- Base micro-zone file
- Street intersections file

- Transit stops file
- Network nodes file (for all streets network based short trip distances)
- Node-to-node shortest path distance file (for all streets network based short trip distances)

Note that it is essential that the buffer measures used in application are consistent with those used for the original model estimation. Thus, when preparing new buffer measures, users should not modify the settings in the buffering tool control file.

Buffer Calculations

As mentioned earlier, buffer variables for a micro-zone are calculated by summing land use variables of all micro-zones within a certain buffer distance of the particular micro-zone. In the past, buffer calculations have used a “flat” buffer, using a certain radius, e.g. ¼ mile, and counting everything within that radius and nothing outside the radius. That approach is simple, but has the disadvantages that (a) it weights all opportunities within the buffer the same, whereas in reality the land use that is very close by will tend to have more influence on behavior than the land use at the edge of the buffer, and (b) there can be “cliff effects” if a large development is located near the edge of the buffer. In the latter case, the measures become sensitive to the somewhat arbitrary specification of the buffer size, and to the rules used to deal with micro-zones that straddle the buffer boundary. This tends to add random “noise” to the buffer measures.

The buffering tool can be set to use flat buffering, or a distance-decay buffer, in which each buffered item is weighted according to the distance from the origin micro-zone centroid. There are two options provided for the weighting function: a logistic function and a negative exponential function. The logistic form is recommended because its shape is more representative of typical behavioral models that use logistic functions. The Fresno ABM uses a distance-decay buffering.

The buffering program simultaneously calculates all the buffer variables for two different buffer sizes. The reason for this is that the DaySim choice models use smaller buffers for some variables (e.g. those that represent attractiveness of walk trips), and larger buffers for some other variables (e.g. those that represent attractiveness of bike trips, or more general neighborhood effects).

For distance decay buffering, the user specifies three parameters for each buffer: (1) the distance parameter, (2) the offset parameter, and (3) the slope parameter (the latter two are used only for logistic buffering). The parameters for the logistic curves used for DaySim model estimation and calibration are listed in Table 5. It is necessary that these same parameters be used for model application. The distance decay weights for both buffers are shown in Figure 5.

TABLE 5. LOGISTIC CURVES PARAMETERS

PARAMETER	BUFFER 1	BUFFER 2
Inflection	BDIST1 = 660 (ft)	BDIST2 = 1320 (ft)
Offset	BOFFS1 = 2640 (ft)	BOFFS2 = 2640 (ft)
Slope	DECAY1 = 0.76	DECAY2 = 0.76

The equation is:

$$Weight = \min\left(1, \frac{1 + e^{DECAY - 0.5 + \frac{BOFFS}{5280}}}{1 + e^{DECAY\left(\frac{Distance}{BDIST} - 0.5 - \frac{BOFFS}{5280}\right)}}\right)$$

Distance is the distance, in feet, from the origin micro-zone to any other micro-zone whose calculation is explained in the next paragraph.

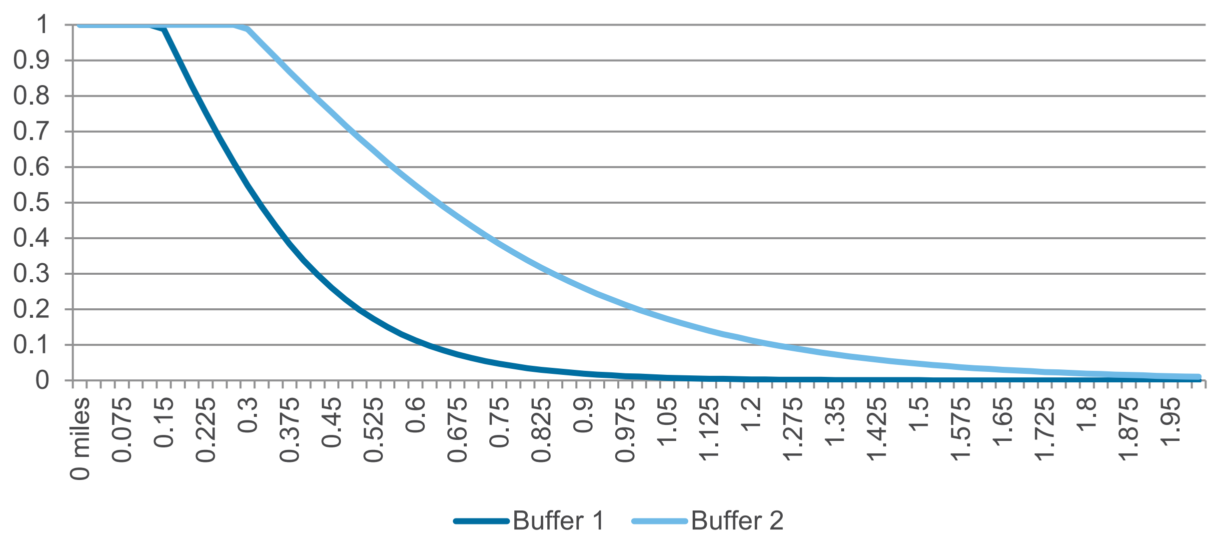

FIGURE 5: BUFFER1 AND BUFFER2 DISTANCE DECAY WEIGHTS

The buffering program also gives the user three options as to how distances are calculated within the buffering program:

1. Use crow-fly distance between the XY coordinates
2. Use interpolation with a “circuity surface” around each micro-zone.
3. Use shortest path distance between the nearest all street network nodes.

Note that in option 1, because the buffer distance is calculated using XY coordinates from centroid to centroid for micro-zones, buffering may not be very accurate for micro-zones that are very large compared to the size of the buffer.

Option 3, used in Fresno ABM, provides more accurate distances that take into account obstacles and directness in the street network and is preferable if the required data exists. The following steps are involved in buffering using distance decay weights and all streets network distances:

1. The buffering tool first associates each micro-zone with the nearest network node and creates a micro-zone-node correspondence.
2. Multiple micro-zones may be associated with a single node and so the base micro-zone file is reduced to node level by aggregating data from all micro-zones that are associated with the same node.
3. Other items such as open spaces/parks and transit stops are also associated with the closest network nodes.
4. At this point, buffering calculations are all done at the node level since node-to-node all street network distance are available. For node pairs that are not within 3 miles of each other, Euclidean distance calculated from XY coordinates is used. Buffer variables for a particular node are calculated by obtaining the weighted sum of land-use variables of all the nodes with the chosen buffer distance. The calculation of distance weights has been described earlier.
5. Once the buffer calculations at the node level are complete, the buffer variables are transferred to micro-zones using the micro-zone-node correspondence created in step 1.

It should also be noted that in case of option 3, during the buffering process, two binary files that have information about node-to-node network shortest path distances are output so the DaySim can use them for simulation of short trips.

The following steps are involved in buffering using distance decay weights and XY/Euclidean distance:

1. Calculate distance weights using the logistic decay equation described earlier.
2. Calculate buffer variables for each micro-zone by counting land-use attributes of the surrounding micro-zones by getting their centroid distances (Euclidean) from that of the micro-zone under consideration and weighting by the corresponding distance weights.

Population Sampler

A common problem in the application of activity-based models to small urban areas is the effect of Monte Carlo simulation variance on the interpretation of results. The simulation error is inversely proportional to the number of decision-makers or agents in the model. For smaller regions like Fresno COG and for cases where the policy of interest is relatively small scale (e.g., a capacity enhancement on a low-volume facility), the simulation error can exceed the sensitivity of the model, confounding the analysis of benefits. To eliminate this problem, the project applied a tool “Population Sampler” that was originally developed for the Bellevue-Kirkland-Redmond region DaySim model to enable oversampling households by geography. Population Sampler reduces the number of feedback iterations required for full model convergence by replicating households whose results are then averaged prior to assignment. The tool is implemented in a Python script and requires specifying the sample rates by zone along with a distribution of households by income and size to ensure that the sampled households are representative of the actual population. For Fresno ABM, the population sampler oversamples households by a factor of 3.0.

DaySim Inputs

This section provides a brief description of inputs required in DaySim model[12].

Micro-zones

The Fresno activity-based model system uses micro-zones as the fundamental spatial unit for generating travel demand. Use of micro-zones improves the sensitivity of the model system to land use, fine-grained urban form and accessibility attributes. However, use of these detailed measures necessitates the preparation of more detailed and larger model input datasets. The micro-zone data input file contains fields that describe the quantities of households, school enrollment by type and employment by industrial sector within quarter mile and half mile buffers. Note that these buffers are based on “all streets” based network accessibilities and employ decay functions that weight closer opportunities more than distant opportunities. In addition, the micro-zone file contains information about urban form and the transportation system on and close to the micro-zone, such as the number of dead-end streets, the proximity of the micro-zone to transit stops, and the price and supply of nearby parking.

Fresno COG provided this file with all the necessary attributes as described in Appendix C

Synthetic Population

The synthetic population is comprised of lists of households and persons that are based on observed or forecasted distributions of socioeconomic attributes and are typically created by sampling detailed Census microdata. These lists function as the basis for all subsequent choice-making simulated in the activity-based model. This project implemented a population

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[12] DaySim is an open source activity-based model stored on a GitHub repository: https://github.com/RSGInc/DaySim. The repository has a wiki page with extensive documentation describing the model.

synthesizer called "PopulationSim" to generate synthetic population that are input to the Fresno ABM. Details of the procedures and instructions to run the software for the base year (2023) are provided inAppendix BAppendix B.

Worker IXXI Fractions

Although the modeling area is defined in such a way as to capture as much "internal" travel by regional residents as possible (that is, travel with both origins and destinations with the modeling area), a certain portion of observed regional travel involves either regional residents travelling to destinations outside the modeling area or people who are not regional residents travelling to destinations within the modeling area. As in a traditional trip-based travel demand model system, these travel markets are typically incorporated into the model through the use of internal-external trip tables, which may be either fixed or dynamic.

A distinguishing feature of the DaySim activity-based model system is that, due to the spatial and behavioral detail embedded in the model, it is sensitive to how this internal-external travel affects the choices made by regional residents. A particular focus of this detail is on ensuring that the right numbers of workers are "out-commuting" to employment locations outside the modeling area, and that the right number of regional jobs are being consumed by non-residents "in-commuting" to the region. At present, this is accomplished by using a file (worker IXXI fractions) that contains TAZ-based shares of workers who are in-commuting and out-commuting, which is provided as an external input to the DaySim model system. The shares either can be held fixed or may be updated by deriving updates shares from the trip-based model outputs.

TAZ Indexes

The TAZ index file enables users to flexibly define non-continuous zones numbering systems, and to identify the availability of external and other zones as destination choices, without impacting DaySim performance.

PNR Nodes

The PNR file provides park and ride locations with corresponding capacity and parking cost. The file is prepared by extracting PNR locations from the highway network (node file). For each location, capacity is set to 100 and cost to 0.

Coefficients

A coefficient file provides a list of variables used in the model and corresponding coefficient values and t-statistics. Each Daysim model component is associated with a coefficient file. For the Fresno ABM, the model coefficients are consistent with the 2019 FresnoABM base year and calibrated to match 2023 observed survey data for the Fresno region.

Roster

A key set of inputs to any travel demand forecasting model system are the files that contain the scenario, mode, user-class, and time period-specific measures of network impedance, often referred to as network “skims.” The roster provides users with the ability to flexibly specify the skims that are associated with the different mode, time period and user classes used in the Fresno activity-based models system, without necessitating changes to the core DaySim model code. For example, a user may want to increase the number of time periods used in the model system to better reflect changes in network impedance by detailed time-of-day. In order to implement such an enhancement, a user would first revise the Cube-based network-processing scripts in order to generate the desired skims and would only need to revise the DaySim impedance roster to make DaySim sensitive to this additional detail.

This model update included automating the generation of the Roster file so that it does not need to be manually updated if changing the model year or running future scenarios.

Roster Combinations

The "Roster Combinations" file gives the possible mode/path type combinations used in DaySim. The file has columns that enumerate the 9 modes used in the current model system: walk, bike, single-occupancy vehicle (SOV), high-occupancy vehicles with 2 persons (HOV2), high-occupancy vehicles with 3 or more persons (HOV3), transit, park-and-ride, school-bus, other. The file also has 7 rows that enumerate the path types currently used (full-network, no-tolls, local-bus, light-rail, premium-bus, commuter rail, ferry). The path type “ferry” is used for BRT. The cells are TRUE for valid combinations within DaySim and FALSE otherwise.

Configuration

The configuration file is the main control file for DaySim. The configuration file informs DaySim about inputs/outputs and various model settings. These settings include input/output file names, types and locations, sample rates, DaySim path building weights, and allow users to specify which DaySim model components should be executed.

The ABM system dynamically generates a configuration file before a DaySim run. This process was updated to include parameters for the new DaySim features for teleworking and paid ride share modes. The model system uses two sets of DaySim configuration files: one for running only work and school location choice models and the second for running all choice models in DaySim. In the first feedback loop when shadow pricing is enabled, DaySim is run for four iterations. The first three iterations run only work and school location choice models and, in the end, generate stabilized shadow prices. These shadow prices are seed to the fourth DaySim iteration that runs all choice models to produce resident travel in the region. Subsequent iterations (and the first iteration when shadow pricing is disabled) run DaySim only once, using the stable shadow price files that were previously generated.

Shadow Prices

The "shadow_prices.txt" is used to constrain employment and enrollment in a parcel by its actual capacity. Similarly, "park_and_ride_shadow_prices.txt" is used to constrain parking at park and ride locations' capacity. The shadow prices are intermediate outputs of a DaySim run. They are optional as inputs. However, it is advisable to have starting shadow prices in order to get stable results. Also, having fixed starting shadow prices is helpful in replicating an ABM run with the same inputs. In this model update, the DaySim module was updated to use the stable shadow prices generated in the shadow pricing step in each iteration of the model. If shadow pricing is turned on, the output shadow prices are saved into the model input folder under 1_Inputs\Daysim\09_SeedShadowPrices. Each time DaySim runs, the shadow price files are updated, however, the setup now grabs the stable prices saved in the inputs so each iteration uses the most stable and reliable shadow prices.

Truck Model

The truck model is retained from the VMIP2 model system. The truck model produces a trip table containing truck demand in three truck classes: small (TS), medium (TM), and heavy (TH).

Auxiliary Demand

The auxiliary demand consists of demand external to the model region. Specifically, it consists of external auto demand and external truck demand. The external demand for internal-external (I-E), external-internal (E-I), and external-external (E-E) trips by time-period (auto) and daily (truck) are provided as input trip tables to the model system. The trip tables are created from the CSTDM, as described in Section 2.2 Input Preparation.

2.5 ASSIGNMENT PREPARATION

Before performing network assignments, the travel demand in the model system is prepared in formats required in the assignments. Specifically, the resident travel from DaySim is converted into vehicle trips and segmented into highway and transit travel in respective assignment classes. Other components of the model demand, internal truck trips and auxiliary demand, are added with the resident travel demand to create time-period specific Cube matrices.

The resident model, DaySim, generates a list of person trips for the residents and outputs them into a trip file in tab separated values format (_trip.tsv). The person trips are segmented into four time periods (see Table 6) using a trip time calculated based on trip's position in the corresponding tour chain. The DaySim trip file contains this information in variable "HALF", which takes value as 1 or 2, indicating if a trip is in first half of the tour or in the second half respectively. If a trip is present in the first half (leg) of the tour (HALF=1), then the trip time is set to trip's arrival time. Otherwise (HALF=2), trip's departure time is considered as the trip time.

TABLE 6. HIGHWAY ASSIGNMENT TIME PERIODS IN THE FRESNO ABM

TIME PERIOD	DURATION
AM (a.m.)	6 am – 9 am
MD (mid-day)	9 am – 4 pm
PM (p.m.)	4 pm – 7 pm
EV (evening)	7 pm – 6 am

Highway

Person auto trips generated by the resident model (DaySim) are converted into vehicle trips using vehicle occupancy factors for high occupancy auto modes (SR2 and SR3). Table 7 presents the occupancy factors used to convert DaySim person trips to vehicle trips.

TABLE 7. OCCUPANCY FACTORS TO CONVERT PERSON TRIPS TO VEHICLE TRIPS

MODE	OCCUPANCY
Drive-Alone (DA)	1
Share-Ride 2 (SR2)	2
Shared-Ride 3+ (SR3)	3.5

The DaySim vehicle demand is combined with truck demand and the auxiliary demand to construct four time-of-day demand tables for highway assignment. The demand tables are generated in Cube matrix format and contain demand in 13 assignment classes – 9 auto classes (3 auto classes x 3 value of time), one external class (EE), and three truck classes (small, medium, and heavy). Three auto classes are DA, SR2, and SR3.

Transit

DaySim produces transit trips across all times of day in which transit service is provided. The DaySim trip file (_trip.tsv) reports all transit trips as transit and does not classify them by access mode (walk or drive). However, another DaySim output, tour file (_tour.tsv), details tours made by a person and reports transit tours by access mode as well. DaySim calculates trips from the tours made by a person. Therefore, if the tour corresponding to a trip is reported as drive-to-transit then the trip is a drive-to-transit too. To get the tour information to the trips, tour and trip files are joined by a common identifier (tourid). Presently in the Fresno model, no KNR sub-mode is included in DaySim, thus, all drive-to-transit trips are reported as PNR trips.

The transit trips are aggregated in OD format into two Cube matrices by transit mode (Bus and Rail). Each matrix contains demand in four assignment classes by time-period (peak and off-peak) and access mode (walk and drive).

Non-Motorized

DaySim also produces lists of trips made for non-motorized modes. These trips are aggregated by MAZ OD format and generated a cube matrix that contains demand by two non-motorized modes (walk and bike).

2.6 NETWORK ASSIGNMENT

The model system assigns three sets of travel demand to the model network: highway, transit, and non-motorized. Note that highway and transit assignment procedures are retained from the VMIP2 model system. The project implemented the non-motorized components in the ABM system.

Highway

The highway assignment is a multi-user class equilibrium assignment that builds paths on a generalized cost function with the cost function differentiated by user class. The generalized cost is a function of travel time and cost (toll) and is converted to time using value of time.

The assignment employs a user equilibrium method that is an iterative process to achieve a convergent solution where no travelers on the roadway network can improve travel-times by shifting routes. Throughout each of these iterations, Cube computes network-link flows, which incorporate link-capacity restraint effects and flow-dependent travel-times.

The ABM system runs highway assignment for four time periods (AM, MD, PM, EV) in every feedback loop and for four time periods (Table 6) in the final assignment step. Note that the truck trips are assigned as PCEs by applying factors of 1.5 and 2.0 for medium and heavy trucks respectively. For convergence criteria, the assignments use a gap value of 0.00001 and maximum iterations of 50 for the peak and 20 for the off-peak periods.

Each converged assignment run produces a loaded network (*.NET) that contains assigned flows on the links. The four time-period specific loaded networks are then post-processed and combined into one loaded network containing flows for all four time periods. The post process also exports the flow data into a DBF file.

Transit

The model system uses Cube-based Pathfinder assignment to assign transit demand to the model transit network. The transit demand is assigned by time period (peak and off-peak), sub-mode (bus and rail), and access mode (walk and drive).

Each transit assignment run produces a loaded network file (*.NET) and a DBF file that contains on and off at every transit stop in the model system. In all, the transit assignment step generates 8 files for each of the two outputs – two time periods (peak and off-peak), two sub-modes (bus and rail), and two access modes (walk and drive).

Non-Motorized

This project implemented a new assignment procedure to assign non-motorized demand to a network. For both bike and walk, the daily demand is assigned to a non-motorized network created in the Input Processing step. The bike assignment calculates best path using a generalized cost based on bike facility type, whereas the walk assignment is set up to directly use distance as a generalized cost. As the non-motorized assignments are not capacity restraint, only one iteration is run in each of the two assignments.

Each non-motorized assignment run produces a loaded network with flows on the network links. However, as described in Section 2.2, the non-motorized network contains the re-numbered node ids that are required for skimming and assignment by MAZ. Therefore, the loaded networks are processed to set the node ids back to the original all-street network node ids. The flows in the new loaded networks are also exported into DBF files.

2.7 FEEDBACK

Feedback is used in two primary ways in the Fresno activity-based model system: between iterations within the highway assignment process, and between “system” iterations of the model system in which both the DaySim activity-based demand components and the Cube-based network supply components are executed. The feedback provides new (congested) travel times calculated based on the previous iteration results to the next iteration.

2.8 REPORTING

This project developed several stand-alone report processes to summarize outputs of DaySim and network assignments. These reports are useful to assess model performance and inform model calibration and validation, as well as other analyses.

DaySim

A DaySim run produces multiple outputs describing daily travel for the residents of the model region. The primary outputs are:

- _household.tsv
- _household_day.tsv
- _person.tsv

- _person_day.tsv
- _tour.tsv
- _trip.tsv

A separate set of R scripts summarize these outputs in various excel spreadsheets. The spreadsheets contain tables and charts summarizing different sub-models in DaySim. The spreadsheets are also utilized during calibration and validation of DaySim. These summaries are now automatically produced in the post-processing step and are available to view after the run completes in the scenario folder under "11_DaySim\daysim_summaries" folder.

Highway Assignment

The outputs of the highway assignment are time-period specific flow tables, which are, during a post-process, combined into one flow table. This flow table can be used to report various highway statistics.

This project created a highway validation spreadsheet that takes a combined highway assignment flow table[13] as input and automatically generates various highway statistics and compares them with the same statistics from observed data (traffic counts). The statistics include:

- Scatter plot of estimated flows and observed counts
- Gap by facility type (also by time of day)
- Gap by volume group
- Root mean squared error

Gap is calculated by taking the difference of estimated traffic volume with the observed count and then dividing it by the observed count.

The highway validation spreadsheet is now an automated part of the model setup and run during the post-processing step. The output can be found in the scenario folder under "10_Reporting\validation".

Transit Assignment

The transit assignment outputs transit boarding tables by period, transit sub-mode and mode access. A python script processes the assignment outputs and reports a summary of daily boardings by transit route. The summary is in a CSV format and is input to a transit validation spreadsheet that generates the following statistics:

[13] A python script generates a combined assignment flow table that is input to the highway validation spreadsheet.

- Scatter plot of estimated boardings and observed boardings
- Boarding rate
- Boardings by route

The transit validation spreadsheet is now an automated part of the model setup and run during the post-processing step. The output can be found in the scenario folder under "10_Reporting\validation".

Non-motorized Assignments

Similar to the highway assignment, the non-motorized assignment outputs walk and bike flows on network links. Two separate validation spreadsheets summarize and compare estimated non-motorized flows with observed counts. Instead of validating every count location separately, the locations are combined and compared in 13 count groups. The groups are created based on the direction of travel and the neighborhood of the location.

2.9 ENHANCEMENTS TO THE 2023 BASE YEAR MODEL

Updates to the Model Data and Parameters

The following updates were introduced to the 2023 base year model without changing the model design.

1. Activated telecommuting model functionality in DaySim (refer to Appendix E).
2. Updated highway network, transit network, and land use data to 2023
3. Updated external demand to 2023 using California Statewide Travel Demand Model (CSTDM) data
4. Updated IXXI worker fractions using 2022 LEHD worker flow data, the latest year available at the time of the model update
5. Updated time and cost coefficients (and by extension, the derived value of time) in tour mode choice coefficients because in the 2019 ABM, (1) the coefficients are not sensitive to income, (2) other purposes (shop, meal, personal business, and social recreation) are not sensitive to parking costs, and (3) the derived value of time by purpose is very similar across all purposes. The new coefficients have higher value of time for higher income households, the same sensitivity to parking costs for all non-work purposes, and work purpose value of time 50% higher than that of all other purposes.

Updates to the Synthetic Population

The PopulationSim setup was revised to generate a synthetic population aligned with the 2023 base year. The primary objective of this update was to preserve the integrity of existing input datasets while ensuring demographic relevance. To achieve this, regional distributions derived from the 2023 census data were applied to the control variables, thereby minimizing changes in the original data structure. 2019 PUMS was used as the seed data.

The following steps were undertaken to implement this update:

- **Income Adjustment** – An inflation factor of 1.19[14] was applied to the household adjusted income values in the seed dataset that originates from the 2019 Public Use Microdata Sample (PUMS). The inflation factor was used to approximate 2023 income levels.
- **Data** – RSG downloaded the latest 2023 American Community Survey (ACS) and PUMS data to inform regional control distributions of the resident population, which includes household size, age of head of household, household workers, household income, household presence of children, person age, person occupation. Group quarter population does not have controls by demographic variables other than the total population by the type of group quarters (university, military, and other).
- **Regional Distribution Generation** – A new python script, *createRegionalDistributions.py*, was developed and added to the PopulationSim setup. This script processes the 2023 ACS and PUMS data to generate regional distributions for all existing control variables used in the PopulationSim.
- **Control Adjustment** – Another python script, *adjustControls.py*, was introduced to apply the regional distributions to both TAZ and region level controls. This step ensures that the synthetic population reflects the updated 2023 demographics.

[14] Obtained from CPI inflation calculator - https://www.bls.gov/data/inflation_calculator.htm with year values from 2019 to 2023

3.0 CALIBRATION & VALIDATION

A calibration process adjusts the model to ensure that the model generates demand that reasonably follows the behavior depicted in observed data. The demand is defined as frequency of trips by origin and destination pair. The frequency of trips by OD pair can have different segmentation, e.g., trip mode, time of day, etc. The demand is then loaded on to the network (assignment) to determine the number of trips using each link in the network. For highways, this provides vehicle flows on every link (road) in the highway network and for transit, it generates number of people (boardings) using each transit service.

After a model is calibrated to produce demand that reasonably predicts observed travel behavior in the region, the model is validated to ensure network-level usage of the demand is reasonable. The model validation includes, on the highway side, comparing estimated traffic volume from the model with observed traffic counts, and on the transit side, comparing estimated transit boardings from the model with observed transit ridership.

The rest of this chapter presents model calibration and validation in separate sections. For each, first, the observed data are discussed followed by summaries from a final calibration and validated model run. In the end, a summary of the chapter presents key takeaways from the discussions.

For the 2023 model update, the observed Vehicle Miles Travelled (VMT) was the primary target that guided the calibration and validation process. As such, the calibration of the demand models focused on a few key submodels: the work from home model, the telecommute model, and the day pattern model.

3.1 CALIBRATION

In model calibration, alternative-specific constants (ASCs) and other model parameters are iteratively adjusted until the model generates demand that reasonably matches travel patterns in observed data. Typically, models are calibrated according to the following procedure: first, create comparisons between observed data and estimated model results. Next, calculate ASC adjustments by calculating the natural log of the ratio between the observed value and the estimated value for each alternative. Then, add the adjustments to the ASCs from the previous iteration. Next, run the model with the updated constants.

Data

Table 8 presents a list of datasets utilized to calibrate the Fresno ABM.

TABLE 8. MODEL CALIBRATION DATASETS

DATASET	YEAR	PURPOSE
Central California Travel Survey (CCTS)	2022-2023	All DaySim Models
Transit On-Board Survey	2024	Transit Tours/Trips
LEHD Origin-Destination Employment Statistics (LODES)	2022	Worker Flows
5-Year Public Use Microdata Sample (PUMS)	2015-2019	Auto Ownership
1-Year American Community Survey (ACS)	2023	Auto Ownership

The 2022-2023 Central California Travel Survey (CCTS) is the primary dataset used during the calibration. Additional datasets are utilized to inform more accurate information for a particular type of travel. For example, a transit survey provides information about transit travel, thus, informing transit travel targets (tours and trips) in mode choice calibration. The 2022 LEHD Origin-Destination Employment Statistics (LODES) data provides flow of workers, which is used to validate estimated work location choice of Fresno residents. Census (5-year PUMS and 1-year ACS) informed targets for adjusting the auto ownership model in DaySim.

Central California Travel Survey (CCTS)

The 2022-2023 Central California Travel Survey (CCTS) was an effort led by Fresno COG in collaboration with the eight metropolitan planning organizations of the San Joaquin Valley region in California: Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare. The purpose of the study was to gather information about the travel behavior of the residents of the San Joaquin Valley region.

The CCTS collected a rich set of demographic and travel behavior data from 7,406 households with complete responses across the eight-county region, amounting to 19,084 persons and representing 150,012 trips across 42,567 complete person-days. Of the 7,406 households, 1,618 households have a home location in the Fresno County, which are used to support the current model calibration efforts. The study implemented a number of data collection methods including a smartphone app, an online website, and a call-center.

The CCTS sampling plan was based on the 2015-2019 American Community Survey (ACS) 5-year estimates, and the survey was expanded (weighted) to the 2019 ACS Public Use Microdata Sample (PUMS) 1-year data to match the survey data to key household and person demographic variables. To support the 2023 base year model update, targeted refinements were applied to the CCTS survey weights of Fresno households to better represent 2023 travel conditions, and the survey data was reformatted to support the calibration efforts. The processing and refinement steps were applied in the following order:

- Trips were imputed in the survey data if missing trips were identified. If a person reported being on the trip with another household member, but the trip is not found for the other household member, the trip was imputed for the latter based on the trip information of the former. If an adult reported their child going to school on the survey day, but school trips were not found in the child's travel diary (which is proxy reported by the adult), the school trips were imputed.
- Tours were created based on the trip data in the survey. A tour is a sequence of trips in which the destination of the final trip is the same as the origin of the first trip (typically home). DaySim uses tours to ensure internal consistency of the travel choices (e.g., mode and time) among all trips on a tour.
- Survey variables were re-coded to match DaySim categories.
- Multi-day travel records were converted to single day records by creating a unique household and person identifier for each day to be compatible with DaySim.
- Person weights were scaled to match the distribution of person type (listed in Table 9) of the synthetic population produced by PopulationSim. Household weights were then adjusted to be the average of the scaled person weights of all household members, and day, trip, and tour weights were scaled by the same factor as the person weights. The scaling of the survey to match PopulationSim was necessary for several reasons. First, the survey was weighted against the 2019 ACS, but the survey was conducted from 2022-2023 and the model base year is 2023. The survey needed to be scaled up to represent the 2023 population totals. Second, if the population in the survey and synthetic population are very different for each type of person (e.g., full-time workers), it is more difficult to calibrate the model to survey targets, e.g. if the number of workers in the survey and the synthetic population are very different, it is not possible to calibrate to total work tours and work tours per worker simultaneously.
- Work-from-home and telecommute workers were scaled to match 2023 PUMS work-from-home worker shares by aligning CCTS definitions with Census usual mode of commute definitions as closely as possible. This was necessary because the survey weighting did not control for work-from-home or telecommute workers. To scale the survey data to 2023 PUMS data, survey workers were flagged as working from home if their telecommute frequency is greater than 50%, and their weights are scaled to match Census work-from-home share while keeping the total number of workers by work type (full-time workers, part-time workers, and university student part-time workers) the same.

- Trips external to Fresno County were removed because the resident model captures only the internal-internal trips, while the external demand is handled separately in the model as described in Section 2.4 to avoid double counting of trips.

Transit On-Board Survey

The 2024 transit on-board survey collected demographic and trip information for transit riders. Demographic information includes age, race, gender, household income, home location, work location, worker status, student status, etc. Transit trip information includes trip origin, destination, boarding stop, alighting stop, access mode, egress mode, time, purpose, transit route(s), and fare type. Since the transit on-board survey year (2024) was really close to the base year (2023), the 2024 transit data by each transit operator were not adjusted to 2023.

LEHD Origin-Destination Employment Statistics (LODES)

Commute travel is a very important and significant component of any regional travel. Therefore, in addition to verifying number of workers by work location, it is essential to validate workers by their origin (home) and destination (work) locations. LODES data was used to validate worker flows between home and work districts. The flows are compared at an aggregate level (10 districts) since observed data are likely to show higher variance/error at a more detailed geography.

Public Use Microdata Sample (PUMS) and American Community Survey (ACS)

PUMS and ACS data were used to develop calibration targets for auto ownership. The PUMS data is useful for developing cross-tabulation of auto ownership with household income and with potential drivers (persons aged 16 or over). 5-year PUMS data was used to have a larger sample size for the cross-tabulations. The 1-year ACS data is useful for getting the latest estimates for vehicle ownership. The 2015-2019 PUMS was used to match the seed data used to generate the synthetic population.

DaySim Calibration Summaries

An R-utility summarizes DaySim outputs into statistics that are meaningful and easy to understand. The summaries are prepared by key model components and include work and school location, auto ownership, day pattern, tour/trip destination choice, mode choice, and time of day. The summaries from the final calibrated model are presented in the following sections. Unless otherwise specified, both the CCTS and ABM data include only the study area, i.e., Fresno County.

Synthetic Population

Table 9 and Table 10 compare synthetic population in the ABM with observed data (CCTS) in Fresno County. The population includes both households (in the “HH” columns) and Group

Quarters (in the "GQ" columns). The group quarter population was excluded from the CCTS sampling frame, but it is important to include the group quarter population in the ABM to make sure that travel by all Fresno County residents is captured. The survey weights were scaled to match the person-type distribution in the synthetic population so the weights match perfectly for non-workers. The workers also match very well but are not identical due to a subsequent step to adjust the work-from-home and telecommute workers to match 2023 Census as described above.

TABLE 9. POPULATION BY PERSON TYPE

PERSON TYPE	CCTS HH	ABM HH	CCTS GQ	ABM GQ
Full Time Worker	330,729	330,433	N/A	596
Part Time Worker	56,084	56,290	N/A	563
Retired	110,549	110,549	N/A	1,118
Non-Worker	159,967	159,967	N/A	2,937
University Student	53,900	53,661	N/A	1,853
Student Age 16+	36,122	36,122	N/A	201
Child Age 5-15	182,345	182,345	N/A	98
Child Age 0-4	65,566	65,566	N/A	78
Total	**995,262**	**994,933**	**N/A**	**7,444**

TABLE 10. POPULATION BY PERSON TYPE (%)

PERSON TYPE	CCTS HH	ABM HH	CCTS GQ	ABM GQ
Full Time Worker	33%	33%	N/A	8%
Part Time Worker	6%	6%	N/A	8%
Retired	11%	11%	N/A	15%
Non-Worker	16%	16%	N/A	39%
University Student	5%	5%	N/A	25%
Student Age 16+	4%	4%	N/A	3%
Child Age 5-15	18%	18%	N/A	1%
Child Age 0-4	7%	7%	N/A	1%
Total	**100%**	**100%**	N/A	**100%**

Work From Home and Telecommute

Workers are classified into three types based on whether they work at their home location: work-from-home workers, telecommute workers, and all other workers. The work location model determines where a worker works and classifies a worker as a work-from-home worker if the work parcel (usual work location) is the same as the home parcel. The telecommute (work at home) model predicts whether a non-work-from-home worker works at home for 3 hours or more on the simulation day and, if so, classifies the worker as a telecommute worker. The rest of the workers are considered out-of-home workers. The work from home and telecommute calibration consists of two main steps. The first step calibrates the models that predicts if a worker works from home or if a worker telecommutes using the work location model and the telecommute model as described above. The second step calibrates the Day Pattern model for each worker type as described later in this section. As presented in Table 11, the number of work-from-home and telecommute workers in the ABM are within 10% of the respective CCTS workers.

TABLE 11: NUMBER OF WORKERS BY WORK FROM HOME CLASSIFICATIONS

WORKER TYPE	CCTS	ABM	CCTS %	ABM %
Work from home workers	21,017	17,308	5.1%	4.2%
Telecommute workers	86,364	81,027	21.1%	19.5%
All other workers	301,583	314,859	73.8%	76.3%
All Workers	408,964	414,509	100.0%	100.0%

Home to Work Distance

As presented in Table 12, the ABM has an average home-to-work distance of 9.2 miles compared to 9.4 miles from the CCTS. The estimated distances to work for all worker types match the survey data well after the calibration in the 2023 base year model update. Note that the home-to-work distances are only for the workers of the Fresno County that have work location within the Fresno County.

TABLE 12. AVERAGE HOME TO WORK DISTANCE (MILES) BY WORKER STATUS

WORKER TYPE	CCTS	ABM
Full Time	10.0	9.8
Part Time	7.7	6.7
Other	6.5	6.8
All Workers	**9.4**	**9.2**

Figure 6 compares distributions of home-to-work distances of workers in the CCTS and the model. The X-axis is distance in miles and the Y-axis is share (%) of workers. Due to relatively lower samples, the observed dataset shows a lumpy distribution. The ABM distribution is smoother and generally follows the observed distributions from the CCTS.

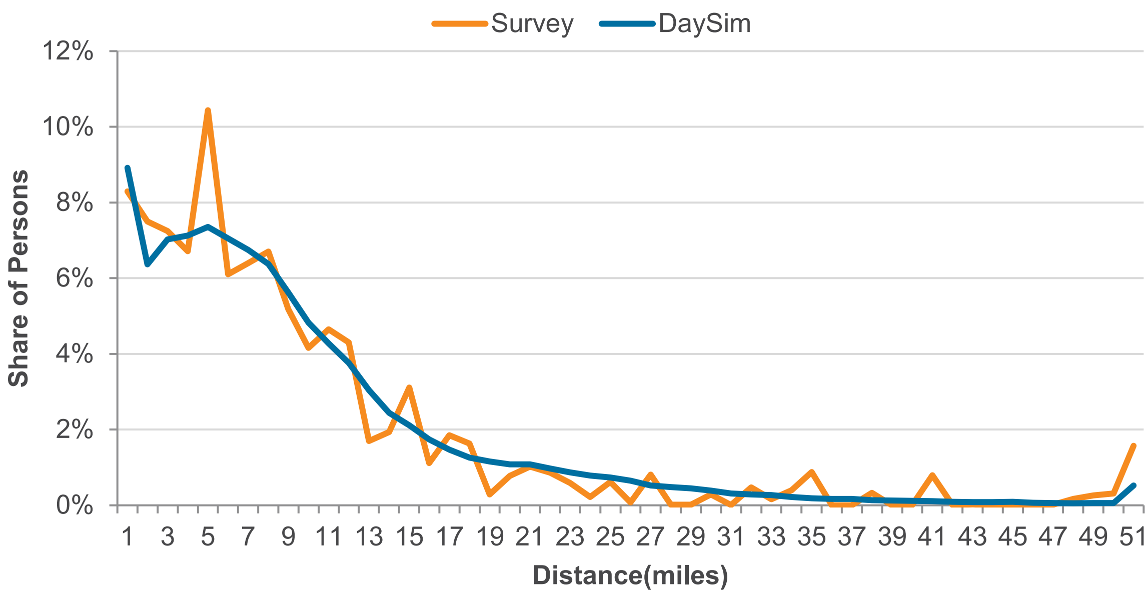

FIGURE 6: DISTRIBUTION OF HOME TO WORK DISTANCES

A comparison of estimated work locations (workers working at a location) and corresponding employment by TAZ, Figure 7, shows a good match with an R-squared value of 0.95. This suggests that the shadow pricing mechanism in DaySim is working well. The shadow pricing iteratively balances number of workers and total employment in a micro-zone. The trendline is below the 45-degree reference line, indicating that there may be slightly fewer workers than zonal employment.

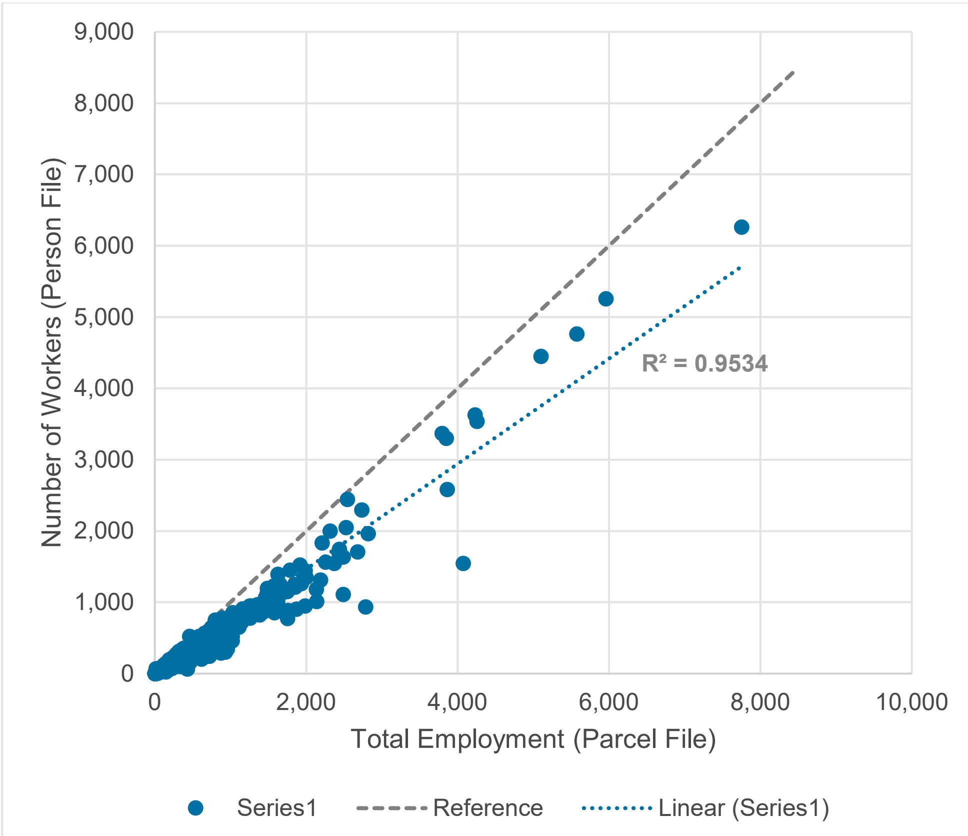

FIGURE 7: EMPLOYMENT VS WORKERS BY TAZ

Table 13 compares the estimated workers working at a location and the corresponding employment and observed workers are at an aggregate geography (10 districts). A map of the districts is shown in Figure 8. The comparison once again confirmed DaySim's ability to balance workers' work location with the available employment. The comparison is extended to compare estimated workers with observed workers from LODES. Note that for comparison observed datasets are scaled to match estimated workers by home district. The number of workers by district generally matches the employment data well, with most districts falling within 10% of the employment data.

TABLE 13. WORKERS BY DISTRICT

WORK DISTRICT	LEHD	EMPLOYMENT	ABM	%DIFF (ABM-EMP/EMP)
1	34,735	35,899	40,341	12%
2	13,028	14,283	11,276	-21%
3	19,838	18,588	19,833	7%
4	31,305	24,291	25,151	4%
5	24,311	25,392	25,560	1%
6	16,500	16,157	15,984	-1%
7	13,966	13,637	13,737	1%
8	44,108	42,362	44,601	5%
9	12,347	13,686	13,379	-2%
10	84,393	90,236	84,668	-6%
TOTAL	**294,530**	**294,530**	**294,530**	**0%**

NOTES:

LEHD data include workers travelling from out of Fresno

ABM is estimated workers working within the Fresno region only

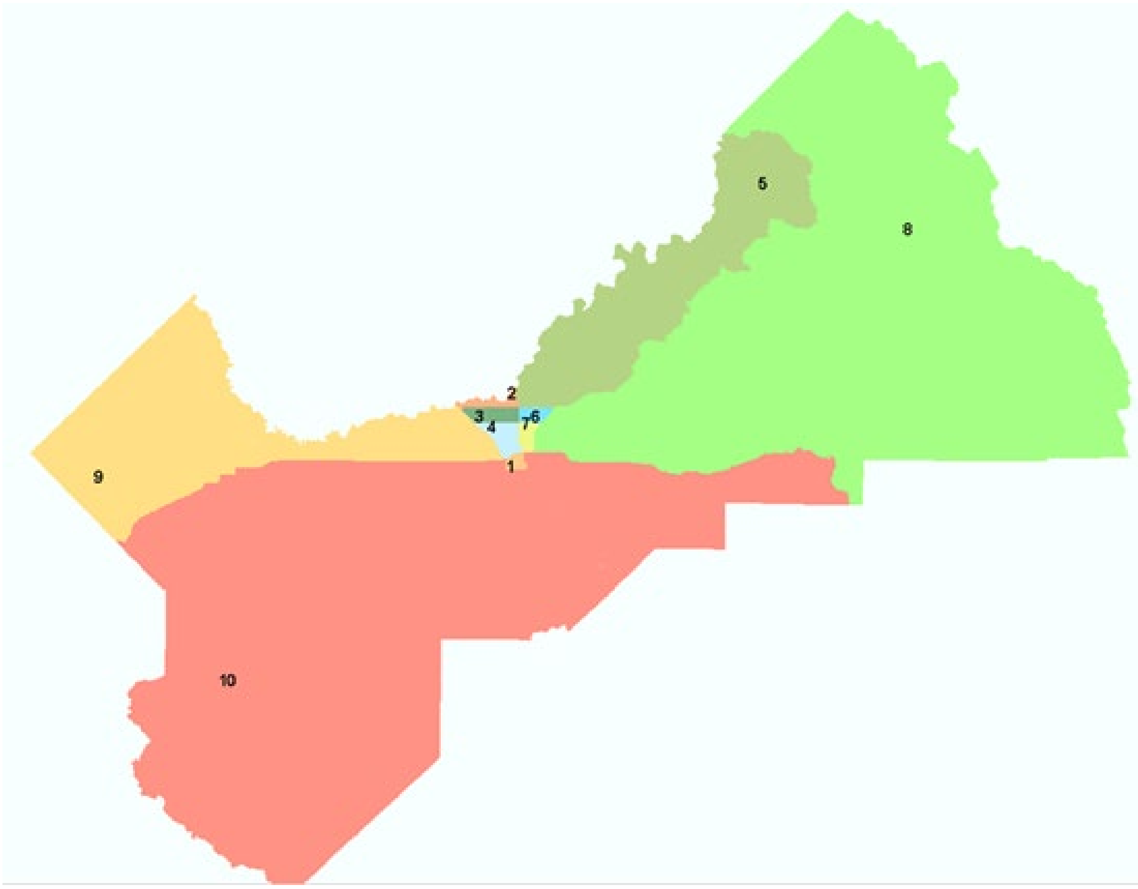

FIGURE 8: MAP OF DISTRICTS

Home to School Distance

The average distance travelled by students to go from home to school is 4.2 miles from the ABM. The CCTS data suggest a slightly higher average distance (4.4 miles), as shown in Table 14. The estimated distances to school match the survey data well after the calibration in the 2023 base year model update.

TABLE 14. AVERAGE HOME TO SCHOOL DISTANCE (MILES) BY STUDENT TYPES

STUDENT TYPE	CCTS	ABM
Kids 5 to 15	3.3	3.2
Student 16+	5.5	4.3
University Student	7.7	7.2
Total	**4.4**	**4.2**

Figure 9 presents a comparison of observed and estimated frequency distribution of trip lengths between home and school. Because of limited sample size, the survey distribution is not very smooth.

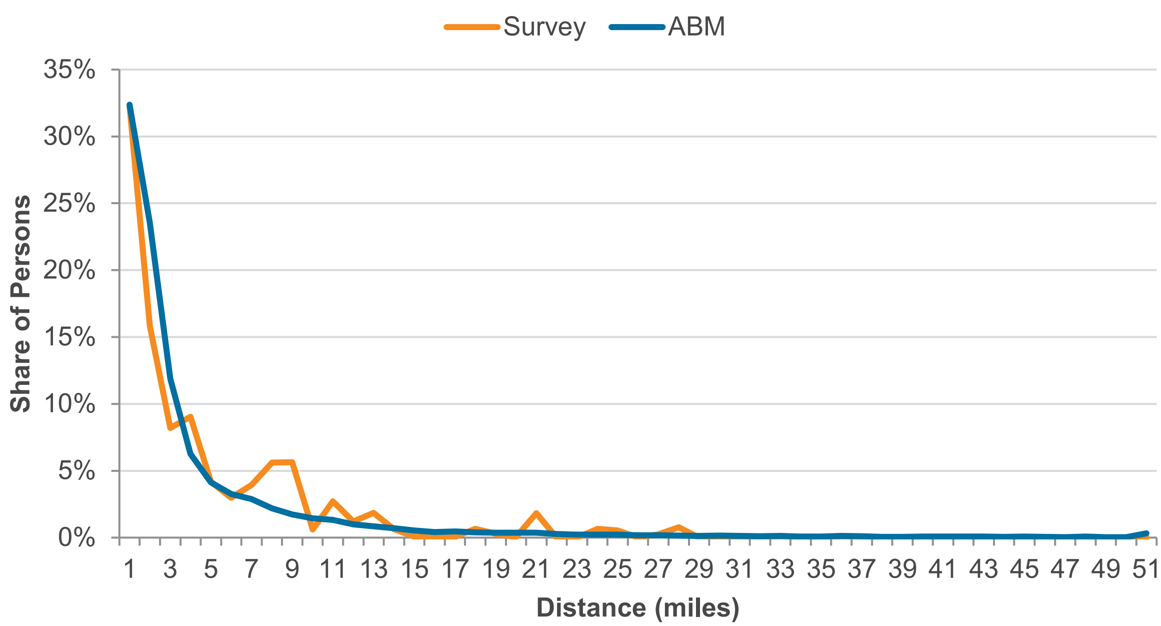

FIGURE 9: DISTRIBUTION OF HOME TO SCHOOL DISTANCE

A comparison of estimated school locations with the corresponding enrollment by TAZ exhibits a reasonable match with a R-squared value of 0.94 (Figure 10). The visible overestimation is due to difference in input enrollment (287k) and number of students (309k) in the synthetic population.

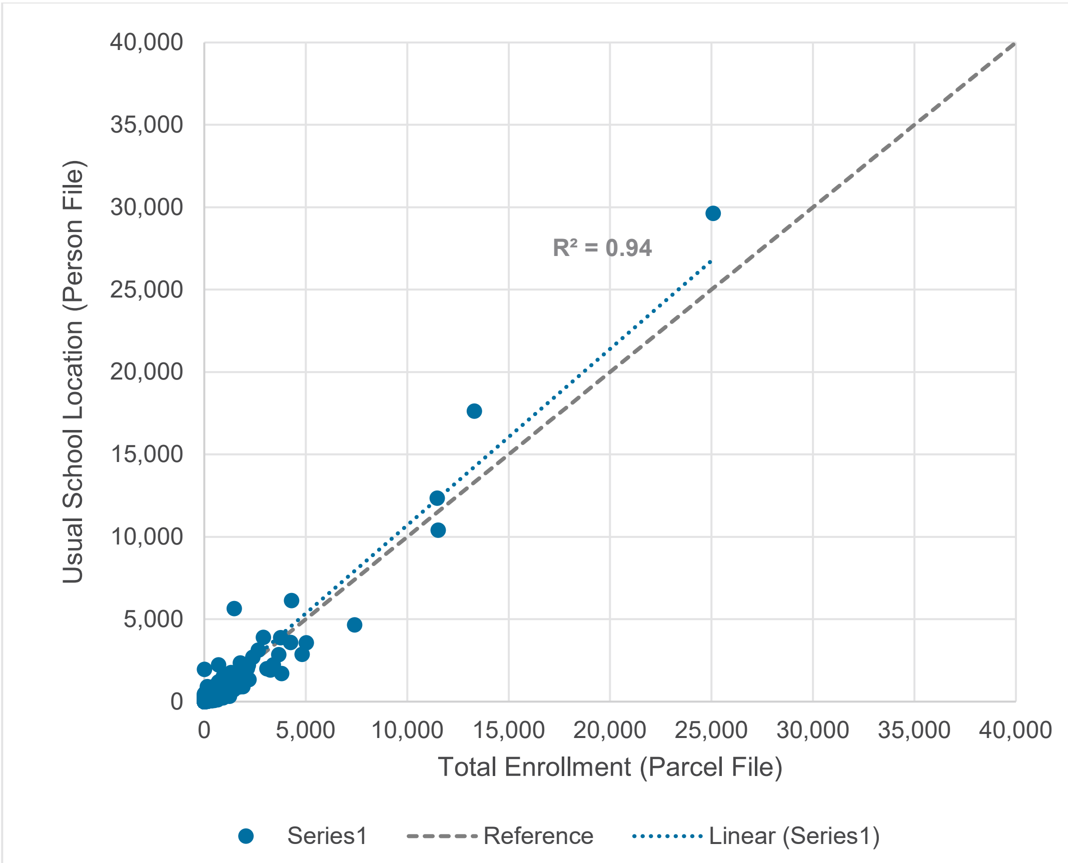

FIGURE 10: ENROLLMENT VS STUDENTS BY TAZ

Auto Ownership

The auto ownership model predicts the number of vehicles owned by a household. The auto ownership model is structured as a multinomial logit (MNL) with five available alternatives: 0, 1, 2, 3, and 4+. Key variables are the numbers of working adults, non-working adults, students of driving age, children below driving age and income.

The observed distributions of households are developed by first generating distribution by number of drivers and autos owned using the 5-year 2015-2019 PUMS and then scaling it to match households by autos owned at the county level from the 1-year 2023 ACS data. Figure 11 shows that the model matches the observed data very well after the calibration in the 2023 base year model update.

Detailed summaries of auto-ownership by number of drivers in the household is available in Appendix A.

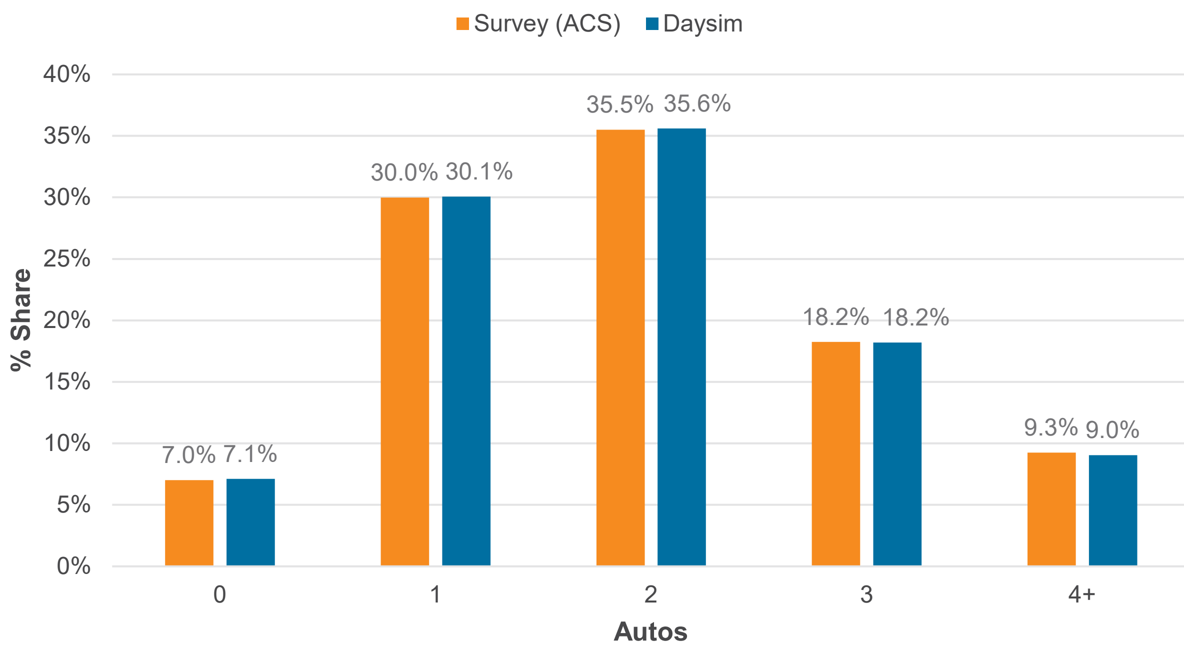

FIGURE 11: AUTO OWNERSHIP DISTRIBUTION – REGIONAL

Day Pattern

The day pattern model predicts whether a person makes at least one tour for each of the seven home-based tour purposes listed in Table 15 (excluding work-based tours), and whether the person makes any intermediate stops on these tours. The model includes variables for work-from-home workers and telecommuters to capture their travel behavior, which includes a lower likelihood of making tours and a higher likelihood of making non-work tours compared to all other workers, i.e., out-of-home workers. In other words, the model captures the rebound effect of telecommuting (non-work trips created by not traveling to work which otherwise would have been avoided had the worker traveled to work).

Day pattern summaries compare observed and estimated resident travel (tours and trips) by purpose and person type. Table 15 compares distribution of tours by tour purpose in the CCTS and the model in the Fresno County. The work tours were calibrated in the 2023 base year model update by worker type (work from home, telecommute, or other). The rest of the purposes were not calibrated and use the same model parameters as the previous model (2019 base year) as the modeled VMT matches with the observed data reasonably well.

TABLE 15: TOURS BY PURPOSE

TOUR PURPOSE	CCTS	ABM	DIFF (ABM-CCTS)
Work	22%	21%	-1%
School	18%	18%	0%
Escort	17%	16%	-1%
Personal Business	11%	11%	0%
Shop	14%	11%	-3%
Meal	6%	4%	-2%
Social/Recreation	11%	13%	2%
Work-based	3%	7%	4%
Total	**100%**	**100%**	**0.0%**

A tour rate is calculated as number of tours divided by number of persons. Table 16 compares tour rates by tour purpose. The CCTS indicates on average 1.34 tours per person in the Fresno County. The work tour rate is under-estimated because the model was calibrated by tour frequency distribution (% of workers with 0, 1, 2+ work tours), but the weighted survey data includes adjustment factors that increases the tour weights (and therefore tour rates) without changing the tour frequency distribution and person weights. The survey was conducted as the region was coming out of the pandemic and there may have been a lot of pent-up travel demand for non-mandatory purposes. Since the primary goal is to calibrate the model to match the observed VMT, all non-work tour rates were not calibrated.

TABLE 16. TOUR RATE BY PURPOSE

TOUR PURPOSE	CCTS	ABM	DIFF (ABM-CCTS)
Work	0.29	0.23	-0.07
School	0.23	0.19	-0.04
Escort	0.22	0.17	-0.05
Personal Business	0.14	0.12	-0.03
Shop	0.18	0.12	-0.07
Meal	0.08	0.04	-0.03
Social/Recreation	0.14	0.14	0.00
Work-based	0.04	0.07	0.03
Total	**1.34**	**1.08**	**-0.26**

Table 17 compares observed and estimated tours by person type. Generally, the tours in the ABM match with the CCTS distribution by person type. Some differences are due to the differences observed by tour purpose. Children aged 0-4 is not shown here because the survey does not collect travel diaries for children aged 4 and under.

TABLE 17. TOURS BY PERSON TYPE

PERSON TYPE	CCTS	ABM	DIFF
Full-Time Worker	41%	35%	-5%
Part-Time Worker	7%	5%	-1%
Retired	8%	9%	2%
Non-Worker	15%	17%	2%
University Student	6%	8%	1%
Student 16+	3%	4%	1%
Child Age 5-15	17%	18%	1%
Total	**100%**	**100%**	**0%**

Table 18 presents a comparison of tour rates by person type. Full-time and part-time workers are under-estimated because the calibration efforts focused on targeted calibration to match VMT and work tour frequency, and the scheduling constraints did not allow for all sub-models to be calibrated. All other person types match reasonably well.

TABLE 18. TOUR RATE BY PERSON TYPE

PERSON TYPE	CCTS	ABM	DIFF (ABM-CCTS)
Full-Time Worker	1.64	1.16	-0.48
Part-Time Worker	1.56	0.99	-0.57
Retired	0.94	0.90	-0.03
Non-Worker	1.23	1.13	-0.10
University Student	1.56	1.52	-0.04
Student 16+	0.96	1.17	0.21
Child Age 5-15	1.21	1.06	-0.15
Total	**1.34**	**1.08**	**-0.26**

The distribution of ABM trips by trip purpose matches well with the CCTS data in Fresno County, as shown in Table 19. Trip rates were not calibrated in the 2023 base year model update.

TABLE 19. TRIPS BY PURPOSE

TRIP PURPOSE	CCTS	ABM	DIFF (ABM-CCTS)
Work	9%	12%	2.9%
School	7%	7%	-0.1%
Escort	13%	9%	-3.9%
Personal Business	9%	10%	1.1%
Shop	11%	13%	2.6%
Meal	7%	8%	1.0%
Social/Recreation	6%	7%	1.4%
Home	39%	34%	-5.0%
Total	**100%**	**100%**	**0.0%**

As shown in Table 20, according to the CCTS data, a resident of the Fresno County makes 3.91 trips in a day on average. The ABM is under-estimating trip rates (2.99) compared to the survey data because the tour rates are under-estimated as explained above. Note that the model calibration was guided by validation of highway VMT.

TABLE 20. TRIP RATE BY PURPOSE

TRIP PURPOSE	CCTS	ABM	DIFF (ABM-CCTS)
Work	0.37	0.37	0.00
School	0.27	0.21	-0.07
Escort	0.50	0.26	-0.23
Personal Business	0.33	0.29	-0.05
Shop	0.42	0.40	-0.02
Meal	0.29	0.25	-0.04
Social/Recreation	0.22	0.21	-0.01
Home	1.51	1.01	-0.51
Total	**3.91**	**2.99**	**-0.92**

As indicated in Table 21, the CCTS data suggests, on average, residents of Fresno County make 2.93 trips on a tour. The ABM produces a similar estimate of 2.76 trips per tour for the residents of the Fresno region.

TABLE 21. TRIPS PER TOUR BY PURPOSE

DESTINATION PURPOSE	CCTS	ABM	DIFF (ABM-CCTS)
Work	1.25	1.62	0.37
School	1.16	1.06	-0.10
Escort	2.25	1.58	-0.67
Personal Business	2.33	2.45	0.12
Shop	2.29	3.38	1.09
Meal	3.78	5.60	1.82
Social/Recreation	1.53	1.49	-0.05
Total	**2.93**	**2.76**	**-0.16**

The distribution of model trips by person type categories is similar to the CCTS data, as summarized in Table 22.

TABLE 22. TRIPS BY PERSON TYPE

PERSON TYPE	CCTS	ABM	DIFF
Full-Time Worker	42%	38%	-3%
Part-Time Worker	6%	5%	-1%
Retired	9%	9%	1%
Non-Worker	16%	16%	0%
University Student	7%	9%	2%
Student 16+	2%	4%	1%
Child Age 5-15	14%	15%	2%
Total	**100%**	**100%**	**0.0%**

As presented in Table 23, similar to the tour rate by person type (see Table 18), the County trip rate in the ABM is lower (2.99 trips/person) than the CCTS trip rate (3.91 trips/person). Person type categories too show lower trip rates in the ABM.

TABLE 23. TRIP RATE BY PERSON TYPE

PERSON TYPE	CCTS	ABM	DIFF (ABM-CCTS)
Full-Time Worker	4.90	3.47	-1.43
Part-Time Worker	4.43	2.77	-1.66
Retired	3.16	2.54	-0.62
Non-Worker	3.91	2.98	-0.93
University Student	5.08	4.75	-0.33
Student 16+	2.32	2.91	0.59
Child Age 5-15	2.89	2.50	-0.40
Total	**3.91**	**2.99**	**-0.92**

Other Tour Destination

A comparison of average tour lengths by purpose between the observed (CCTS) and the model data is presented in Table 24. A tour length is calculated as distance between tour origin and primary destination. The comparison includes only non-mandatory tour purposes, as mandatory tour purposes (work and school) have already been discussed before (see Table 12 and Table 14). Due to insufficient sample size for each purpose category, shopping and personal business purposes are aggregated into the Maintenance category, and meal and social/recreational purposes are aggregated into the Discretionary category.

Due to the small sample size in the observed datasets, the tour length frequency distributions are very lumpy (CCTS distributions by purpose is available in Appendix A) which makes it difficult to know the real travel behavior for these tours. The average tour lengths match the survey data well after the calibration in the 2023 base year model update.

TABLE 24. AVERAGE TOUR LENGTHS FOR OTHER TOUR PURPOSE

TOUR PURPOSE	CCTS	ABM
Maintenance	5.4	5.4
Discretionary	4.4	4.8
Escort	4.2	4.3
Work-based	2.7	3.3

Tour Mode Choice

Tour mode is an abstract concept, defined as the main mode of travel used to get from the origin to the primary destination and back. The following 9 tour modes are available in the ABM: drive alone, shared-ride 2, shared-ride 3+, bike, walk, drive-transit, walk-transit, school bus, and TNC. The tour mode is coded in the survey based on a set of rules that are dependent on the combination of trip modes used on the tour. The rules can be summarized as follows:

- Any tour with a transit trip is defined as a transit tour
    - Any transit tour with a PNR-transit trip is defined as a PNR-transit tour
    - Any transit tour with neither a PNR-transit trip or a KNR-transit trip is defined as a walk-transit tour
- Any tour with a bicycle trip is defined as a bicycle tour
- Any tour with an auto trip is defined as an auto tour
    - The highest occupancy mode of all auto trips on the tour is used to set the occupancy of the tour
- Remaining tours are walk tours

A similar set of rules is used in tour mode choice to constrain the availability of trip modes based on tour mode. These rules also influence the accessibilities used to choose the locations of intermediate stops on tours; for example, transit and walk accessibilities are used to choose stop locations on transit tours, rather than auto accessibilities.

After scaling the original CCTS targets to accommodate transit targets from the 2024 transit on-board survey, the CCTS targets are scaled one more time for tour mode calibration. Generally, a tour mode choice calibration aims to adjust the mode choice model so that the distribution of tours by mode is similar to observed share. Therefore, tour mode choice adjustments are made to alternative-specific constants to match observed mode shares. As transit tour targets are calculated directly from a transit on-board survey, the model needs to be calibrated to the same numbers. However, when calibrated using mode shares, the number of transit tours based on the share of transit mode in the CCTS would result in a different number due to a different value of total tours in the ABM. For example, if a survey says that there are 100 transit tours among 10,000 total tours, then the transit share would be 1%. However, if the model is generating 12,000 total tours, then calibrating the model to the survey transit share of 1% will result in 120 transit tours. Since we want to calibrate the model to match the absolute number of transit tours inferred from the on-board survey, we adjust observed tours by mode, keeping the transit tours constant but scaling other modes to match total tours in the model by purpose and auto sufficiency.

Overall, the tour mode shares in the ABM match the CCTS shares reasonably well after the calibration in the 2023 base year model update (Figure 12). The comparisons for each tour purpose category are available in Appendix A. The CCTS observes an overall tour mode share of 35% by drive-alone (SOV) and 26% and 25.7% by shared-ride 2 and shared-ride 3, respectively compared to the ABM shares of 34%, 26.1% and 26.9%. The non-motorized tour modes (walk and bike) make up for 9.1% of the tours in the region according to the CCTS, compared to 9.3% in the ABM. The newly implemented TNC mode is a very small percent of total mode share. Only 1.3% of the tours in CCTS use some form of transit mode, where most of those transit tours use walk to transit (1.1%) compared to the model share of 1.0% which are almost exclusively walk to transit.

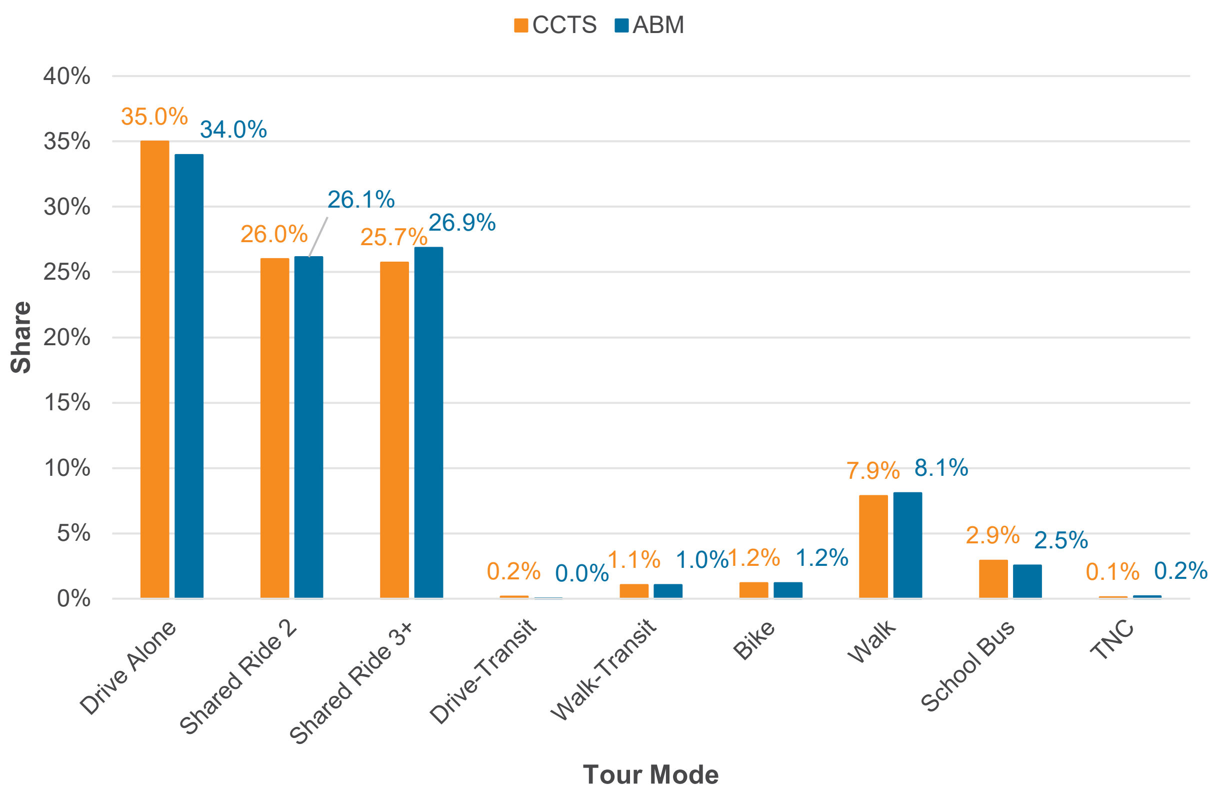

FIGURE 12. TOUR MODE SHARES (TOTAL)

Trip Destination

As presented in Table 25, the CCTS data suggest an average trip length of 4.76 miles regionwide (Fresno). The ABM average trip length matches the target of 4.76 miles and was not calibrated in the 2023 base year model update. The purpose is based on the destination purpose of the trip, e.g., a trip form work to home is considered to have a “home” trip destination purpose.

TABLE 25. AVERAGE TRIP LENGTHS

TRIP PURPOSE	CCTS	ABM
Home	4.93	5.14
Work	7.55	6.29
School	4.22	3.34
Escort	4.10	4.20
Personal Business	5.84	5.40
Shop	3.43	3.87
Meal	3.04	3.66
Social/Recreational	4.26	4.40
Total	**4.76**	**4.76**

Tour Time-of-Day

Plots of tour arrival and departure times at primary destination are presented in Figure 13 through Figure 20. The ABM distributions generally match well with the CCTS distribution by purpose, so the tour time-of-days models did not require calibration in the 2023 base year model update.

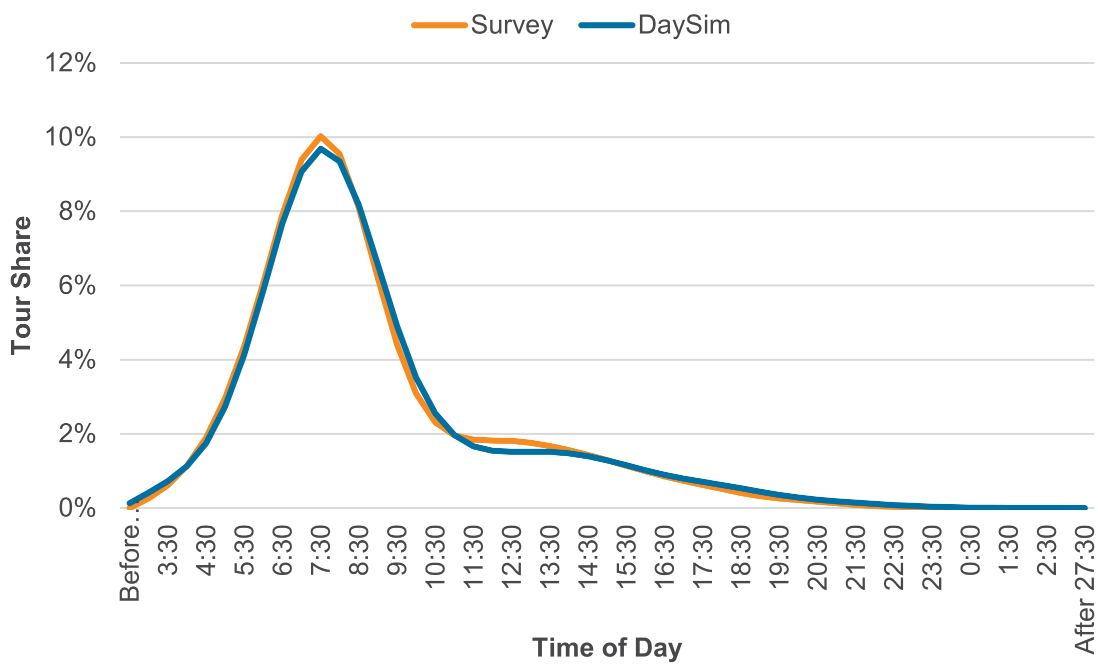

FIGURE 13: TIME OF DAY DISTRIBUTION OF WORK ARRIVAL TIMES

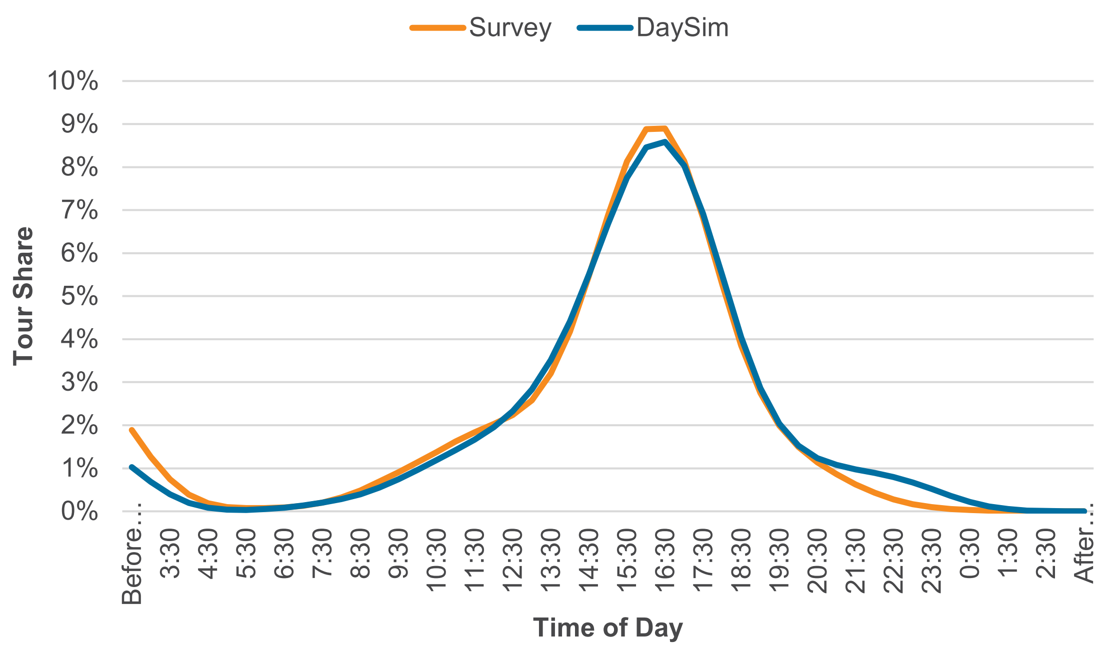

FIGURE 14: TIME OF DAY DISTRIBUTION OF WORK DEPARTURE TIMES

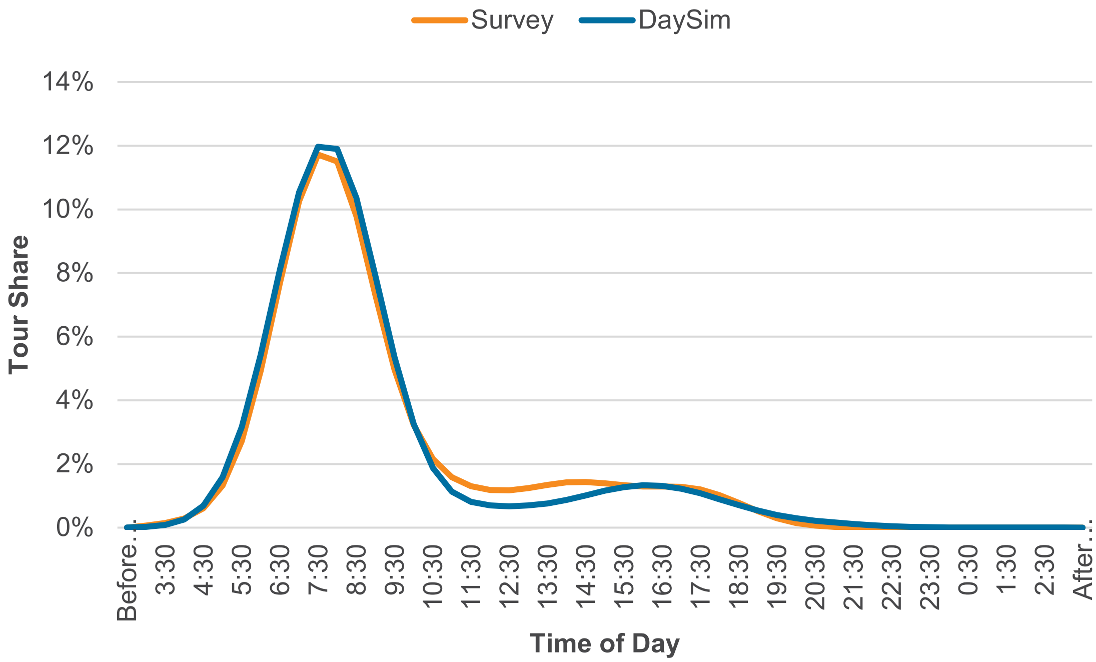

FIGURE 15: TIME OF DAY DISTRIBUTION OF SCHOOL ARRIVAL TIMES

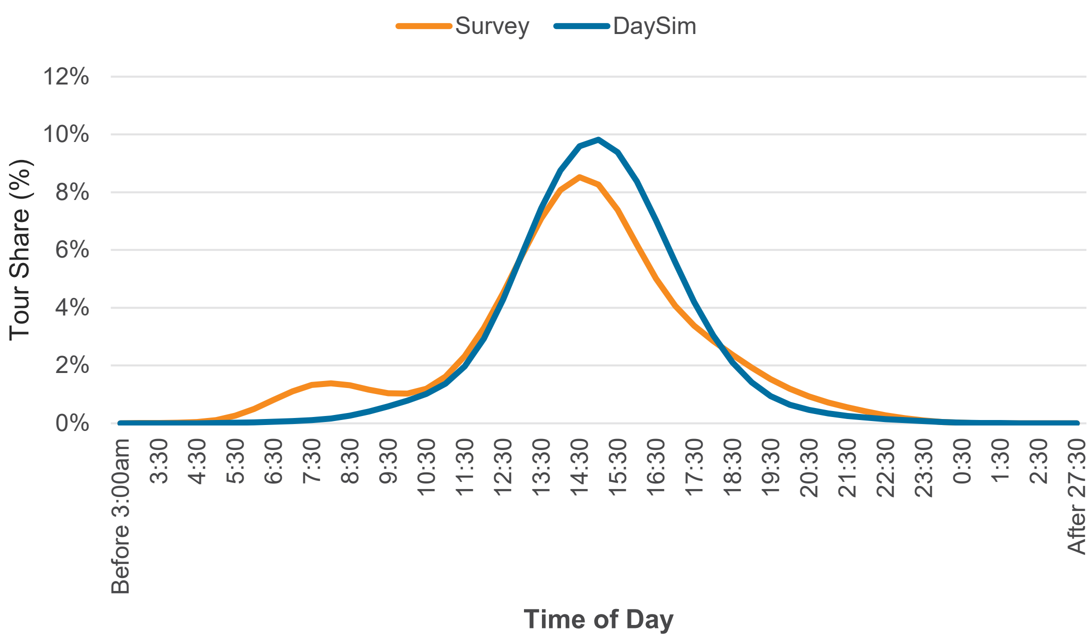

FIGURE 16: TIME OF DAY DISTRIBUTION OF SCHOOL DEPARTURE TIMES

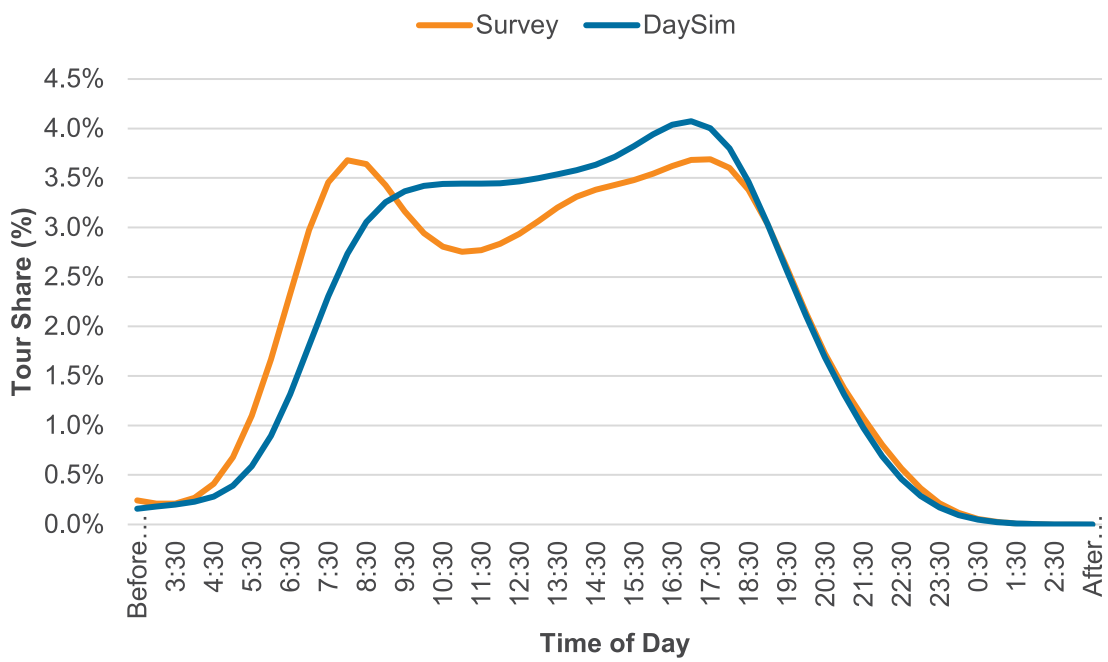

FIGURE 17: TIME OF DAY DISTRIBUTION OF OTHER PURPOSE ARRIVAL TIMES

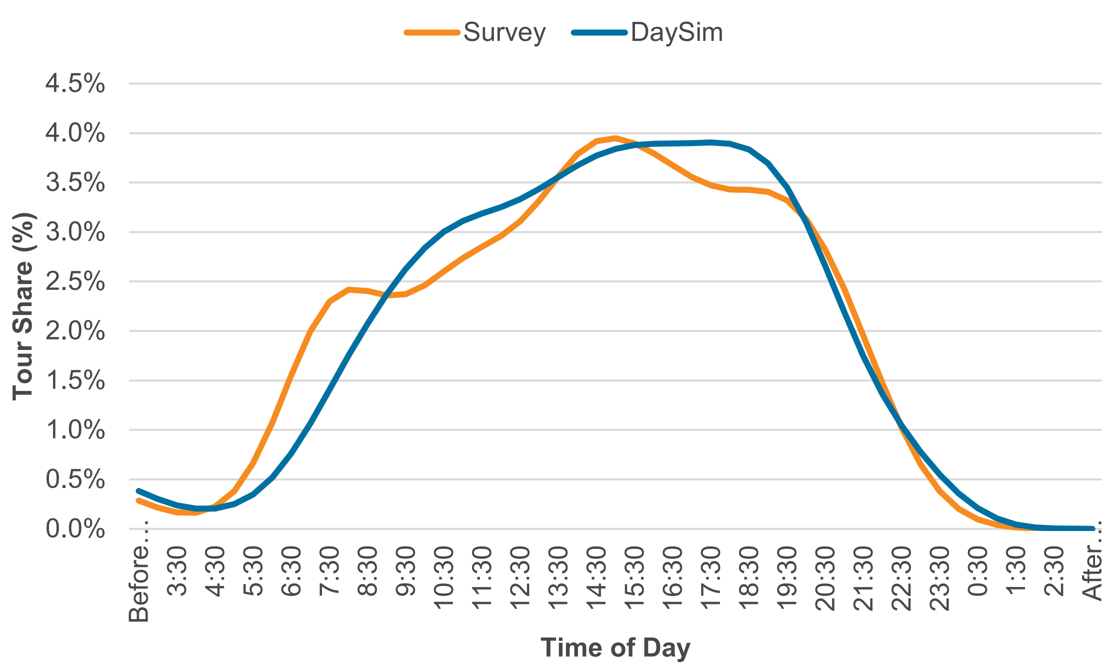

FIGURE 18: TIME OF DAY DISTRIBUTION OF OTHER PURPOSE DEPARTURE TIMES

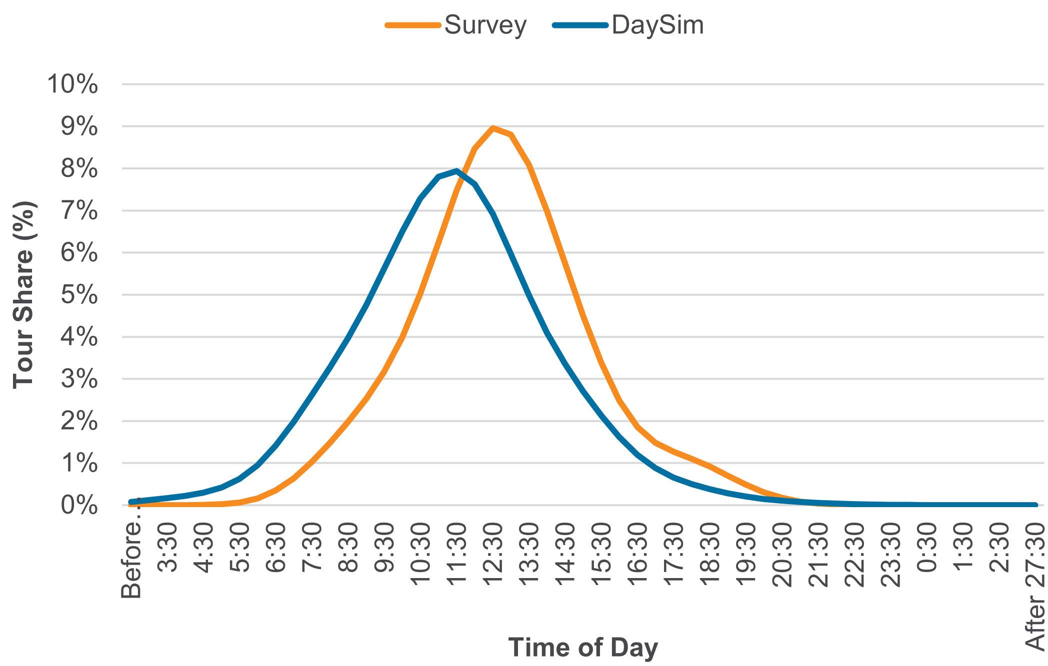

FIGURE 19: TIME OF DAY DISTRIBUTION OF WORK-BASED ARRIVAL TIMES

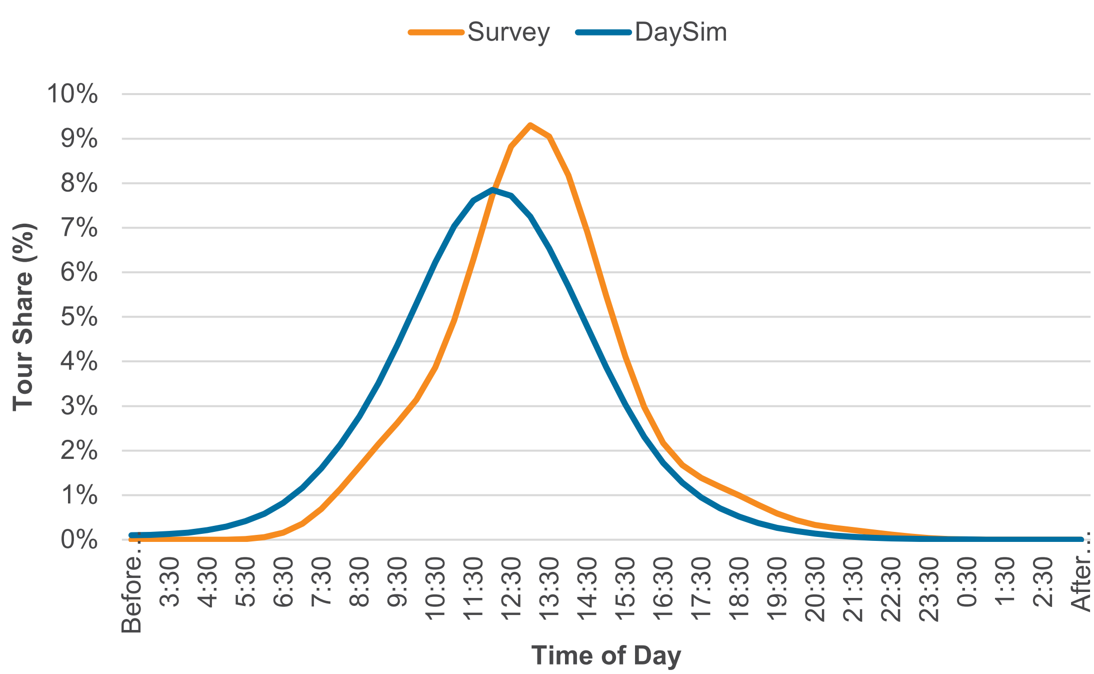

FIGURE 20: TIME OF DAY DISTRIBUTION OF WORK-BASED DEPARTURE TIMES

Trip Mode Choice

Trip mode targets are prepared from the CCTS data and updated with transit trip targets from the 2024 transit on-board survey. Other mode targets are appropriately scaled to keep the total trips by purpose the same, similar to the process described above for creation of tour mode choice targets. This ensures that the absolute number of expanded transit trips from the transit on-board survey is matched in calibration.

The trip mode choice model can be thought of as a 'mode switching' model, in which the tour mode constrains which modes are available for trips on tours. The trip mode choice model did not require calibration in the 2023 base year model update.

Overall, the ABM generates a trip mode distribution which is very similar to observed (Figure 21). The trip mode share by purpose distributions can be found in Appendix A. The CCTS data indicate that on an average weekday, 40.4% trips in the Fresno County are drive alone and 43.8% are shared-ride (SR2 and SR3), approximately 1.5% of Fresno County resident trips are made by transit, and 14.2% are made by a non-motorized mode (walk or bike).

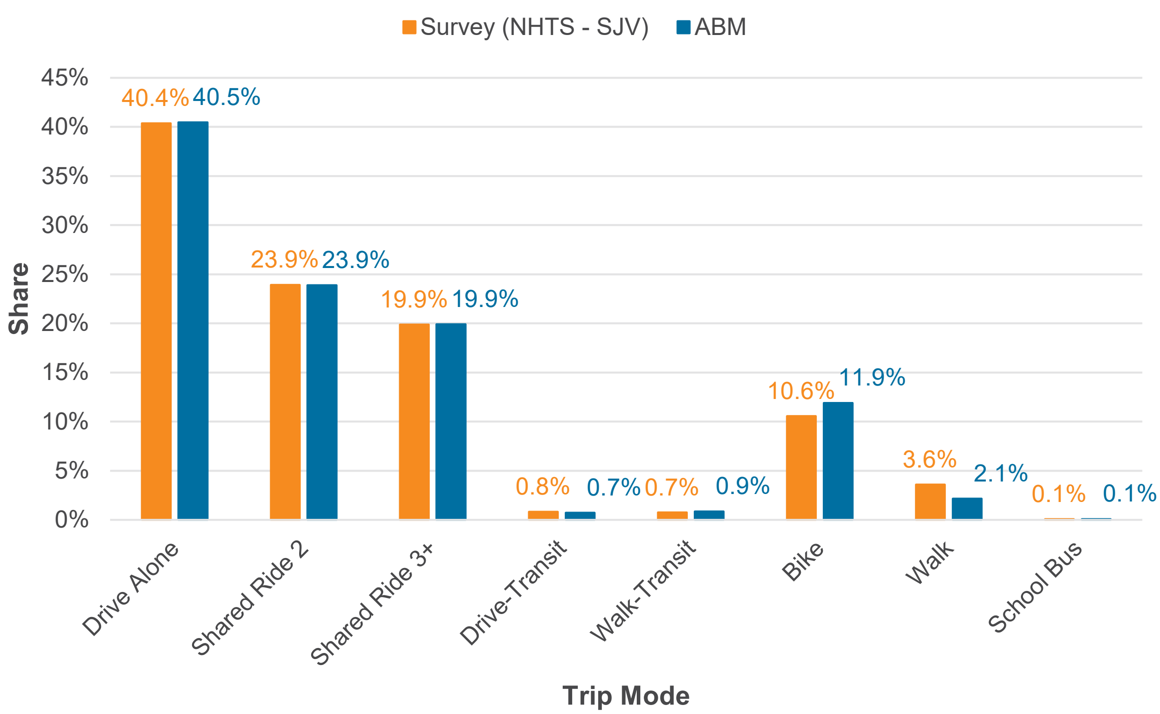

FIGURE 21: TRIP MODE SHARES (TOTAL)

3.2 MODEL VALIDATION

A model validation tests the model's predictive capabilities before it is used to produce forecasts. There are two types of model validation:

- The static validation compares model outputs against independent data that was not used to build the travel model. Model parameters are adjusted until the outputs from model assignment fall within an acceptable range of error to the observed data.
- The dynamic validation involves systematically varying the model inputs to assess the reasonableness of model responses, which is described later in Section 4.0.

In the assignment step, model demand (e.g. trips by time period, mode, and vehicle class\value-of-time) are loaded on to network. In highway assignment, the output includes vehicle flows on every link (road) in the highway network and for transit assignment, the output includes the number of boardings on each route. These are compared to observed traffic counts and observed transit ridership respectively. The two observed datasets (traffic counts and transit boardings) used in the present model validation are described in the next section, followed by highway, transit, and non-motorized validation summaries.

Note that, if available, model performance is compared against recommended guidelines in the FHWA's Travel Model Validation and Reasonableness Checking Manual (Cambridge Systematics, Inc. 2010). However, the latest version of the manual does not recommend any particular threshold to assess reasonableness of model performance. This report does mention the previously recommended thresholds, however, does not strictly follow those in examining validation summaries. The thresholds are included just for informational purposes.

Validation Data

Table 26 presents a list of datasets utilized in the validation of the Fresno ABM.

TABLE 26. MODEL VALIDATION DATASETS

DATASET	YEAR	SOURCE	PURPOSE
Traffic Counts	2023	CalTrans and Fresno COG	Highway Validation
Vehicle Miles Travelled (VMT)	2023	CalTrans Highway Performance Management System (HPMS)	Highway Validation
Transit Ridership	2024	FAX, Clovis Transit, and FCRTA	Transit Validation

Highway

Observed traffic counts are used to validate link-level estimated daily traffic flow generated by a model, whereas the observed vehicle miles travelled (VMT) validates the regionwide network-usage as estimated by the model.

Traffic Counts (CalTrans and local)

The observed traffic counts are assembled from four sources: CalTrans, Fresno COG, Fresno City and Clovis City. The Caltrans traffic census program[15] provides traffic counts on highways (interstates and state routes) in the State of California. These Caltrans traffic counts in year 2023 are downloaded for the Fresno region and in a shapefile format. The count locations (points) in the shapefile are then joined to the model roadway network using a combination of automated and manual review process. The automated process first matched the points in the shapefile to the network links and the manual process reviewed the match and corrected the joins that appeared incorrect. Also, an appropriate count value (Before AADT or After AADT) is assigned to the joined link in the model network.

Fresno COG provided processed and geocoded traffic counts for freeways from Caltrans and for the other facility types (arterial, collector, local etc.) from the County and the two cities. The traffic counts already had the corresponding model network link for a count. However, during the model validation, several issues related to suspect wrong link match were discovered, therefore, some traffic counts and network attributes such as speed, lane, and facility type were manually reviewed for their correctness.

VMT

The 2023 observed VMT is obtained from Caltrans Highway Performance Monitoring System (HPMS)[16]. Caltrans provide daily vehicle miles of travel for Fresno COG.

Transit

Transit ridership (boardings) by route are compared to the estimated boardings in the model by transit line for transit validation.

Transit Boardings

The transit boardings are assembled from three sources: FAX, Clovis Transit and FCRTA. The three transit agencies provided monthly ridership in 2023 and 2024 for their transit routes.

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[15] http://www.dot.ca.gov/trafficops/census/

[16] Table 9 in https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/hpms2023-prd-final.pdf

Ridership data are weekday data (excluding holidays) for May 2024 for FAX, October 2023 to February 2024 for Clovis Transit, and February 2024 for FCRTA.

Highway Validation

The estimated traffic flows from the model and the observed traffic counts are compared in various dimensions, including:

- Region
- Facility Type
- Volume Group
- Key Corridors

Region

The observed traffic count database used in this model validation effort encompasses 1,231 links on the highway network. The total traffic across these links amounts to 15.3 million vehicles as shown in Table 27. On the same links, the ABM under-estimates the traffic volume by ~10% (13.8 million vehicles). According to the HPMS, on an average weekday in year 2023, the roadway travel in the Fresno region resulted in 23.24 million vehicle miles of travel (VMT). The estimated traffic flows from the ABM produce a daily regionwide VMT value of 23.14 million, within 0.5% of the observed estimate from the HPMS.

TABLE 27. HIGHWAY VALIDATION – REGION

MEASURE	OBSERVED	ABM	DIFF	% DIFF
Traffic Volume	15,256,975	13,765,409	(1,491,566)	-9.8%
VMT*	23,239,900	23,140,594	(99,306)	-0.4%

Note: Observed VMT is from the HPMS estimate of the total VMT in the Fresno region for year 2023

Regionally, the estimated traffic flows are compared with the observed traffic counts by creating a scatter plot, Figure 22. Points in the scatter plot are links where traffic counts are available. A point represents observed traffic count on the X-axis and the corresponding estimated flow on the Y-axis. The scatter plot includes several measures/guidelines assessing accuracy of the model flows with respect to the observed traffic counts.

First, the plot includes a 45-degree line representing a virtual scenario of a perfect match between traffic counts and estimated flows. The 45-degree line is useful in quickly identifying overestimation (flow>count) or underestimation (flow<count) of a flow. Highway validation aims to make most points as close to this line as possible. An ideal validation would have all count

locations on the 45-degree line. However, a perfect match for all count locations is almost impossible to achieve due to various reasons such as errors in traffic counts, simulation errors in the model, etc. Acknowledging this fact, Caltrans provides recommendations on maximum (high and low) deviations of an estimation flow from the corresponding traffic count value. The scatter plot displays these Caltrans high and low deviations as red and green lines above and below the 45-degree line respectively. Lastly, a linear regressed line of all points is also added to the plot. The slope of the regressed line measures regional match between the estimated flows and the traffic counts - a slope of less than 1 means underestimation regionwide and more than 1 indicates overestimation. The plot also displays a r-squared value representing goodness of fit of all data points.

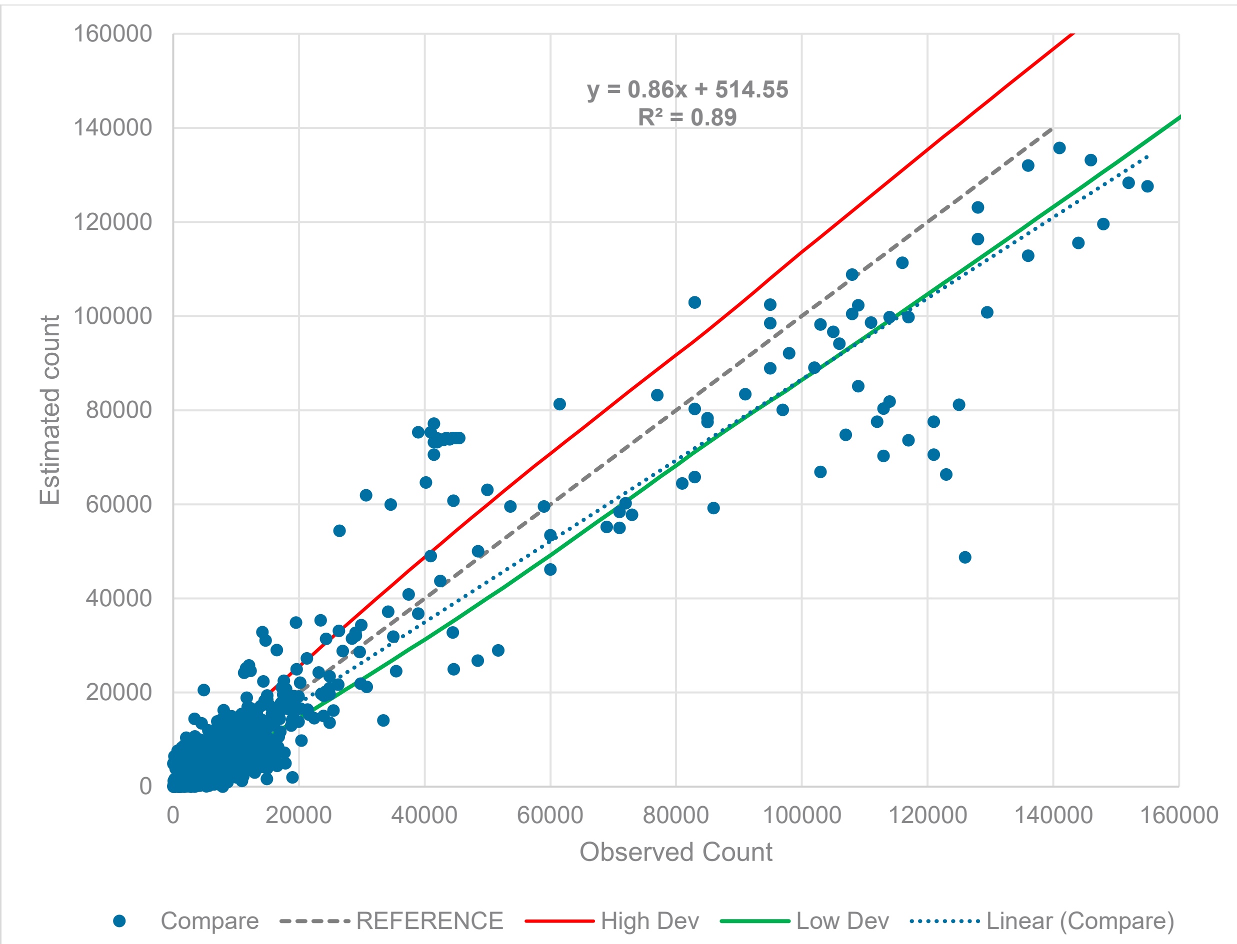


FIGURE 22: DAILY ESTIMATED FLOWS VS OBSERVED TRAFFIC COUNTS

As displayed in the scatter plot, the linear regressed line has a slope of 0.86 and R-squared value of 0.89. The r-squared close to 1.0 indicates that fitted regression line represents the data well.

Facility Type

Table 28 presents a summary of links by facility type. The facilities in the Fresno region are grouped into three categories: freeway, highway, and other (collectors, local roads, ramps). The table also contains the FHWA's guidelines of recommended threshold of difference for each facility type. Overall, the estimated traffic volume from the model matches closely with the total counts on the compared links. The comparison within the facility type exhibits a reasonable match. The model's estimates of traffic volume meet the Caltrans' recommended thresholds for highway and other, while being slightly over the threshold for freeway.

TABLE 28. HIGHWAY VALIDATION – BY FACILITY TYPE

FACILITY TYPE	COUNT	ABM	DIFF	DIFF (%)	*CALTRANS DIFF
Freeway	6,793,500	6,172,381	(621,119)	-9%	7%
Highway, Expressway, Arterial	5,293,730	4,903,628	(390,102)	-7%	15%
Other (Collector, local, ramp, connector)	3,169,745	2,689,400	(480,345)	-15%	25%
Total	**15,256,975**	**13,765,409**	**(1,491,566)**	**-9.8%**	**25%**

*Source: FHWA's Travel Model Validation and Reasonableness Checking Manual (Cambridge Systematics, Inc. 2010)

Volume Group

The estimated and observed volumes are compared by the level of volume on the links. Table 29, compares the estimated traffic flows and the traffic counts in 7 volume groups that are formed based on the range of the observed traffic counts. Overall, links with lower volumes show bigger differences and RMSE values. This is not surprising given that these links are more likely to be collectors or arterials and as we discussed before, respective traffic counts are less reliable. The count locations with observed volume less than 60,000 show larger RMSE value than desired. The team reviewed some of these locations and found some network coding issues along SR 180, which were corrected. Beyond that, there weren't any other obvious network issues.

TABLE 29. HIGHWAY VALIDATION – BY VOLUME GROUP

VOLUME GROUP		COUNT	ABM	DIFF	DIFF (%)	RMSE	*CALTRANS RMSE
>=0	<1000	49,638	99,125	49,487	100%	360%	60%
>=1000	<2500	318,054	375,413	57,359	18%	123%	47%
>=2500	<5000	944,638	905,559	(39,079)	-4%	68%	36%
>=5000	<10000	2,610,787	2,169,088	(441,699)	-17%	46%	29%
>=10000	<25000	3,448,521	2,828,864	(619,657)	-18%	41%	25%
>=25000	<60000	1,784,337	2,262,703	478,366	27%	54%	22%
>=60000		6,101,000	5,124,658	(976,342)	-16%	24%	21%
ALL		**15,256,975**	**13,765,409**	**(1,491,566)**	**-10%**	**61%**	**40%**

* Source: FHWA's Travel Model Validation and Reasonableness Checking Manual (Cambridge Systematics, Inc. 2010)

Key Highway Corridors

Figure 23 presents a spatial distribution of the count locations on the highways in the Fresno region. The color of a point on the map indicates the percent difference between the estimated and observed traffic volume. As shown in the legend, a red circle means underestimation (<-20%) in the ABM, whereas a green color represents overestimation (>20%). The color becomes darker with increase in overestimation or underestimation. For example, light green indicates overestimation of 20% to 50% and dark green indicates overestimation of more than 50%.

Regionally, it is evident that highways outside the urban areas are generally overestimated in the ABM. That is probably due to the coarser representation of the roadway network in those areas and therefore resulting in missing important streets or incorrect location of the centroid connectors for the zones in those areas. Missing important streets in the roadway network would lead the ABM to re-route the traffic to other major streets and overestimate the volume on these major streets. Incorrect locations of the centroid connectors would load unreasonable demand onto the connected facility, thus resulting in higher estimation of traffic volume on the facility. The roadway network should be reviewed for these issues to improve ABM's performance in those areas.

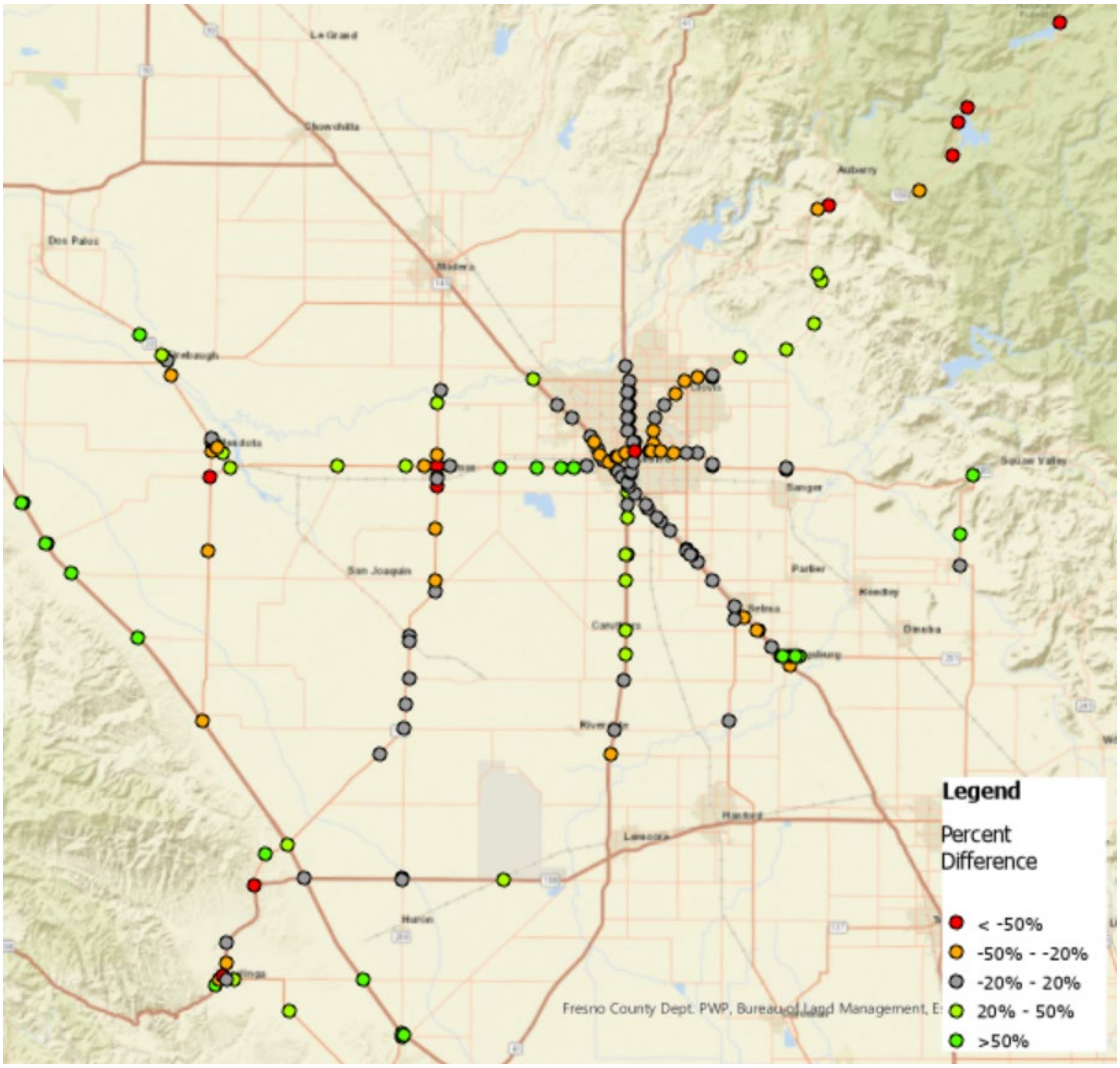


FIGURE 23: HIGHWAY VALIDATION – SPATIAL PERFORMANCE OF THE FRESNO HIGHWAY

Table 30 compares six key high-volume highway corridors in the Fresno region: I5, SR33, SR41, SR99, SR168, and SR180. All the highway corridors, except for I5, are doing reasonably well with a percentage difference within 22% of the observed traffic count. The overestimation of the I5 corridor is likely due to the imperfect external demand data from the CSTDM.

TABLE 30. HIGHWAY VALIDATION – KEY CORRIDORS

ROUTE	CALTRANS_AADT	ABM_VOL	DIFF	DIFF (%)
5	597,000	1,036,015	439,015	74%
33	176,350	202,348	25,998	15%
41	1,679,477	1,647,709	(31,768)	-2%
99	3,108,500	2,801,996	(306,504)	-10%
168	728,350	566,648	(161,702)	-22%
180	1,620,750	1,283,823	(336,927)	-21%
Total	**7,910,427**	**7,538,540**	**(371,887)**	**-5%**

To examine the model's performance along corridors, separate validation plots are prepared for these key highway corridors (see Figure 24 to Figure 29). The plots validate estimated model flows at each count location on the corridor. The count locations are arranged sequentially either from South to North or West to East depending on the corridor's travel direction. Note that the direction of the corridor represents only the order of count locations and not the direction of traffic flow. The traffic flows for both estimated and observed data are aggregates of the two flow directions (A to B and B to A). Each figure contains two solid lines representing the estimated traffic flows and the observed counts for count locations on the corridor. It also includes a dotted line showing percentage difference between the two data. The count locations are placed on the X-axis, whereas traffic volume (in vehicles) is on the primary Y-axis and percentage difference between the estimated and the observed traffic volume is on the secondary Y-axis.

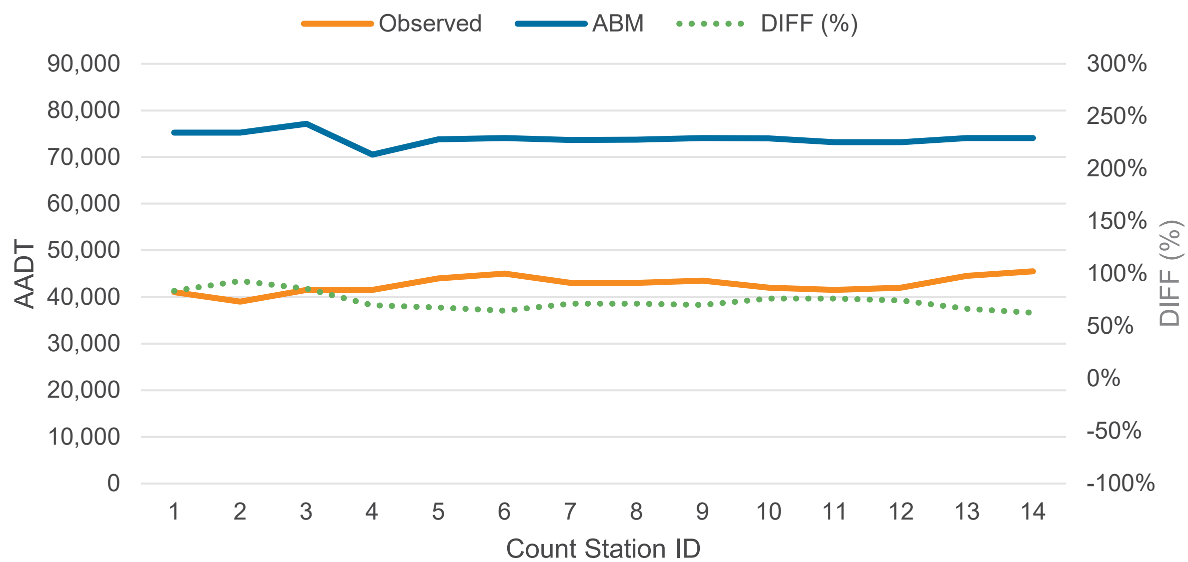


FIGURE 24. HIGHWAY VALIDATION – I5 (SOUTH TO NORTH)

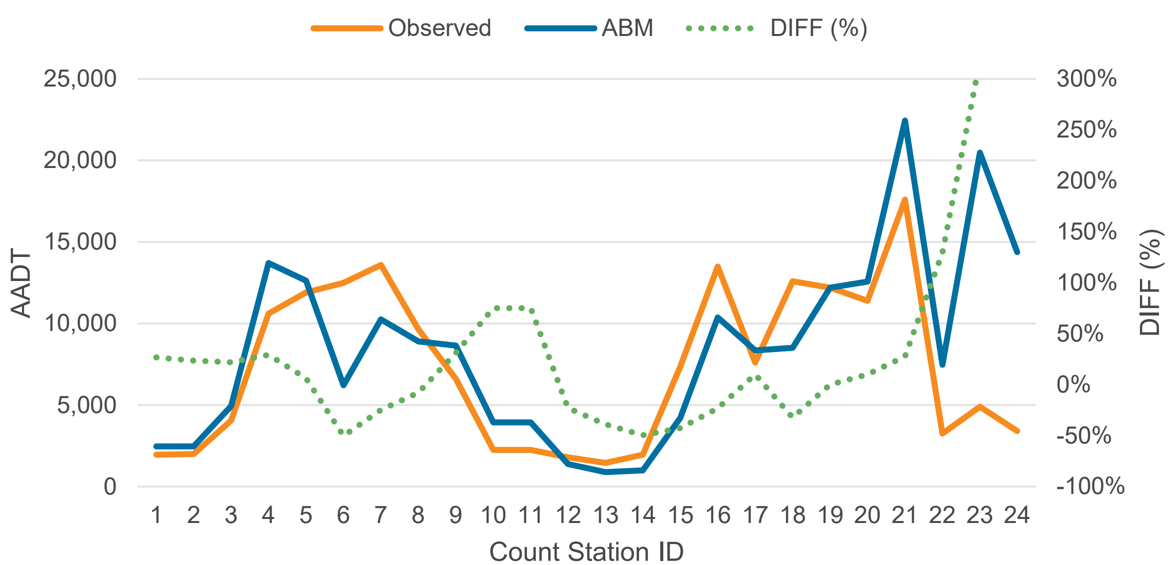


FIGURE 25. HIGHWAY VALIDATION – SR33 (SOUTH TO NORTH)

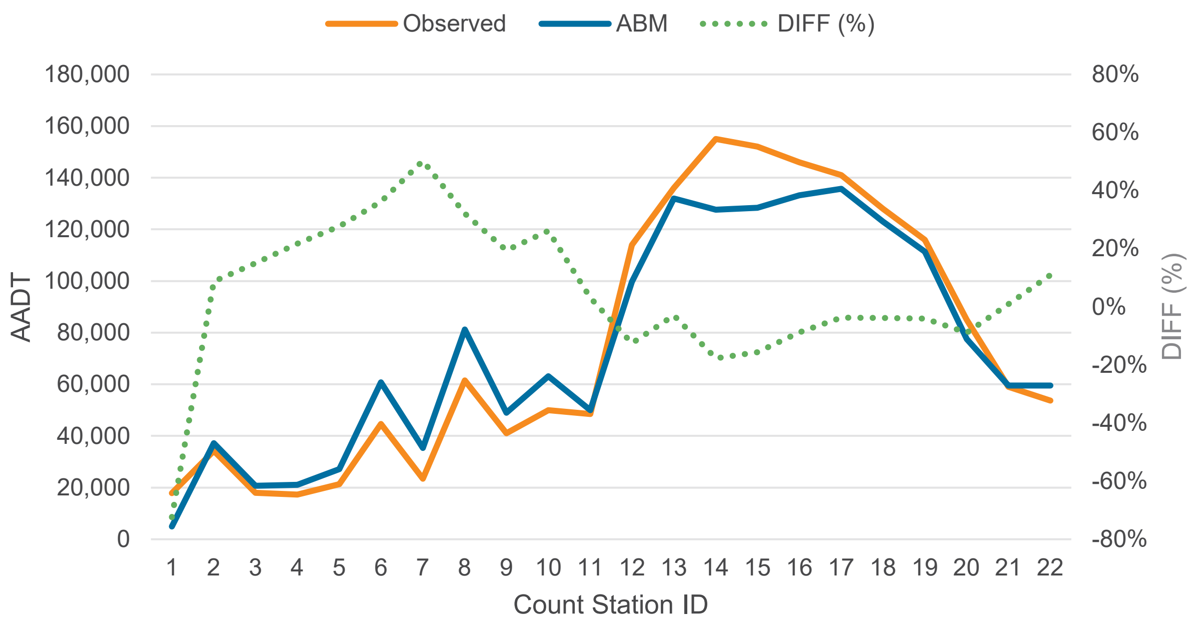


FIGURE 26: HIGHWAY VALIDATION – SR41 (SOUTH TO NORTH)

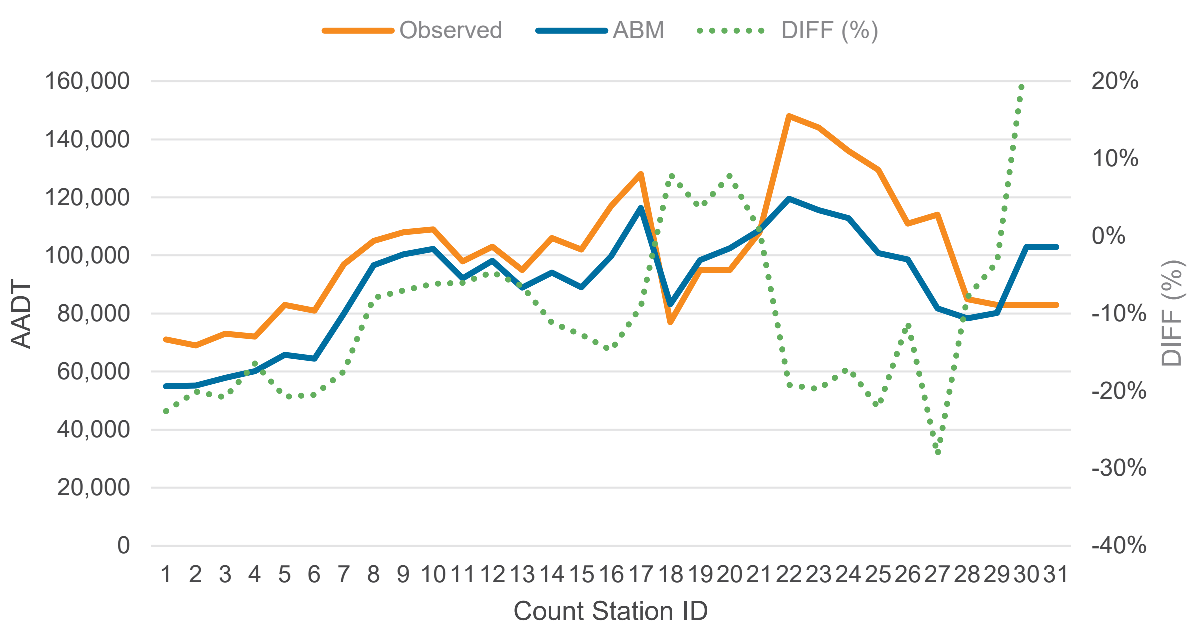


FIGURE 27: HIGHWAY VALIDATION – SR99 (SOUTH TO NORTH)

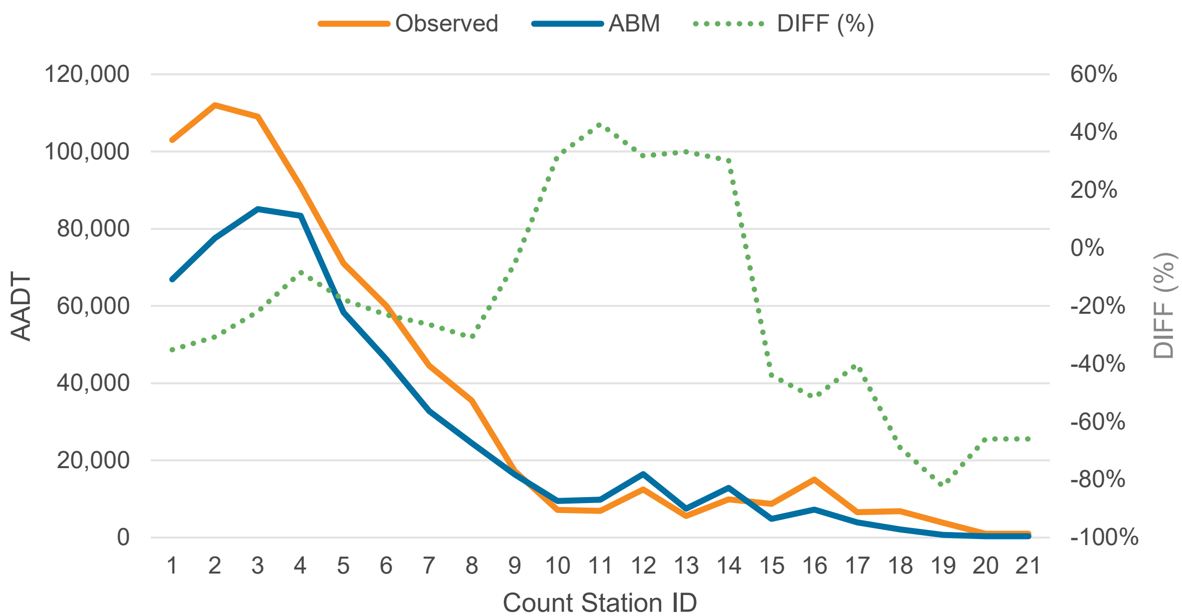


FIGURE 28: HIGHWAY VALIDATION – SR168 (WEST TO EAST)

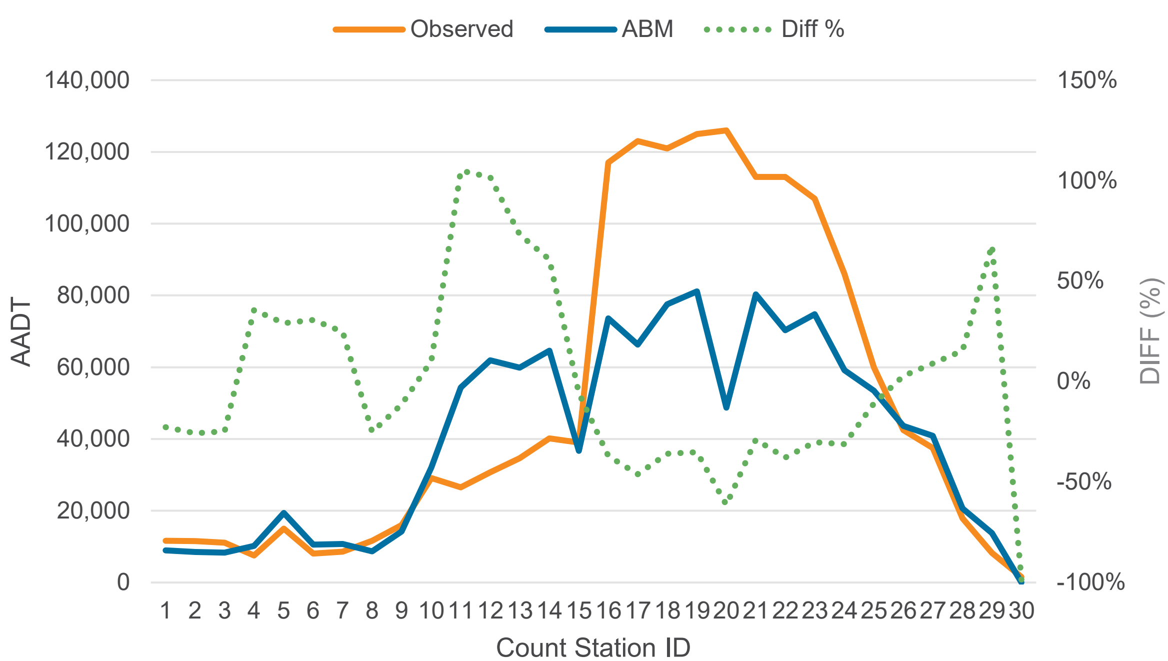


FIGURE 29: HIGHWAY VALIDATION – SR180 (WEST TO EAST)

Transit Validation

Transit ridership produced by the model is compared against the observed ridership. The ridership (boarding) is compared regionally as well as by transit line.

The FHWA previously provided guidelines to check reasonableness of the transit assignment results from a model. The relevant recommended guidelines are presented in Table 31.

TABLE 31. FHWA'S TRANSIT VALIDATION GUIDELINES

METRIC	THRESHOLD
Difference between actual counts and model results for a given year by Transit Mode (e.g. light rail, bus, etc.)	+/- 10%

*Source: The Travel Model Validation and Reasonableness Checking Manual, II Second Edition, September 2010.

Region

Regionally, Table 32, the ABM generates transit boardings within 9% of the observed ridership. The model indicates a boarding rate (boardings/trips) of 1.59.

TABLE 32. TRANSIT SUMMARIES - REGIONAL

MEASURE	OBSERVED	ABM	DIFF	% DIFF
Boardings	32,154	35,001	2,847	9%
Trips	-	21,956	-	-
Boarding rate	-	1.59	-	-

Transit Line

A comparison of ridership by transit line examines the model's ability of producing transit ridership by transit line. A scatter plot in Figure 30 shows the relationship between the transit boardings from the ABM and the observed boarding by transit line. The X-axis in the plot represents the observed boardings and the estimated boardings from the model are presented on the Y-axis.

The regression line fitting all data points shows an R-squared value of 0.92 indicating that it is a reasonable fit. This suggests that the model is predicting the transit behavior reasonably well.

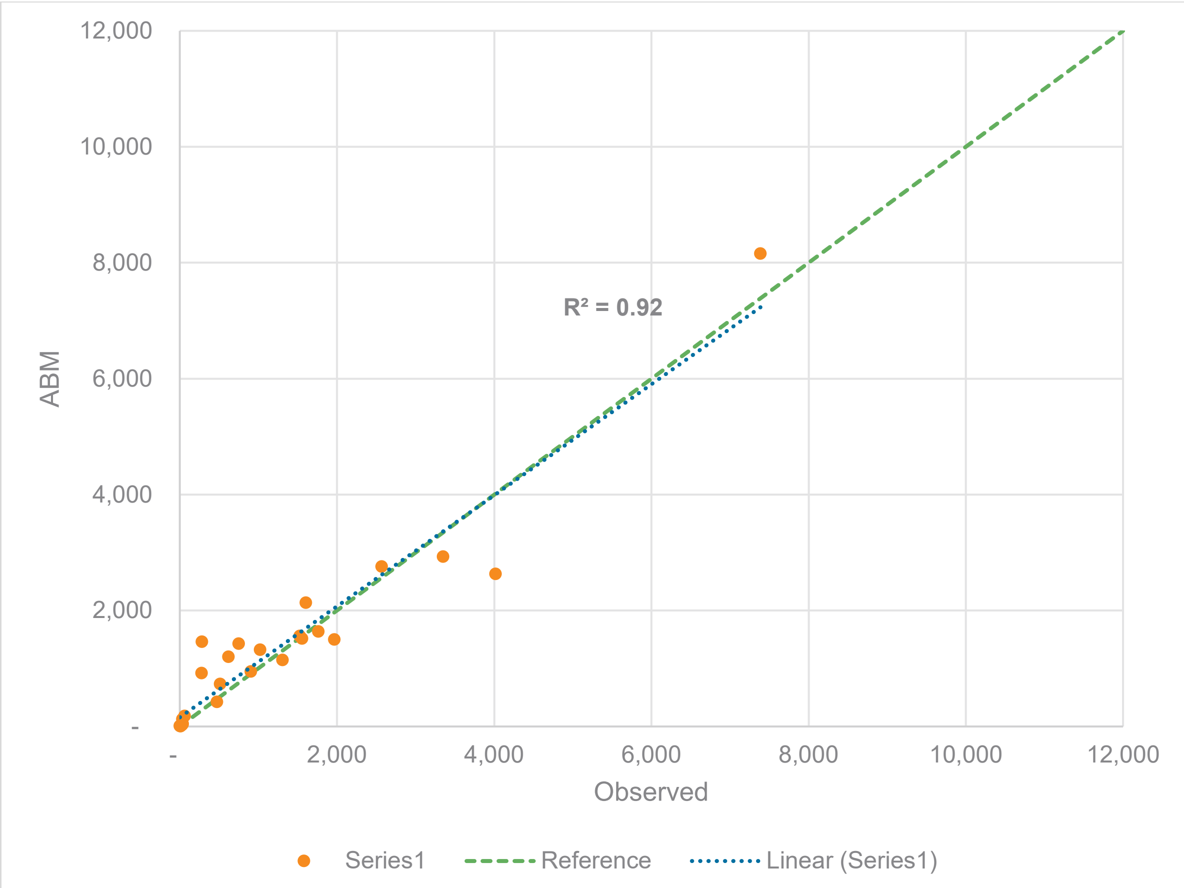


FIGURE 30: OBSERVED AND ESTIMATED TRANSIT BOARDINGS

A comparison of number of boardings by individual transit line is presented in Figure 31. The X-axis is transit line ID and the Y-axis is number of boardings. The transit lines are sorted from high observed boarding to low observed boarding. In general, the plot shows a reasonable match across all transit lines, so it was not calibrated in the 2023 base year model update. A significant effort was made to improve transit validations in the previous model update to the 2019 base year. In the previous model update, the Clovis Transit service area was found to have too many zero-auto households, potentially causing the overestimation of ridership on Clovis routes. Additional coefficients were employed to adjust the share of zero auto households in the calibration districts that overlapped the Clovis transit services. The attractiveness of university students to transit was also adjusted in the school tour mode choice coefficients file as many of the over-estimated routes served university locations.

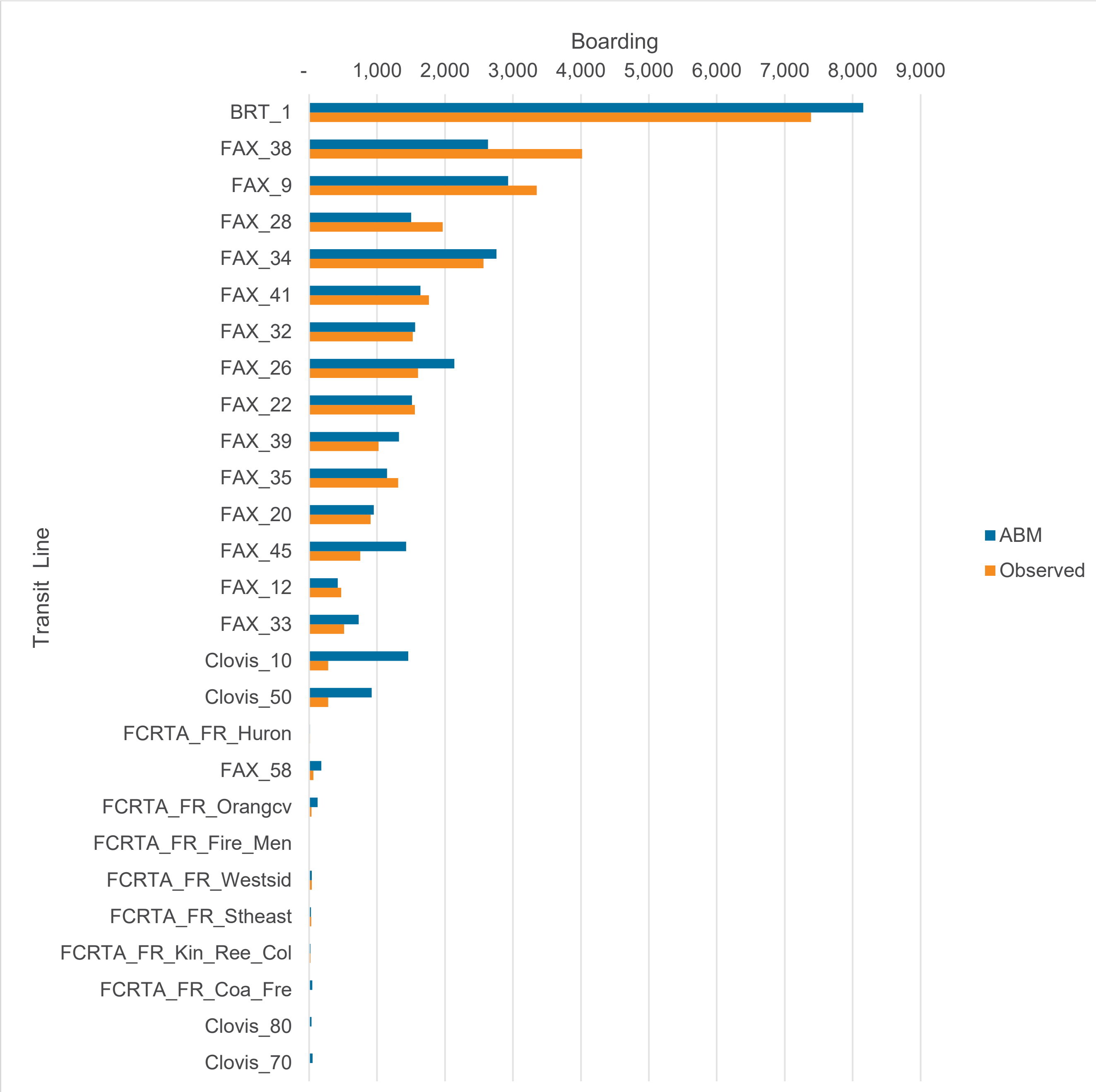


FIGURE 31: ESTIMATED AND OBSERVED BOARDINGS BY TRANSIT LINE

3.3 SUMMARY

The Fresno ABM is reasonably calibrated to match observed travel behavior reported in the 2022-2023 Central California Travel Survey (CCTS).

The model validation also showed reasonable match of estimated volumes with observed traffic counts. However, there are a few areas that still need improvement and should be addressed in future model development tasks:

- Both the Replica data and the CSTDM data, each with its own limitations, were considered and the latter was used in the 2023 model update. The model development team spent significant time to quality check and resolve issues when possible while developing external trip tables input to the model. We suspect the external trip tables still contain issues impacting model's performance. Better quality data for external travel would certainly improve model validation.
- DaySim is calibrated to represent the observed travel behavior primarily in the 2022-2023 CCTS. However, two-thirds of the completed survey samples were collected in 2022, one year earlier than the model base year (2023). While this is typically acceptable and reasonable, especially when data collection spans multiple years, this was a period of rapidly changing travel behavior due to the COVID-19 pandemic. Therefore, it possibly represents outdated or non-normative travel patterns.
- Even though the ABM reasonably predicts VMT travel within an acceptable range, the DaySim model outputs do not consistently match the survey data. This was partly by design as VMT was the primary target and the schedule constraint made a full-scale calibration infeasible. However, future model updates and calibration should take advantage of the availability of the CCTS to improve model calibration and validation.

4.0 SENSITIVITY TESTS

Sensitivity testing assesses the model's sensitivity to changing inputs like fuel prices, transit fares, new land uses, or new infrastructure. During this project, five sets of tests are designed to examine the Fresno ABM's sensitivity and include:

1. Auto operating Cost
2. Transit Fare
3. New Transit Service
4. Transit Frequency
5. New Employment

For each test, shadow pricing is either turned on or off depending on the expected effect of the project. For example, small changes in the highway or transit network are not expected to have large effects on work and school location choice. For these types of tests, stable shadow prices from the base run are used. For cases where there are very broad changes in the travel system like changes in auto-operating costs, the shadow pricing loop is turned on to generate shadow prices for the new scenario. The 'model setup' section in each test description will indicate whether or not shadow prices are re-calculated.

4.1 CHANGE IN AUTO OPERATING COST (AOC)

Two model runs, Table 33, examine model's response to change in auto operating cost (AOC): double AOC and half AOC.

TABLE 33. SENSITIVITY TESTS – AUTO OPERATING COST

SENSITIVITY TEST	DESCRIPTION
Double AOC	AOC is 200% of the original AOC
Half AOC	AOC is 50% of the original AOC

The next sections start with describing the process of setting up the ABM for these tests and then discuss the results.

Model Setup

The ABM uses a consistent auto operating cost (AOC) value across the demand (DaySim) and the supply (network assignment) side. Both model systems read an input CSV file[17] that contains auto operating cost (cents per mile) by year.

The AOC value for the 2023 base year is 25.69 cents per mile. For each test, the input CSV file is updated with a new AOC value. For the double AOC test, the AOC value is increased to 51.38 cents per mile and for the half AOC test, the AOC value is decreased to 12.85 cents per mile. Shadow pricing is turned on.

Results

The outputs from the two model runs are compared with the outputs from the base year model run. The sensitivity of the model is measured by change in tour lengths by purpose, tour/trip mode shares, and regional VMT.

Tour Lengths

As expected, Table 34, increase in auto-operating cost by 200% results in shorter tour lengths. That means residents of Fresno County are finding closer activity locations to home due to the higher cost of traveling by car. Discretionary tour lengths decrease the most (-20%) with escort and maintenance tour length following (-17%).

Decreasing the auto-operating cost increased tour lengths. The relative response by tour purpose is similar to the results of the double AOC test. Discretionary and escort purposes see the most increase (15% and 14% respectively).

[17] The input CSV file is here: 1_Inputs\6_Static\AutoOperatingCost.csv

TABLE 34. AOC SENSITIVITY - TOUR LENGTHS (MILES) BY PURPOSE, PERCENT CHANGE FROM BASE

TOUR PURPOSE	DOUBLE AOC	HALF AOC
Work	-15%	10%
School	-16%	12%
Maintenance	-17%	11%
Discretionary	-20%	15%
Escort	-17%	14%
Work-based	-10%	8%

Mode Share

As presented in Table 35, the drive alone tour mode sees the most decrease (-8.3%) due to a higher auto operating cost (double AOC). The higher occupancy auto modes show relatively lower sensitivity with shared-ride (SR) 2 and 3+ losing only 3.0% and 0.5% of the original tours, respectively. Mostly travelers switch to non-auto modes to minimize increase cost of travel. All non-auto modes including transit (walk or drive), bike, and walk see an increase in their tours. The results suggest that higher cost of travel pushes travelers to either choose a higher occupancy auto mode or travel by non-auto modes (transit, bike and walk). The TNC mode showed an increase of 11.8%. The TNC costs remained fixed in this sensitivity test suggesting that TNC became more affordable compared to the cost of a private auto in some cases.

Lowering the operating cost (half AOC) results in more tours by auto mode and fewer by non-auto modes. The travelers are making more drive-alone tours (5.8%) because of its lower cost. Even some higher occupancy (SR3+) travelers are choosing a lower occupancy travel (drive-alone or SR2). The non-auto modes generally respond similarly, with bike, walk and transit tour mode shares all decreasing. TNC mode also decreases, suggesting that the reduced auto operating cost makes driving a private auto more affordable than TNC services in some cases.

TABLE 35. AOC SENSITIVITY - TOUR MODE SHARE, PERCENT CHANGE FROM BASE

TOUR MODE	DOUBLE AOC	HALF AOC
Drive Alone	-8.3%	5.8%
Shared Ride 2	-3.0%	2.3%
Shared Ride 3+	-0.5%	0.4%
Drive-Transit	20.0%	-15.6%
Walk-Transit	7.9%	-4.3%
Bike	14.6%	-5.2%
Walk	9.2%	-4.6%
School Bus	-0.1%	-0.2%
TNC	10.1%	-5.5%
Total	**-3%**	**2.2%**

The change in trip mode shares, Table 36, also exhibits a similar behavior as the tour mode shares.

TABLE 36. AOC SENSITIVITY - TRIP MODE SHARE, PERCENT CHANGE FROM BASE

TRIP MODE	DOUBLE AOC	HALF AOC
Drive Alone	-8.3%	5.7%
Shared Ride 2	-2.4%	1.5%
Shared Ride 3+	0.3%	-0.2%
Transit	9.6%	-5.1%
Bike	13.8%	-4.5%
Walk	11.4%	-6.8%
School Bus	0.0%	-0.6%
TNC	11.2%	-5.6%
Total	**-2.4%**	**1.8%**

Regional VMT

The regionwide total vehicle miles travelled (VMT), Table 37, responds expectedly to the change in auto operating cost. Doubling the auto operating cost reduce the VMT by 9.4%, whereas halving the cost increase the VMT by 7.1%.

To examine magnitude of the VMT response, a mid-link elasticity value in response to the AOC change are calculated. The ABM is producing elasticities of -0.14 and -0.11 for double AOC and half AOC respectively.

TABLE 37. AOC SENSITIVITY – REGIONAL VMT, PERCENT CHANGE FROM BASE

MEASURE	DOUBLE AOC	HALF AOC
VMT	-9.4%	7.1%
Elasticity	-0.14	-0.11

4.2 CHANGE IN TRANSIT FARE

Two model runs, Table 38, examine model’s response to change in transit fare: double transit fare and half transit fare.

TABLE 38. SENSITIVITY TESTS – TRANSIT FARE

SENSITIVITY TEST	DESCRIPTION
Double Transit Fare	Transit fare is 200% of the original fare
Half Transit Fare	Transit fare is 50% of the original fare

The next sections start with describing the process of setting up the ABM for these tests and then discuss the results.

Model Setup

The 2023 base year ABM apply two sets of fare for the transit services in the Fresno County. The first set is a flat fare of $1 for FAX and $0 (free) for Clovis transit. The other set is a distance-based fare for the inter-city buses by FCRTA. Both sets of fares are updated in the transit fare sensitivity tests. Shadow pricing is turned off.

Results

The outputs from the two model runs are compared with the outputs from the base year model run. The sensitivity of the model is measured by the change in tour/trip mode shares, transit trips by income groups and regional transit ridership (boardings).

Mode Shares

As presented in Table 39, with double fare, walk to transit tours decreases by 11.8% while driving modes increased 0.1%. The tours leaving transit are now choosing other modes as the non-transit modes see increase in their respective tours, though the increase is not big due to very low share of transit tours overall (1%), as shown in Section 3.1. With half fare, the walk transit tours increase by 6.6% while driving modes decreased 0.1%.

TABLE 39. TRANSIT SENSITIVITY - TOUR MODE SHARE, PERCENT CHANGE FROM BASE

TOUR MODE	DOUBLE FARE	HALF FARE
Drive Alone	0.1%	-0.1%
Shared Ride 2	0.1%	0.0%
Shared Ride 3+	0.1%	-0.1%
Drive-Transit	-1.1%	0.0%
Walk-Transit	-11.8%	6.6%
Bike	0.5%	-0.4%
Walk	0.1%	-0.1%
School Bus	0.1%	-0.1%
TNC	0.1%	-0.3%
Total	0.0%	0.0%

The change in trip mode shares, Table 40, also exhibits a similar behavior as the tour mode shares.

TABLE 40. TRANSIT FARE SENSITIVITY - TRIP MODE SHARE, PERCENT CHANGE FROM BASE

TRIP MODE	DOUBLE FARE	HALF FARE
Drive Alone	0.1%	-0.1%
Shared Ride 2	0.1%	0.0%
Shared Ride 3+	0.1%	-0.1%
Transit	-13.7%	7.6%
Bike	0.6%	-0.1%
Walk	0.0%	-0.02%
School Bus	0.2%	-0.1%
TNC	0.4%	-0.2%
Total	**0.0%**	**0.0%**

Transit Trips by Household Income

Table 41 examines traveler's sensitivity to change in transit fare by household income. The table looks at transit travelers within 6 household income categories and calculates percentage change in their transit trips due to change in transit fare. For both increase and decrease in transit fare, travelers in lower income categories are the least sensitive to the price change. The sensitivity to the transit fare change increases with increase in average household income. The results make sense as lower income populations may represent more captive riders, i.e., those with fewer or no household autos who have fewer choices for travel mode.

TABLE 41. TRANSIT FARE SENSITIVITY – TRANSIT TRIPS BY HOUSEHOLD INCOME, PERCENT CHANGE FROM BASE

HOSEHOLD INCOME	DOUBLE FARE	HALF FARE
$0-$15,000	-10.7%	5.6%
$15,000-$35,000	-13.5%	7.0%
$35,000-$50,000	-12.6%	8.4%
$50,000-$75,000	-14.3%	8.3%
$75,000-$100,000	-15.3%	8.6%
$100,000+	-16.0%	8.2%

Transit Boardings

The regionwide transit ridership, Table 42, responds appropriately to the change in transit fare; doubling the transit fare reduces the ridership by 14.4% and halving the transit fare increases the ridership by 7.2%.

To examine magnitude of the ridership response, a mid-link elasticity value in response to the transit fare change is calculated. The ABM is producing elasticities of -0.22 and -0.11 for double transit fare and half transit fare, respectively.

TABLE 42. TRANSIT FARE SENSITIVITY – TRANSIT BOARDINGS

MEASURE	DOUBLE FARE	HALF FARE
Change in Boardings from Base	-14.4%	7.2%
Elasticity	-0.22	-0.11

4.3 NEW TRANSIT SERVICE

To evaluate the model's response to a new transit service, a new transit line is tested as both a local bus and a Bus Rapid Transit (BRT) line. Figure 32 shows the route of the new line.

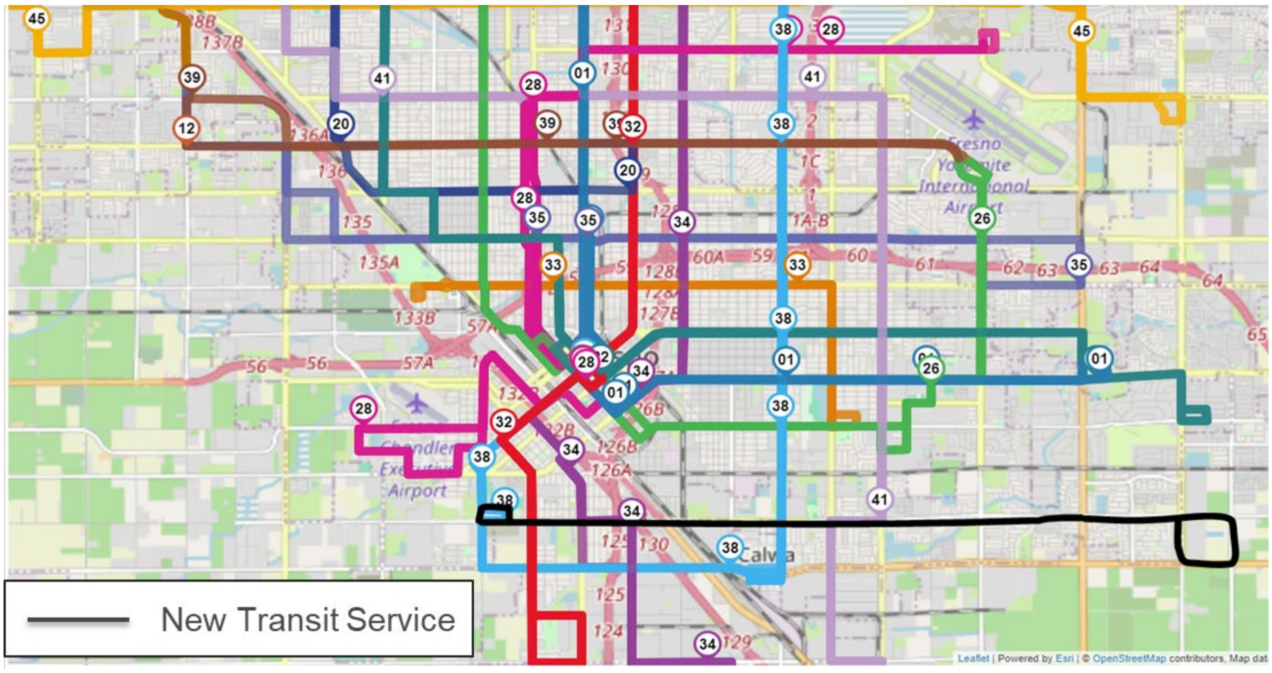


FIGURE 32: SENSITIVITY TEST - NEW TRANSIT SERVICE

Model Setup

The new transit line is added to the transit line file (LinFile19.lin) as a FAX service. Two tests are performed, one with the transit mode as local bus, and one with the transit mode as BRT. The local bus is coded with 30 minute peak and off-peak headways with 0.8min dwell times. Local bus stops are every 0.25 mi along the route. The BRT line is coded with 10 minute peak and 15 minute off-peak headways and a dwell time of 0.5 minutes. The BRT is coded with stops every 0.5 mi along the route. Shadow pricing is turned off and stable shadow prices from the base run are used.

Results

The addition of the line into the 2023 base year transit system results in a small increase in overall transit boardings (1.9% and 2.5% for the local bus and BRT coding), as summarized in Table 43. The line as a local bus attracts 403 daily riders, while the line as a BRT nearly doubles the line ridership (718 daily boardings). In both cases, the increase in systemwide total boardings is higher than the increase in the boardings on the new lines. This indicates that the new line is facilitating trips which transfer to other services as well.

TABLE 43. SENSITIVITY TEST – NEW BRT SERVICE BOARDINGS, COMPARISON TO BASE

LINE CODING	NEW LINE BOARDINGS	TOTAL TRANSIT BOARDINGS	CHANGE IN TOTAL BOARDINGS	TOTAL BOARDINGS PERCENT DIFFERENCE
Local Bus	403	35,680	679	1.9%
BRT	718	35,893	892	2.5%

4.4 TRANSIT FREQUENCY

To evaluate the model's response to changes in transit frequencies, an existing transit line (FAX-41) is tested with half and double its base frequency. Figure 33 shows the route of the selected FAX-41 line.

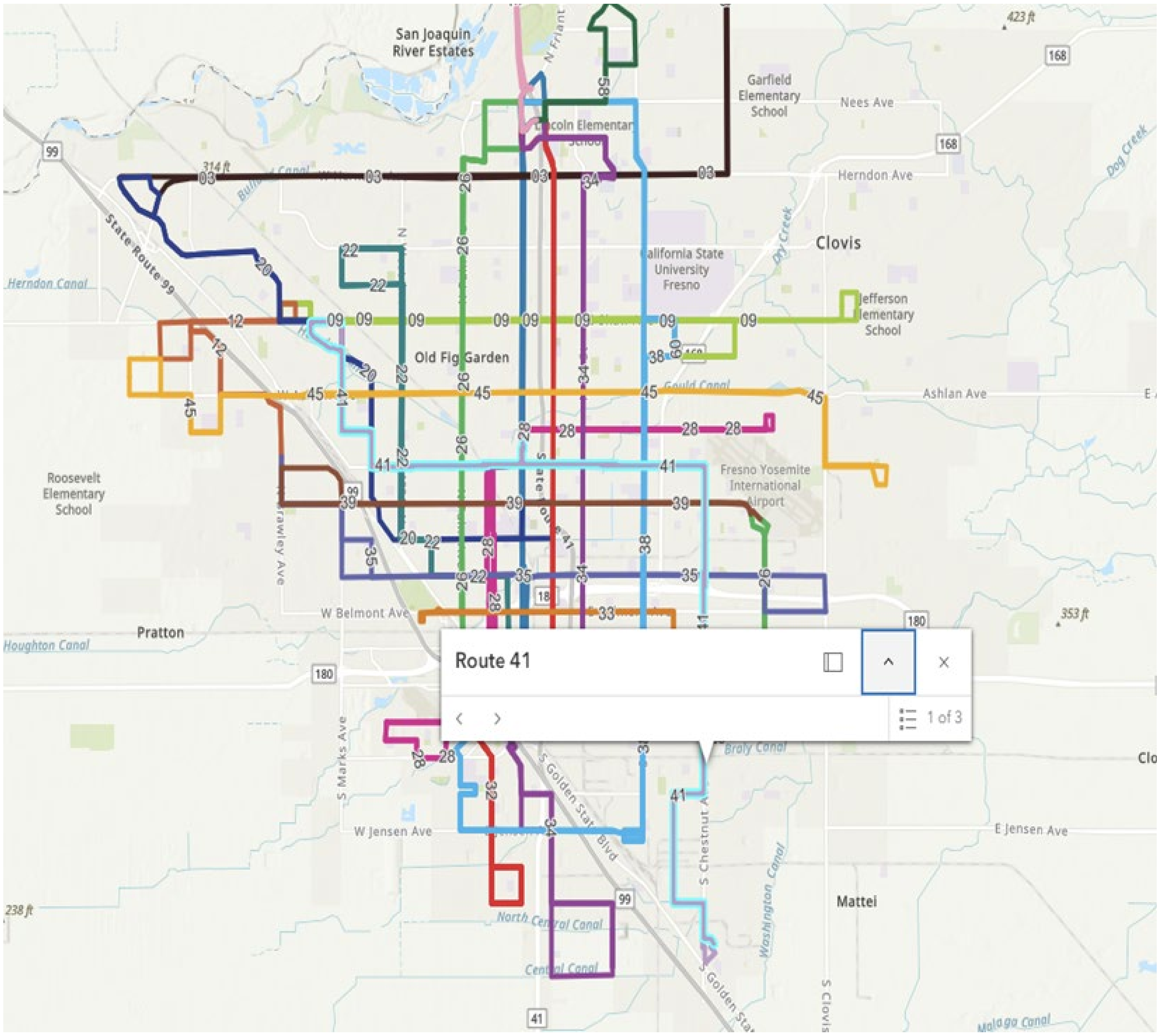


FIGURE 33: SENSITIVITY TEST – TRANSIT FREQUENCY

Model Setup

The frequency of the FAX-41 line is modified in the transit line file (LinFile19.lin). Two tests are performed, one with half (15 mins) its base frequency and another with double (60 mins) the base frequency. Shadow pricing is turned off and stable shadow prices from the base run are used.

Results

Reducing the FAX-41 line frequency to 15 minutes in the 2023 base year transit system results in a substantial increase (40%) in line boardings and a small increase (1.8%) in overall transit system boardings. Conversely, increasing the headway to 60 minutes leads to a notable decrease (18%) in line boardings and a slight reduction (0.8%) in total transit boardings.

With the double frequency scenario, the FAX-41 line attracts 652 additional riders, while the overall transit system gains only 629 riders, as shown in Table 44. Similarly, with the halffrequency, the line loses 302 riders, whereas the overall system loses 288 riders. This indicates that a portion of the riders gained or lost on this line are substituting to or from other lines rather than representing net new riders.

To evaluate the magnitude of the ridership response, a mid-link elasticity value with respect to the frequency change is calculated. The ABM produces elasticity values of -0.50 and -0.30 for the half and double frequency scenarios, respectively.

TABLE 44. SENSITIVITY TEST – TRANSIT FREQUENCY, COMPARISON TO BASE

LINE FREQUENCY	FAX 41 BOARDINGS CHANGE	FAX 41 BOARDINGS PERCENT CHANGE	TOTAL TRANSIT BOARDINGS	TOTAL BOARDINGS CHANGE	TOTAL BOARDINGS PERCENT CHANGE
Double Service	652	40%	35,630	629	1.8%
Half Service	-302	-18%	34,713	-288	-0.8%

4.5 NEW EMPLOYMENT

Three model runs, Table 45, examine model’s response to changes in land-use, specifically employment: employment center, half of the employment center, and 1.5 times the employment center.

TABLE 45. SENSITIVITY TEST - EMPLOYMENT CHANGES

SENSITIVITY TEST	DESCRIPTION
Employment Center	New employment added to base employment
50% Employment Center	50% of the new employment center
150% Employment Center	150% of the new employment center

The next sections start with describing the process of setting up the ABM for these tests and then discuss the results.

Model Setup

In the 2023 base year ABM, changes were made to employment in three Fresno County zones (18739, 19008, and 19010) without redistributing employment to other zones. Table 46 summarizes the employment in these zones for the three sensitivity tests. For the first test, employment was calculated as the sum of base and new employment. The second and third tests used 50% and 150% of the first test's employment, respectively, for the said three zones. Shadow pricing is turned on.

TABLE 46. MAZ EMPLOYMENT CHANGES

MAZ ID	New Employment	Base Employment	Employment Center	50% Emp Center	150% Emp Center
18739	1200	0	1200	600	1800
19008	693	107	800	400	1200
19010	1658	192	1850	925	2775
Total	**3551**	**299**	**3850**	**1925**	**5775**

Results

Changes in employment at the three selected zones were tested to evaluate the model's sensitivity to localized employment growth. As expected, vehicle miles traveled (VMT) increased monotonically with higher employment. Compared to the base scenario, total VMT increased by 0.09%, 0.04%, and 0.16% for the Employment Center, 50% Employment Center, and 150%

Employment Center tests, respectively (Table 47). This pattern aligns with expectations, as higher employment levels typically generate additional travel. Total transit boardings increased slightly in all three Employment Center scenarios compared to the base scenario.

TABLE 47: CHANGES IN TOTAL VMT AND TRANSIT BOARDINGS

Measure	Base	Employment Center	50% Emp Center	150% Emp Center
VMT	23,140,594	23,161,244	23,150,364	23,176,887
VMT Diff.	-	20,650	9,770	36,293
VMT Diff (%)	-	0.09%	0.04%	0.16%
Transit Boardings	35,001	34,901	35,012	35,221

4.6 SUMMARY

Five sets of tests are conducted to examine the Fresno ABM’s sensitivity. The results of change in these inputs were compared with base scenario and appropriate measures were calculated to analyze change in results. The model is behaving with reasonable sensitivity in these sensitivity tests.

5.0 FRESNO ABM USER'S GUIDE

This chapter describes model setup and steps to run the Fresno ABM for base year 2023. It also describes the structure and content of the model directory.

5.1 SOFTWARE REQUIREMENTS

The instructions are for a machine with Windows operating systems. The following software are required:

Cube Voyager

Cube version 6.5 or greater should be installed on the machine.

Python - Anaconda 2

Anaconda is a python data science platform. It contains a lot of useful python libraries. We are using a python script in our CUBE work flow that would require some python libraries. Instead of installing libraries separately it is better to install an Anaconda package as that would contain all the required libraries.

Latest Anaconda 2 can be downloaded from here:

https://www.anaconda.com/download/

Here are instructions on installing Anaconda on windows:

https://docs.anaconda.com/anaconda/install/windows

PopulationSim uses Anaconda 3. The installation requirements are provided in Appendix B.

R Software

R v3.4.4 should be installed on the machine. The model uses R to generate summaries for both PopulationSim and DaySim outputs, making it essential for validating the results. This version of R can be downloaded from CRAN website:

https://cran.r-project.org/bin/windows/base/old/

5.2 SETUP ABM

System Setup

Once all the required software is installed (5.1 Software Requirements), users need to copy the following files to their respective directories:

OMX DLL

The AB model uses an OMX DLL to convert Cube skims to OMX format, which are then read in DaySim. Users need to copy OMX DLL (“OMXLib.dll”) to the cube voyager installation directory (C:\Program Files\Citilabs\CubeVoyager). The DLL is available under the *App* directory in the model setup.

Python Resource File

The ABM uses a Python script to run the model within the Cube environment. To do so, Cube creates a python resource file (“PYTHON.Rsc”) that primarily contains the python program path. User needs to update that path (see Figure 34) and copy the resource file to the following location:

C:\Users\<username>\AppData\Roaming\Citilabs\Cube\User

The resource file is available under the *App* directory in the model setup.

```
* RSC file for User Program PYTHON
*
#PYTHON

&ProgPath=C:\Program Files\Anaconda2\python.exe
&ProgDesc=Python Software for Python Programming Language Programs Inclusion
&ProgType=1
&ProgUI=0
&UsePath=0


 &FILES
1100
 0,"Script File   ","*  ",1,PYT,"      ",1
 1,"Data File 1   ","*  ",1,PYT,"      ",1
 2,"Data File 2   ","*  ",1,PYT,"      ",1
 3,"Data File 3   ","*  ",1,PYT,"      ",1
 4,"Data File 4   ","*  ",1,PYT,"      ",1
 5,"Data File 5   ","*  ",1,PYT,"      ",1
 6,"Data File 6   ","*  ",1,PYT,"      ",1
 7,"Data File 7   ","*  ",1,PYT,"      ",1
 8,"Data File 8   ","*  ",1,PYT,"      ",1
 9,"Data File 9   ","*  ",1,PYT,"      ",1
10,"Data File 10  ","*  ",1,PYT,"      ",1

 &PARAM
 &PARHLP
 &PAREG

 &OPTION

 &OPTHLP

 &COMLIN
Inputs
Outputs

&END
```

FIGURE 34: PYTHON RESOURCE FILE – UPDATE PROGRAM PATH

Model Setup

Additional software packages are required for running the DaySim input preparation steps, summarizing DaySim outputs, and generating validation summaries. These software packages have been provided with the model setup as a 7zip file (software.7z). This should be extracted on the local machine. The folder location should be added to the Cube Catalog Keys “ANACONDA_DIRECTORY” and “R_DIRECTORY”.

5.3 RUN ABM

To run the ABM, open the catalogue file (*Fresno_ABM.cat*) in Cube. A catalogue file is a group of applications (steps) run in a pre-defined order. When opened in Cube, user should see four frames on the left side (see Figure 35): Scenario, Data, App, and Keys.

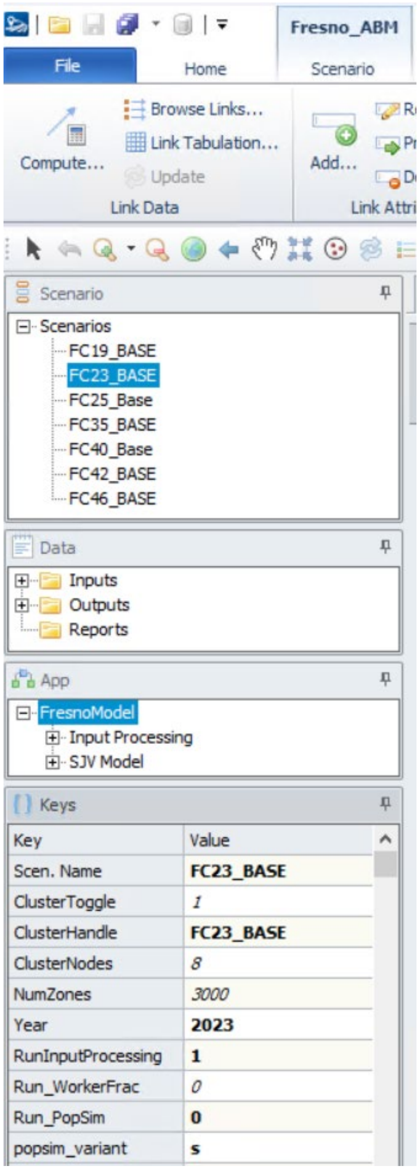


FIGURE 35: MAIN CUBE CATALOG FILE

The *Scenario* frame contains a list of scenarios to pick for the current run. User needs to pick a scenario under this frame. For 2023, user would select FC23_BASE. The *Data* frame contains a list of inputs and outputs. User does not need to do anything here. The *Keys* section contains a list of parameters. When a scenario is selected (double-clicked) a screen will pop-up showing the catalog keys and their values to the user as shown in Figure 36. Table 48 describes the new keys added as part of the model update and enhancements. A comprehensive list of catalog keys is provided in Appendix F.

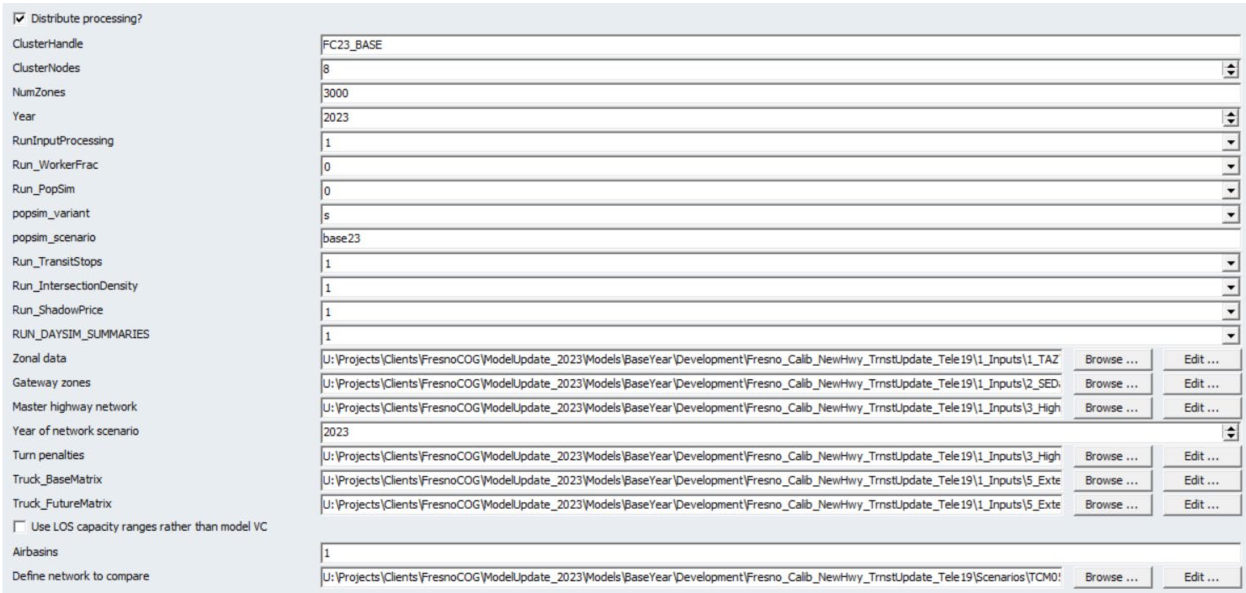


FIGURE 36: SCENARIO KEYS SCREEN

TABLE 48: NEW CATALOG KEYS

KEY	DEFAULT VALUE	DESCRIPTION
RunInputProcessing	1	0 to skip the input processing step. 0 may be selected if a model run does not need to re-generate DaySim inputs, does not have any network updates.
Run_WorkerFrac	0	This step generates the IXXI worker fractions used by DaySim and developed from LEHD Lodes data. This input file only needs to be created for a new model base year
Run_PopSim	0	The PopulationSim setup is run from the Cube Catalog. This step only needs to be run if updates to the synthetic population are needed.
Run_TransitStops	1	In input processing, the transit stops file is generated when this flag is set to 1.

KEY	DEFAULT VALUE	DESCRIPTION
Run_IntersectionDensity	1	In input processing, the intersection density file is generated when this flag is set to 1.
Run_ShadowPrice	1	If set to 1, the first model feedback loop will run DaySim 3 times to generate stable shadow pricing files. These will be saved and used for subsequent DaySim runs
Run_DaySimSummaries	1	After the full model run, the DaySim summaries will automatically be generated when set to 1
Run_Validation	1	After the full model run, the model validation report will automatically be generated when set to 1
HOV2_TOLL_FACTOR	0	Fractional value to be applied to SOV tolls for HOV2 toll value
HOV3_TOLL_FACTOR	0	Fractional value to be applied to SOV tolls for HOV3+ toll value
ANACONDA_DIRECTORY	[path]\software\Anaconda2	Directory where Anaconda2 folder was unzipped
R_DIRECTORY	[path]\software\R	Directory where R folder was unzipped

The *App* section contains one group: FresnoABM. This group includes two steps: Input Processing and SJV Model.

The Fresno AB model is run in one step with the option to skip input processing if needed. The two main modules are:

- Input Processing prepares initial inputs for model to use in feedback loops. The processing includes setting up the working directory, creating model networks, initial skimming, external trips, truck model etc. As bike and walk skimming is performed only once, it is also included in the input processing.
- SJV Model, includes feedback loops and final assignment. A feedback loop start with generating highway and transit skims. After generating external and truck demand, it

runs DaySim. This produces demand matrices by mode and time period. The demand matrices are then assigned on highway and transit networks for AM and MD periods. After three feedback loops, a final assignment of all four periods is performed. Assignment also include bike and walk assignments.

IMPORTANT: Here are sequential steps to run ABM:

1. Open *Fresno_ABM.cat* in Cube.
2. Select a scenario under *Scenarios* section.
3. Update the catalog keys as required for the desired model run.
4. Double click on *FresnoModel* under *App* and click Run on the Home ribbon, as shown in Figure 37.
5. This will bring up a Run Application window. Enter "Run Title" of your choice and click OK, as shown in Figure 38. This will start Cube processing.

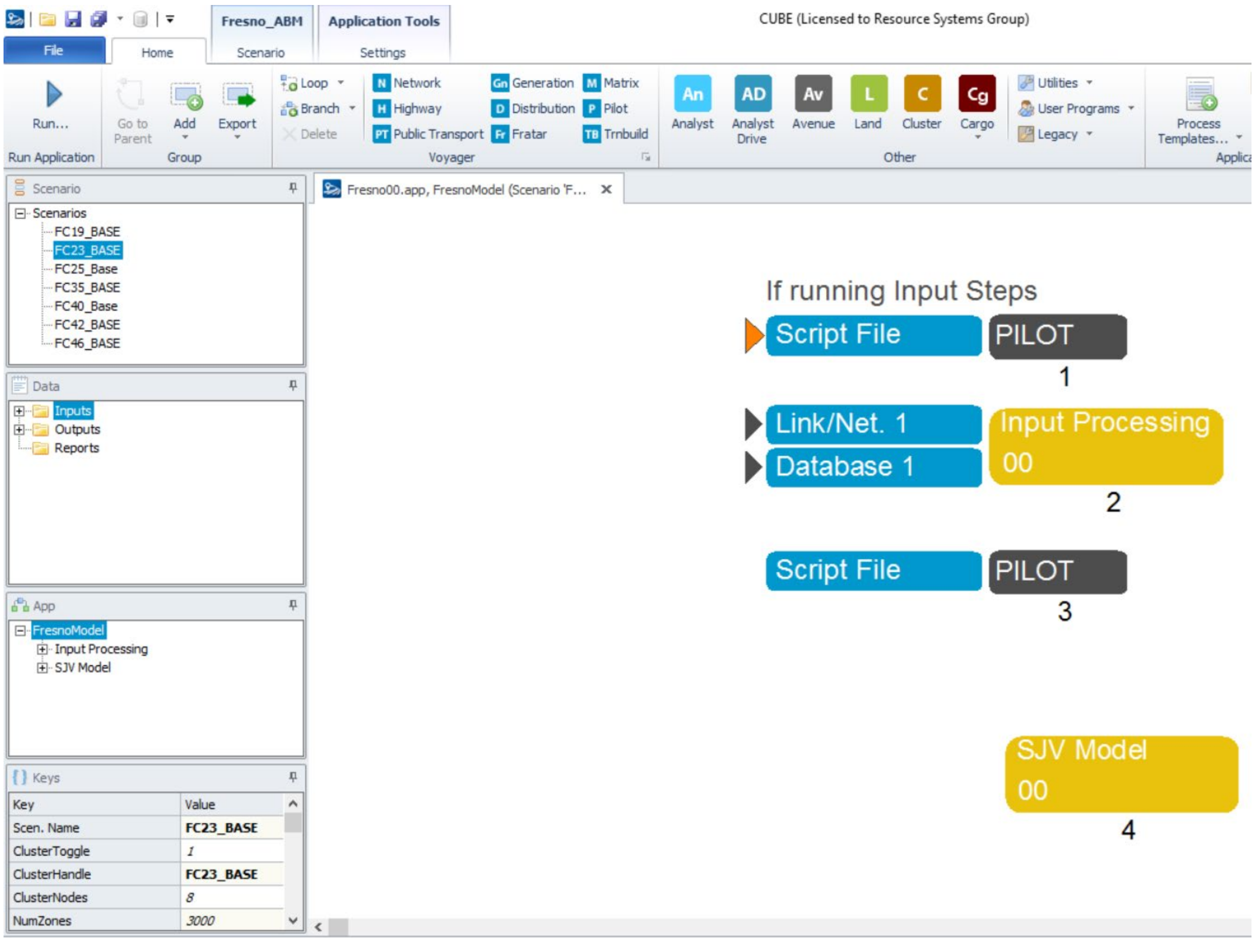


FIGURE 37: STARTING A MODEL RUN IN CUBE

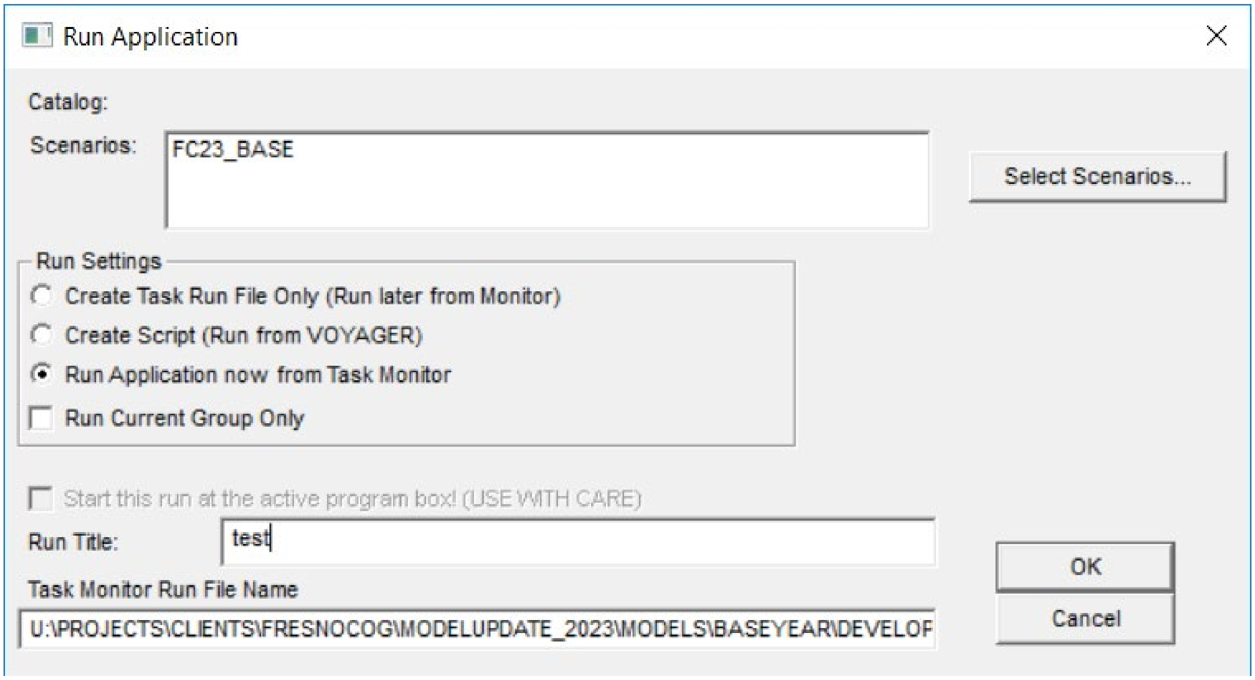


FIGURE 38: SPECIFYING RUN DETAILS IN CUBE

Note: after you click OK, Cube may prompt a message saying that errors have been found while checking for files. Ignore the error and choose “Create Job Anyway”.

5.4 MASTER DIRECTORY STRUCTURE

Figure 39 presents directory structure for the Fresno Activity-Based Model setup. The structure includes initial setup, as well as directories after a model run is finished.

The primary model file linking the entire ABM system is in the root folder and is called as “Fresno_ABM.cat”. This catalogue file is used to view and run the model using Cube Voyager.

The directory “*1_Inputs”* holds all the input data used by the ABM system. DaySim inputs are also stored in an appropriate sub-directory (*8_DaySim*) within the inputs directory. The *App* directory houses cube scripts and other applications (DaySim executable, parcel buffer, summary scripts, and population sampler). The *GIS* folder contains geodatabase and ArcMap documents.

Once a model run is finished, a new directory *Scenarios* is added to the initial model directory. The output directory (*Scenarios*) contains scenario specific sub-folders (ex. FC23_BASE for year 2023). The scenario specific folders contain outputs organized by model components. In addition, a temp folder contains intermediate files produced during a scenario run.

FIGURE 39: FRESNO ABM DIRECTORY STRUCTURE

5.5 INPUTS

This section provides description and structure of input files required in Fresno ABM.

DaySim

This section describes input files required for a DaySim run. The DaySim input files include synthetic population (household and person files), micro-zone land-use, zone index, worker IXXI fraction, PNR nodes, coefficients, roster, roster combinations, and configuration.

Micro-zone Land-use File

The input micro-zone file provides information on location and land-use for micro-zones in the Fresno region. The file is in comma separated value format and is located at "1_Inputs/8_DaySim/02_Parcel/maz_2023_parks.csv". This file is created in-house by Fresno COG. Table 49 presents a list of fields available in the input micro-zone file.

Off-street parking location and pricing information is used in the activity-based model system to influence mode and other choices. Note that this parking information is focused on publicly accessibility off-street locations and does not consider private off-street parking locations (such as those available only to workers in an office building), nor does it consider on-street parking location. Future year parking locations and costs can be easily added to the model system by simply updating the input micro-zone file to identify parking capacity and costs for individual micro-zones. Where data is unavailable or unknown, the parking attributes should be set to 0.

TABLE 49: MICRO-ZONE FILE FORMAT

HEADER LABEL	VALID VALUES	DESCRIPTION, COMMENTS
parcelid	1 – 9999999	The parcel ID number. Values must be unique positive integers, in ascending order. (Gaps are allowed, but not efficient for memory.)
xcoord_p	1-999999999	The x coordinate of the parcel centroid, in integer length units (typically SPF).
ycoord_p	1-999999999	The y coordinate of the parcel centroid, in integer length units (typically SPF).
sqft_p	0-999999999	The area of the parcel, in thousands of square length units (typically sqf, does not need to be an integer)
taz_p	1-9999999	The zone that the parcel is in. Must be a valid zone_id in the "zone" file
block_p	0-9999999	This variable is used to store park area in square feet
hh_p	Real >=0	The number of households residing on a parcel.
stugrad_p	Real >=0	The number of grade school (K-8) students enrolled in schools on a parcel
stuhgh_p	Real >=0	The number of high school (9-12) students enrolled in schools on a parcel. If this is not available separately, then set to 0 & put the number of K-12 students in stugrd_p
stuuni_p	Real >=0	The number of university/college students enrolled in schools on a parcel.
empedu_p	Real >=0	The number of educational employees working on a parcel
empfoo_p	Real >=0	The number of food service employees working on a parcel
empgov_p	Real >=0	The number of government employees working on a parcel
empind_p	Real >=0	The number of industrial employees working on a parcel
empmed_p	Real >=0	The number of medical employees working on a parcel
empofc_p	Real >=0	The number of (other) office employees working on a parcel

HEADER LABEL	VALID VALUES	DESCRIPTION, COMMENTS
empret_p	Real >=0	The number of retail employees working on a parcel
empsvc_p	Real >=0	The number of (other) service employees working on a parcel
empoth_p	Real >=0	The number of other sector employees working on a parcel. Typically contains construction, agriculture, mining.
emptot_p	Real >=0	The total number of employees working on a parcel. Should equal the sum of the 9 previous fields.
parkdy_p	Real >=0	The number of paid public off-street parking spaces on a parcel with per day pricing. (May overlap with parkhr_p if have both types of pricing.)
parkhr_p	Real >=0	The number of paid public off-street parking spaces on a parcel with per hour pricing. (May overlap with parkdy_p if have both types of pricing.)
ppricdyp	Real >=0	The average price of public off-street parking spaces on a parcel with per day pricing. (In cents per day)
pprichrp	Real >=0	The average price of public off-street parking spaces on a parcel with per hour pricing. (In cents per hour)

Synthetic Population

DaySim requires household and person files in ASCII delimited format with a header record. The PopulationSim software produces synthetic population in two CSV files: household and person. A python script then converts these files into DaySim format to use in a DaySim run. The Household file is "1_Inputs\8_DaySim\03_Household\Fresno_household.dat" and the person file is "1_Inputs\8_DaySim\03_person\Fresno_person.dat"

Table 50 provides a list of fields available in the household file. Of the variables listed below, only five (hhno, hhsize, hhincome, hhparcel, and hhexpfac) are strictly needed by DaySim as inputs on the raw data file. One (hhvehs) is predicted by DaySim. The rest can be computed based on other data files or aren't currently used in model application. DaySim also adds two variables to the working and output household file ("fraction_with_jobs_outside", which is a property of the residence zone, and "zone_id" which is DaySim's internal zone ID corresponding to "hhtaz").

TABLE 50: HOUSEHOLD FILE FORMAT

HEADER LABEL	VALID VALUES	DESCRIPTION, COMMENTS
hhno	1 - 9999999	The household ID number. Values must be unique positive integers, and should be in ascending order.
hhsize	1 – 99	The number of persons in the household. Must equal the number of person records for the household in the raw person file
hhvehs	0 - 99	The number of autos in the household. (This could be made optional as input, as it is predicted by DaySim.)
hhwkrs	0 – 99	The number of workers in the household. (This could be made optional as input, as it is computed by DaySim from the person records.)
hhftw	0 – 99	The number of HH members with person type=full-time worker. (This could be optional as input, as it is computed by DaySim.)
hhptw	0 – 99	The number of HH members with person type=part-time worker. (This could be optional as input, as it is computed by DaySim.)
hhret	0 – 99	The number of HH members with person type=retired adult. (This could be optional as input, as it is computed by DaySim.)
hhoad	0 – 99	The number of HH members with person type=other non-working adult. (This could be optional as input, as it is computed by DaySim.)
hhuni	0 – 99	The number of HH members with person type=university student. (This could be optional as input, as it is computed by DaySim.)
hhhsc	0 – 99	The number of HH members with person type=grade school student age 16+. (This could be optional as input, as it is computed by DaySim.)
hh515	0 – 99	The number of HH members with person type=child age 5-15. (This could be optional as input, as it is computed by DaySim.)
hhcu5	0 – 99	The number of HH members with person type=child age 0-4. (This could be optional as input, as it is computed by DaySim.)

hhincome	-1 – 9999999	The household annual income, in integer dollars. (A negative value is interpreted as missing data in DaySim estimation mode.)
hhownrent	1 – 9	Household own versus rent status. (This could be optional as input, as it is not currently used in the DaySim model code.)
hhrestype	1 – 9	Household residence building type. (This could be optional as input, as it is not currently used in the DaySim model code.)
hhparcel	1 – 9999999	The ID of the parcel on which the household lives. Must be a parcel ID found in the raw parcel file.
hhhtaz	1 – 9999999	The ID of the zone in which the household lives. (This could be optional as input, as the Parcel file has the parcel-zone correspondence.)
hhexpfac	Real >= 0	The expansion factor for the household – a non-negative real number. (Is typically 1.0 in a synthetic population.)
samptype	0 - 99	The type of sample used. (This could be optional as input, as it is not used in the DaySim model code, but can be useful with survey data in model estimation to identify different sample types.)

Table 51 provides a list of fields available in the person file. Of the variables in the list, only seven (hhno, pno, pptyp, pagey, pgend, pwtyp, pstyp) are needed by DaySim as inputs in the raw data file. Four (pwpcl, pspcl, ptpass and ppaidprk) are predicted by DaySim. The rest are computed based on other data files or aren't currently used in model application and can be coded as -1 by the user. DaySim also adds one variable to the beginning of each record in the output person file ("ID" which is a sequential, unique person ID created by DaySim)

TABLE 51: PERSON FILE FORMAT

HEADER LABEL	VALID VALUES	DESCRIPTION, COMMENTS
hhno	1 - 9999999	The household ID number. Values must be unique positive integers, and should be in ascending order. Must be present in the Household file.

HEADER LABEL	VALID VALUES	DESCRIPTION, COMMENTS
pno	1 – 99	The person sequence number within the household. Values must be unique positive integers within a household, and in ascending order from 1 up to “hhsize” on the Household file.
pptyp	1 - 8	Person type (1= full time worker, 2 =part time worker, 3=non-worker age 65+, 4 = other non-working adult, 5 = university student, 6 = grade school student/child age 16+, 7 = child age 5-15, 8 = child age 0-4. (There could be a switch to make this optional and compute it within DaySim for synthetic populations based on ACS PUMS. For other survey data, the coding and rules may be more variable and better done outside DaySim.)
pagey	0 – 99	Age in years (integer)
pgend	1 – 9	Gender (1=male, 2=female, 9=missing data for estimation)
pwtyp	0 - 2	Worker type (0=non-worker, 1=full time worker, 2=part time worker)
pwpcl	-1 - 9999999	Usual work location parcel ID. -1 for none/missing, otherwise must be a valid parcel ID present in the Parcel file.
pwtaz	-1 - 9999999	Usual work location zone ID. (This could be optional as input, as the Parcel file has the parcel-zone correspondence.)
pwautime	-1 - 9999999	The 1-way peak auto travel time between the residence and usual work parcels (a real number of minutes, -1 if no usual work location. Could be optional as input, used as output for calibration.)
pwaudist	-1 - 9999999	The 1-way peak auto travel distance between the residence and usual work parcels (a real number of miles, -1 if no usual work location. Could be optional as input, used as output for calibration.)
pstyp	0 - 2	Worker type (0=non-student, 1=full time student, 2=part time student if known – part-time distinction not used in DaySim code)
pspcl	-1 - 9999999	Usual school location parcel ID. -1 for none/missing, otherwise must be a valid parcel ID present in the Parcel file.

HEADER LABEL	VALID VALUES	DESCRIPTION, COMMENTS
pstaz	-1 - 9999999	Usual school location zone ID. (This could be optional as input, as the Parcel file has the parcel-zone correspondence.)
psautime	-1 - 9999999	The 1-way peak auto travel time between the residence and usual school parcels (a real number of minutes, -1 if no usual school location. Could be optional as input, used as output for calibration.)
psaudist	-1 - 9999999	The 1-way peak auto travel distance between the residence and usual school parcels (a real number of miles, -1 if no usual school location. Could be optional as input, used as output for calibration.)
puwmode	-1 – 9	The usual mode used to work. (This is optional, as it is a placeholder for possible models that may be added to DaySim in the future.)
puwarrp	-1 – 9	The usual arrival period at work. (This is optional, as it is a placeholder for possible models that may be added to DaySim in the future.)
puwdepp	-1 – 9	The usual departure period from work. (This is optional, as a placeholder for possible models that may be added to DaySim in the future.)
ptpass	0 – 1	Transit pass ownership (0=no, 1=yes. This is predicted by DaySim, so could be an optional input in application mode.)
ppaidprk	0 – 1	Worker has to pay to park at work (0=no, 1=yes. This is predicted by DaySim, so could be an optional input in application mode.)
pdiary	0 – 1	Survey respondent used their diary? (0=no, 1=yes. This is only relevant for survey data in estimation, so could be optional in application mode.)
pproxy	0 – 1	Survey responses by proxy? (1=no, 2=yes, 3=by mail, 9=missing. This is only relevant for survey data in estimation, so could be optional in application mode.)

HEADER LABEL	VALID VALUES	DESCRIPTION, COMMENTS
psexpfac	Real >= 0	The expansion factor for the person – a non-negative real number. (In application mode, this could be optional, since it is set equal to hhexpfac)

Zone Index File

This is often referred to as the “taz index” file. Its main purpose is to indicate to DaySim which zone numbers are valid. If there are gaps in the zone numbering (unused zone numbers), then this file is used to set up a mapping from the nominal zone numbers to an internal zone numbering that is used to compress the amount of memory used to store zone-to-zone skim matrices in memory. The file is ASCII delimited with a header record and located at “1_Inputs\8_DaySim\01_TAZ_Index\Fresno_taz_indexes.dat”. Table 52 presents format of the file.

TABLE 52: ZONE INDEX FILE FORMAT

HEADER LABEL	VALID VALUES	DESCRIPTION, COMMENTS
Zone_ID	1 – 9999999	The zone ID number used in the network software that produces skims. Values must be unique positive integers, in ascending order.
Zone_ordinal	1 – 9999999	A zone index number internal to DaySim, which is mapped to Zone_id. Values must be unique positive integers in ascending order. Value will generally begin at 1 with no gaps in numbering, although gaps are allowed.
Dest_eligible	0 or 1	A binary variable indicating whether or not a zone is eligible as a destination in Daysim. Zones that are not eligible as destinations are external zones or special park and ride lot zones.
External	0 – 99	This variable was originally used as a binary variable to indicate external zones, but was not used in the DaySim code, so it is now used to indicate a District mapping of the zones. Including a district mapping is optional – only necessary if ODShadowPricing is used, or other region-specific variables that are District-based

HEADER LABEL	VALID VALUES	DESCRIPTION, COMMENTS
xcoord	1 – 9999999	**OPTIONAL** –only needed if Transit Stop Areas are used for transit skims. The x coordinate of the zone centroid, in integer length units (typically SPF).
ycoord	1 – 9999999	**OPTIONAL** –only needed if Transit Stop Areas are used for transit skims. The x coordinate of the zone centroid, in integer length units (typically SPF).

Workers IXXI Fractions

This is a file that DaySim uses for the work location model, to set the percent of workers living in each zone that work outside the region, and the percent of jobs in each zone that are filled by workers living outside the region. DaySim does not select a usual workplace or simulate internal home-work tours for the I-X fraction of workers, and makes the X-I fraction of jobs unavailable as usual work locations for region residents. Both fractions tend to be larger towards the edges of modeled regions.

The file is ASCII delimited without a header record and located at "1_Inputs\8_DaySim\05_ixxi\Fresno_worker_ixxifractions.dat". Table 53 presents format of the file.

TABLE 53: WORKERS IXXI FRACTIONS FILE FORMAT

HEADER LABEL	VALID VALUES	DESCRIPTION, COMMENTS
Zone_ID	1 - 9999999	The zone ID number. Values must be unique positive integers, in ascending order. There must be the same number of records in the same order as in the raw Zone file.
Worker_IX Frac	0.00 - 1.00	The fraction of workers living in the zone that have a usual work location outside the modeled region (not in a destination-eligible zone)
Jobs_XIFr ac	0.00 - 1.00	The fraction of jobs in the zone that are filled by workers living outside of the region (not in a destination-eligible zone)

Park and Ride File

This file is for park and ride lot/path choice in DaySim. It is **optional**, and not needed if either (a) the park and ride mode is not included in the model for the region, or (b) the park and ride skim matrices are prepared in the network software rather than using the path choice in DaySim.

The file is ASCII delimited with a header record and located at "1_Inputs\8_DaySim\10_ParkAndRide\p_r_Nodes_2023.dat". Table 54 presents format of the file.

TABLE 54: PARK AND RIDE FILE FORMAT

HEADER LABEL	VALID VALUES	DESCRIPTION, COMMENTS
Node_ID	1 - 9999999	The park and ride node ID number. Values must be unique positive integers, in ascending order.
Zone_ID	1 - 9999999	The zone that the lot is associated in. Must be a zone ID present in the raw Zone file. May be either an internal (destination-eligible zone) or a special park and ride zone, which allows more accurate zone-to-zone skims for park and ride
xcoord	1 – 9999999	The x coordinate of the lot, in integer length units (typically SPF).
ycoord	1 – 9999999	The y coordinate of the lot, in integer length units (typically SPF).
capacity	0 – 9999999	The number of parking spaces in the lot. A value of 0 makes the lot unavailable as a choice option, but can be useful for including a lot as a placeholder for future/alternative scenarios
cost	0 – 9999999	The daily parking cost for the lot, in hundredths of monetary units (typically this is cents)

Node-to-Node Distance File

The node-to-node distance file is an input to the DaySim buffer tool. The ABM Cube process automatically generates maz-to-maz walk skim in a text format as described in Table 55. Other input, INPUT_NODE.csv, required for the buffer tool is also generated by the Cube process. With these two distance related inputs, the buffer tool generates a binary version of the distance file which is then used by DaySim for short trip distance calculations. In addition, the buffer tool generates a maz to node id correspondence, maz_node_{year}.dat, and an index file, {node_distance_file_index.txt} for DaySim to use node to node distance data.

TABLE 55: NODE TO NODE DISTANCE FILE FORMAT

FIELD	DESCRIPTION
RECORD_ID	Record id number
FROM_NODE_ID	Origin node id
TO_NODE_ID	Destination node id
DISTANCE	Shortest path distance in miles

Intersection Data File (Buffer Tool)

This file is an input to the buffer tool that generates buffered micro-zone file for DaySim. A unique measure of urban form that DaySim incorporates is the number of intersections or nodes of different types around a micro-zone. These intersection types include, dead-ends (1 link), T-intersections (3-links), and tradition intersections (4+ links), and help characterize the pattern of urban development.

The intersection data is in a CSV file and resides at "1_Inputs\8_DaySim\02_Parcel\intersection_2023_nohwys.csv". Table 56 presents contents of the file.

TABLE 56: INTERSECTION DATA FILE FORMAT

FIELD	DESCRIPTION
Id	Intersection ID number
Links	Number of links associated with node
xcoord_p	X coordinate – state plane feet
ycoord_p	Y coordinate – state plane feet

This file is automatically generated in the input processing step.

Transit Stops File (Buffer Tool)

This file is an input to the buffer tool that generates buffered micro-zone file for DaySim. In addition to using zone-level information on access times to transit, DaySim also incorporates detailed micro-zone-level information on the distance to transit by transit sub-mode. This file is created from transit network by extracting stops on transit routes.

The file is located at "1_Inputs\8_DaySim\02_Parcel\stops_transit_2023.csv". Table 57 summarizes the contents of this file.

TABLE 57: TRANSIT STOPS FILE FORMAT

FIELD	DESCRIPTION
Id	Transit stop ID number
Mode	Transit sub-mode code 1=local bus 2=express bus 3=commuter rail 4=ferry (BRT) 5=light rail
xcoord_p	X coordinate – state plane feet
ycoord_p	Y coordinate – state plane feet

When developing or updating forecast year or project alternative networks, careful consideration should be given to the location of individual bus stops. In addition to the bus stops located in urban areas of the county, it is also necessary to incorporate bus stop locations for rural transit routes into the model. This fine-grained information is used by DaySim to develop micro-zone-level estimates of access time to transit. Ideally, forecast year transit networks would include a similar level of detail. Forecast year travel model transit network do include information on stop locations as part of the network coding. However, these stop locations are constrained by the coarser travel model roadway networks, and thus may tend to make transit access times appear longer by not including stops that are on major roads included in the roadway network. This file is automatically generated in the input processing module under "DaySim Input Prepper"

Parks/Open Spaces Data Stops File

This file is an input to the buffer tool that generates buffered micro-zone file for DaySim. A unique feature of DaySim is that it incorporates measures of access to publicly accessible open space. Although open space is clearly an attractor of travel for recreational, social and other purposes, typically open space is not included in travel models because the traditional "size" measures used as input to travel models, such as employment and population, are not good indicators of the attractiveness of open space (i.e. a popular park will often have no employment and no population). The open space measures incorporated into DaySim capture the proximity of each micro-zone to the nearest open space, and the amount of open space present in the buffer area around the micro-zone.

The open space park file resides at "1_Inputs\8_DaySim\02_Parcel\openspace_active_fresno.csv". Contents of the file are presented in Table 58.

TABLE 58: OPEN SPACE DATA FILE FORMAT

FIELD	DESCRIPTION
Id	Open space ID number
xcoord_p	X coordinate – state plane feet
ycoord_p	Y coordinate – state plane feet
Sqft	Open space grid cell size in sq ft

The individual records in the open space file are based on converting a shapefile of regional, publicly accessibility open spaces into a smaller set of open space grid cells.

Appendix C provides details of the procedure to create this input file.

Coefficient Files

Coefficient for each model is a separate text file (.F12 format) that can be edited by the user for calibration purpose. There are a total of 23 files corresponding to all the models described in section 5.9. All coefficient files are in the same directory at 1_Inputs\8_DaySim\07_Coefficients. For example, the person day pattern model coefficient is a file named IndividualPersonDayPatternCoefficients_Nash-v1.8.F12. Figure 40 provides an example of a coefficient file.

```
Auto availability auto27.ALO
Created by ALOGIT version 4                          22:08:29 on 30 Dec 20
END
 1 Beta000001 F -3.75488401423
 2 Beta000002 F -1.43947756024
 3 Beta000003 F -3.25364812373
 4 Beta000004 F -4.30330562145
 5 Beta000005 F -4.05176795548
 6 Beta000006 F -1.41819142329
 7 Beta000007 F -1.47531914845
 8 Beta000008 F -3.13089802675
 9 Beta000009 F -3.33391748513
 10 Beta000010 F -0.59233491336
 11 Beta000011 F -0.30703688340
 12 Beta000012 F -0.96373295824
 13 Beta000013 F -2.56166024388
 14 Beta000014 F -0.55021635237
 15 Beta000015 F -0.20725368004
 16 Beta000016 F -0.23469785064
  18 Beta000018 F   0.29809501011
  19 Beta000019 F   0.97804158764
  20 Beta000020 F   0.34302331597
  22 Beta000022 F   -0.56184165791
  24 Beta000024 F   -0.07875177966
  25 Beta000025 F   0.27622060968
  26 Beta000026 F   0.07021559821
  28 Beta000028 F   0.00229947670
  29 Beta000029 F   -0.78751694870
  31 Beta000031 F   2.66149521117
```

FIGURE 40: COEFFICIENT FILE EXAMPLE

Roster File

The Roster file is a very convenient and flexible way to define which skim matrices are used for all modes/path types and level-of-service (LOS) variables, for all times of day. The roster file is here: “1_Inputs\8_DaySim\06_Roster\roster_mz.csv”.

The Roster file must also be in CSV format and must include the columns listed below and shown in the example below.

- **#variable**: A variable label, as referred to in DaySim code
- **mode**: A mode label, as referred to in the DaySim code and present in the RosterCombinations file
- **path-type**: A path type label, as referred to in the DaySim code, and the mode/path type combination must be TRUE in the RosterCombinations file In the example, the “walk”, “bike”, “sov”, “hov2” and “hov3” are input only for the “full-network” path type, while separate “transit” skims are input for five different path types.
- **vot-group**: A value of time class, with boundaries set in the configuration file. Valid names are very-low, low, medium, high, very-high, or all.
- **start-minute** and **end-minute:** The time period for which the skim matrix applies, in minutes past midnight. For example, 0-1439 is the entire day, and 360-539 is 6:00 am to

8:59 am. For each variable/mode/path-type/vot-group combination, the skims should cover all minutes from 0 to 1439. An example is the last 5 lines above for toll, for 5 time periods. The last period 1110-179 spans midnight, and is 6:30 pm to 2:59 am.

- **length:** The "zone" system used for the matrix. "maxzone" uses Zone, "transitstop" uses TransitStopArea, "null" just returns a value of 0 instead of reading in a matrix (in which case the "file-type" and "name" columns should also be "null").
- **file-type**: The format of the file. Valid types are:
  - **text-ij:** Text files with a record for each I-J zone pair that can contain more than 1 skim variable. Column 1 of the text file is always the I zone and column 2 the J zone.
  - **transcad**: Native binary format written by TransCAD-requires a valid TransCAD license to be installed when running.
  - **cube**: Native binary format written by Cube. Requires a valid Cube license to be installed when running.
  - **emme**: Native binary format written to EMME databanks.
  - **visum-binary**: Native binary format written by Visum.
  - **hdf5**: HDF5 format, which can be written by various network packages or converters.
  - **omx**: Open Matrix format (modified HDF5), which can be written by various network packages or converters.
  - **bin:** A custom DaySim binary format, which is fastest to load, but requires pre-processing of the matrices.
  - **null:** Returns a value of 0. ("length" and "name" should also be set to "null")
- **name**: The matrix file name (plus the table name for HDF5 or OMX files). The directory path is assumed to be the same as for the Roster file. Note that different roster rows may refer to the same file—such as the first four rows in the example using "walkSkim.h5/1". In that case, the same matrix is used for multiple variables, but only read and stored in memory once. In the example, the toll matrices use the same table number, but different file names for the five time periods.
- **field**: The matrix number on the file for the particular variable. For "text-ij", it is the column number. For "cube" it is the Cube matrix number.
- **transpose**: This indicates that the origin and destination zones for the matrix should be "switched" and the transpose used. For example, the transpose of the AM peak transit matrices can be used to represent the PM peak period.

- **blend-variable**: This is the variable to use for "short distance blending". It is only relevant for the walk, bike and auto modes, but not for transit. In practice, this should always be set as "distance", which is what the DaySim code assumes.
- **blend-path-type**: This is the path type to use for "short distance blending". If it is set to "null", then DaySim assumes that the "blend-path-type" is the same as the "path-type" entry on the same row. It would be possible to use a different path type for the same mode if no "distance" matrix was available for "path type", but in almost all cases, the user should leave this as "null"
- **factor**: This allows one variable to be set as a factored version of another variable. In the example below, "walk" "time" is set to use the same matrix as "walk" "distance", but with a factor of 20, which assumes a walk speed of 20 minutes per mile. Similarly, "bike" "time" is set to use the same matrix as "bike" "distance", but with a factor of 6, which assumes a bike speed of 6 minutes per mile. If the entry is "null", the default factor is 1.0.
- **scaling**: This last setting causes some confusion, so deserves careful explanation. DaySim stores all matrix values in memory as 2-byte unsigned integers, which can take values between 0 and roughly 65,000. Those values are assumed to be hundredths of miles for distance, hundredths of minutes for times, hundredths of dollars (cents) for costs, and hundredths of boardings for transit boardings or transfers. So, the maximum skim values that can be stored in memory are roughly 650 miles, minutes, dollars, or boardings, which is sufficient for regional models. (Any values larger than this are capped at the maximum value.)

In most cases, the input matrices are in units of miles, minutes, or dollars. In that case, "scaling" should be set to TRUE, and DaySim will scale the values by 100 when storing them in memory, and then "unscale" them back to the original units when accessing them from memory. That is done for most of the walk, bike, and auto variables in the example, as well as transit times and boardings ("nboard").

In the example, the toll and fare matrices were already in units of cents rather than dollars, so no scaling is necessary, and "scaling" is FALSE for those variables. However, the DaySim code assumes that these costs are in dollars, so a factor of 0.1 is necessary to convert the cost in cents to a cost in dollars. In general, the rules are:

In summary, if the matrices are in units of miles, minutes or dollars, the proper setting of "scaling" is "TRUE" and "factor" is "null" (unless converting walk distance to walk time, or a similar conversion).

If the matrices are in cents, or they are already pre-scaled to hundredths of miles or hundredths of minutes, the proper setting of "scaling" is "FALSE" and "factor" is "0.01".

Roster Combinations File

The RosterCombinations file is used together with the Roster file and tells which mode-path type combinations are valid in the Roster file. A "path type" is essentially a "submode" in DaySim, such as tolled versus non-tolled networks for auto modes or local bus versus light rail (plus optional bus) networks for transit. The roster combinations file is here: "1_Inputs\8_DaySim\06_Roster\roster_combinations.csv".

The RosterCombinations file must be in .CSV format and is a matrix where the columns give the vaild mode labels for the Roster entries, and the rows give the valid "path type" labels for the Roster entries.

The format is presented in Table 59. A TRUE entry means that the mode/path type combination is valid for the matrix entries in the Roster, and a FALSE entry means that it is not valid. A TRUE entry does not mean that the path type is required, however, so using the file below would not require separate "no-tolls" matrices for the auto modes, or separate "ferry" matrices for transit – but it would allow them.

A few other things to note in this example…

There is a "park-and-ride" mode listed, but that does not require that the user provide skims for park and ride. (That is an option, but DaySim can also use its internal lot/path choice to create park and ride paths from the "sov" and "transit" skims.)

All of the path types are FALSE for the "school-bus" mode. Typically, the school bus mode uses the "hov3" skims in the models, so no separate "school-bus" skims are listed in the Roster.

The "other" mode is basically a placeholder, not currently used in the models. For BKR, we may add a "taxi-uber" mode, but that will use "hov2" skims, so all of the path types could remain FALSE.

Some DaySim users let the network software choose the best transit path, so only use a single path type. In that case, they often list the path type for all of the "transit" skims as "local-bus", but it would also be possible to list them all as "full-network", and change the RosterCombinations file so that only the "full-network" row is TRUE under transit, and all of the other rows are FALSE.

A user can add or substituted different path type names, and even different mode names, but that could require substantial corresponding changes to the DaySim code—essentially every call to PathTypeModel includes a mode label and path type label, and that combination must be TRUE in the RosterCombinations file.

TABLE 59: ROSTER COMBINATIONS FILE FORMAT

#	WALK	BIKE	SOV	HOV2	HOV3	TRANSIT	PARK-AND-RIDE	SCHOOL-BUS	OTHER

full-network	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE
no-tolls	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE
local-bus	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE
light-rail	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE
premium-bus	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE
commuter-rail	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE
ferry	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE

DaySim Configuration File

The configuration file is the main user input control file for DaySim. This file is created automatically before a DaySim run. As mentioned previously, for each feedback loop DaySim is run for four iterations. The first three iterations of DaySim run only long-term choice models (work and school location choice) to get stable shadow prices. The last iteration runs all models (long-term and short-term choice models). In all, each feedback loop generates two sets of properties files under the DaySim folder in a scenario directory: configuration.properties and configuration_shadow_price.properties.

Appendix D describes various settings available to configure a DaySim model run.

5.6 OUTPUTS

DaySim

The outputs generated from a DaySim run are stored inside a scenario folder here: "Scenarios\FC23_BASE\11_DaySim". This section describes all necessary DaySim outputs, including the intermediate outputs generated by the buffer tool which are then used in DaySim.

Buffered Micro-zone File

The buffered micro-zone file is an output from the buffer tool and used in a DaySim run. This is a space-delimited delimited ASCII text format file (.dat) with one row of data per micro-zone and is the primary file used to maintain socioeconomic information. The file begins with several fields identifying the micro-zone and describing the physical location and size of the micro-zone. Then contains fields that describe the quantity of housing, school enrollment, and employment around the micro-zone using logistic distance decay curves with 1/8th mile and quarter mile inflection points. These two distance decay curves with 1/8th and quarter mile inflection points result in "buffer 1" and "buffer 2" variables respectively which are referred to in the file format table below. In addition, the micro-zone file contains information about urban form and the transportation system on and close to the micro-zone, including the proximity to transit stops and the price and supply of parking.

Table 60 presents a list of fields available in the buffered micro-zone file.

TABLE 60: BUFFERED MICRO-ZONE FILE

FIELD	DESCRIPTION
Id	Micro-zone ID number
xcoord_p	X coordinate – state plane feet
ycoord_p	Y coordinate – state plane feet
sqft_p	Area – square feet
taz_p	TAZ number
lutype_p	Park area (square feet)
hh_p	households on micro-zone
stugrd_p	grade school enrollment on micro-zone
stuhgh_p	high school enrollment on micro-zone
stuuni_p	university enrollment on micro-zone
empedu_p	educational employment on micro-zone
empfoo_p	food employment on micro-zone
empgov_p	government employment on micro-zone
empind_p	industrial employment on micro-zone
empmed_p	medical employment on micro-zone
empofc_p	office employment on micro-zone
empret_p	retail employment on micro-zone
empsvc_p	service employment on micro-zone
empoth_p	other employment on micro-zone
emptot_p	total employment on micro-zone

FIELD	DESCRIPTION
parkdy_p	offstreet daily parking on micro-zone
parkhr_p	offstreet hourly parking on micro-zone
Ppricdyp	offstreet daily parking price
Pprichrp	offstreet hourly parking price
hh_1	households within buffer 1
stugrd_1	grade school enrollment within buffer 1
stuhgh_1	high school enrollment within buffer 1
stuuni_1	university enrollment within buffer 1
empedu_1	educational employment within buffer 1
empfoo_1	food employment within buffer 1
empgov_1	government employment within buffer 1
empind_1	industrial employment within buffer 1
empmed_1	medical employment within buffer 1
empofc_1	office employment within buffer 1
empret_1	retail employment within buffer 1
empsvc_1	service employment within buffer 1
empoth_1	other employment within buffer 1
emptot_1	total employment within buffer 1
parkdy_1	offstreet daily parking within buffer 1
parkhr_1	offstreet hourly parking within buffer 1
ppricdy1	average offstreet daily parking price within buffer 1
pprichr1	average offstreet hourly parking price within buffer 1
nodes1_1	number of single link street nodes (dead ends) within buffer 1
nodes3_1	number of three-link street nodes (T-intersections) within buffer 1

FIELD	DESCRIPTION
nodes4_1	number of 4+ link street nodes (traditional 4-way +) within buffer 1
tstops_1	number of transit stops within buffer 1
nparks_1	number of open space parks within buffer 1
aparks_1	open space area in swuare feet within buffer 1
hh_2	households within buffer 2
stugrd_2	grade school enrollment within buffer 2
stuhgh_2	high school enrollment within buffer 2
stuuni_2	university enrollment within buffer 2
empedu_2	educational employment within buffer 2
empfoo_2	food employment within buffer 2
empgov_2	government employment within buffer 2
empind_2	industrial employment within buffer 2
empmed_2	medical employment within buffer 2
empofc_2	office employment within buffer 2
empret_2	retail employment within buffer 2
empsvc_2	service employment within buffer 2
empoth_2	other employment within buffer 2
emptot_2	total employment within buffer 2
parkdy_2	offstreet daily parking within buffer 2
parkhr_2	offstreet hourly parking within buffer 2
ppricdy2	average offstreet daily parking price within buffer 2
pprichr2	average offstreet hourly parking price within buffer 2
nodes1_2	number of single link street nodes (dead ends) within buffer 2
nodes3_2	number of three-link street nodes (T-intersections) within buffer 2

FIELD	DESCRIPTION
nodes4_2	number of 4+ link street nodes (traditional 4-way +) within buffer 2
tstops_2	number of transit stops within buffer 2
nparks_2	number of open space parks within buffer 2
aparks_2	open space area in swuare feet within buffer 2
dist_lbus	distance to nearest local bus stop from micro-zone
dist_ebus	distance to nearest express bus stop from micro-zone
dist_crt	distance to nearest commuter rail stop from micro-zone
dist_fry	distance to nearest ferry stop from micro-zone
dist_lrt	distance to nearest light rail stop from micro-zone
dist_park	distance to nearest park from micro-zone

Tour File (_tour.tsv)

This file has tour-level variables for all persons predicted by a DaySim run. The file is ASCII delimited with a record and is stored here: "Scenarios\FC23_BASE\11_DaySim_tour.tsv". Table 61 presents a list of fields available in the tour file.

TABLE 61: TOUR FILE FORMAT

HEADER LABEL	VALID VALUES	DESCRIPTION, COMMENTS
id		Internal DaySim record ID
person_id		Internal DaySim record ID
person_day_id		Internal DaySim record ID
hhno	1 - 9999999	The household ID number
pno	1 – 99	The person sequence number within the household

day	1 – 99	The survey day sequence, if using multi-day survey data, or if DaySim were programmed to simulate multiple days per household (which is not a current feature).
tour	1 – 99	The tour sequence within the person-day
jtindex	0 – 99	Links to the sequence number of the tour in the JointTour file records for the HouseholdDay. (Only relevant for the H version of the models.)
parent	0 - 99	If it is a work-based subtour, the “tour” sequence number of the “parent” work tour, otherwise 0.
subtours	0 - 99	For home-based work tours, the number of work-based subtours made from the work activity of that tour.
pdpurp	1 - 9	The tour primary destination purpose (1=work, 2=school, 3=escort, 4=personal business (& medical), 5=shopping, 6=meal, 7=social (& recreation), 8=recreation (H version only) 9=medical (H version only)
tlvorig	0 - 1439	The time leaving the (sub)tour origin, in minutes after midnight (or hours*100+minute for estimation mode)
tardest	0 - 1439	The time arriving at the (sub)tour destination, in minutes after midnight (or hours*100+minute for estimation mode)
tlvdest	0 - 1439	The time leaving the (sub)tour destination, in minutes after midnight (or hours*100+minute for estimation mode)
tarorig	0 - 1439	The time arriving back at the (sub)tour origin, in minutes after midnight (or hours*100+minute for estimation mode)
toadtyp	1 - 5	Tour origin address type (1=home, 2=usual work location, 3=usual school location, 4=other location in region, 5=out of region/missing (survey data only)
tdadtyp	1 - 5	Tour destination address type (1=home, 2=usual work location, 3=usual school location, 4=other location in region, 5=out of region/missing (survey data only)

topcl	-1 - 9999999	Tour origin parcel ID. Must be a valid parcel ID present in the Parcel file.
totaz	-1 - 9999999	Tour origin zone ID. Must be a valid zone ID present in the Zone file.
tdpcl	-1 - 9999999	Tour destination parcel ID. Must be a valid parcel ID present in the Parcel file.
tdtaz	-1 - 9999999	Tour destination zone ID. Must be a valid zone ID present in the Zone file.
tmodetp	1 - 8	Tour main mode type (1=walk, 2=bike, 3=sov, 4=hov 2, 5=hov 3+, 6=walk to transit, 7=park and ride, 8=school bus, 9=TNC, 10=other – survey only)
tpathtp	1 - 8	Tour main mode path type (1=full network, 2=no-toll network, 3=local bus, 4=light rail, 5=premium bus, 6=commuter rail, 7=ferry)
tautotime	-1 - 9999999	The one-way auto travel time between the origin and destination (a real number of minutes)
tautocost	-1 - 9999999	The one-way auto toll cost between the origin and destination (a real number of dollars)
tautodist	-1 - 9999999	The one-way auto travel distance between the origin and destination (a real number of miles)
tripsh1	1 - 99	The number of trips segments on the half tour to the destination.
tripsh2	1 - 99	The number of trips segments on the half tour from the destination.
phtindx1	0 - 99	Links to the sequence number of the first half tour in the PartialHalfTour file records for the HouseholdDay. (Only relevant for the H version of the models.)
phtindx2	0 - 99	Links to the sequence number of the second half tour in the PartialHalfTour file records for the HouseholdDay. (Only relevant for the H version of the models.)

fhtindx1	0 - 99	Links to the sequence number of the first half tour in the FullHalfTour file records for the HouseholdDay. (Only relevant for the H version of the models.)
fhtindx2	0 - 99	Links to the sequence number of the second half tour in the FullHalfTour file records for the HouseholdDay. (Only relevant for the H version of the models.)
toexpfac	Real >= 0	The expansion factor for the tour – a non-negative real number. (Is set equal to hhexpfac in application mode)

Trip File

This file is an output from a DaySim run and has trip-level variables for all persons predicted by a DaySim run. The file is ASCII delimited with a record and is stored here: “Scenarios\FC23_BASE\11_DaySim_trip.tsv”. Table 62 presents a list of fields available in the trip file.

TABLE 62: TRIP FILE FORMAT

HEADER LABEL	VALID VALUES	DESCRIPTION, COMMENTS
Id		Internal DaySim record ID
Tour_id		Internal DaySim record ID
hhno	1 - 9999999	The household ID number. Values must be unique positive integers, and should be in ascending order. Must be present in the Household file.
pno	1 – 99	The person sequence number within the household. Values must be unique positive integers within a household, and match the hhno/pno combinations in the Person file
day	1 – 99	The survey day sequence, if using multi-day survey data, or if DaySim were programmed to simulate multiple days per household (which is not a current feature).
tour	1 – 99	The tour sequence within the person-day. Must match a tour present for the person-day in the Tour file.

half	1 –2	The half tour (1=to the destination, 2=from the destination)
tseg	1 - 99	The trip sequence number within the half tour.
tsvid	1 - 99	Links to a travel survey trip ID (not relevant in application mode)
opurp	0 – 10	The purpose at the trip origin (0=home, 1=work, 2=school, 3=escort, 4=personal business (& medical), 5=shopping, 6=meal, 7=social (& recreation), 8=recreation (H version only) 9=medical (H version only), 10=change mode at a park and ride lot
dpurp	0 – 10	The purpose at the trip destination (0=home, 1=work, 2=school, 3=escort, 4=personal business (& medical), 5=shopping, 6=meal, 7=social (& recreation), 8=recreation (H version only) 9=medical (H version only), 10=change mode at a park and ride lot
oadtyp	1 – 6	Trip origin address type (1=home, 2=usual work location, 3=usual school location, 4=other location in region, 5=out of region/missing (survey data only), 6=inserted change mode location for park and ride
dadtyp	1 – 6	Trip dest. address type (1=home, 2=usual work location, 3=usual school location, 4=other location in region, 5=out of region/missing (survey data only), 6=inserted change mode location for park and ride
opcl	-1 - 9999999	Trip origin parcel ID. Must be a valid parcel ID present in the Parcel file.
otaz	-1 - 9999999	Trip origin zone ID. Must be a valid zone ID present in the Zone file.
dpcl	-1 - 9999999	Trip destination parcel ID. Must be a valid parcel ID present in the Parcel file.
dtaz	-1 - 9999999	Trip destination zone ID. Must be a valid zone ID present in the Zone file.
mode	1 - 8	Trip mode (1=walk, 2=bike, 3=sov, 4=hov 2, 5=hov 3+, 6=walk to transit, 7=park and ride, 8=school bus, 9=TNC, 10=other – survey only)

pathtype	1 - 8	Trip path type (1=full network, 2=no-toll network, 3=local bus, 4=light rail, 5=premium bus, 6=commuter rail, 7=ferry)
dorp	0 - 999	For auto trips, 1=driver, 2=passenger; for transit trips, is set to the total walk access+egress time, in integer minutes
deptm	0 – 1439	The trip departure time, in minutes after midnight (or hours*100+minute for estimation mode)
arrtm	0 – 1439	The trip arrival time, in minutes after midnight (or hours*100+minute for estimation mode)
endacttm	0 – 1439	The end time of the destination activity, in minutes after midnight (or hours*100+minute for estimation mode)
travtime	-1 - 9999999	The travel time by the trip mode and path type (a real number of minutes)
travcost	-1 - 9999999	The travel cost by the trip mode and path type (a real number of dollars)
travdist	-1 - 9999999	The network distance between the trip origin and destination (a real number of miles, SOV distance used for transit trips)
trexpfac	Real >= 0	The expansion factor for the trip – a non-negative real number. (Is set equal to hhexpfac in application mode)

Household and Household Day Files

These files are outputs from a DaySim run. The household and household day output files append the model predicted information into the household input files. Household output file is in the same format as the input file in Table 50. The household file is here: "Scenarios\FC23_BASE\11_DaySim_household.tsv"

The household day output file is here: "Scenarios\FC23_BASE\11_DaySim_household_day.tsv". Table 63 presents the format of the file. Table 63 presents a list of fields available in the household day file.

TABLE 63: HOUSEHOLD DAY FILE FORMAT

HEADER LABEL	VALID VALUES	DESCRIPTION, COMMENTS

id		Internal DaySim record ID
hhno	1 - 9999999	The household ID number. Values must be unique positive integers, and should be in ascending order. Must be present in the Household file.
day	1 – 99	The survey day sequence, if using multi-day survey data, or if DaySim were programmed to simulate multiple days per household (which is not a current feature).
dow	1 - 7	The day of the week, which is relevant for survey data, but is not currently used in the DaySim models.
jttours	0 - 99	The number of fully joint tour records output for the household. (Is set only in the H version of the DaySim models.)
phtours	0 - 99	The number of partially joint half tour records output for the household. (Is set only in the H version of the DaySim models.)
fhtours	0 - 99	The number of fully joint half tour records output for the household. (Is set only in the H version of the DaySim models.)
hdexpfac	Real >= 0	The expansion factor for the household-day – a non-negative real number. (Is set equal to hhexpfac in application mode)

Person and Person Day Files

The person output file is in the same format as the input person file in Table 51. The person file is here: “Scenarios\FC23_BASE\11_DaySim_person.tsv”

The person-day output file has the person-day-level variables from a DaySim run. The file is here: “Scenarios\FC23_BASE\11_DaySim_person_day.tsv”. The format of the file is shown in Table 64.

TABLE 64: PERSON DAY FILE FORMAT

HEADER LABEL	VALID VALUES	DESCRIPTION, COMMENTS
id		Internal DaySim record ID
person_id		Internal DaySim record ID

HEADER LABEL	VALID VALUES	DESCRIPTION, COMMENTS
household_day_id		Internal DaySim record ID
hhno	1 - 9999999	The household ID number. Values must be unique positive integers, and should be in ascending order. Must be present in the Household file.
pno	1 – 99	The person sequence number within the household. Values must be unique positive integers within a household, and match the hhno/pno combinations in the Person file
day	1 – 99	The survey day sequence, if using multi-day survey data, or if DaySim were programmed to simulate multiple days per household (which is not a current feature).
beghom	0 – 1	A flag if the survey diary day begins at home. (Not currently relevant for application mode, where all days are simulated to begin at home.)
endhom	0 – 1	A flag if the survey diary day ends at home. (Not currently relevant for application mode, where all days are simulated to end at home.)
hbtours	0 – 99	The total number of home-based tour records predicted for the person-day.
wbtours	0 – 99	The total number of work-based subtour records predicted for the person-day.
uwtours	0 – 99	The total number of home-based work tours predicted to go to the usual workplace in the person-day
wktours	0 – 99	The number of home-based work tours predicted in the person-day
sctours	0 – 99	The number of home-based school tours predicted in the person-day
estours	0 – 99	The number of home-based escort tours predicted in the person-day
pbtours	0 – 99	The number of home-based personal business tours predicted in the person-day (also includes medical tours in the Default models)
shtours	0 – 99	The number of home-based shopping tours predicted in the person-day

HEADER LABEL	VALID VALUES	DESCRIPTION, COMMENTS
mltours	0 – 99	The number of home-based meal tours predicted in the person-day
sotours	0 – 99	The number of home-based social tours predicted in the person-day (also includes recreational tours in the Default models)
retours	0 – 99	The number of home-based recreation tours predicted in the person-day. (Is only predicted by the H version of the models.)
metours	0 – 99	The number of home-based medical tours predicted in the person-day. . (Is only predicted by the H version of the models.)
wkstops	0 – 99	The number of home-based work stops predicted in the person-day
scstops	0 – 99	The number of home-based school stops predicted in the person-day
esstops	0 – 99	The number of home-based escort stops predicted in the person-day
pbstops	0 – 99	The number of home-based personal business stops predicted in the person-day (also includes medical stops in the Default models)
shstops	0 – 99	The number of home-based shopping stops predicted in the person-day
mlstops	0 – 99	The number of home-based meal stops predicted in the person-day
sostops	0 – 99	The number of home-based social stops predicted in the person-day (also includes recreational stops in the Default models)
restops	0 – 99	The number of home-based recreation stops predicted in the person-day. (Is only predicted by the H version of the models.)
mestops	0 – 99	The number of home-based medical stops predicted in the person-day. (Is only predicted by the H version of the models.)
wkathome	0 – 1439	The number of minutes spent working at home during the day. (Is only predicted by the H version of the models.)
pdexpfac	Real >= 0	The expansion factor for the household-day – a non-negative real number. (Is set equal to hhexpfac in application mode)

Network Skims

The model produces three sets of skims: highway, transit, and non-motorized. The skims are under "Scenarios\FC23_BASE\01_Skims".

Highway

The highway skims are for two time periods (PK: peak and OK: off-peak) and three modes (D1: drive alone, S2: shared-ride 2, and S3: shared-ride 3+). In all, six highway skims are output as {Scenario_Name}_SKM_{tod}_{mode}.mat, with each containing attributes as shown in Table 65.

TABLE 65: HIGHWAY SKIM ATTRIBUTES

SKIM INDEX	ATTRIBUTE	DESCRIPTION
1	GENTIME_0Veh	Generalized time for zone pair for low value-of-time group
2	TIME_0Veh	Congested travel time (mins) for zone pair for low value-of-time group
3	DIST_0Veh	Travel distance (miles) for zone pair for low value-of-time group
4	COST_0Veh	Travel cost for zone pair for low value-of-time group
5	GENTIME_1Veh	Generalized time for zone pair for medium value-of-time group
6	TIME_1Veh	Congested travel time (mins) for zone pair for medium value-of-time group
7	DIST_1Veh	Travel distance (miles) for zone pair for medium value-of-time group
8	COST_1Veh	Travel cost for zone pair for medium value-of-time group
9	GENTIME_2Veh	Generalized time for zone pair for high value-of-time group
10	TIME_2Veh	Congested travel time (mins) for zone pair for high value-of-time group

SKIM INDEX	ATTRIBUTE	DESCRIPTION
11	DIST_2Veh	Travel distance (miles) for zone pair for high value-of-time group
12	COST_2Veh	Travel cost for zone pair for high value-of-time group

Transit

The transit skims are for two time periods (PK: peak and OK: off-peak), two sub-modes (B: bus and R: rail), and two access modes (W: walk and D: drive). In all eight transit skims are output as { scenario_name}_SKM_{tod}_T{access_mode}{mode}.mat, with each containing attributes as shown in Table 66.

TABLE 66: TRANSIT SKIM ATTRIBUTES

SKIM INDEX	SKIM ATTRIBUTE	DESCRIPTION
1	IVTT	In-vehicle travel time (mins)
2	DRV_P	
3	DRVDIST_P	
4	WLK_P	Walk access time (mins)
5	WLK_A	Walk egress time (mins)
6	WLK_X	Walk transfer time (mins)
7	IWAIT	Initial wait time (mins)
8	XWAIT	Transfer wait time (mins)
9	FARE	Fare (dollars)
10	BRDS	Number of boardings

Non-motorized

The non-motorized (bike and walk) skims are generated at micro-zone (MAZ) level. Though, walk skims are also produced at zonal (TAZ) level. The bike skim is {scenario_name}_MAZ_SKM_BIKE.mat and contains attributes as shown in Table 67.

TABLE 67: BIKE SKIM (MAZ) ATTRIBUTES

SKIM INDEX	SKIM ATTRIBUTE	DESCRIPTION
1	DIST_BIKE	Bike distance (miles) for OD pair

The MAZ and TAZ walk skims are WALK_SKIM_MAZ_MAZ_SORTED.TXT and {scenario_name}_TAZ_SKM_WALK.mat respectively. Available attributes are presented in Table 68 and Table 69.

TABLE 68: WALK SKIM (MAZ) ATTRIBUTES

FIELD	DESCRIPTION
Record_id	Record number
From_node_id	Origin node id
To_node_id	Destination node id
Distance	Distance (miles)

Note: node ids are nearest nodes to micro-zones. The file “maz_node_2023.dat” provides nearest node to a micro-zone. The file is in the following format: id (mazid), node_id (nearest node id).

TABLE 69: WALK SKIM (TAZ) ATTRIBUTES

SKIM INDEX	SKIM ATTRIBUTE	DESCRIPTION
1	TIME_WALK	Walk travel time (mins) for OD pair
2	DIST_WALK	Walk distance (miles) for OD pair

Assignment Results

Assignment results are output in “Scenarios\FC23_BASE\09_Assignment”.

Highway

The highway assignment results are output in a CUBE network format "FC23_BASE_LOADEDNETWORK_DETAIL.NET"), as well as in a database file format ("FC23_BASE_LOADEDNETWORK_DETAIL.DBF"). Both outputs contain attributes as shown in Table 70.

TABLE 70: ATTRIBUTES IN HIGHWAY ASSIGNMENT RESULT

FIELD	DESCRIPTION
A	A node
B	B node
SHAPE_LENGT	Link length (feet)
DISTANCE	Distance (miles)
CAPCLASS	Capacity class
LANES	Number of lanes
NAME	Street name
ROUTE	Route
TERRAIN	Terrain type (F or R)
JURISDICTIO	Jurisdiction
SCREENLINE	Screen line id
SPEED	Speed (mph)
AREATYP	Area type (R-rural, U-urban, SU-suburban)
FACTYP	Facility type 0: local 1: Freeway 2: Highway

FIELD	DESCRIPTION
	3: Expressway 4: Arterial 5: Collector 6: Local 7: Ramp-Freeway-Freeway 8: Ramp-Slip 9: Ramp-Loop 10: Connector1 11: Connector2
AUX	Presence of auxiliary lane (1-yes; 0-no)
USE	Type of use
TOLL	Toll (dollars)
IMPROVED	Improvement id
A01_VOL	AB volume in AM peak hour
TOT_A01_VOL	Total (AB+BA) volume in AM peak hour
A03_VOL	AB volume in AM period
TOT_A03_VOL	Total (AB+BA) volume in AM period
M07_VOL	AB volume in MD period
TOT_M07_VOL	Total (AB+BA) volume in MD period
P01_VOL	AB volume in PM peak hour
TOT_P01_VOL	Total (AB+BA) volume in PM peak hour
P03_VOL	AB volume in PM period

FIELD	DESCRIPTION
TOT_P03_VOL	Total (AB+BA) volume in PM period
E11_VOL	AB volume in EV period
TOT_E11_VOL	Total (AB+BA) volume in EV period
D24_VOL	Daily AB volume
TOT_D24_VOL	Daily total (AB+BA) volume
A01_PAS_VOL	AB passenger car volume in AM peak hour
TOT_A01_PAS	Total (AB+BA) passenger car volume in AM peak hour
A03_PAS_VOL	AB passenger car volume in AM period
TOT_A03_PAS	Total (AB+BA) passenger car volume in AM period
M07_PAS_VOL	AB passenger car volume in MD period
TOT_M07_PAS	Total (AB+BA) passenger car volume in MD period
P01_PAS_VOL	AB passenger car volume in PM peak hour
TOT_P01_PAS	Total (AB+BA) passenger car volume in PM peak hour
P03_PAS_VOL	AB passenger car volume in PM period
TOT_P03_PAS	Total (AB+BA) passenger car volume in PM period
E11_PAS_VOL	AB passenger car volume in EV period
TOT_E11_PAS	Total (AB+BA) passenger car volume in EV period
D24_PAS_VOL	Daily AB passenger car volume
TOT_D24_PAS	Daily total (AB+BA) passenger car volume
A01_XX_VOL	AB external volume in AM peak hour

FIELD	DESCRIPTION
TOT_A01_XX_	Total (AB+BA) external volume in AM peak hour
A03_XX_VOL	AB external volume in AM period
TOT_A03_XX_	Total (AB+BA) external volume in AM period
M07_XX_VOL	AB external volume in MD period
TOT_M07_XX_	Total (AB+BA) external volume in MD period
P01_XX_VOL	AB external volume in PM peak hour
TOT_P01_XX_	Total (AB+BA) external volume in PM peak hour
P03_XX_VOL	AB external volume in PM period
TOT_P03_XX_	Total (AB+BA) external volume in PM period
E11_XX_VOL	AB external volume in EV period
TOT_E11_XX_	Total (AB+BA) external volume in EV period
D24_XX_VOL	Daily AB external volume
TOT_D24_XX_	Daily total (AB+BA) external volume
A01_TS_VOL	AB small truck volume in AM peak hour
TOT_A01_TS_	Total (AB+BA) small truck volume in AM peak hour
A03_TS_VOL	AB small truck volume in AM period
TOT_A03_TS_	Total (AB+BA) small truck volume in AM period
M07_TS_VOL	AB small truck volume in MD period
TOT_M07_TS_	Total (AB+BA) small truck volume in MD period
P01_TS_VOL	AB small truck volume in PM peak hour

FIELD	DESCRIPTION
TOT_P01_TS_	Total (AB+BA) small truck volume in PM peak hour
P03_TS_VOL	AB small truck volume in PM period
TOT_P03_TS_	Total (AB+BA) small truck volume in PM period
E11_TS_VOL	AB small truck volume in EV period
TOT_E11_TS_	Total (AB+BA) small truck volume in EV period
D24_TS_VOL	Daily AB small truck volume
TOT_D24_TS_	Daily total (AB+BA) small truck volume
A01_MED_VOL	AB medium truck volume in AM peak hour
TOT_A01_MED	Total (AB+BA) medium truck volume in AM peak hour
A03_MED_VOL	AB medium truck volume in AM period
TOT_A03_MED	Total (AB+BA) medium truck volume in AM period
M07_MED_VOL	AB medium truck volume in MD period
TOT_M07_MED	Total (AB+BA) medium truck volume in MD period
P01_MED_VOL	AB medium truck volume in PM peak hour
TOT_P01_MED	Total (AB+BA) medium truck volume in PM peak hour
P03_MED_VOL	AB medium truck volume in PM period
TOT_P03_MED	Total (AB+BA) medium truck volume in PM period
E11_MED_VOL	AB medium truck volume in EV period
TOT_E11_MED	Total (AB+BA) medium truck volume in EV period
D24_MED_VOL	Daily AB medium truck volume

FIELD	DESCRIPTION
TOT_D24_MED	Daily total (AB+BA) medium truck volume
A01_HVY_VOL	AB heavy truck volume in AM peak hour
TOT_A01_HVY	Total (AB+BA) heavy truck volume in AM peak hour
A03_HVY_VOL	AB heavy truck volume in AM period
TOT_A03_HVY	Total (AB+BA) heavy truck volume in AM period
M07_HVY_VOL	AB heavy truck volume in MD period
TOT_M07_HVY	Total (AB+BA) heavy truck volume in MD period
P01_HVY_VOL	AB heavy truck volume in PM peak hour
TOT_P01_HVY	Total (AB+BA) heavy truck volume in PM peak hour
P03_HVY_VOL	AB heavy truck volume in PM period
TOT_P03_HVY	Total (AB+BA) heavy truck volume in PM period
E11_HVY_VOL	AB heavy truck volume in EV period
TOT_E11_HVY	Total (AB+BA) heavy truck volume in EV period
D24_HVY_VOL	Daily AB heavy truck volume
TOT_D24_HVY	Daily total (AB+BA) heavy truck volume
A01_TRK_VOL	AB truck volume in AM peak hour
TOT_A01_TRK	Total (AB+BA) truck volume in AM peak hour
A03_TRK_VOL	AB truck volume in AM period
TOT_A03_TRK	Total (AB+BA) truck volume in AM period
M07_TRK_VOL	AB truck volume in MD period

FIELD	DESCRIPTION
TOT_M07_TRK	Total (AB+BA) truck volume in MD period
P01_TRK_VOL	AB truck volume in PM peak hour
TOT_P01_TRK	Total (AB+BA) truck volume in PM peak hour
P03_TRK_VOL	AB truck volume in PM period
TOT_P03_TRK	Total (AB+BA) truck volume in PM period
E11_TRK_VOL	AB truck volume in EV period
TOT_E11_TRK	Total (AB+BA) truck volume in EV period
D24_TRK_VOL	Daily AB truck volume
TOT_D24_TRK	Daily total (AB+BA) truck volume
A01_ASG_SP	AB speed in AM peak hour
A03_ASG_SP	AB speed in AM period
M07_ASG_SP	AB speed in AM period
P01_ASG_SP	AB speed in PM peak hour
P03_ASG_SP	AB speed in PM period
E11_ASG_SP	AB speed in EV period
D24_ASG_SP	Average daily AB speed
AIRBASIN	
LOS_AM	Level of service in AM period
LOS_MD	Level of service in MD period
LOS_PM	Level of service in PM period

FIELD	DESCRIPTION
LOS_EV	Level of service in EV period
LOS_AM1HR	Level of service in AM peak hour
LOS_PM1HR	Level of service in PM peak hour
TSM	
EJ	
A03_DA	AB drive alone volume in AM peak hour
TOT_A03_DA	Total (AB+BA) drive alone volume in AM peak hour
A03_DA	AB drive alone volume in AM period
TOT_A03_DA	Total (AB+BA) drive alone volume in AM period
M07_DA	AB drive alone volume in MD period
TOT_M07_DA	Total (AB+BA) drive alone volume in MD period
P01_DA	AB drive alone volume in PM peak hour
TOT_P01_DA	Total (AB+BA) drive alone volume in PM peak hour
P03_DA	AB drive alone volume in PM period
TOT_P03_DA	Total (AB+BA) drive alone volume in PM period
E11_DA	AB drive alone volume in EV period
TOT_E11_DA	Total (AB+BA) drive alone volume in EV period
D24_DA	Daily AB drive alone volume
TOT_D24_DA	Daily total (AB+BA) drive alone volume
A03_S2	AB shared-ride 2 volume in AM peak hour

FIELD	DESCRIPTION
TOT_A03_S2	Total (AB+BA) shared-ride 2 volume in AM peak hour
A03_S2	AB shared-ride 2 volume in AM period
TOT_A03_S2	Total (AB+BA) shared-ride 2 volume in AM period
M07_S2	AB shared-ride 2 volume in MD period
TOT_M07_S2	Total (AB+BA) shared-ride 2 volume in MD period
P01_S2	AB shared-ride 2 volume in PM peak hour
TOT_P01_S2	Total (AB+BA) shared-ride 2 volume in PM peak hour
P03_S2	AB shared-ride 2 volume in PM period
TOT_P03_S2	Total (AB+BA) shared-ride 2 volume in PM period
E11_S2	AB shared-ride 2 volume in EV period
TOT_E11_S2	Total (AB+BA) shared-ride 2 volume in EV period
D24_S2	Daily AB shared-ride 2 volume
TOT_D24_S2	Daily total (AB+BA) shared-ride 2 volume
A03_S3	AB shared-ride 3+ volume in AM peak hour
TOT_A03_S3	Total (AB+BA) shared-ride 3+ volume in AM peak hour
A03_S3	AB shared-ride 3+ volume in AM period
TOT_A03_S3	Total (AB+BA) shared-ride 3+ volume in AM period
M07_S3	AB shared-ride 3+ volume in MD period
TOT_M07_S3	Total (AB+BA) shared-ride 3+ volume in MD period
P01_S3	AB shared-ride 3+ volume in PM peak hour

FIELD	DESCRIPTION
TOT_P01_S3	Total (AB+BA) shared-ride 3+ volume in PM peak hour
P03_S3	AB shared-ride 3+ volume in PM period
TOT_P03_S3	Total (AB+BA) shared-ride 3+ volume in PM period
E11_S3	AB shared-ride 3+ volume in EV period
TOT_E11_S3	Total (AB+BA) shared-ride 3+ volume in EV period
D24_S3	Daily AB shared-ride 3+ volume
TOT_D24_S3	Daily total (AB+BA) shared-ride 3+ volume

Transit

The transit assignment results are available by two time periods (PK: peak and OK: off-peak), two sub-modes (B: bus and R: rail), and two access modes (W: walk and D: drive). The outputs are produced both in CUBE network format ({scenario_name}_VOL_{tod}_T{access_mode}{submode}.NET), as well as in database file format {scenario_name}_VOL_{tod}_T{access_mode}{submode}.DBF). The outputs contain attributes as shown in Table 71.

TABLE 71: ATTRIBUTES IN TRANSIT ASSIGNMENT RESULTS

FIELD	DESCRIPTION
A	Node A
B	Node B
MODE	Transit sub-mode id 1: local bus (FAX and Clovis) 2: local bus (FCRTA)
OPERATOR	Transit operator
NAME	Transit line name

FIELD	DESCRIPTION
LONGNAME	Transit line long name
DIST	Distance (miles)
TIME	Transit travel time
LINKSEQ	Link sequence
HEADWAY_2	Headway
STOPA	Is node A stop (1: yes, 0: no)
STOPB	Is node B stop (1: yes, 0: no)
VOL	Transit volume
ONA	On-boarding at node A
OFFA	Off-boarding at node A
ONB	On-boarding at node B
OFFB	Off-boarding at node B
REV_VOL	Revised transit volume
REV_ONA	Revised on-boarding at node A
REV_OFFA	Revised off-boarding at node A
REV_ONB	Revised on-boarding at node B
REV_OFFB	Revised off-boarding at node B

Non-motorized

The non-motorized assignment results are output in database file format: FC23_BASE_LOADEDNETWORK_BIKE.DBF and FC23_BASE_LOADEDNETWORK_WALK.DBF. Attributes of bike and walk assignment outputs are presented in Table 72 and Table 73.

TABLE 72: ATTRIBUTES IN BIKE ASSIGNMENT RESULTS

FIELD	DESCRIPTION
A	Node A
B	Node B
DISTANCE	Distance (miles)
CAPCLASS	Capacity class
LANES	Number of lanes
NAME	Street name
ROUTE	Route number
TERRAIN	Terrain
JURISDICTIO	Jurisdiction
SCREENLINE	Screen line id
SPEED	Posted speed (mph)
AREATYP	Area type
FACTYP	Facility type 0: local 1: Freeway 2: Highway 3: Expressway

	4: Arterial 5: Collector 6: Local 7: Ramp-Freeway-Freeway 8: Ramp-Slip 9: Ramp-Loop 10: Connector1 11: Connector2
AUX	Presence of auxiliary lane
USE	Use type
TOLL	Toll (dollars)
IMPROVED	Improvement id
BIKE_FACTY	Bike facility type : Shared Roadway (No Bikeway Designation). 1: Class I Bikeway (Bike Path). Provides a completely separated right of way for the exclusive use of bicycles and pedestrians with crossflow by motorists minimized. 2: Class II Bikeway (Bike Lane). Provides a striped lane for one-way bike travel on a street or highway. 3: Class III Bikeway (Bike Route). Provides for shared use with pedestrian or motor vehicle traffic. 4: Class IV Separated Bikeway (cycle tracks). On-street bicycle facilities that include a vertical physical barrier between the bikeway and moving traffic. 5: Separate highway overcrossings 6: Unpaved Multipurpose Trails 9: Freeways and Ramps (bicycling not permitted)
BIKE_VOL	Bike volume

TABLE 73: ATTRIBUTES IN WALK ASSIGNMENT RESULTS

FIELD	DESCRIPTION
A	Node A
B	Node B
DISTANCE	Distance (miles)
CAPCLASS	Capacity class
LANES	Number of lanes
NAME	Street name
ROUTE	Route number
TERRAIN	Terrain
JURISDICTIO	Jurisdiction
SCREENLINE	Screen line id
SPEED	Posted speed (mph)
AREATYP	Area type
FACTYP	Facility type 0: local 1: Freeway 2: Highway 3: Expressway 4: Arterial 5: Collector 6: Local 7: Ramp-Freeway-Freeway 8: Ramp-Slip

FIELD	DESCRIPTION
	9: Ramp-Loop 10: Connector1 11: Connector2
AUX	Presence of auxiliary lane
USE	Use type
TOLL	Toll (dollars)
IMPROVED	Improvement id
BIKE_FACTY	Bike facility type: Shared Roadway (No Bikeway Designation). 1: Class I Bikeway (Bike Path). Provides a completely separated right of way for the exclusive use of bicycles and pedestrians with crossflow by motorists minimized. 2: Class II Bikeway (Bike Lane). Provides a striped lane for one-way bike travel on a street or highway. 3: Class III Bikeway (Bike Route). Provides for shared use with pedestrian or motor vehicle traffic. 4: Class IV Separated Bikeway (cycle tracks). On-street bicycle facilities that include a vertical physical barrier between the bikeway and moving traffic. 5: Separate highway overcrossings 6: Unpaved Multipurpose Trails 9: Freeways and Ramps (bicycling not permitted)
WALK_VOL	Pedestrian volume

Reports and Summaries

Several summaries and reports are generated during a model run. DaySim summaries are generated in "11_DaySim\daysim_summaries" folder under the scenario folder, including the following outputs files in Table 74.

TABLE 74. DAYSIM SUMMARIES OUTPUTS

FILE	DESCRIPTION
VehAvailability.xlsm	Auto ownership summaries
WrkLocation.xlsm	Work location choice summaries
SchLocation.xlsm	School location choice summaries
DayPattern.xlsm	Person daily activity pattern summaries
TourDestination_[purpose].xlsm	Tour destination choice summaries by purpose (meal, shopping, personal business, social/recreation, escort, work-based)
TourDestination_maintenance.xlsm	Tour destination choice summaries for maintenance purpose – aggregation of shopping and personal business
TourDestination_discretionary.xlsm	Tour destination choice summaries for maintenance purpose – aggregation of meal and social/recreation
TripDestination.xlsm	Trip destination choice summaries
TourMode.xlsm	Tour mode choice summaries
TripMode.xlsm	Trip mode choice summaries
TourTOD.xlsm	Tour time of day summaries
TripTOD.xlsm	Trip time of day summaries

Highway and transit validation summaries are generated in "10_Reporting\validation\validation_summary_2023.xlsx". The summaries include traffic count validation by facility type and volume group, traffic count validation along key highway corridors, vehicle trips and vehicle miles traveled by external market, transit boarding validation, bike and walk validation, and vehicle miles traveled validation by facility type, time of day, and vehicle class.

APPENDIX A. DAYSIM CALIBRATION SUMMARIES

TABLE 75. SHARE OF HOUSEHOLDS BY VEHICLES AND DRIVERS (ACS)

	NUMBER OF VEHICLES					
No. of Drivers	**0**	**1**	**2**	**3**	**4+**	**Total**
1	17.5%	63.3%	14.2%	3.7%	1.3%	100.0%
2	4.0%	22.1%	54.2%	16.3%	3.4%	100.0%
3	2.5%	14.1%	31.0%	38.9%	13.5%	100.0%
4+	1.3%	7.7%	21.6%	29.5%	40.1%	100.0%
Total	**7.0%**	**30.0%**	**35.5%**	**18.2%**	**9.3%**	**100.0%**

TABLE 76: SHARE OF HOUSEHOLDS BY VEHICLES AND DRIVERS (ABM)

	NUMBER OF VEHICLES					
No. of Drivers	**0**	**1**	**2**	**3**	**4+**	**Total**
1	17.9%	62.8%	14.2%	3.8%	1.3%	100.0%
2	4.0%	22.4%	54.0%	16.2%	3.4%	100.0%
3	2.4%	14.6%	31.7%	38.0%	13.2%	100.0%
4+	1.3%	7.6%	21.8%	30.1%	39.1%	100.0%
Total	**7.1%**	**30.1%**	**35.6%**	**18.2%**	**9.0%**	**100.0%**

TABLE 77: DIFFERENCE IN SHARE OF HOUSEHOLDS BY VEHICLES AND DRIVERS (ABM - ACS)

	NUMBER OF VEHICLES					
No. of Drivers	0	1	2	3	4+	Total
1	2.4%	-0.7%	0.0%	2.7%	-2.2%	0.0%
2	-1.3%	1.3%	-0.2%	-0.2%	-2.3%	0.0%
3	-3.9%	3.7%	2.3%	-2.3%	-2.0%	0.0%
4+	6.1%	-0.7%	1.1%	2.1%	-2.3%	0.0%
Total	**1.2%**	**0.3%**	**0.3%**	**-0.3%**	**-2.2%**	**0.0%**

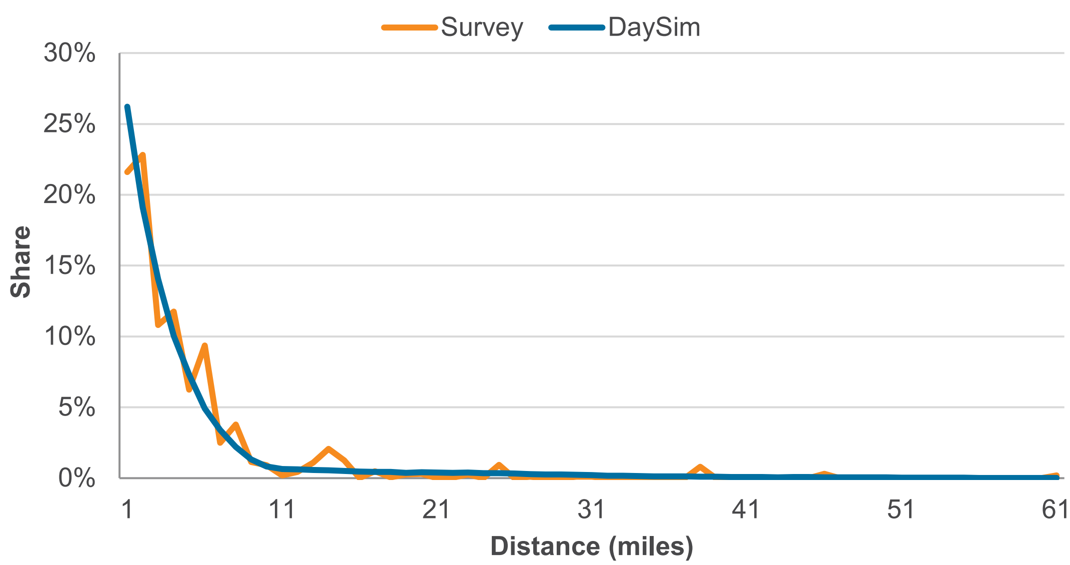


FIGURE 41: TOUR LENGTH DISTRIBUTION FOR DISCRETIONARY TRAVEL

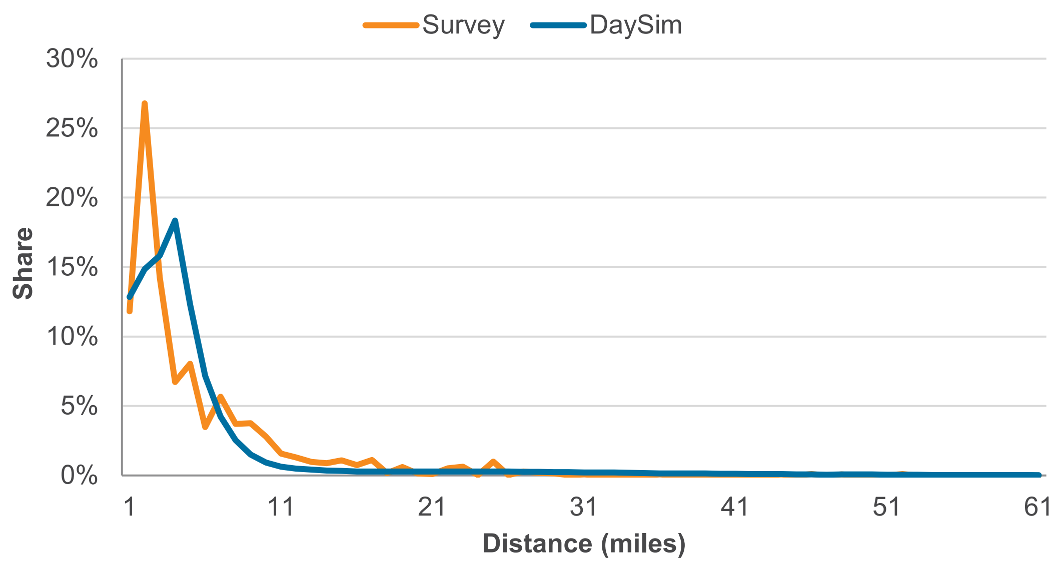


FIGURE 42: TOUR LENGTH DISTRIBUTION FOR MAINTENANCE TRAVEL

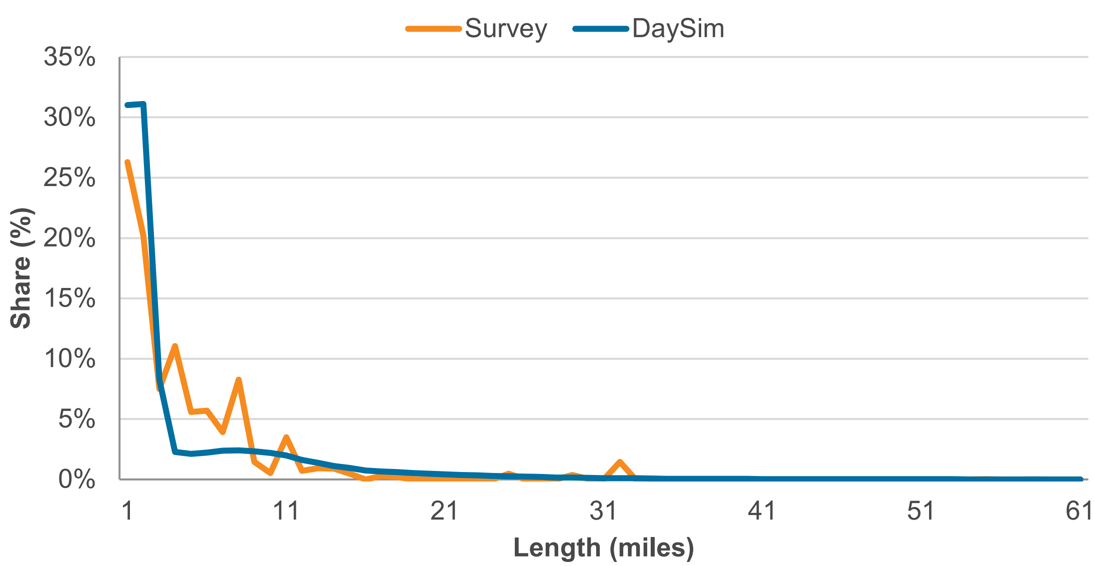


FIGURE 43: TOUR LENGTH FREQUENCY DISTRIBUTION FOR ESCORT TRAVEL

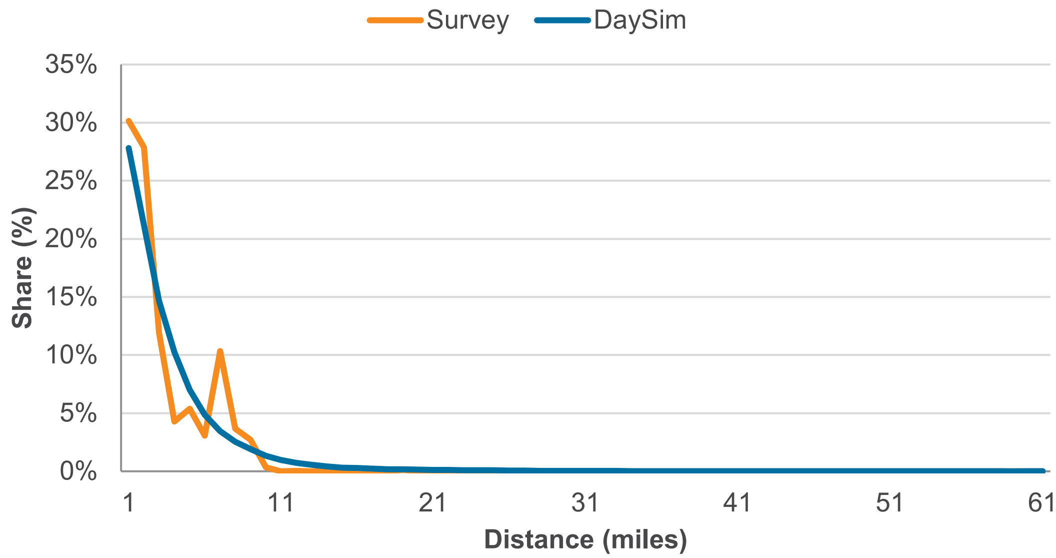


FIGURE 44: TOUR LENGTH FREQUENCY DISTRIBUTION FOR WORK-BASED TRAVEL

TABLE 78: TOUR MODE SHARES (CCTS)

MODE	WORK	SCHOOL	ESCORT	OTHER	WORK-BASED	TOTAL
Drive Alone	70%	21%	1%	31%	66%	35.0%
SR2	18%	17%	43%	29%	17%	26.0%
SR3+	7%	32%	48%	27%	9%	25.7%
Drive Transit	0.7%	0.0%	0.0%	0.0%	0.0%	0.2%
Walk Transit	1.4%	1.6%	0.0%	1.2%	0.1%	1.1%
Bike	1.0%	0.7%	0.0%	2.2%	0%	1.2%
Walk	2%	13%	8%	9%	9%	7.9%
School Bus	0%	14%	0%	1%	0%	2.9%
TNC	0%	0%	0%	0%	0%	0.1%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

TABLE 79: TOUR MODE SHARES (ABM)

MODE	WORK	SCHOOL	ESCORT	OTHER	WORK-BASED	TOTAL
Drive Alone	71%	16%	0%	30%	65%	34.0%
SR2	17%	18%	42%	30%	17%	26.1%
SR3+	7%	35%	50%	28%	9%	26.9%
Drive Transit	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Walk Transit	1.4%	1.5%	0.0%	1.2%	0.1%	1.0%
Bike	0.9%	0.8%	0.0%	2.2%	0%	1.2%
Walk	2%	14%	8%	9%	10%	8.1%
School Bus	0%	14%	0%	0%	0%	2.5%
TNC	0%	0%	0%	0%	0%	0.2%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

TABLE 80: DIFF IN TOUR MODE SHARES (ABM-CCTS)

MODE	WORK	SCHOOL	ESCORT	OTHER	WORK-BASED	TOTAL
Drive Alone	1.5%	-4.4%	-0.2%	-1.1%	-1.0%	-1.0%
SR2	-0.4%	1.0%	-1.1%	0.7%	0.0%	0.2%
SR3+	-0.2%	2.3%	1.9%	1.2%	-0.1%	1.1%
Drive Transit	-0.7%	0.0%	0.0%	0.0%	0.0%	-0.1%
Walk Transit	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Bike	-0.1%	0.0%	0.0%	0.0%	0.2%	0.0%
Walk	-0.1%	1.1%	-0.3%	0.0%	0.9%	0.2%
School Bus	0.0%	-0.4%	-0.2%	-0.7%	0.0%	-0.4%
TNC	0.0%	0.4%	0.0%	0.0%	0.0%	0.1%
Total	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**

TABLE 81. TRIP MODE SHARES (CCTS)

MODE	WORK	SCHOOL	ESCORT	OTHER	WORK-BASED	TOTAL
Drive Alone	75%	21%	26%	27%	67%	40.4%
SR2	16%	21%	35%	27%	17%	23.9%
SR3+	5%	25%	31%	25%	9%	19.9%
Transit	0.8%	1.3%	0.0%	1.1%	0.1%	0.8%
Bike	1%	1%	0%	1%	0%	0.7%
Walk	3%	19%	8%	14%	7%	10.6%
School Bus	0%	11%	0%	5%	0%	3.6%
TNC	0%	0%	0%	0%	0%	0.1%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

TABLE 82. TRIP MODE SHARES (ABM)

MODE	WORK	SCHOOL	ESCORT	OTHER	WORK-BASED	TOTAL
Drive Alone	75%	17%	18%	33%	63%	40.5%
SR2	14%	17%	34%	31%	16%	23.9%
SR3+	5%	26%	35%	23%	7%	19.9%
Transit	0.9%	0.9%	0.0%	0.9%	0.0%	0.7%
Bike	1%	0%	0%	2%	0%	0.9%
Walk	4%	25%	13%	11%	13%	11.9%
School Bus	0%	13%	0%	0%	0%	2.1%
TNC	0%	0%	0%	0%	0%	0.1%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

TABLE 83. TRIP MODE SHARES (ABM-CCTS)

MODE	WORK	SCHOOL	ESCORT	OTHER	WORK-BASED	TOTAL
Drive Alone	-0.1%	-4.4%	-7.2%	6.3%	-3.8%	0.1%
SR2	-1.9%	-4.0%	-1.0%	3.7%	-1.3%	0.0%
SR3+	0.9%	1.3%	3.5%	-2.4%	-1.4%	0.1%
Transit	0.1%	-0.4%	0.0%	-0.1%	0.0%	-0.1%
Bike	-0.2%	-0.1%	0.1%	0.5%	0.2%	0.1%
Walk	1.2%	6.0%	4.8%	-3.2%	6.3%	1.3%
School Bus	0.0%	1.5%	-0.3%	-4.6%	0.0%	-1.5%
TNC	-0.1%	0.2%	0.0%	0.0%	0.0%	0.0%
Total	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**

APPENDIX B. SYNTHETIC POPULATION

This appendix describes the setup and process to generate synthetic population for the Fresno Activity-Based Model (Fresno ABM). The synthetic population is generated using PopulationSim, an open platform for population synthesis, and is automated using several Python and R scripts and Windows Command Prompt batch files.

PopulationSim is a state-of-the-art standardized population synthesis program first developed for the Oregon Department of Transportation (ODOT) and its partner agencies. It is implemented in the Python-based ActivitySim modeling framework. Software development adheres to software engineering best practices. The system is under continuous integration (CI), which means the software and documentation are automatically built and tested against sample datasets to ensure that new features do not break the code base for any user. The PopulationSim source code and technical documentation are available online at the following public GitHub repository: https://github.com/RSGInc/populationsim.

PopulationSim is implemented for the Fresno modeling region to generate the synthetic population for base year 2023. The implementation is largely automated. All the data processing scripts are written in Python and R and automated using batch files including processes to build geographic crosswalks, download Census data across various geographies, build controls, process the Public Use Microdata Sample (PUMS), running the PopulationSim software and generating validation summaries and plots. The following sections describe setting up a PopulationSim run, details of Python and R scripts, batch files, and validation.

SOFTWARE REQUIREMENTS

The software below are for a machine with Windows operating systems (Windows 7). The following software are required to run the PopulationSim setup:

- R
- Anaconda 3

R software is included with the PopulationSim setup delivered to Fresno COG and Anaconda 3 setup is delivered in a zipped package “miniforge.zip”. The zipped conda package contains two environments – one to generate crosswalks and other to run PopulationSim. The user needs to unzip the package to a separate location as the path to this location will be used to run PopulationSim.

POPULATIONSIM DIRECTORY

Figure 45 presents the directory structure for the PopulationSim setup created for Fresno. The folders and files in the directory are explained as follows:

- The *Data* directory contains various geography shapefiles (BlockGroup, CensusTract, PUMS, TAZ, and MAZ), seed data (PUMS) and downloaded census data (Census)
- The *output* folder will have the final synthetic household and person file and summary attributes after a successful run. The household and group-quarter populations are stored separately under *HH* and *GQ* directories and a total combined synthetic population results are stored under *Combined* directory. It also contains a sub-folder *DaySimFormat* to contain formatted outputs to directly use in DaySim.
- The *logs* directory is where log files of each part of the run are stored.
- The *validation* directory houses the convergence and control plots generated by the validation step.

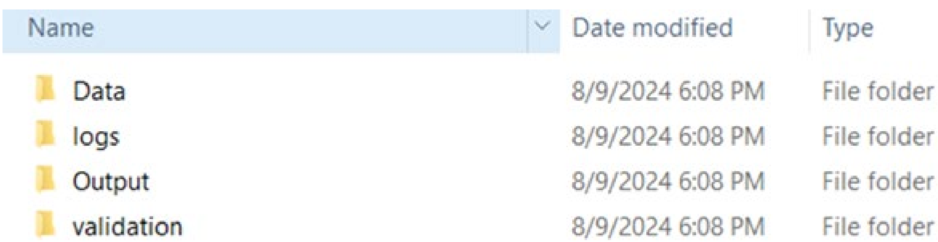


FIGURE 45: POPULATIONSIM FOLDER STRUCTURE

Additional settings for PopulationSim are stored in the “App\Setup” folder of the model. These settings only need to be changed if reconfiguring PopulationSim to new controls.

- The *configs* folder contains the **settings.yaml** file and **controls.csv** file for both household (HH) and group-quarters (GQ) setups.
- PopulationSim is configured using the **settings.yaml** file. For this project, it is configured to run in base mode which means it is run from beginning to end and produces a new synthetic population
- **controls.csv** file specifies all the targets, geography, seed table, control field and their expression to the seed table required for the PopulationSim run.
- The *data* directory holds all intermediate files that are prepared for input to PopulationSim: seeds data, control data, and crosswalks.
- **run_populationsim.py** launches a PopulationSim run. The script is used in **RunPopulationSimHH.bat** file and **RunPopulationSimGQ.bat** file.
- **RunPopulationSimHH.bat (RunPopulationSimGQ.bat)** sets paths to Anaconda install and calls the run_populationsim.py to launch a PopulationSim run. This batch file

activates the PopulationSim environment and then calls the **run_populationsim.py** Python script to launch a PopulationSim run. This batch file is called by the main batch file "**RunAll.bat**".

Run PopulationSim

The PopulationSim setup is now integrated in the Cube Catalog as a standalone feature. It must be run separately from the model run. Before starting, the user needs to configure two scenario keys – "Run_PopSim" set to 1, and "ANACONDA_DIRECTORY" set to the path of the unzipped *miniforge.zip* package. After updating these keys to appropriate values the user can then run PopulationSim by navigating to the PopulationSim module and selecting "Run" and checking "run current application only" as shown in Figure 46.

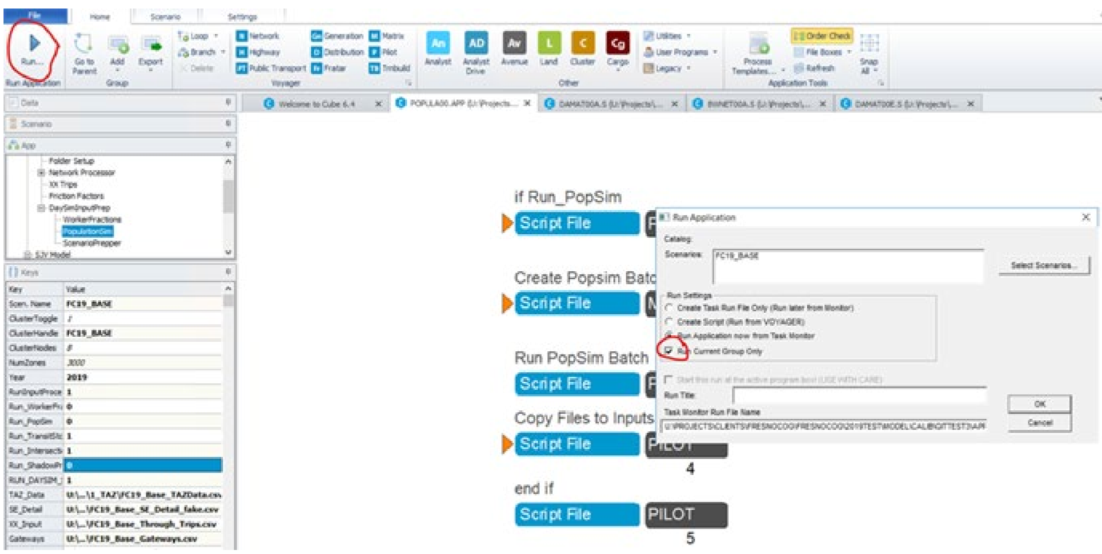


FIGURE 46: RUNNING POPULATIONSIM FROM THE CUBE CATALOG

A PopulationSim run generates outputs under "PopulationSim\\output\HH(GQ)": synthetic_households.csv and synthetic_persons.csv. These outputs are then automatically converted into DaySim format here: PopulationSim\Setup\output\daysim_format. When RUN_POPSIM_GQ is set to "YES", the outputs of the HH Run and the GQ run will automatically be processed and combined. The output will be in "PopulationSim\Setup\output\Combined". To update the population in the 2023 base year, the user should update the files described in Table 84.

TABLE 84: FILES FOR UPDATING POPULATION DATA

FILE NAME	FILE LOCATION	DATA
MazData.csv	PopulationSim\Data\Scenarios\base23	Number of Households in each MAZ
gq_maz.csv	PopulationSim\Data\Scenarios\base23	Number of University, Military, and other non-institutional group quarters in each MAZ
countyData.csv	PopulationSim\Data\Scenarios\base23	Total household population in the Fresno County

These files will determine the number of households and group quarters in each zone. The population will be generated based on the development of controls from census data.

The following section describes the processes that happen in a PopulationSim run.

Population Synthesis Procedure

PopulationSim is configured to run using a batch file and the order of execution of different steps are as follows: 1) creation of geographic crosswalk; 2) preparation of seed data and build controls; and 3) validation of ouputs.

Geography Crosswalk

The main inputs to a PopulationSim are:

- Disaggregate population samples (Seed Sample)
- Marginal control distributions (Control variables)

PopulationSim can represent both household and person level controls at multiple geographic levels. Therefore, the user must define what geographic units to use for each control. The hierarchy of geographies is important when choosing controls. The Meta geography is the entire region. Currently, PopulationSim can handle only one Meta geography. The Seed geography is the geographic resolution of the seed data. There can be one or more Seed geographies. PopulationSim can handle any number of nested Sub-Seed geographies.

The geography level (hierarchy) selected for Fresno implementation to which the marginal distributions are specified are as follows:

- Seed Geography: PUMA

- Sub-seed Geography: TAZ and MAZ

Preparing Seed and Control Data

Preparing Seed Sample

One of the main requirements for the seed sample is that it should be representative of the modeling region. It must contain all the specified control variables, as well as any variables that are needed for the travel model but not specified as controls. The seed sample is obtained from 2012-2016 5-Year PUMS data. The PUMS data contain five years of household records. The PUMS data is downloaded from PUMS website and it is extracted both demographically and geographically for the Fresno region using PUMA codes conforming to the region. There are 7 PUMA regions in the Fresno county. The seed sample must include an initial weight field. In this project, the Seed sample contains a weight field, WGTP, which is used for control of total households.

Preparing Control Data

Controls or targets are the marginal distributions that form the constraints for the PopulationSim procedure. The objective of the PopulationSim procedure is to produce a synthetic population whose attributes match these marginal distributions. Controls can be specified for both household and person variables. The choice of control variables depends on the needs of the project. The mandatory requirement for a population synthesizer is to generate the right number of households in each travel model geography. Therefore, it is mandatory to specify a control on total number of households in each geographical unit at the lowest geographical level. If this control is matched perfectly, it ensures that all the upper geographies also have the correct number of households assigned to them. Once the raw data is obtained, it is aggregated or disaggregated to the desired geography to build these controls.

Level: Region

- Person by occupation at Census Tract Level

Level: TAZ

- Households by Household Size at Block Group Level
- Households by age of householder head at Block Group Level
- Households by number of workers at Census Tract Level
- HHs by income at Census Tract Level
- HHs by presence or absence of Kids at Tract Level
- Person by age at Census Tract Level

<u>Level: MAZ</u>

- Total households

The data obtained at this level is total number of households aggregated for each MAZ. Once the control files are prepared, the total number of households and persons are calculated across geographies to check for consistency.

Validation

One of the most critical steps in population synthesis is validating the final synthetic population. Validation can give us clues about inconsistencies among controls, data processing errors or misspecification of any settings. The validation procedure implemented for Fresno PopulationSim produces a validation summary, validation chart, frequency plots and expansion factor distribution. Each of these are described briefly below:

Validation summary statistics

At a regional level, for each control, the total number of records (household/person) desired by the control, the total number of records synthesized, the difference between the synthesized totals and the control totals and the percentage difference are reported.

Statistics that inform us of convergence at a more disaggregate level are also computed – please note that these statistics are being computed for the geography at which the controls are specified i.e. MAZ, TAZ or Meta as the case might be. The following three statistics are computed as a part of this exercise:

1. The average percentage difference between the control totals and the synthesized totals,
2. The standard deviation of the percentage difference – this measure informs us of how much dispersion from the average exists, and
3. The percentage root mean square error (RMSE) - an indicator of the proximity of synthesized and control totals.

The number of geographies for which the control is non-zero (N) are also reported.

Validation Chart

The validation chart is a visualization of the disaggregate summary statistics – mean percentage difference, STDEV and RMSE of percentage differences. A form of dot and whisker plot is generated for each control where the dots are the mean percentage differences and horizontal bars are twice the STDEV or RMSE centered around zero.

Frequency Distribution Plots

These are simply frequency distribution plots of differences between control and synthesized values across the geography at which the controls were specified.

Expansion factor Distribution

While a synthetic population may match the controls well, it is important to know how uniform the household weights are, and how different they are from the initial weights. The closer the final weights are to the initial PUMS weight, higher is the chance of matching the distribution of uncontrolled variables. An expansion factor is computed for each record in the PUMS data as total final weight/initial weight. A distribution plot of these expansion factors is created for each PUMA. A good synthetic population would have most of these expansion factors as close to one as possible.

Scripts

The PopulationSim works with Python and R databases. In the existing setup, the main batch file makes system calls to various Python and R scripts.

The data processing steps required to prepare inputs for PopulationSim in the right format are implemented via Python scripts. Separate R scripts handle data processing and creates validation summaries and plots. The **RunAll.bat** file makes system calls to run these scripts. A brief description of each script is as follows:

Note that the main batch file (RunAll.bat) creates various user inputs and parameters. The main batch file writes all the user settings to a CSV file and then calls the scripts. The scripts read the CSV parameters file and calls other scripts as required. The parameters file (parameters.csv) is read by other scripts as well to read in user parameters and settings.

downloadCensusData.py

This script downloads the census data required to build controls for the PopulationSim run. Census data is downloaded from the web which creates the appropriate URL to fetch data via the Census API. Census data which is not available for download via the Census API is downloaded once and is always read from the data directory.

buildControls.py

The objective of this script is to build MAZ and TAZ controls as well as process the seeds household and person data. The main inputs are block group or tract level Census data and the existing MAZ and TAZ level data which mainly contains the number of households for each geography.

Once the Census data has been downloaded at the block group and tract level, the next step is to allocate the control data and scale it to match the households at each of the relevant geographies. Block group level data is allocated to MAZs to create MAZ level controls and tract level data is allocated to TAZs to create TAZ level controls. MAZ level data can also aggregated to TAZ geography to create TAZ level controls. The allocations are done proportional to the number of households in each lower geography. The allocation step requires two geographic crosswalks: MAZ-block group and TAZ-tract. The crosswalk creation is described in the next sub-section. The allocated data was scaled to match the total number of households for each geography as specified in the existing MAZ and TAZ level data. PopulationSim requires integer controls; therefore, the allocated data was rounded off to the nearest integer. To ensure that the resulting distribution of households sums to the total households, the difference between scaled households and target households was added to the majority category for each household variables. Similar checks were made for the population variables as well.

For person controls, first average persons in household with 4 or more persons are calculated in the PUMS data. The average persons are used to calculate total implied population in the household size category. Fresno COG provided an estimate of population in Fresno county. The estimate provided the required population in the households of 4 or more persons by taking the difference of the estimate with the implied population in households size 3 or less. Next, a factor on the average persons in household size 4 or more are calculated by taking the ratio of required population and the existing population in household size 4 or more. A new value of average persons in household size 4 or more is calculated by applying the factor to the average size from PUMS. The updated average persons are used in the calculating population at TAZ. Then the controls (age and gender) are scaled to match estimate of the Fresno population. Additionally, the census tract level population data by age includes both group quarter and household populations. The group quarter population is subtracted out from the total population in the age distribution categories using the same distribution factor of household to group quarter population from the PUMS data.

createGeogXWalks.py

This script creates the geographic crosswalk between MAZ, TAZ, PUMA, Block Group, Census Tract and Region boundaries to be used as input in the PopulationSim run. The script determines a geometrical hierarchy starting from the smallest geographical boundaries. MAZ's are described by a representative point. A representative point is similar to a polygon's centroid, but it is not allowed to be outside of the polygon. The representative point of each MAZ is mapped to a TAZ that the point is within. Next the TAZs are mapped with their representative points to the Block Group the point is within. This process is repeated with each geometry. Census shape files block groups and tracts were downloaded for Census 2010 boundaries[1].

For creating geographic crosswalks, it was assumed that each MAZ lies within a block group and correspondence can be established if the MAZ representative point lies within a block group polygon. Similar assumptions were made for TAZ centroids and Census Tracts. The crosswalk was produced with the geographies:

1. MAZ – TAZ - Block Group -Census Tract – PUMA – County

validatePopulationSim.R

The script generates standard deviation and PRMSE maps comparing generated synthetic population with controls data. The script reads “columnMapPopSim_Fresno.csv” as input from the “PopulationSim/Setup/Validation” directory. This specifies the controls which should be included in the validation process and their field names in summary views and controls tables.

popsimToDaysim(GQ).R

The script converts outputs of PopulationSim to formats required in DaySim. The script reads outputs from PopulationSim and raw PUMS data. It creates correspondence between ids in output synthetic population and PUMS data. Then it merges PUMS information to the synthetic population and calculated household and person variables as required in DaySim. The script outputs space delimited household and person files.

popsimToDaysimMerge.R

The script merges the household and group quarter daysim files into one total population and total households file. Each household and group quarter is given a unique ID and the group quarter records are appended to the household records.

mergeHHandGQ.py

The script combines the outputs from the HH PopulationSim run with the GQ PopulationSim run. It creates a unique ID for the group quarters and appends the resulting tables to the HH synthetic_households.csv and synthetic_persons.csv. This script is automatically run when RUN_POPSIM_HH or RUN_POPSIM_GQ is set to “YES” and the results are stored in “PopulationSim\setup\outputs\combined”.

Base Year (2023) Validation

This section first presents the performance of the existing PopulationSim setup and validation of the recommended controls for 2023. A base year (2023) PopulationSim run was completed with the initial setup, which included the following controls at various geographies:

1. MAZ

a. Total number of households

b. Total number of non-institutional group quarters

2. TAZ

a. Number of households by household size groups [1, 2, 3, 4+]

b. Number of households by number of workers [0, 1, 2, 3+]

c. Number of households by income groups [0-$25K, $25K-$60K, $60K-$100K, $100K+]

d. Number of persons by age groups [0-19, 20-34, 35-64,65+]

3. REGION
a. Total population
b. Persons with Management occupations
c. Persons with Professional occupations
d. Persons with Services occupations
e. Persons with Retail occupations
f. Persons with Manual occupations
g. Persons with Military occupations

Table 85 describes the source of data for each control. Note that the data was scaled to 2023 1-year ACS as described in Section 2.9.

TABLE 85. CONTROL DATA SOURCE DESCRIPTION

Control Name	Control Geography	Data Source	Tables/Variables
Total households	MAZ	Fresno MAZ Data	
HH Size 1	TAZ	2015-19 ACS Block Group	["B11016_001E" to "B11016_016E"]
HH Size 2	TAZ	2015-19 ACS Block Group	["B11016_001E" to "B11016_016E"]
HH Size 3	TAZ	2015-19 ACS Block Group	["B11016_001E" to "B11016_016E"]
HH Size 4+	TAZ	2015-19 ACS Block Group	["B11016_001E" to "B11016_016E"]
HH Income (-Inf, $25K)	TAZ	2015-19 ACS Tract	["B19001_001E" to "B19001_017E"]
HH Income [$25K, $60K)	TAZ	2015-19 ACS Tract	["B19001_001E" to "B19001_017E"]

HH Income [$60K, $100K)	TAZ	2015-19 ACS Tract	["B19001_001E" to "B19001_017E"]
HH Income [$100K, +Inf)	TAZ	2015-19 ACS Tract	["B19001_001E" to "B19001_017E"]
HH Workers 0	TAZ	2015-19 ACS Tract	["B08202_001E" to "B08202_005E"]
HH Workers 1	TAZ	2015-19 ACS Tract	["B08202_001E" to "B08202_005E"]
HH Workers 2	TAZ	2015-19 ACS Tract	["B08202_001E" to "B08202_005E"]
HH Workers 3+	TAZ	2015-19 ACS Tract	["B08202_001E" to "B08202_005E"]
HH w/ children	TAZ	2015-19 ACS Tract	["B25012_001E" to "B25012_017E"]
HH w/o children	TAZ	2015-19 ACS Tract	["B25012_001E" to "B25012_017E"]
Population age 0 to 19 years	TAZ	2015-19 ACS Tract	["B01001_001E" to "B01001_049E"]
Population age 20 to 34 years	TAZ	2015-19 ACS Tract	["B01001_001E" to "B01001_049E"]
Population age 35 to 64 years	TAZ	2015-19 ACS Tract	["B01001_001E" to "B01001_049E"]
Population age 65plus years	TAZ	2015-19 ACS Tract	["B01001_001E" to "B01001_049E"]
Non-Institutional Group Quarters	MAZ	Fresno MAZ Data	
Occupation	MAZ	Fresno MAZ Data	

We address the inconsistencies among the controls by appropriately scaling the controls to match the total number of households to the MAZ level total number of households control for each geography. The validation results from the run for 2019 are presented in Figure 47.

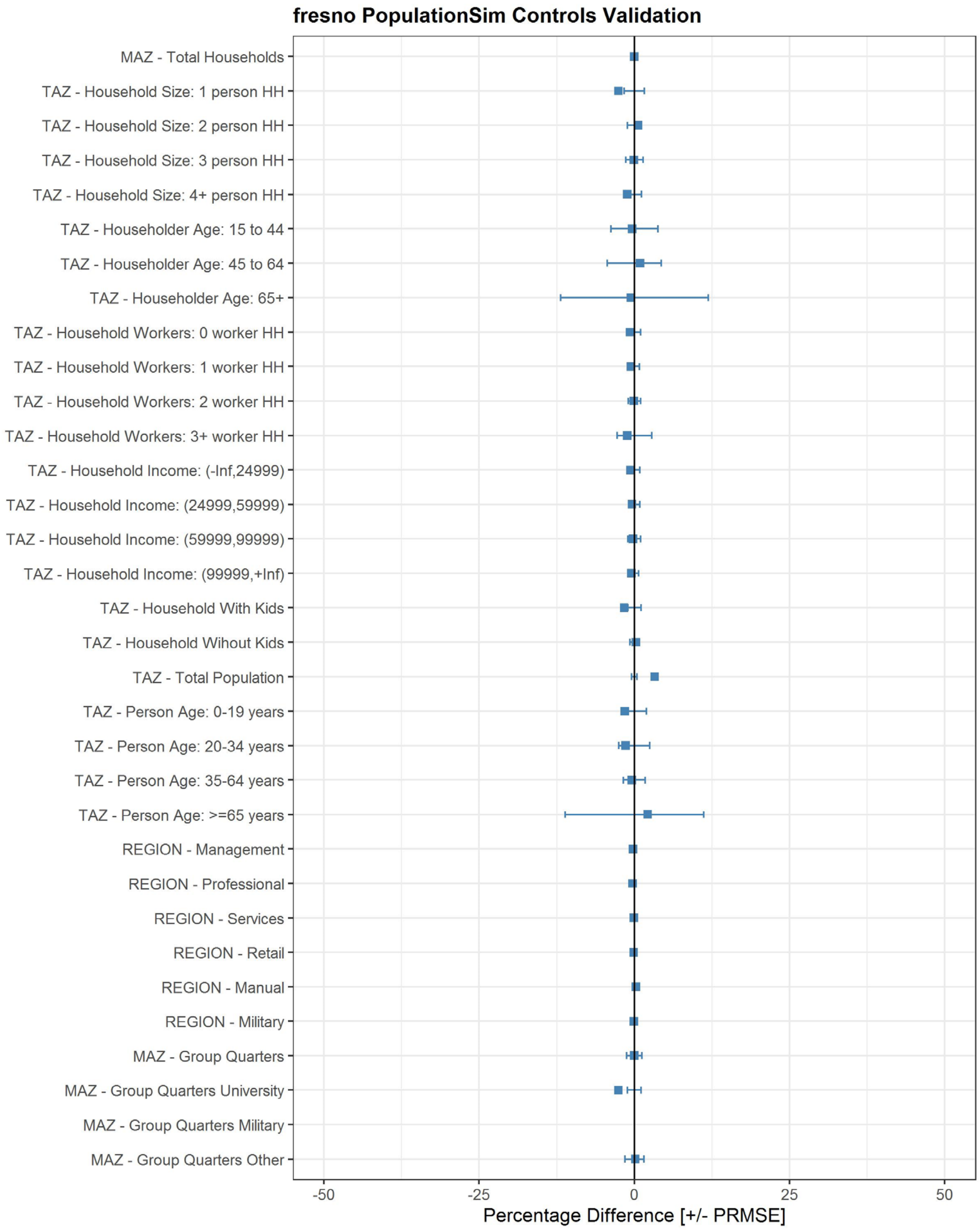


FIGURE 47. POPULATIONSIM VALIDATION – BASE YEAR (2023)

The validation results indicate that PopulationSim does reasonably well in matching the controls overall, as can be observed by the close to zero mean percentage differences across all controls. The standard deviation is also quite low for all the controls. However, some deviation can be observed for the person age group controls.

APPENDIX C. DAYSIM INPUT FILES

Input Micro-zone File

The input MAZ file, “1_Inputs\8_DaySim\02_Parcel\maz_2019_parks.csv”, provides landuse data input to DaySim. The input file is created from a shapefile provided by Fresno COG.

Table 86 presents a list of fields that are needed in the MAZ shapefile to be exported into the MAZ input file. It also describes the action required for a field, whether you need to add it as a new field or it already exists, and the field data type. If a new field is required, the corresponding field in the shapefile is provided.

TABLE 86. MAZ SHAPEFILE FIELDS

DAYSIM FIELD	DESCRIPTION
Parcelid	Unique parcel ID
xcoord_p	X coordinate of parcel centroid
ycoord_p	Y coordinate of parcel centroid
sqft_p	Square footage of parcel
taz_p	TAZ of parcel
hh_p	Total households in parcel
block_p	Census block of parcel
stugrd_p	Student gradeschool enrollment
stuhgh_p	Student high school enrollment
stuuni_p	Student university enrollment
empedu_p	NAICS 61
empfoo_p	NAICS 72
empgov_p	NAICS 92

DAYSIM FIELD	DESCRIPTION
empind_p	NAICS 22,31-33, 42, 48-49
empmed_p	NAICS 62
empofc_p	NAICS 51-56
empret_p	NAICS 44-45
empsvc_p	NAICS 71, 81
empoth_p	NAICS 11, 21, 23
emptot_p	Total employment
parkdy_p	
parkhr_p	
Ppricdyp	
Pprichrp	

This formatted CSV file should be name “maz_2019_parks.csv” and be placed in the model directory under the folder “1_Inputs\8_DaySim\02_Parcel”.

Transit Stops File

The transit stops file is created using the input transit network and is automated in the input processing step of the model. The module “Scenario Prepper” inside the ‘DaySimInputPrep’ module (Figure 48) contains the process to generate this file. It must be run after the network processor. The network is exported to a shapefile as links and nodes. A python script reads the node shapefile and processes the transit line file to read all the stop nodes with their associated transit mode. This information is joined to the coordinate data of the nodes and exported in the format shown in Figure 49.

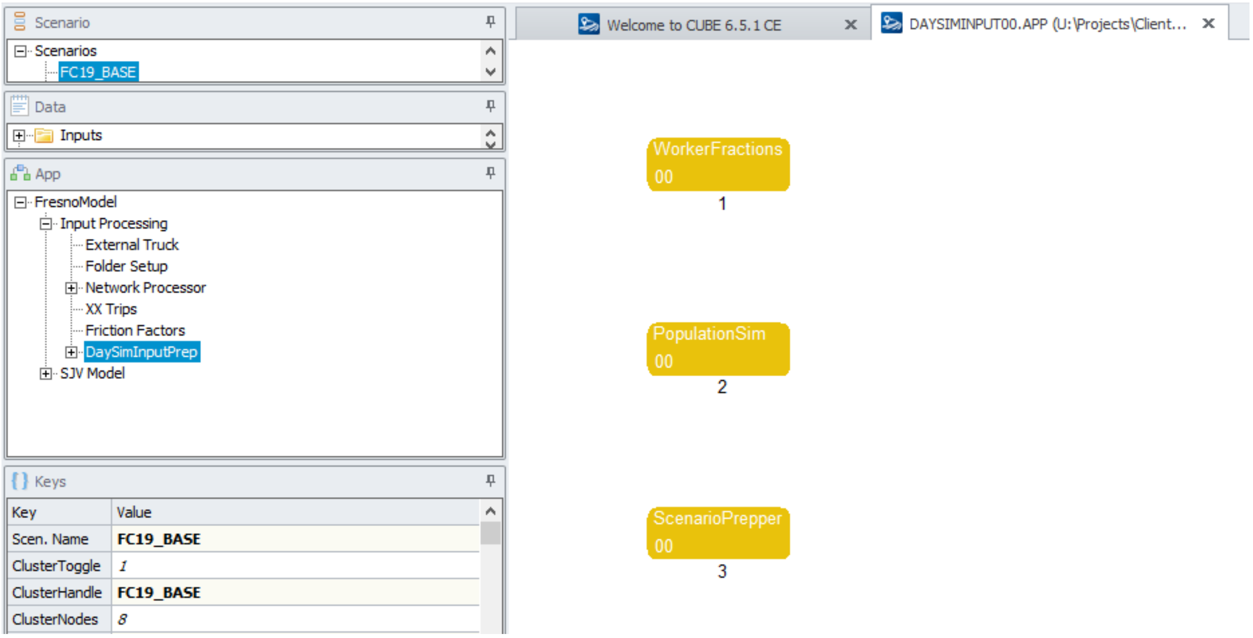


FIGURE 48. DAYSIM INPUT PREP MODULE

The stops file is in the following format:

id	mode	xcoord_p	ycoord_p
1	1	6309142	2167872
2	1	6309117	2166434
3	1	6309112	2165240
4	1	6307677	2165242
5	1	6306517	2165245
6	1	6306529	2166560
7	1	6306503	2167889
8	1	6309149	2169329
9	1	6309154	2170526
10	1	6309171	2171830
11	1	6307831	2173200
12	1	6306543	2173215
13	1	6305216	2173227
14	1	6303896	2173225
15	1	6303887	2174830

FIGURE 49. TRANSIT STOPS FILE FORMAT

Intersections File

The intersection file provides number of roads (links) at an intersection (node). The all-street network in the model is a dual road network where a two-way street is represented as one link for each direction. A two-way road is represented by two links representing to and from direction. Therefore, this network cannot simply be used to calculate number of links at an intersection. In the DaySim Input Prep Step in the cube catalog, the processed scenario network is exported as a shapefile and a python script is run to clean the network of two-way links, and determine the correct intersection density. The file is formatted and saved in the model inputs folder.

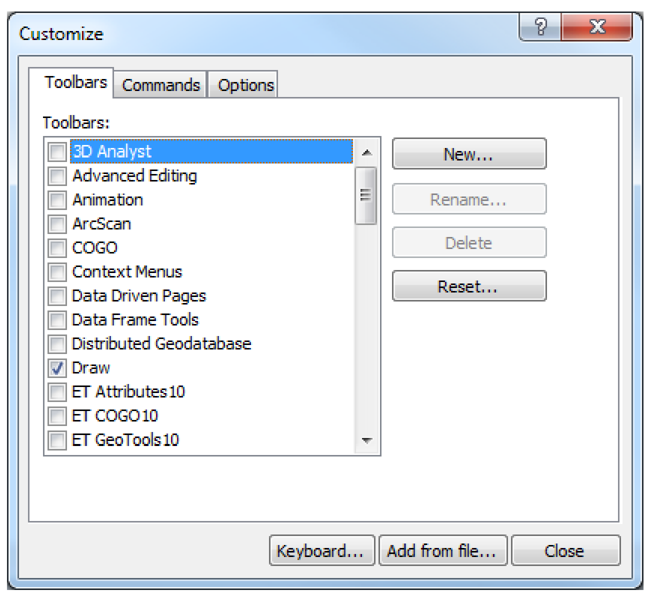
OpenSpace and Parks File

An ArcTool (ArcMap based) is created to process data in shapefile format and generate information in DaySim format. The tool is available on the Fresno ABM GitHub repository under tools.

Downloading and Installing ET Geowizards:

Continue to the next section if the current version of "ET Geowizards" is installed on the work computer.

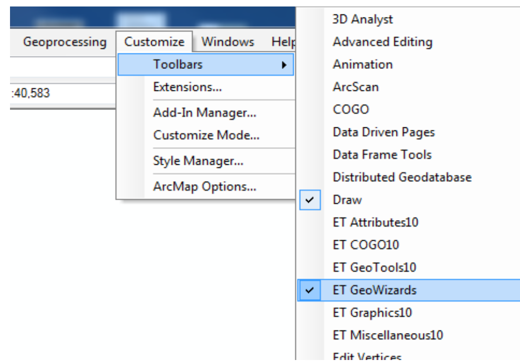
Following the steps below:



1. Locate the "ET Geowizards" installer (which can be found at the following Web address: http://www.ian-ko.com/ . *Note: Makes sure that correct installer is downloaded for the specific computer and the specific version of ArcGIS being run on that computer.
2. Install the software by following the instructions that accompany the installer file.
3. Open a new project in ArcMap
4. Click the "Customize" dropdown menu at the top of the ArcMap window→ hover over "Toolbars"→

Select “ET Geowizards” in the adjacent dropdown menu (see graphic to the right). Feel free to doc the “ET Geowizards toolbar”.

5. If “ET Geowizards” does not appear in the aforementioned dropdown menu, please recheck that the installer ran correctly. If it did install correctly, navigate to the bottom of the list of “Toolbars” and select “Customize” → a new window will appear which should look like the graphic to the right. Click on the “Add from file….” Button, and navigate to the *.dll file created by the Geowizards installer.



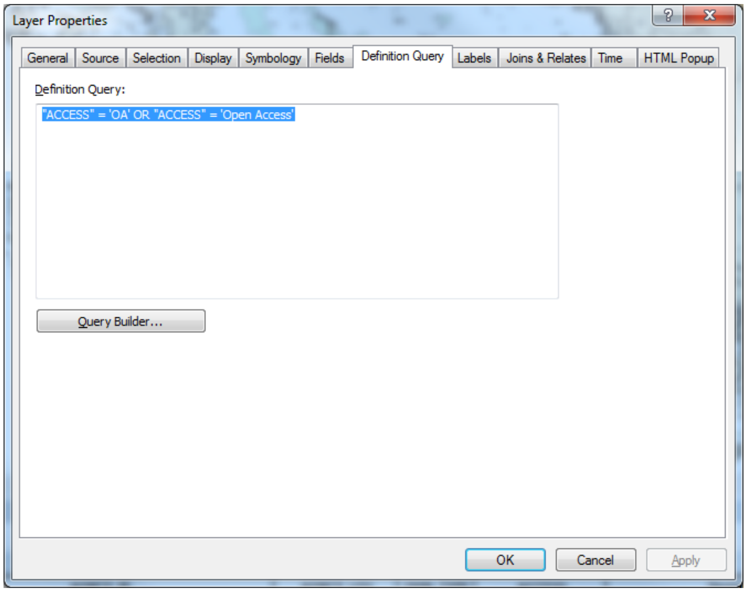
Finding Open source Representations of Protected Areas

Continue to the next section if adequate spatial representations (in polygon format) of the region’s open space areas have already been obtained.

Protected areas are locations which receive protection because of their recognized natural, *ecological* and/or cultural benefits. The USGS, as well as some state government agencies, actively monitor and inventory these areas. Spatial representations of California’s “Protected Areas” can be found here: *http://www.calands.org/* . For spatial representations of “Protected Areas” at a national level, follow this link: *http://gapanalysis.usgs.gov/data/padus-data/* *Note, the following steps use the California data, additional notes will supply directions for using the national data.

6. Navigate to the “CPAD: California Protected Areas Database” website using the link above. Download the most recently updated geospatial data. *Suggestion: download the data in *gdb format.
7. *Note: if using the national database, navigate to the second web address provided and download the equivalent data.
8. Once the data has completed downloading, open a new project in ArcMap and use the “Add Data” button  to add the shapefile (or feature class) named in the following convention “*_Holdings” (this data will be referred to as “_Holdings”).
9. Right click on the “_Holdings” file in the “Table of Contents” and select properties.
10. Navigate to the “Definition Query” tab.
11. In the box under “Definition Query:” write in the following expression:

"ACCESS" = 'OA' OR "ACCESS" = 'Open Access'

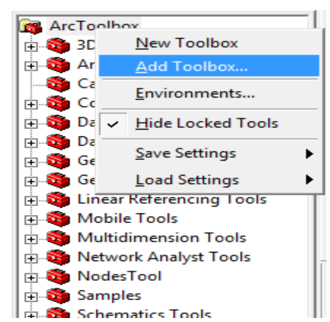


*Note: Users of the "national" database will have to determine their own qualifications for the equivalent of California's "Open Access" space

12. Add the shapefile/feature class representing the region's extent (forward referred to in the documentation as Extent").

Adding the "OpenspaceTool" to ArcToolbox

An ArcTool was created to process the data created in the previous steps.

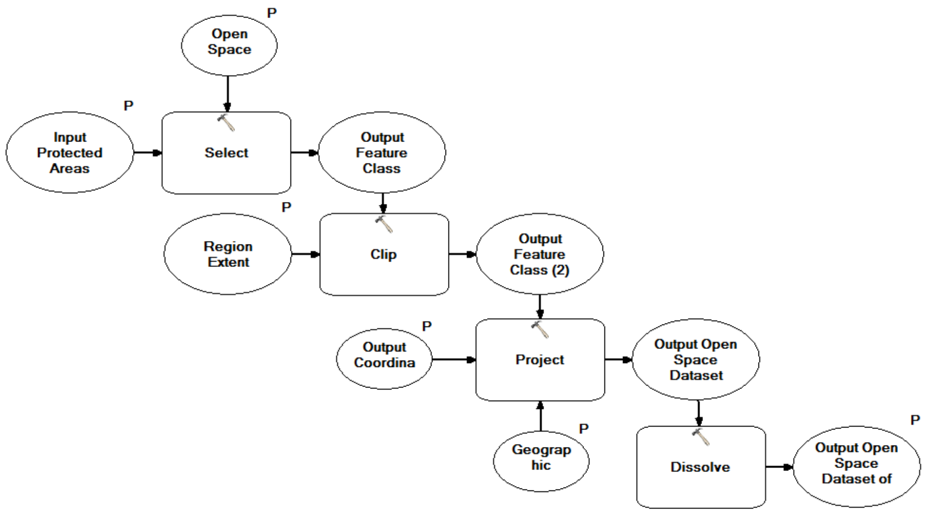


13. Open the ArcToolbox 

14. Right Click the "ArcToolbox" folder at the top of the directory and select "Add Toolbox"

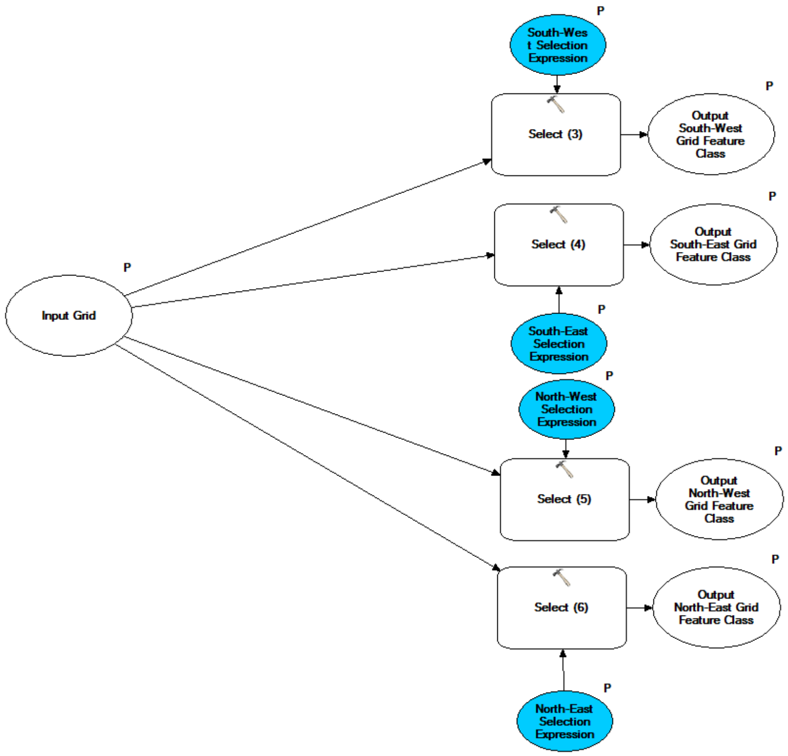
15. Locate the "ParksTool" Toolbox on the computer and select "Ok"

**Note: If problems arise with the "OpenspaceTool" Model consult the below image to understand the processes that make up the tool's operation.*



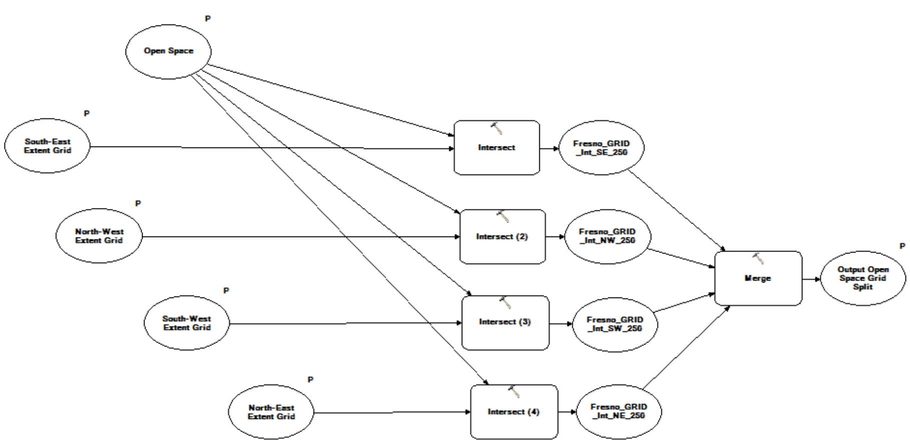
The tool first Selects the data by attribute to subset the "Open Space" data from the larger umbrella of "Protected Areas" (it is up to the user to decide what "attribute" in the database designates a feature as "Open Space", for the California Data we suggest the "ACCESS" field where attributes are either 'OA' or 'Open Access'); The tool then clips the subset to the extent of the region in question; Then, the tool projects the data into the proper projection (reminder: all data should be prepared in a common projection); Last, the output is dissolved into one feature, this output constitutes all the "Open Space" in the region in question.

*Note: If problems arise with the "Grid1" Model consult the below image to understand the processes that make up the tool's operation.



The tool merely selects data from the input grid and creates 4 new shapefiles/feature classes.

*Note: If problems arise with the “Grid2” Model consult the below image to understand the processes that make up the tool’s operation.



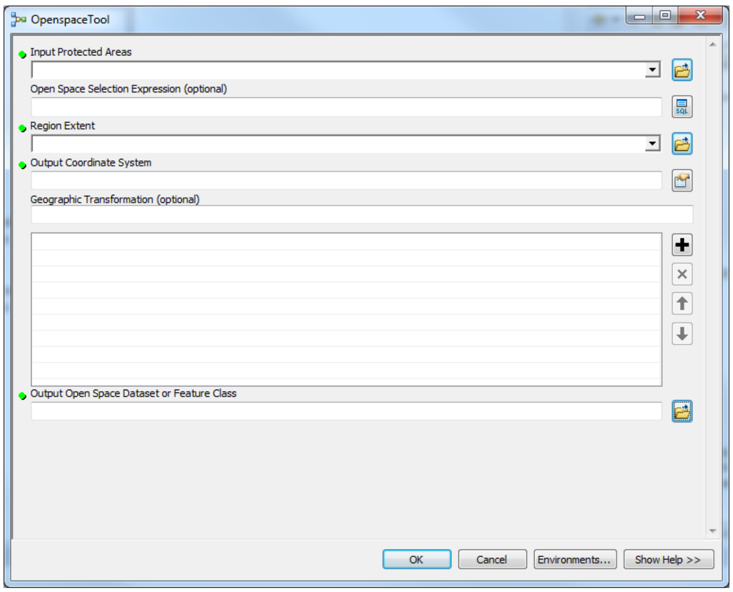
Based on user inputs the tool runs intersect the “Open Space” data with each of the 4 distinct sub-regions; once the data has been intersected, the 4 sub-regions are merged together.

Refining the "Protected Areas" data into "Open Space" Representations

NOTE: Steps 16-19 are not needed as Fresno COG provided open space that are only in Fresno County.

The following steps will use the protected areas data, "OpenspaceTool", and Geowizards Toolbar to refine and separate the data into sections.

16. Open the "OpenspaceTool" Model in the "ParksTool", a window like the one below should appear.



17. Submit the form with the following inputs:

    -Input Protected Areas: -"_HOLDINGS" feature class

    -Open Space Selection Expression (optional):-*"ACCESS" = 'OA' OR "ACCESS" = 'Open Access'*

    -Region Extent -"Extent" feature class

    -Output Coordinate System -Default Projection for Project

    -Geographic Transformation -Leave blank unless asked to fill

    -Output Open Space Dataset or Feature Class - Name/Location of Open space feature class (forward referred to in the documentation as " Extent Open Space")

18. Click "OK".

**Note: if an error occurs run the "Select Tool" → "Clip Tool" → "Project Tool" and "Dissolve Tool" to get the same results*

19. Make sure the new feature class, “Extent OpenSpace”, is added to the ArcMap display. Remove all other data in the table of contents. This new feature class represents all the “Open Space” in the region in question.

Refining “Open Space” data to create a DAYSIM Input File

The following steps: 1.) Divide the region into a grid with 250’ by 250’ grid cells; 2.) Intersect the open space data, that has already been created, with the new grid; 3.) Converts the intersected “Open Space” data into centroid points that contain area data.

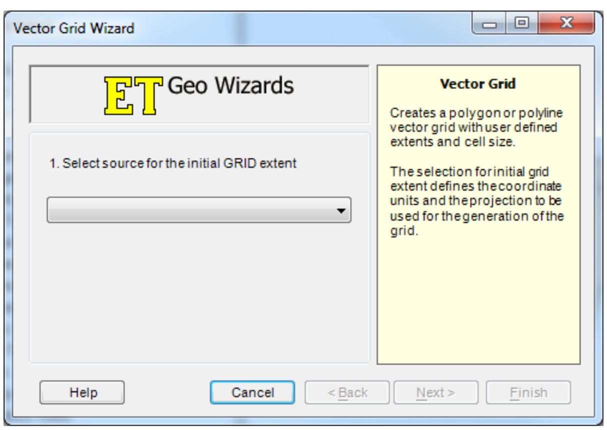
While ET Geowizards is a useful tool, there are many limitations to the tasks that the software can run. Many of the following steps concern getting around these limitations to create data that is as fine as possible. Feel free to attempt condensing the following steps into a single step (this may be possible for smaller, and/or less irregularly shaped, regions).

1. Open the “ParksExtent” excel workbook.

   *Note: the excel document will be used to calculate some values to guide the production of the grid.

2. Return to ArcMap and Click the “ET Geowizards” Toolbar 

3. Navigate to the “Sampling” Tab → Double Click on the “Vector Grid” tool. A window similar to the one below will appear.



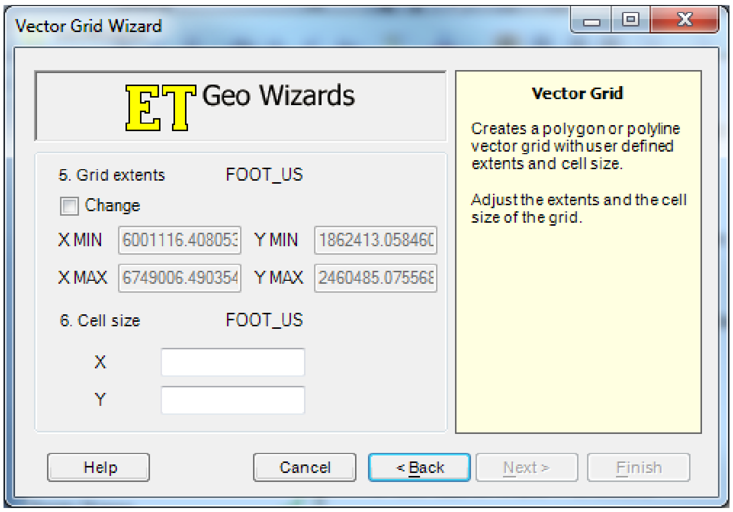
4. For object #1 “Select source for the initial GRID extent” use the “Extent OpenSpace” feature class.

5. For object #2 “Specify output feature class or shapefile” use a name and location of users choice (here forward referred to as “Extent_Grid”) → Click on the “Next>” button.

6. For #3 “Select output coordinate system”, click the “Select Output coordinate system” button and ensure that the coordinate system matches the default coordinate system for

the project. If it does not, change the projection to match the default projection for the project.

7. For object #4 “Select GRID type” select the option for “Polygon”. Click on the “Next>” button. The window should now look like this:

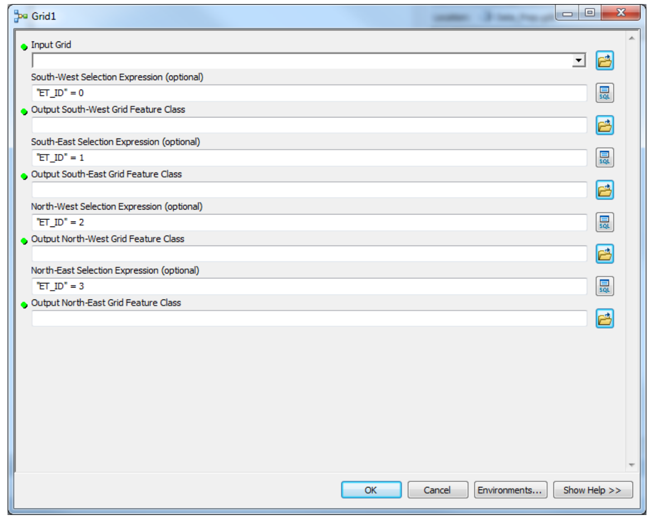


8. Object #5 “Grid extents” will need to be updated. The excel workbook generates the required values based on the region specific data. Copy the “X Min”, “X Max”, “Y Min”, and “Y Max” values into the appropriate cells in the excel workbook. The work book generates new “X Max” and “Y Max” values, copy and paste the new values into their appropriate places in Object #5.

   The values can be copied by checking “Change“. This will turn boxes to edit box and you can copy value from each cell and paste into the excel workbook.

9. For Object #6 “Cell Size”, fill in the “X” and “Y” dimensions based on the values in the excel workbook. Click the “Finish” button.

10. Once the Geowizards processes have finished running, make sure that the new feature class, “Extent Grid,” is added to the display. The region should have been split into 4 different regions: two north and two south.



11. *Note: Given the limitation of the Geowizards software, the entire region can rarely ever be converted to a 250' by 250' Grid in one step. One can make an attempt at creating the 250' by 250' Grid in one step, but should not be surprised if/when the software fails.
12. Double click on the "Grid1" Model within the "ParksTool" Toolbox. A window similar to the one to the right will open.
13. *Note, the "Grid1" Tool separates the "Extent Grid" into 4 separate files. The defaults identify Geowizards conventions to separate the region into SE, SW, NE, and NW regions. If this tool fails to run, the step can be replicated by manually selecting each region, and exporting the selected data to shapefile.

    Submit the form with the following inputs:

    -Input Grid - "Extent_Grid" feature class

    - South-West Selection Expression (optional) - "ET_ID" = 0

    -Output South-West Grid Feature class - Name/Location of choosing (forward referred to as "Extent_Grid_SW")

    - South-East Selection Expression (optional) - "ET_ID" = 1

    -Output South-East Grid Feature class- Name/Location of choosing (forward referred to as "Extent_Grid_SE")

    - North-West Selection Expression (optional) - "ET_ID" = 2

    -Output North-West Grid Feature class - Name/Location of choosing (forward referred to as "Extent_Grid_NW")

    - North-East Selection Expression (optional) - "ET_ID" = 3

    -Output North-East Grid Feature class - Name/Location of choosing (forward referred to as "Extent_Grid_NE")
14. The following steps will subdivide each of the 4 regions created by step #19 into 250 foot grid cells. Re-open the "ET Geowizards" form and navigate to the "Vector Grid" tool. Submit the form once for each region using the following inputs (* represents each of the four subdivisions):

    #1 "Select source for the initial GRID extent" - once each for all "Extent_Grid_*"

#2 “Specify output feature class or shapefile” - Name/Location of users choosing

(forward referred to as “Extent_Grid_*_250”)

#3 “Select output coordinate system”- Check that it matches the default projection for which all data is being prepared

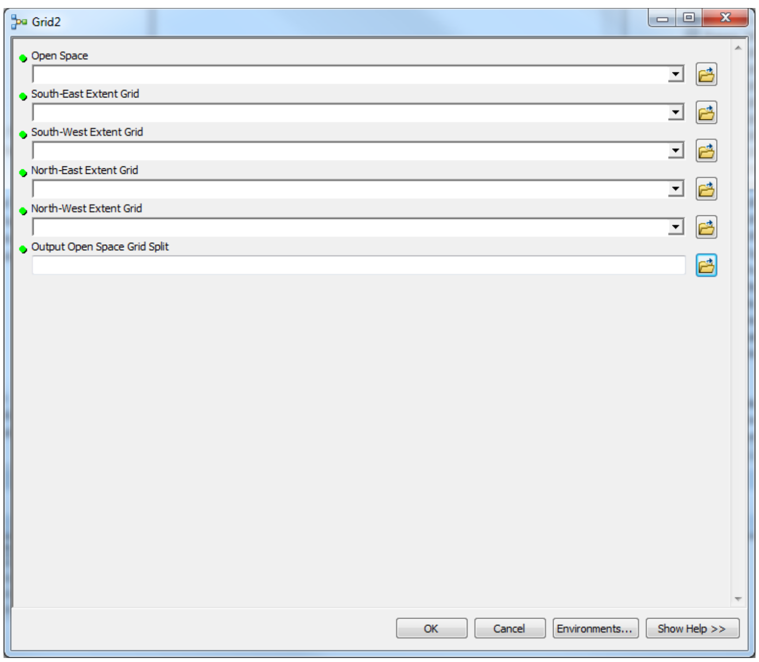
#4 “Select GRID type”- Polygon

#5 “Grid extents” - Use default

#6 “Cell Size” - both X and Y should = 250

Once generated, make sure all the “Extent_Grid_*_250” shapefiles are present in the ArcMAP display.

15. Double click the “Grid2” model within the “ParksTool” Toolbar. A window should appear matching the image below.



Fill in the appropriate fields with the following data:

“Open Space” - “Extent Open Space” feature class

“South-East Extent Grid” -“Extent_Grid_SE_250” feature class

“South-West Extent Grid” -“Extent_Grid_SW_250” feature class

“North-East Extent Grid” -“Extent_Grid_NE_250” feature class

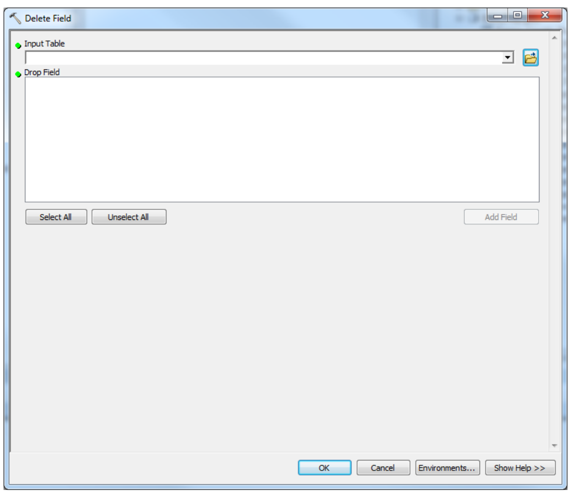
"North-West Extent Grid" -"Extent_Grid_NW_250" feature class

"Output Open Space Grid Split" - Name/Location of choosing

(forward referred to as "Extent Open Space 250")

Click the "OK" button once all fields have been properly filled. Make sure the feature class generated through this tool, "Extent Open Space 250", is added to the display.

16. Navigate to the "Delete Field" Tool in the ArcToolbox ("Data Management Tools" → "Fields" → "Delete Field"). A form like the image below should open.



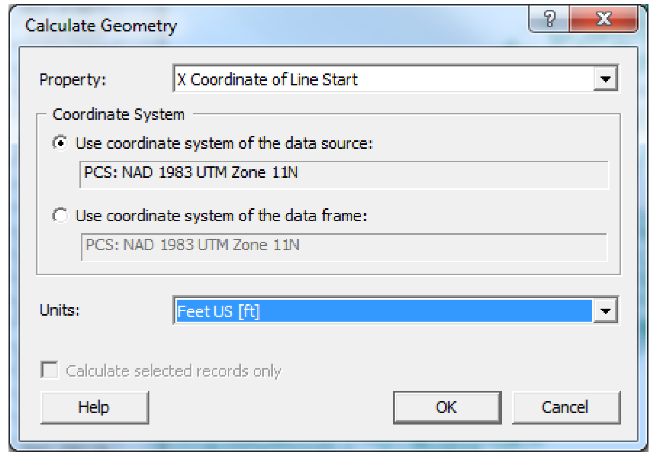
17. The "Input Table is the "Extent Open Space 250" feature class. Check the box next to all the fields present in the "Drop Field" box. Click Ok.

18. Open the "Extent Open Space 250" feature class 's attribute table to check that all fields ("ID", "FID", "Name", etc.) have been removed. **Note: some fields are structurally mandatory and cannot be removed.*

19. In the Attribute Table menu select  and click on the option to "Add Field". The "Name" will be "sqft" and the "Type" will be Long Integer.

20. Repeat the above step and add fields "xcoord_p" (Long) and "ycoord_p" (Long)

21. Right click on the "sqft" column heading and click the option to "Calculate Geometry…" The "property to be calculated" is "Area"; The Coordinate System choice is "Use coordinate system of the data source" and the Units should be "Square Feet US [sq ft]". Click "OK"



22. Right click on the "xcoord_p" column heading and click the option to "Calculate Geometry…" The "property to be calculated" is "X Coordinate of Centroid"; The Coordinate System choice is "Use coordinate system of the data source" and the Units should be "Feet US [sq ft]". Click "OK"
23. Right click on the "ycoord_p" column heading and click the option to "Calculate Geometry…" The "property to be calculated" is "Y Coordinate of Centroid"; The Coordinate System choice is "Use coordinate system of the data source" and the Units should be "Feet US [sq ft]". Click "OK".

This will give you the openspace and parks data in required DaySim format.

Future Year DaySim Inputs

Table 87 provides instructions on what DaySim inputs to update for a future scenario (DaySim inputs are here: 1_Inputs\8_DaySim):

TABLE 87. INSTRUCTIONS FOR FUTURE YEAR DAYSIM INPUTS

INPUT LOCATION	INSTRUCTION
01_TAZ_Index	Don't need to change unless your scenario has updated zone system.
02_Parcel	Need to update three input files. Open space and park file would not need to be changed, unless you know open space and park information for the future scenario which is unlikely. This appendix provides instructions to create these files: • maz_20XX_parks.csv • intersections_20XX_nohwys.csv

INPUT LOCATION	INSTRUCTION
	• stops_transit_20XX.csv
03_Household	Need to update. Output of PopSIm converted to DaySim format.
04_Person	Need to update. Output of PopSim converted to DaySim format.
05_ixxi	Update if you have share of XI and IX workers by zone (XI-outside workers working in Fresno; IX-resident workers going out for work). Otherwise, use the same as base year
06_Roster	Will automatically be updated in the input processing step.
07_Coefficients	Don’t need to change.
10_ParkAndRide	Change only if you have updated park and ride locations in the region.

APPENDIX D. DAYSIM CONFIGURATION

This appendix describes the settings used in running DaySim. Note that a Cube script creates a configuration file before a DaySim run. So, any change to a setting, filename or file path needs to be done in two Cube scripts: DAMAT00F.S (Configuration_shadow_price.properties) and DAMAT00A.S (Configuration.properties). Both configuration files have the same settings, except that some models are turned off in shadow price runs. Table 88 presents the settings in the configuration files. The column "VALUE" contains the setting as in the Configuration.properties.

TABLE 88. DAYSIM CONFIGURATION FILE (CONFIGURATION.PROPERTIES)

SETTING	VALUE	DESCRIPTION
Sampling		
HouseholdSampling RateOneInX	1	The denominator of the fraction of households in the input sample to be simulated (e.g., 100 is for 1/100)
HouseholdSampling StartWithY	1	The household number to simulate first (e.g., 2, in combination with 100 above would simulate HH 2, 102, 202, etc.)
SamplingWeights SettingsType	SamplingWeights SettingsSimple	
General Path Settings		
BasePath	[CATALOG_DIR]\1 _Inputs\8_DaySim	Base directory; all DaySim inputs will be stored
OutputSubpath	[SCENARIO_DIR]\ 11_DaySim	Output folder path; DaySim outputs will be generated in this directory
WorkingDirectory	[SCENARIO_DIR]\ 11_DaySim \working	Directory for other DaySim outputs. DaySim generates other outputs in this directory.
WorkingSubpath	[SCENARIO_DIR]\ 11_DaySim\workin g	Directory path for other DaySim outputs
Threading Settings		
NProcessors	48	Number of processors (threads) to be used
NBatches	50	
Region Specific		

SETTING	VALUE	DESCRIPTION
ShouldRunInputTester	true	Flag to run DaySim input checks
CustomizationDll	Fresno.dll	Region-specific DLL
Parcel Buffered Data		
ImportParcels	true	Flag to import parcel file
RawParcelPath	[SCENARIO_DIR]\ Fresno_mzbuffer_allstreets_2019.dat	Buffered parcel file name
RawParcelDelimiter	32	Buffered parcel file delimiter (9=TAB, 32=space, 44=comma)
UseParcelLandUseCodeAsSquareFeetOpenSpace	True	Switch for using open space square feet data from land-use type field ("lutype_p") in the parcel file
Roster Impedance		
UseMicrozoneSkimsForBikeMode	TRUE	Switch for using bike skims by microzones
RosterPath	.\06_Roster\roster_mz.csv	Name of roster CSV file, including full directory path
RosterCombinations Path	.\06_Roster\roster_combinations.csv	Name of valid roster combinations CSV file, including full directory path
UseShortDistance NodeToNode Measures	true	TRUE to use node-to-node distance in accessibility measures calculations
RawParcelNode Path	[SCENARIO_DIR]\ maz_node_2019.dat	File name providing the nearest node ID for a parcel
RawParcelNode Delimiter	32	Delimiter of the input parcel node file (9=TAB, 32=space, 44=comma)
NodeIndexPath	[SCENARIO_DIR]\ WALK_SKIM_MAZ_MAZ_SORTED_INDEX.TXT	File name for the file providing, for every node ID, starting and end record indices in node short-distance file (NodeDistancePath)
NodeIndexDelimiter	32	Delimiter of the node index file (9=TAB, 32=space, 44=comma)

SETTING	VALUE	DESCRIPTION
NodeDistances Path	[SCENARIO_DIR]\WALK_SKIM_MAZ_MAZ_SORTED.TXT.dat	File name for the file providing short distances for node pairs
MaximumBlending Distance	3	The maximum (network) Distance for which short-distance blending should be used, in miles. For short trips, DaySim uses a linear combination of parcel-to-parcel distances from an all streets network and zone-zone distances from the skim matrices. When the zone-zone skim distance exceeeds this MaximumBlendingDistance, DaySim stop using the parcel-parcel distance and just use the zone-zone from the skims.
AllowNodeDistanceAsymmetry	True	
UseShortDistance CircuityMeasures	false	true to use circuity distance in accessibility measures calculations
Value of Time		
VotVeryLowLow	0	Boundary between VeryLow and Low VOT groups, in monetary units per hour
VotLowMedium	6	Boundary between Low and Medium VOT groups, in monetary units per hour
VotMediumHigh	12	Boundary between Medium and High VOT groups, in monetary units per hour
VotHighVeryHigh	5001	Boundary between High and VeryHigh VOT groups, in monetary units per hour
Global Settings		

SETTING	VALUE	DESCRIPTION
DataType	Default	Identifies the presence of client-specific household input data (currently only used for Actum)
ChoiceModelRunner	Default	Type of choice model runner
Settings	DefaultSettings	
Debug Settings		
TraceSimulatedChoice Outcomes	false	true to trace simulated choice outcomes
TraceModelResult Validity	false	true to trace model result
InvalidAttempts BeforeTrace	100	
InvalidAttempts BeforeContinue	4	
ReportInvalidPerson Days	false	true to report invalid person days during a run
Shadow Price Settings for work and school locations		
ShouldUse ShadowPricing	true	true to apply shadow pricing for the Work Location and School Location models
UsualWorkParcel Threshold	5	Parcel-specific threshold used in the shadow price calculations of usual work location
UsualSchoolParcel Threshold	5	Parcel-specific threshold used in the shadow price calculations of usual school location
UsualUniversity ParcelThreshold	5	Parcel-specific threshold used in the shadow price calculations of usual university location
NumberOfParcels InReportDiffs	10	Control for printing out reporting on shadow price calculations
UsualWork PercentTolerance	0	Percentage tolerance to trigger work parcel shadow price adjustment
UsualWork AbsoluteTolerance	0	Absolute tolerance to trigger work parcel shadow price adjustment

SETTING	VALUE	DESCRIPTION
UsualSchool PercentTolerance	0	Percentage tolerance to trigger school parcel shadow price adjustment
UsualSchool AbsoluteTolerance	0	Absolute tolerance to trigger school parcel shadow price adjustment
UsualUniversity PercentTolerance	0	Percentage tolerance to trigger university parcel shadow price adjustment
UsualUniversity AbsoluteTolerance	0	Absolute tolerance to trigger university parcel shadow price adjustment
Shadow Price Settings		
ShadowPriceDelimiter	9	Delimiter of the shadow price files (9=TAB, 32=space, 44=comma)
ShouldUse ParkAndRide ShadowPricing	TRUE	true to use park-and-ride shadow pricing in the model
ParkAndRide ShadowPrice Delimiter	9	Delimiter of the park-and-ride shadow pricing file (9=TAB, 32=space, 44=comma)
ParkAndRide ShadowPrice MaximumPenalty	-3	
ParkAndRide ShadowPriceTime Spread	20	
ParkAndRide ShadowPriceStep Size	0.15	
Model Run Flags		
Should Run Choice Models	True	A toggle switch to run all choice models (true can be overridden by switches below and by individual model switches)
ShouldRunHouseholdModels	true	A toggle switch to run household-level models (used to perform partial runs, TRUE can be overridden by individual model switches)
ShouldRun PersonModels	True	A toggle switch to run person-level models (used to perform partial runs, true can be overridden by individual model switches)
ShouldRun PersonDayModels	true	A toggle switch to run person-day-level models (used to perform partial runs, TRUE can be overridden by individual model switches)
ShouldRunTour Models	True	A toggle switch to run tour-level models (used to perform partial runs, true can be overridden by individual model switches)

SETTING	VALUE	DESCRIPTION
ShouldRunTourTripModels	true	A toggle switch to run trip-level models (used to perform partial runs, true can be overridden by individual model switches)
ShouldRunSubtourModels	True	A toggle switch to run subtour level models (used to perform partial runs, true can be overridden by individual model switches)
ShouldRunSubtourTripModels	true	A toggle switch to run trip level models for subtours (used to perform partial runs, true can be overridden by individual model switches)
DestinationScale	1	For a model that uses parcels, this should be set at 0. If the model uses blocks (microzones) instead, then set this at 1, and it allows intra-microzone trips. But, with it set at 0, it does not allow intra-microzone trips.
ShowRunChoiceModelsStatus	True	true to show percentage of households simulated on the screen during simulation
ShouldRunRawConversion	True	If true, DaySim will convert and input all of the raw data files
Random Seed Settings		
RandomSeed	1234	Initial seed value for the random number generator
ShouldSynchronize RandomSeed	True	If true, DaySim will use a seed for each person/tour/trip/model combination that depends only on the initial seed
Inernal-External Workers Settings		
IxxiPath	.\05_ixxi\Fresno_worker_ixxifractions.dat	Input worker IXXI fractions file name
IxxiDelimiter	32	Delimiter for the input file (9=TAB, 32=space, 44=comma)
IxxiFirstLineIsHeader	False	If true, DaySim expects a header record for this file (all other raw data files have headers)
Park-and-Ride Nodes		
RawParkAndRide NodePath	.\10_ParkAndRide\p_r_Nodes_2019.dat	Input park-and-ride node file; if none given, the park-and-ride mode will not be available)

SETTING	VALUE	DESCRIPTION
RawParkAndRideNodeDelimiter	9	The delimiter for the input file (9=TAB, 32=space, 44=comma)
ImportParkAndRideNodes	true	If true, the raw file should be imported (always true if ShouldRunRawConversion=true)
ShouldReadParkAndRideNodeSkim	false	
Zones		
ImportZones	true	If true, the zone file should be imported (always true if ShouldRunRawConversion=true)
RawZonePath	.\01_TAZ_Index\Fresno_taz_indexes.dat	Input zone index file name
RawZoneDelimiter	9	The delimiter for the input zone index file (9=TAB, 32=space, 44=comma)
RawHouseholdPath	.\03_Household\Fresno_household_sampled.dat	Input household file
RawHouseholdDelimiter	32	The delimiter for the input household file (9=TAB, 32=space, 44=comma)
RawPersonPath	.\04_Person\Fresno_person_sampled.dat	Input person file
RawPersonDelimiter	32	The delimiter for the input household file (9=TAB, 32=space, 44=comma)
DaySim Output Files		
ImportHouseholds	True	
OutputHousehold Path	_household.tsv	The full path name for the household output file
OutputHousehold Delimiter	9	Delimiter for the household output file (9=TAB, 32=space, 44=comma)
ImportPersons	True	
OutputPersonPath	_person.tsv	Person output filename

SETTING	VALUE	DESCRIPTION
OutputPerson Delimiter	9	Delimiter for the person output file (9=TAB, 32=space, 44=comma)
OutputHousehold DayPath	_household_day.ts v	
OutputHousehold DayDelimiter	9	Household day output filename
OutputPersonDay Path	_person_day.tsv	Person day output filename
OutputPersonDay Delimiter	9	Delimiter for the person day output file (9=TAB, 32=space, 44=comma)
OutputTourPath	_tour.tsv	Tour output filename
OutputTourDelimiter	9	Delimiter for the tour output file (9=TAB, 32=space, 44=comma)
OutputTripPath	_trip.tsv	Trip output filename
OutputTripDelimiter	9	Delimiter for the trip output file (9=TAB, 32=space, 44=comma)
OutputJointTour Delimiter	9	Delimiter for the join tour output file (9=TAB, 32=space, 44=comma)
OutputJointTour Path	_joint_tour.tsv	Joint tour output filename
OutputFullHalfTour Path	_full_half_tour.tsv	Full half-tour output filename
OutputFullHalfTour Delimiter	9	Delimiter for the full half-tour output file (9=TAB, 32=space, 44=comma)
OutputPartialHalf TourPath	_partial_half_tour.ts v	Partial half-tour filename
OutputPartialHalf TourDelimiter	9	Delimiter for the partial half-tour output file (9=TAB, 32=space, 44=comma)
ShouldOutputTDM TripList	false	
Logsums		

SETTING	VALUE	DESCRIPTION
ShouldLoadAggregate LogsumsFromFile	False	true to read the aggregate logsums from a file generated by a previous run (otherwise recalculated)
ShouldOutput AggregateLogsums	True	true to write the aggregate logsums to a file for a subsequent run
OutputAggregate LogsumsPath	aggregate_logsums .dat	File name to write out aggregate logsums
ShouldLoadSampling WeightsFromFile	False	true to read the precalculated sampling weights from a file generated by a previous run (otherwise recalculated)
ShouldOutputSampling Weights	False	true to write the precalculated sampling weights to a file for a subsequent run
OutputSampling WeightsPath	sampling_weights.d at	File name write out sampling weights
Model Coefficients		
WorkLocationModelSampleSize	100	The maximum number of destinations to be sampled for this model
WorkLocationModelCoefficients	.\07_Coefficients\WorkLocationCoefficients.F12	Path of the coefficient file for the work location model
ShouldRunWorkLocationModel	True	A toggle switch to run the work location model; can be used for partial runs, TRUE can be overridden by more general switches above

SETTING	VALUE	DESCRIPTION
IncludeWorkLocationModel	True	false to always exclude this model from the set of models to be run. Set both - this and ShouldRUnWorkLocatinModel - to the same (true or false).
SchoolLocationModelSampleSize	100	The maximum number of destinations to be sampled for this model
SchoolLocationModelCoefficients	.\07_Coefficients\SchoolLocationCoefficients.F12	Path of the coefficient file for the school location model
ShouldRunSchool LocationModel	True	A toggle switch to run the school location model; can be used for partial runs, TRUE can be overridden by more general switches above
IncludeSchool LocationModel	True	false to always exclude this model from the set of models to be run. Set both - this and ShouldRunSchoolLocationModel - to the same (true or false).
PayToParkAtWorkplace ModelCoefficients	.\07_Coefficients\PayToParkAtWorkplaceCoefficients.F12	Path of the coefficient file for the pay to park and workplace model
ShouldRunPayTo ParkAtWorkplace Model	True	A toggle switch to run the pay-to-park and workplace model; can be used for partial runs, true can be overridden by more general switches above

SETTING	VALUE	DESCRIPTION
IncludePayTo ParkAtWorkplace Model	True	false to always exclude this model from the set of models to be run. Set both - this and ShouldRunPayToParkAtWorkplaceModel - to the same (true or false).
TransitPassOwnership ModelCoefficients	.\07_Coefficients\TransitPassOwnershipCoefficients.F12	Path of the coefficient file for the transit pass ownership model
ShouldRunTransit PassOwnershipModel	True	A toggle switch to run the transit pass ownership model; can be used for partial runs, true can be overridden by more general switches above
IncludeTransit PassOwnershipModel	True	false to always exclude this model from the set of models to be run. Set both - this and ShouldRunTransitPassOwnershipModel - to the same (true or false).
AutoOwnership ModelCoefficients	.\07_Coefficients\AutoOwnershipCoefficients.F12	Path of the coefficient file for the auto ownership model
ShouldRun AutoOwnershipModel	True	A toggle switch to run the auto ownership model; can be used for partial runs, true can be overridden by more general switches above

SETTING	VALUE	DESCRIPTION
IndividualPerson DayPatternModel Coefficients	.\07_Coefficients\IndividualPersonDayPatternCoefficients.F12	Path of the coefficient file for the individual person-day pattern model
ShouldRunIndividual PersonDayPattern Model	True	A toggle switch to run the individual person day pattern model; can be used for partial runs, true can be overridden by more general switches above
PersonExactNumberOf ToursModel Coefficients	.\07_Coefficients\PersonExactNumberOfToursCoefficients.F12	Path of the coefficient file for the person exact number of tours model
ShouldRunPerson ExactNumberOf Tours Model	True	A toggle switch to run the person exact number of tours model; can be used for partial runs, true can be overridden by more general switches above
WorkTourDestination ModelSampleSize	100	Maximum number of destinations to be sampled for the work tour destination model
WorkTourDestination ModelCoefficients	.\07_Coefficients\WorkTourDestinationCoefficients.F12	Path of the coefficient file for the work tour destination model
ShouldRunWorkTour DestinationModel	True	
OtherTourDestination ModelSampleSize	100	Maximum number of destinations to be sampled for the other tour destination model
OtherTourDestination ModelCoefficients	.\07_Coefficients\OtherTourDestinationCoefficients.F12	Path of the coefficient file for the tour destination model

SETTING	VALUE	DESCRIPTION
ShouldRunOtherTourDestination Model	True	A toggle switch to run the tour destination model; can be used for partial runs, true can be overridden by more general switches above
WorkBasedSubtourGenerationModelCoefficients	.\07_Coefficients\WorkbasedSubtourGenerationCoefficients.F12	Path of the coefficient file for the work-based subtour generation model
ShouldRunWorkBasedSubtourGenerationModel	True	A toggle switch to run the work-based subtour generation model; can be used for partial runs, true can be overridden by more general switches above
WorkTourMode ModelCoefficients	.\07_Coefficients\WorkTourModeCoefficients.F12	Path of the coefficient file for the work tour mode model
ShouldRunWorkTour ModeModel	True	A toggle switch to run the work tour mode model; can be used for partial runs, true can be overridden by more general switches above
SchoolTourMode ModelCoefficients	.\07_Coefficients\SchoolTourModeCoefficients.F12	Path of the coefficient file for the school tour mode model
ShouldRunSchool TourModeModel	True	A toggle switch to run the school tour mode model; can be used for partial runs, true can be overridden by more general switches above

SETTING	VALUE	DESCRIPTION
WorkBasedSubtour ModeModelCoefficients	.\07_Coefficients\WorkBasedSubtourModeCoefficients.F12	Path of the coefficient file for the work-based subtour mode model
ShouldRunWorkBased SubtourModeModel	True	A toggle switch to run the work-based subtour mode model; can be used for partial runs, true can be overridden by more general switches above
EscortTourMode ModelCoefficients	.\07_Coefficients\EscortTourModeCoefficients.F12	Path of the coefficient file for the escort tour model model
ShouldRunEscort TourModeModel	True	A toggle switch to run the escort tour model model; can be used for partial runs, true can be overridden by more general switches above
OtherHomeBased TourModeModel Coefficients	.\07_Coefficients\OtherHomeBasedTourModeCoefficients.F12	Path of the coefficient file for the other home-based tour mode model
ShouldRunOther HomeBasedTour ModeModel	True	A toggle switch to run the other home-based tour mode model; can be used for partial runs, true can be overridden by more general switches above
WorkTourTime ModelCoefficients	.\07_Coefficients\WorkTourTimeCoefficients.F12	Path of the coefficient file for the work tour time model

SETTING	VALUE	DESCRIPTION
ShouldRunWorkTour TimeModel	True	A toggle switch to run the work tour time model; can be used for partial runs, true can be overridden by more general switches above
SchoolTourTime ModelCoefficients	.\07_Coefficients\SchoolTourTimeCoefficients.F12	Path of the coefficient file for the school tour time model
ShouldRunSchoolTourTimeModel	True	A toggle switch to run the school tour time model; can be used for partial runs, true can be overridden by more general switches above
OtherHomeBasedTour TimeModelCoefficients	.\07_Coefficients\OtherHomeBasedTourTimeCoefficients.F12	Path of the coefficient file for the other home-based tour time model
ShouldRunOtherHomeBasedTour TimeModel	True	A toggle switch to run the home-based tour time model; can be used for partial runs, true can be overridden by more general switches above
WorkBasedSubtourTimeModelCoefficients	.\07_Coefficients\WorkbasedSubtourTimeCoefficients.F12	Path of the coefficient file for the work-based subtour time model
ShouldRunWorkBasedSubtourTimeModel	True	A toggle switch to run the work-based subtour time model; can be used for partial runs, true can be overridden by more general switches above

SETTING	VALUE	DESCRIPTION
IntermediateStopGenerationModelCoefficients	.\07_Coefficients\IntermediateStopGenerationCoefficients.F12	Path of the coefficient file for the intermediate stop generation model
ShouldRunIntermediateStopGenerationModel	True	A toggle switch to run the intermediate stop generation model; can be used for partial runs, true can be overridden by more general switches above
IntermediateStopLocationModelSampleSize	100	The maximum number of destinations to be sampled for the intermediate stop location model
IntermediateStopLocationModelCoefficients	.\07_Coefficients\IntermediateStopLocationCoefficients.F12	Path of the coefficient file for the intermediate stop location model
ShouldRunIntermediateStopLocationModel	True	A toggle switch to run the intermediate stop location model; can be used for partial runs, true can be overridden by more general switches above
TripModeModelCoefficients	.\07_Coefficients\TripModeCoefficients.F12	Path of the coefficient file for the trip mode model
ShouldRunTripModeModel	True	A toggle switch to run the trip mode model; can be used for partial runs, true can be overridden by more general switches above

SETTING	VALUE	DESCRIPTION
TripTimeModelCoefficients	.\07_Coefficients\TripTimeCoefficients.F12	Path of the coefficient file for the trip time model
ShouldRunTripTimeModel	True	A toggle switch to run the trip time model; can be used for partial runs, true can be overridden by more general switches above
Path Impedance Parameters		
PathImpedance_ PathChoiceScaleFactor	1.5	A scale factor for the coefficients of the path-type models; the inverse of a logsum coefficient in upper-level models. Not really used in BKRCast as BKRCast has only local bus under transit so don't have any path type competing under any modes.
PathImpedance_ AutoOperatingCostPerMile	0.22	Auto operating cost, in monetary units per distance unit
PathImpedance_ TransitInVehicleTimeWeight	1.0	Relative weight on transit in-vehicle time in the transit and park-and-ride path type models. These are all multiples of the auto in-vehicle time coeffcient, which is set in the VOT parameters.
PathImpedance_ TransitFirstWaitTimeWeight	2.0	Relative weight on transit first wait time in the transit and park-and-ride path-type models
PathImpedance_ TransitTransferWaitTimeWeight	2.0	Relative weight on transit transfer wait time in the transit and park-and-ride path-type models

SETTING	VALUE	DESCRIPTION
PathImpedance_ TransitNumber BoardingsWeight	8.0	Relative weight on transit number of boardings in the transit and park-and-ride path-type models
PathImpedance_ TransitDriveAccess TimeWeight	2.0	Relative weight on transit drive access in-vehicle time in the park-and-ride path-type models
PathImpedance_ TransitWalkAccess TimeWeight	2.0	Relative weight on transit walk access and egress times in the transit and park-and-ride path-type models
PathImpedance_ WalkTimeWeight	2.5	Relative weight on walk mode time in the walk path-type model
PathImpedance_ BikeTimeWeight	4.0	Relative weight on bike mode time in the bike path-type model
PathImpedance_ WalkMinutesPerMile	20.0	Factor to convert parcel-based transit walk access/egress distance into time (in minutes per distance unit)
PathImpedance_ TransitWalkAccess DistanceLimit	1.0	Maximum parcel-based transit walk access or egress distance allowed for available transit paths

SETTING	VALUE	DESCRIPTION
PathImpedance_TransitWalkAccessDirectLimit	1.0	Maximum parcel-based transit walk access or egress distance allowed for direct transit paths to be chosen over mixed paths
PathImpedance_ TransitSingleBoarding Limit	1.1	Maximum number of boardings for a transit path to be considered a "direct path" (no transfers). When DaySim figures out the walk time from a parcel to the nearest transit stop for path types other than local bus, DaySim wants to figure out whether those paths could include local bus feeder or if they are a direct path with no transfers (the boardings skim value is >=TransitSingleBoardingLimit). The fraction is because some transit skims are an average across multiple paths, some direct and some not.
PathImpedance_ AutoTolledPath Constant	0.0	Path-type constant for an auto path that includes a nonzero toll cost (reflects extra resistance to paying tolls)
PathImpedance_ AvailablePath UpperTimeLimit	200.0	Maximum total (unweighted) path travel time (in minutes) for a path to be considered an available option
PathImpedance_ TransitLocalBus PathConstant	0.0	Path-type constant for transit local bus only paths

SETTING	VALUE	DESCRIPTION
PathImpedance_ TransitPremiumBus PathConstant	0.0	Path-type constant for transit premium bus (possibly plus feeder) paths
PathImpedance_ TransitLightRail PathConstant	0.0	Path-type constant for transit light rail (possibly plus feeder) paths
PathImpedance_ TransitCommuterRail PathConstant	0.0	Path-type constant for transit commuter rail (possibly plus feeder) paths
PathImpedance_ TransitFerry PathConstant	0.0	Path-type constant for transit passenger ferry (possibly plus feeder) paths
PathImpedance_ TransitUsePathType SpecificTime	True	A switch to use additional skims and weights to reflect transit submode-specific in-vehicle times (SACOG-specific)
PathImpedance_ TransitPremiumBus TimeAdditiveWeight	0.00	An additive weight on premium bus submode-specific in-vehicle time (adds to TransitInVehicleTimeWeight)
PathImpedance_ TransitLightRail TimeAdditiveWeight	-0.15	An additive weight on light-rail submode-specific in-vehicle time (adds to TransitInVehicleTimeWeight)

SETTING	VALUE	DESCRIPTION
PathImpedance_ TransitCommuterRail TimeAdditiveWeight	-0.25	An additive weight on commuter rail submode-specific in-vehicle time (adds to TransitInVehicleTimeWeight)
PathImpedance_ TransitFerryTime AdditiveWeight	-0.40	An additive weight on passenger ferry submode-specific in-vehicle time (adds to TransitInVehicleTimeWeight)
PathImpedance_ BikeUseTypeSpecific DistanceFractions	False	A switch to use additional skims and weights to reflect bicycle distances on specific facility types (SACOG-specific)
PathImpedance_ BikeType1Distance FractionAdditiveWeight	0.0	An additive weight on bike distance on Class 1 bike paths (adds to BikeTimeWeight, distance is converted to time)
PathImpedance_ BikeType2Distance FractionAdditiveWeight	0.0	An additive weight on bike distance on Class 2 bike paths (adds to BikeTimeWeight, distance is converted to time)
PathImpedance_ BikeType3Distance FractionAdditiveWeight	0.0	An additive weight on bike distance on Class 3 bike paths (adds to BikeTimeWeight, distance is converted to time)

SETTING	VALUE	DESCRIPTION
PathImpedance_ BikeType4Distance FractionAdditiveWeight	0.0	An additive weight on bike distance on Class 4 bike paths (adds to BikeTimeWeight, distance is converted to time)
PathImpedance_ TransitUseFareDiscount Fractions	True	A switch (true/false) to use transit fare discount fractions based on person type and age
PathImpedance_ TransitFareDiscount FractionChildUnder5	0.8	Transit fare discount fraction for children under age 5
PathImpedance_ TransitFareDiscount FractionChild5To15	0.5	Transit fare discount fraction for children ages 5 to 15
PathImpedance_ TransitFareDiscount FractionHighSchool Student	0.5	Transit fare discount fraction for high school students (children age 16+)
PathImpedance_ TransitFareDiscount FractionUniverity Student	0.5	Transit fare discount fraction for college students
PathImpedance_ TransitFareDiscount FractionAge65Up	0.5	Transit fare discount fraction for adults age 65+
PathImpedance_ TransitPassCost PercentChangeVersus Base	0	Policy input variable to change the cost of transit passes with respect to base year
Path-type Impedance Coefficients		
Coefficients_ BaseCostCoefficient PerDollar	-0.15	Base cost coefficient (per monetary unit), when income=BaseCostCoefficientIncomeLevel

SETTING	VALUE	DESCRIPTION
Coefficients_ BaseCostCoefficient IncomeLevel	30000	Household income level (monetary units per year) where the cost coefficient is the BaseCostCoefficient
Coefficients_ CostCoefficient IncomePower_Work	0.6	Power function exponent to use for adjusting the cost coefficient for income, for work tours
Coefficients_ CostCoefficient IncomePower_Other	0.3	Power function exponent to use for adjusting the cost coefficient for income, for nonwork tours
Coefficients_ MeanTimeCoefficient _Work	-0.03	Mean time coefficient (/minute) for work tours
Coefficients_ MeanTimeCoefficient _Other	-0.015	Mean time coefficient (/minute) for nonwork tours
Coefficients_ StdDeviationTime Coefficient_Work	0.8	Standard deviation of the time coefficient (/minute) for work tours, when using random VOT distribution
Coefficients_ StdDeviationTime Coefficient_Other	1.0	Standard deviation of the time coefficient (/minute) for nonwork tours, when using random VOT distribution

SETTING	VALUE	DESCRIPTION
Coefficients_ HOV2CostDivisor _Work	1.741	Divisor for the cost coefficient for the HOV2 mode for work tours (to reflect cost-sharing)
Coefficients_ HOV2CostDivisor _Other	1.741	Divisor for the cost coefficient for the HOV2 mode for nonwork tours (to reflect cost-sharing)
Coefficients_ HOV3CostDivisor _Work	2.408	Divisor for the cost coefficient for the HOV3+ mode for work tours (to reflect cost-sharing)
Coefficients_ HOV3CostDivisor _Other	2.158	Divisor for the cost coefficient for the HOV3+ mode for nonwork tours (to reflect cost-sharing)
UseRandomVotDistribution	True	TRUE to randomly simulate a time coefficient for each tour, using a log-normal distribution
UrbanThreshold	500	
New Work-At-Home (Telecommute) Model settings		
UseDiaryVsSmartphoneBiasVariables	TRUE	
UseProxyBiasVariables	TRUE	
UseWorkAtHomeModelAndVariables	TRUE	Toggle Telecommute Model On/Off with True/False Value
WorkAtHome_DurationThreshold	2.5	Minimum hours that must be worked at home to be considered "telecommuting"
WorkAtHome_AlternativeSpecific Constant	-1.8067	Telecommute Alternative Specific Constant
WorkAtHome_PartTimeWorkerCoefficient	-0.264	Part Time Worker Telecommute Coefficient
WorkAtHome_Income0to50Coefficient	0.349	Income 0-50K telecommute coefficient

SETTING	VALUE	DESCRIPTION
WorkAtHome_IncomeOver150Coefficient	0.3	Income >150K telecommute coefficient
WorkAtHome_NonWorkerAndKidsInHHCoefficient	0.399	Non-worker and kids in households telecommute coefficient
WorkAtHome_NoVehiclesInHHCoefficient	0.412	No Vehicles in households telecommute coefficient
WorkAtHome_FractionMedicalJobsCoefficient	-0.415	Medical Profession telecommute coefficient
WorkAtHome_FractionEducationJobsCoefficient	0	Education profession telecommute coefficient
WorkAtHome_FractionServiceJobsCoefficient	0	Service profession telecommute coefficient
WorkAtHome_FractionOtherJobsCoefficient	1.396	Other profession telecommute coefficient
WorkAtHome_FractionGovernmentJobsLowIncomeCoefficient	-0.65	Government Profession telecommute coefficient
WorkAtHome_FractionIndustrialJobsLowIncomeCoefficient	-0.402	Industrial jobs telecommute coefficient
WorkAtHome_FractionRetailFoodJobsLowIncomeCoefficient	-0.418	Retail and Food profession telecommute coefficients
WorkAtHome_FractionOfficeJobsLowIncomeCoefficient	-0.63	Low income and office worker telecommute coefficient
WorkAtHome_FractionGovernmentJobsHigherIncomeCoefficient	-0.311	High income and government profession telecommute coefficient
WorkAtHome_FractionIndustrialJobsHigherIncomeCoefficient	0.431	High income and industrial profession telecommute coefficient
WorkAtHome_FractionRetailFoodJobsHigherIncomeCoefficient	-0.385	High income and retail/food profession telecommute coefficient
WorkAtHome_FractionOfficeJobsHigherIncomeCoefficient	0.295	High income and office profession telecommute coefficient
Ride Share Settings		
PaidRideShareModeIsAvailable	TRUE	Include Taxi/TNC ride share modes in Mode Choice models
PaidRideshare_UseEstimatedInsteadOfAssertedCoefficients	True	Use estimated coefficients for the Ride Share Model
PaidRideshare_OutputNumberOfPassengersOnTripRecord	True	Output Number of passengers to trip records
PaidRideshare_1PassengerShareForWorkTours	0.7	
PaidRideshare_2PassengerShareForWorkTours	0.2	
PaidRideshare_AverageNumberFor3plusPassengerWorkTours	4	
PaidRideshare_1PassengerShareForSchoolTours	0.5	
PaidRideshare_2PassengerShareForSchoolTours	0.3	

SETTING	VALUE	DESCRIPTION
PaidRideshare_AverageNumberFor3plusPassengerSchoolTours	4	
PaidRideshare_1PassengerShareForEscortTours	0.1	
PaidRideshare_2PassengerShareForEscortTours	0.4	
PaidRideshare_AverageNumberFor3plusPassengerEscortTours	3.3	
PaidRideshare_1PassengerShareForOtherTours	0.45	
PaidRideshare_2PassengerShareForOtherTours	0.35	
PaidRideshare_AverageNumberFor3plusPassengerOtherTours	4.25	
Other Settings		
RawPersonPath	.\2016_prec_pp.csv	
DestinationScale	0	
HouseholdIncomeAdjustmentFactorTo2000Dollars	1	
UseWorkShadowPricingForWorkAtHomeAlternative	false	
CountAllIntermediateStopsOnPersonDayRecord	true	
PathImpedance_BikeUseTypeSpecificDistanceFractions	True	

APPENDIX E. TELECOMMUTE SHARES

Telecommute models can be turned on by adjusting the configurations in the DaySim module (Step 10 and 15). The “UseWorkAtHomeModelAndVariables” variable should be switched to True as shown in Figure 50.

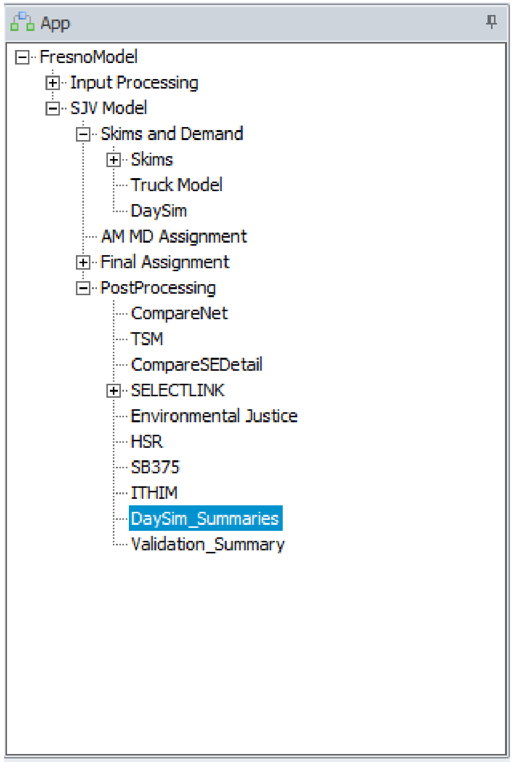
```
'\n',
'\nPaidRideshare_1PassengerShareForEscortTours = 0.1',
'\nPaidRideshare_2PassengerShareForEscortTours = 0.4',
'\nPaidRideshare_AverageNumberFor3plusPassengerEscortTours = 3.3',
'\n',
'\nPaidRideshare_1PassengerShareForOtherTours  = 0.45',
'\nPaidRideshare_2PassengerShareForOtherTours = 0.35',
'\nPaidRideshare_AverageNumberFor3plusPassengerOtherTours = 4.25',
'\n',
'\nUseDiaryVsSmartphoneBiasVariables = True',
'\nUseProxyBiasVariables = True',
'\nUseWorkAtHomeModelAndVariables = False',
'\nWorkAtHome_DurationThreshold = 2.5',
'\nWorkAtHome_AlternativeSpecificConstant = -1.8067',
'\nWorkAtHome_PartTimeWorkerCoefficient = -0.264',
'\nWorkAtHome_Income0to50Coefficient = 0.349',
'\nWorkAtHome_IncomeOver150Coefficient = 0.3',
'\nWorkAtHome_NonWorkerAndKidsInHHCoefficient = 0.399',
'\nWorkAtHome_NoVehiclesInHHCoefficient = 0.412',
'\nWorkAtHome_FractionMedicalJobsCoefficient = -0.415',
'\nWorkAtHome_FractionEducationJobsCoefficient = 0',
'\nWorkAtHome_FractionServiceJobsCoefficient = 0',
'\nWorkAtHome_FractionOtherJobsCoefficient = 1.396',
'\nWorkAtHome_FractionGovernmentJobsLowIncomeCoefficient = -0.65',
'\nWorkAtHome_FractionIndustrialJobsLowIncomeCoefficient = -0.402',
'\nWorkAtHome_FractionRetailFoodJobsLowIncomeCoefficient = -0.418',
'\nWorkAtHome_FractionOfficeJobsLowIncomeCoefficient = -0.63',
'\nWorkAtHome_FractionGovernmentJobsHigherIncomeCoefficient = -0.311',
'\nWorkAtHome_FractionIndustrialJobsHigherIncomeCoefficient = 0.431',
'\nWorkAtHome_FractionRetailFoodJobsHigherIncomeCoefficient = -0.385',
'\nWorkAtHome_FractionOfficeJobsHigherIncomeCoefficient = 0.295',
'\n'
```

FIGURE 50. DAYSIM CONFIGURATION TELECOMMUTE PARAMETER

After you run DaySim with this flag set to True, the *person* day.tsv file output from Daysim will have a field ‘wkathome’ which will have values of 0 or 4. 0 mean there were no hours worked at home, 4 means at least 3 hours of paid work were done at home that day.

The share of work from home will be the number of workers who worked at home divided by the total number of workers. In the WorkLocation.xlsx calibration spreadsheet (daysim_summaries), there is a tab for telecommute where this summary will be populated. The Calibration_Dist sheet (Figure 51) includes some helpful calculations. The user must:

1. Populate cell F26 to get the desired telecommute share in cell F31.
2. Populate cell N26 with the current Telecommute Alternative Specific Constant (ASC) (line 384 of the Daysim Configuration generation script in Figure 50)
3. Replace the ASC in the DaySim configuration file with the value in cell Q26.
4. Re-Run daysim with the same shadow pricing files (paste into “11_DaySim/working” folder)
5. Re-Run the DaySim summaries to see the new telecommute shares. (Note: this may be done from the Cube Catalog by navigating to the “DaySim Summaries” screen in the App window, and running the module being sure to select “Run Current Group Only”.

i. 

6. Repeat until the desired share is met.

Total	280,094	47,250	34,354	361,699

Total	219,070	35,157	23,497	277,723

Then distance segmented coefficients

Share

Distance (mi)	FT	PT	NotFTPT	TOTAL
0-3.5	35%	50%	37%	36.9%
3.5-10	39%	33%	30%	37.0%
>= 10	27%	17%	33%	26.1%
Total	100%	100%	100%	100%

Distance (mi)	FT	PT	NotFTPT	TOTAL
0-3.5	27%	34%	30%	28.4%
3.5-10	40%	43%	52%	41.4%
>= 10	33%	22%	18%	30.2%
Total	100%	100%	100%	100%

Distance Adjustments (FT Workers)

CoeffIndex	Old Coeff.	Ratio (FT)	Adj.	New Coeff.	damp
6	-2.1163000000000	1.27	0.000000000	-2.1163000000000	0
7	-1.18943121399	0.97	0.000000000	-1.18943121399	0
8	-0.4869326356412	0.82	0.000000000	-0.48693263564	0

Work From Home

	Survey	DaySim
WFH	1,090	22,093
Total	381,660	383,300

Share

	Survey	DaySim
WFH	4.50%	5.76%
Total	100%	100%

Telecommute

	Survey	DaySim
Telecommute	-	46,440
Total	-	381,660

Share

	Survey	DaySim
Telecommute	50.00%	12.17%
Total	0%	100%

Telecommute Adjustment

CoeffIndex	Old Coeff.	Ratio (FT)	Adj.	New Coeff.	damp
WorkAtHom	-1.8067000000000	4.11	1.41	-0.3934777530094	1

Work from home Adjustment

CoeffIndex	Old Coeff.	Ratio (FT)	Adj.	New Coeff.	damp
41	0.1760450429894	0.78	-0.25	-0.0715056777262	1

Distance Adjustments (PT and NotFTPT) - based on manual regression analysis below

Coeff. Index	Ratio	Adj.	Old Coeff.	New Coeff.	damp
9		0.01	-3.5799247754	-3.5799247754	0
10		0.02	-2.3045599118	-2.3045599118	0

		PT		NotFTPT		Adjust	
Distance	LN(Distance)	Survey	Model	Survey	Model	PT	NotFTPT
0.5	0.405	12%	13%	4%	7%	-0.02	-0.58
1.5	0.916	19%	8%	32%	8%	0.92	1.35
2.5	1.253	2%	9%	2%	10%	-1.78	-1.52
3.5	1.504	34%	9%	0%	10%	1.28	0.00
4.5	1.705	4%	8%	5%	10%	-0.86	-0.67
5.5	1.872	2%	8%	10%	10%	-1.41	-0.02
6.5	2.015	2%	7%	2%	8%	-1.33	-1.60
7.5	2.140	4%	6%	0%	8%	-0.43	0.00
8.5	2.251	3%	5%	13%	6%	-0.61	0.81
9.5	2.351	2%	4%	0%	5%	-0.81	0.00
10.5	2.442	6%	3%	13%	3%	0.64	1.40
11.5	2.526	2%	3%	0%	3%	-0.20	0.00

Use Regression under Data Analysis

PT Note: choose L47 as output cell

SUMMARY OUTPUT

... WorkAtHome | Telecommute | Documentation | CoeffDef | WorkLocationCoefficients | County Codes | calibration_flow | calibration_dist

FIGURE 51. TELECOMMUTE ASC ADJUSTMENT

APPENDIX F. CATALOG KEYS

KEY	DESCRIPTION
ClusterHandle	Cluster handle name
ClusterNodes	Number of cluster nodes
NumZones	Number of zones
Year	Scenario year
RunInputProcessing	Boolean variable to enable or disable running Input Processing
Run_WorkerFrac	Boolean variable to enable or disable running Worker Frac
Run_PopSim	Boolean variable to enable or disable running PopulationSim
Run_TransitStops	Boolean variable to enable or disable running Transit Stops
Run_IntersectionDensity	Boolean variable to enable or disable running Intersection Density
Run_ShadowPrice	Boolean variable to enable or disable Shadow Price
RUN_DAYSIM_SUMMARIES	Boolean variable to enable or disable running DaySim summaires
Zonal data	Path to zonal data file
Socio-economic detail	Path to social economic detail file

KEY	DESCRIPTION
MXD_Parameters	Path to MXD parameters file
Master highway network	Path to highway network file
Year of network scenario	Year of network scenario
Turn penalties	Path to turn penalties file
Truck_BaseMatrix	Path to Truck Base Matrix file
Truck_FutureMatrix	Path to Truck Future Matrix file
Use LOS capacity ranges rather than model VC	Check box to enable using LOS capacity ranges instead of model VC
Airbasins	
Define network to compare	Path to network file to compare to
Define SE Detail to compare	Path to SE detail file to compare to
Adjust trips to match value	Check box
Zones to adjust to match (ex. 101-105, 107)	
Trip targets by zone	Path to .DBF file with Zone,A1_IN, A1_OUT, P1_IN, P1_OUT, DAY_IN, DAY_OUT
Select Link/Zone Listing	Path to select/zone listing file
Rail Ridership	Rail .DBF file path

KEY	DESCRIPTION
Collisions per VMT	Number of collisions per VMT
Total Collisions	Number of total collisions
Collision PDO	
Collision Injuries	Number of collision injuries
Collision Fatalities	Number of collision fatalities
Deaths	Number of deaths
Injuries	Number of injuries
Maximum travel time (minutes)	Maximum travel time in minutes
Time Interval for Summary (minutes)	
Range of Origin Zones for Summary	Origin zones to generate summaries for
Range of Destination Zones for Summary	Destination zones to generate summaries for
pt network available	Check to indicate public transit network is available
Non-highway transit links	Path to non-highway transit links file
XY coordinates for transit only nodes	Path to XY cooridnates of transit notes file
Peak transit lines file	Path to peak transit lines file

KEY	DESCRIPTION
Peak drive access block file	Path to peak drive access block file
Peak walk access block file	Path to peak walk access block file
Off-peak transit drive access block	Path to off-peak transit drive access block
Off-peak transit walk access block	Path to off-peak transit walk access block
TransitFares	Path to transit fares file
TransitFactors	Path to transit factors file
TransitFactorsBus	Path to transit factors for bus
TransitSystem	Path to transit system points file path
TransitSystemBus	Path to bus system points file path
TripGenRates	Path to trip generation rates file
Truck Generation Rates	Path to truck generation rates file
SpdCapLookup	
AutoOpCosts	Path to auto operating costs file
MCParameters	Path to mode choice parameters file
FricFacParam	Path to friction factors parameters file

KEY	DESCRIPTION
DiurnalFactors	Path to diurnal factors file
TimeFacB_1	Transit speed time factor on facility class 1
TimeFacB_2	Transit speed time factor on facility class 2
TimeFacB_3	Transit speed time factor on facility class 3
TimeFacB_4	Transit speed time factor on facility class 4
TimeFacB_5	Transit speed time factor on facility class 5
TimeFacB_6	Transit speed time factor on facility class 6
TimeFacB_7	Transit speed time factor on facility class 7
TimeFacB_8	Transit speed time factor on facility class 8
TimeFacB_9	Transit speed time factor on facility class 9
VOT_0Veh	Low value of time
VOT_1Veh	Medium value of time
VOT_2Veh	High value of time
Speed_Bike	Bike speed (units)
Speed_Walk	Walk speed (units)

KEY	DESCRIPTION
MaxBikeDist	Maximum bike distance (units)
MaxWalkDist	Maximum walk distance (units)
AOF_HW_SR3	
Dist_Iter_Truck	
Assign_Iter_Peak	
Assign_Iter_OffPeak	
AM Period Capacity Factor	AM period capacity factor
Mid-Day Period Capacity Factor	MD period capacity factor
PM Peak Period Capacity Factor	PM period capacity factor
Night-time Period Capacity Factor	EV period capacity factor
AM Peak Period Hours	AM peak period hours (24-hr format)
Mid-day Period Hours	MD period hours (24-hr format)
PM Peak Period Hours	PM peak period hours (24-hr format)
Night-time Period Hours	EV period hours (24-hr format)
AM Peak 1HR	AM peak hour (24-hr format)

KEY	DESCRIPTION
PM Peak 1HR	PM peak hour (24-hr format)
TS_PCE	Small truck passenger car equivalent
TM_PCE	Medium truck passenger car equivalent
TH_PCE	Heavy truck passenger car equivalent
Truck Freeway Speed Factor	Truck freeway speed factor
Average rent for single-family development in first zone	Average rent for a single-family development in the first zone
Real estate attributes	Path to real estate attributes file
Initial zonal attributes for Cube Land	
DaySim Parcel File	Path to DaySim parcel file
DaySim Household File	Path to DaySim household file
DaySim Person File	Path to DaySim person file
Seed shadow price file	Path to seed shadow price file
AOF_SR3	
DaySimSeed	DaySim seed
NumMAZ	Number of MAZs

KEY	DESCRIPTION
FareMatrix	Path to fare matrix file
Run_Validation	Boolean to enable or disable validation
HOV2_TOLL_FACTOR	HOV2 toll factor
HOV3_TOLL_FACTOR	HOV3 toll factor
ANACONDA_DIRECTORY	Anaconda installation directory
R_DIRECTORY	R installation directory

Appendix C. Transportation and Land Use

Item 5. Off-Model Strategies

Off-model Strategies

Fresno COG will generally follow the guidelines detailed in the Appendices of CARB's Final SCS Program and Evaluation Guidelines Report and supplement with local data as much as possible. Off-model strategies that are currently being considered by Fresno COG include:

a. Carpool/Vanpool

Key assumptions:
Fresno County Measure C carpool program is funded by Fresno County's ½ cent sales tax, Measure C. It provides incentives to carpooling commuters. It is assumed that the level of participation in this program will continue into the future at the rate as reported in the most recent year, with the assumption that a new measure similar to Measure C will pass in 2026.

CalVans provides vanpool services to farm workers and commuters in the rural counties in California, including Fresno County. CalVans has multiple funding sources. In addition to Federal and State funding, such as AHSC Grant, CalVans also receives local funding from Fresno County Measure C, which provides funds for vanpool programs to encourage, facilitate, and help fund new vanpools and offer financial assistance to existing vanpools to ensure their viability.

In recent development of events related to CalVans financial issues, Fresno COG has withdrawn from the Joint Power Agreement of CalVans, which resulted in our not taking vanpool credit in CalVans. However, Enterprise Van Pool operating in Fresno County, which has received subsides from Measure C, is still included in the vanpool calculation using a growth forecast developed for CalVans.

Data sources:
Fresno COG has an improved database for carpool & vanpool programs. The database provides information such as trip length, vehicle occupancy rate, OD addresses, etc. Fresno COG plans to use the information in the database to quantify the VMT/GHG reduction from such programs. The carpool VMT data is sourced by Fresno COG carpool program, and vanpool VMT data is sourced by CalVans and Fresno COG vanpool program. CalVans has been documenting its growth over the years, as shown in the Figure 1 below. Last cycle, CalVans predicted that the strong growth will continue in the future, which will be updated with the availability of the new dataset. Fresno COG's vanpool projection for the 2026 RTP/SCS will carry on the 2022 RTP/SCS methodologies with an updated forecast base year of 2023-2024. Similar growth rates will be applied as

the last round of RTP/SCS which vary between 12% and 6% with the growth rate trending lower as it goes into the future years. Fresno COG's vanpool assumptions also include other vanpool programs such as Enterprise Van Pool, which also receive funding from Fresno COG and complements CalVans service in the region.

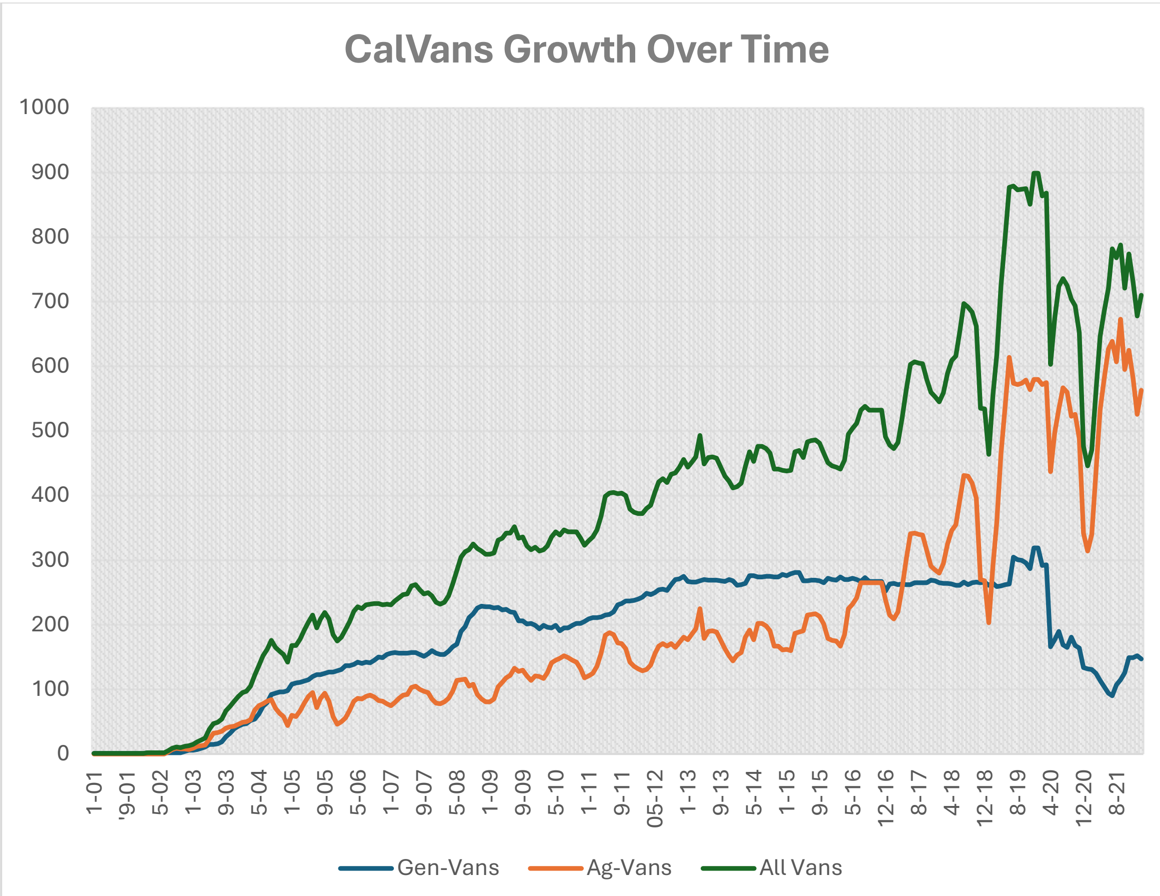


Figure 2: Historical Trend of Vanpools in the region

<u>Quantification method:</u>

Although Fresno COG is not claiming credit from CalVans, we use CalVans data for off-model calculations. CalVans reports number of vans operated and passenger counts by county. Average riders per van was calculated based on these figures to be used as input to the San Joaquin Valley 2026 RTP/SCS Off-model Strategy Analysis (v2.0) spreadsheet developed by Trinity Consultants. Other vanpool programs which receive subsidies from Fresno COG, such as Enterprise Vanpool, report their VMT to Fresno COG vanpool program administrator. Measure C carpool program also reports daily commute carpool VMT. Fresno COG will use these datasets as the basis to forecast future carpool/vanpool GHG reductions.

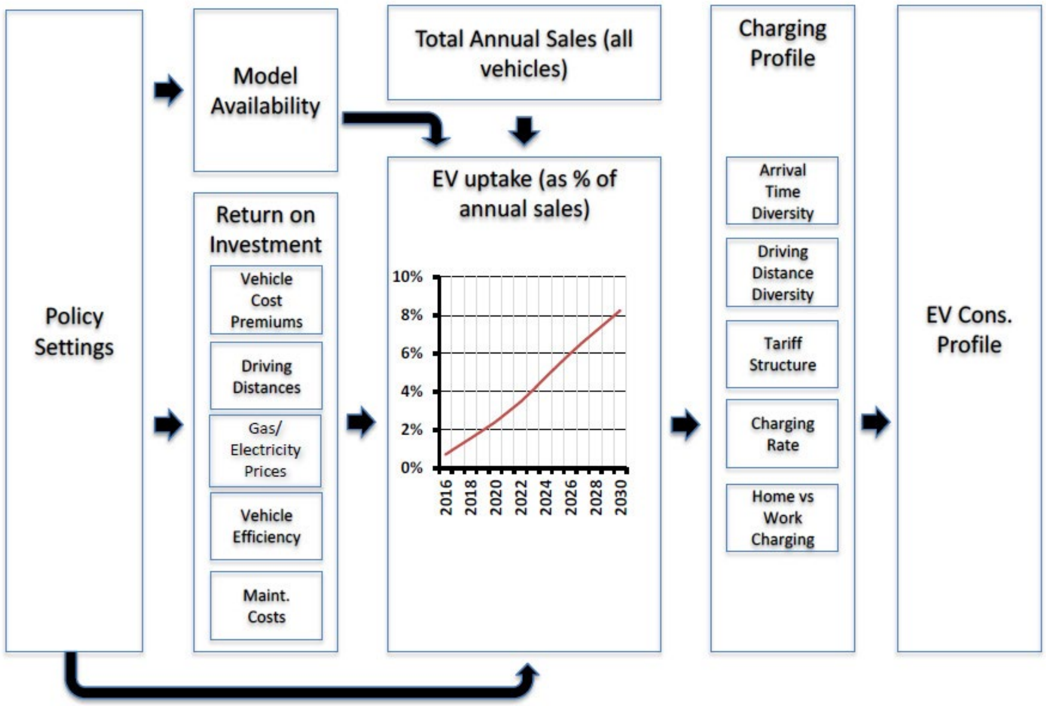
Fresno COG utilized SJV valley-wide off-model spread sheet to calculate the GHG savings provided by vanpool strategy. In light of no new vanpool data update available, a similar projection methodology like the last round of RTP/SCS is adopted, in which in year 2024-2025, the growth rate is assumed to be 12% per year. Then the annual growth rates decrease gradually over the years from 10% in 2026 to 6% in 2036.

Fresno COG is continuing its effort to promote the carpool program. It is assumed that the level of participation in this program will continue at the rate reported in the most recent year and scaled up to reflect county employment growth into the future. The GHG saving provided by the carpool programs will be captured by multiplying VMT reduction by EMFAC emission factors calculated at the regional level.

b. Electric Vehicle Charging Infrastructure (charger & micro-grid system) Program

<u>Key assumptions:</u>
Fresno COG completed Regional Electric Vehicle Readiness Plan (EVRP), which identified funding sources for charging infrastructure and EV incentives that can be used to quantify the VMT/GHG reductions. Funding sources include federal, state, regional and local sources (Measure C, local sales tax aimed at improving the overall quality of Fresno County's transportation system). Fresno COG's New Technology Grant Program through the local sales tax measure (Measure C) and FTA's Low or No Emissions Program has funded several grants to deploy electric buses in charging infrastructure.

<u>Data sources:</u>
In the EVRP, Energeia's personal electric vehicle (PEV) uptake model, depicted below, forecasts the adoption of PEVs by segment based on policy, model availability and financial drivers. It was configured based on current and forecast conditions in Fresno County over the next 10 years. The model is configured for a given market using regression to identify the correct factor parameterization.



The plan recommended installing 4,983 level 2 public charging ports sited within incorporated Fresno County cities by 2030. PHEV drivers in Fresno County would be able to drive a larger share of miles in electric mode because of accessibility to public chargers, instead of shifting to gasoline-powered mode when battery run out. The Electric Vehicle Charging Infrastructure strategies can reduce GHG emissions as the PHEV cVMT be replaced by eVMT.

Table 8- Regional EV Charger Program Calculation Parameters

Parameter	Value	Source
PHEV population	21,283	EMFAC 2021, 2035 calendar year, FCOG region
# of new EV chargers	4,983	Fresno COG, Electric Vehicle Readiness Plan
cVMT to eVMT	13 miles/PHEV/day	SCS guidelines Appendix E
PHEV emission rate – gasoline	283.4 grams/mile	EMFAC 2021, 2035 calendar year, FCOG region

Quantification method:

Fresno COG follows the Method a) in SCS guideline: Estimate CO_2 emission reductions from PHEV eVMT based on estimated average VMT shift per PHEV from gasoline to electricity (cVMT to eVMT) as a result of increased workplace and public charges. The steps are as follows:

Step 1: Identify number of public EV chargers to install in the region as part of strategy based on funding commitment and/or policies.

- The EVRP recommended 4,983 new public chargers by 2030.

Step 2-3: Identify the number of PHEVs in the region that could use EV chargers installed as a result of the strategy.

- Assuming 7 PHEVs per charger installed, the new public chargers in EVRP would be able to serve 7 * 4,983 = 34,881 PHEV.
- The 2035 Fresno region PHEV population acquired from EMFAC 2021 is 21,283. The reason EVRP has more chargers than region total PHEV needs is that Fresno COG' EVRP considered the charging need for BEVs.
- As the SCS EV charging infrastructure strategy is for PHEV benefits, we only include regional PHEV population from EMFAC 2021 data (21,283 PHEVs) for SCS off-model calculation.

Step 4-5: Estimate the total increased PHEV eVMT in the region resulting from strategy implementation.

- Assume an average of 13 eVMT increased per day per PHEV using a workplace EV charging connector (SCS guidelines Appendix E).
- Estimate the total increased PHEV eVMT: 21,283 * 13 = 276,679 miles

Step 6-7: Determine total regional GHG emission reductions due to the shift in PHEV operating mode from gasoline to electric.

- Obtain average emission factor for decreased PHEV gasoline consumption (Emission FactorGas) as PHEV operating mode is shifted from gasoline to 100% electric through increased workplace EV charging as a result of strategy implementation. Assume 198 grams of CO_2 is avoided for each PHEV mile transferred from gasoline to electric operation.
- Total reductions in regional CO_2 emissions = 276,679 * 198 gram/day

c. Electric Vehicle Incentive

Key assumptions:

The proposed Measure C electric vehicle incentive program would provide approximately $2 million annually to support electric vehicle adoption. The analysis assumes the program will provide a $1,000 incentive for 2,000 first-time battery electric vehicle (BEV) purchases per year through 2035. The program is expected to complement existing incentive programs, including California's Clean Vehicle Rebate Project (CVRP) and the San Joaquin Valley Air Pollution Control District's Drive Clean Rebate Program.

Data sources:

The Measure C Revenue Forecast allocates 4.0 percent of projected sales tax revenues to the Access and Innovation category, representing approximately $5.17 million in 2027 and increasing to approximately $7.08 million by 2035. For this analysis, it is assumed that approximately $2 million annually from this category will be dedicated to an electric vehicle incentive program.

The analysis also assumes that the California Clean Vehicle Rebate Project (CVRP) and the San Joaquin Valley Air Pollution Control District's Drive Clean Rebate Program remain available through 2035, providing rebates of $2,500 and $2,000 per battery electric vehicle purchase, respectively.

Quantification method:

Fresno COG follows the steps of Electric Vehicle Incentive Strategy in the SCS guideline: Estimate CO2 emission reductions from new non-ZEV's replaced by new ZEV's purchased through the incentive program. The steps are as follows:

Step 1: Identify the total funding (Total Program Funds) allocated for the subsidy/rebate program established by the MPO

The project is assumed to provide a $1,000 incentive for 2,000 new battery electric vehicle purchases annually. Because the renewed Measure C program is projected to take effect in mid-2027, the analysis assumes the incentive program becomes fully operational at the beginning of 2028. Benefits are calculated through the beginning of 2035, resulting in seven full years of program implementation (2028–2034).

Total funding allocated for the subsidy/rebate by 2035

= 2,000 vehicles/year * $1,000/vehicle * 7 years

Step 2: Identify the individual ZEV subsidy/rebate amount (Subsidy/Rebate Amount) for the subsidy/rebate program established by the MPO

Individual ZEV subsidy/rebate amount proposed is $1,000

Step 3: Estimate the number of new ZEV's (Total Program ZEV) that could be purchased through the subsidy/rebate program established by the MPO

Total Program ZEV = Total Program Funds/ (Subsidy/Rebate Amount)

Step 4: Identify the average trip length (Average Trip Length). Use the daily usage for a vehicle (miles per day per vehicle) from EMFAC.

EMFAC 2021 estimates an average vehicle travel distance of 37 miles per vehicle per day for light-duty vehicles in Fresno County.

Step 5: Calculate the average total eVMT from all trip purposes (ZEV VMT) associated with new ZEV's purchased through the incentive program.

ZEV eVMT = Total Program ZEV x Average Trip Length

Step 6: Obtain the average regional GHG emission factors for new non-ZEV's (Non ZEV EF) replaced by new ZEV's purchased through the incentive program from the most recent version of EMFAC.

Emission Factor for new-non-ZEVs in Fresno region is 215.28 g/mi in EMFAC 2021.

Step 7: In addition to MPOs incentive program, if other rebate or incentive programs are utilized for the Electric Vehicle Incentive strategy (e.g., CVRP), calculate the MPO's fraction of overall EV incentives provided.

Consistent with the SCS Guidelines, only the MPO's proportional share of the total incentive package is credited toward GHG reductions to avoid double-counting benefits associated with other funding sources. The calculation considered the funding from California's Clean Vehicle Rebate Project (CVRP) $2,500 for battery electric vehicles, and San Joaquin Valley Air Pollution Control District' Drive Clean Rebate Project $2,000 for battery electric vehicles

MPO Electric Vehicle Incentive Strategy Fraction

= MPO Electric Vehicle Incentive Amount / Total Incentive Amount

= $1,000 / ($1,000 + $2,500 + $2,000)

= 0.18

Step 8: Calculate GHG emission reductions from new non-ZEV's replaced by new ZEV's purchased through the incentive program. For this strategy a battery electric vehicle is required to be purchased, thus the ZEV EF can be assumed to be 0 g/mi.

GHG Reductions = ZEV eVMT x MPO Electric Vehicle Incentive Strategy Fraction x (Non ZEV EF - ZEV EF)

d. Pedestrian Infrastructure Improvement

Key assumptions:
Many projects have been proposed in this SCS planning cycle in the Fresno COG region to improve the infrastructure and promote walking and biking. Although Fresno COG's ABM model incorporated bike and trail facilities in the roadway network, sidewalks are not modeled. Therefore, any GHG benefit originated from improvements to the region's sidewalk network will have to be captured by off-model calculation.

Data sources: Many projects have pedestrian infrastructure improvement, like sidewalk, incorporated in the scope. The complete RTP/SCS project list will provide detailed information regarding these pedestrian improvements. Future transportation funding sources are also identified for active transportation facilities in the RTP/SCS.

Quantification method:
Fresno COG, upon reviewing the list of reference literature recommended by CARB staff in Impacts of Pedestrian Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions Policy Brief (CARB), decided to estimate the GHG

reduction from pedestrian infrastructure improvements using findings identified by Fan, Y. (2007), The Built Environment, Activity Space, and Time Allocation: An Activity-based Framework for Modeling the Land Use and Travel Connection. The paper found that vehicle miles traveled per person decreases 0.02% for every 1% increase in sidewalk length. Fresno COG summarizes the sidewalk project lane miles for 2035 and 2049 and applies the above relationship to factor the GHG reductions for these respective years.

e. Transportation System Management (TSM)/Intelligent Transportation Systems (ITS)

Key assumptions:
In the current SCS there are many TSM/ITS projects or components incorporated in various planned projects, such as ramp metering and signal control management. These improvements are not modeled by Fresno COG's ABM model. To properly account for these improvements, off-model calculation will be utilized.

Data sources:
The complete RTP/SCS project list will provide detailed information regarding the TSM/ITS improvements. Future transportation funding sources are also identified for active transportation facilities in the RTP/SCS. The list of TSM/ ITS improvement projects in the preferred RTP/SCS scenario with location, project description, estimated complete years, and project cost information will be provided. The targeted population of TSM-ITS Strategies is the general residents of Fresno County. The funding source will be a combination of Federal, State, and local funds and programs identified in the RTP document.

Quantification method:
Fresno COG utilized the methodology employed in the San Joaquin Valley SCS Off-model Strategy Analysis spreadsheet developed by Trinity Consultants for TSM-ITS strategies, which involves the following steps:

1. Identify the amount of funding for the TSM-ITS strategy by summarizing the TSM-ITS project cost in the RTP/SCS preferred scenario.
2. Identify the unit cost of installation and/or maintenance of the specific TSM related system by calculating the average project cost.
3. Calculate the approximate number of TSM-ITS projects the given funding would allow.

4. Fresno COG assumed the average hourly travel speed to be 40 miles/hour and will calculate the percentage of VMT on the affected roadway network of the regional total provided by Fresno ABM.
5. Based on the proposed number of and type of TSM-related systems, estimate the impact of the proposed TSM strategy to travel speed from empirical literature. The benefit of implementing Adaptive Signal Control Technologies (ASCT) is quantified in Rural Intelligent Transportation Systems (ITS) Toolkit (https://ruralsafetycenter.org/resources/rural-its-toolkit/) to be improvement of average performance metrics by 10 percent or more. In this case, Fresno COG estimated the average hourly travel speed with TSM to be 45 miles/hour.
6. Estimate the GHG emission factors for travel speeds with and without the effects of the TSM strategy using the latest EMFAC model.
7. Estimate the effects of the TSM strategy to GHG emissions. The off-model reductions were then applied to the total SB375 GHG emission reduction calculations for the respective years.

f. Employer-based trip reduction program (Rule 9410)

San Joaquin Valley Air Pollution Control District (SJVAPC) Rule 9410 requires large employer to implement programs aimed at reducing home-based work trips. Fresno COG used local data and valley wide methodology from the valley consultant to quantify the VMT/GHG reduction from such programs.

<u>Key assumptions:</u>
San Joaquin Valley Air Pollution Control District Rule 9410 implements Employer Based Trip Reduction through eTRIP program. The eTRIP Rule (Rule 9410, Employer Based Trip Reduction), was adopted by the Air District in 2009. The rule will require larger employers to establish an Employer Trip Reduction Implementation Plan (eTRIP) to encourage employees to reduce single-occupancy vehicle trips, thus reducing pollutant emissions associated with work commutes.

Per the final (2009) Air District staff report on Rule 9410, Rule 9410 would apply to an estimated 1,883 worksites throughout the Valley, representing a wide range of sectors and accounting for approximately 500,000 commuting employees. This rule distinguishes those facilities into two tiers. Tier One Worksites are those with 100-249 eligible employees and Tier Two Worksites have 250 or more eligible employees. However, based on eligible worksites data received from Air district in 2026, there are an estimated 81 worksites in Fresno County, of which 46 falls into Tier 1 and 35 into Tier 2. In addition to this, the telecommute survey data was also received from Air district, conducted between 2020 and 2024. Since the telecommute within the Fresno County region is already accounted within the

ABM this time, the telecommute shares within Rule 9410 will be deducted using the survey data received from Air district, thereby avoiding the double counting.

<u>Data sources:</u>
Eligible Worksites along with the employee telecommute survey datasets received from the Air District are used to compute the Rule 9410 related off-model GHG reductions.

<u>Quantification method:</u>

Fresno COG utilized the methodology from Valley consultant SCS off-model spreadsheet for the quantification of Rule 9410 strategy, which involves the following steps:
Step 1: Find out the number of eligible worksites and categorize them by Tiers. Since the future data is not available, the current data is used for future year calculations.

Step 2: Average number of employees in each Tier is an assumption, taken from the standard valley wide methodology.

Step 3: Average percentage of employees telecommuting on the worksite is calculated from the employee telecommute survey. The survey data was segregated by tier and the highest number of telecommute employees between Monday-Thursday is taken as the telecommute number for that worksite

Step 4: Telecommute share is calculated by dividing the number of telecommuting employees by total number of survey respondents

Step 5: The telecommute share is averaged across all the worksites within the respective Tier for a given year

Step 6: The latest available data for 2024 is used for 2035 and other future years

Step 7: The trip reduction is used from the valley wide standard methodology. The number of eligible 1-way trips is calculated by subtracting the telecommute share, calculated in step 5, for a given Tier and year.

Step 8: The base year employment and 1-way Home Based Work (HBW) trip length is calculated from the model

Step 9: Since the telecommute share has been deducted, the rebound effect is no longer applicable in our methodology

Step 10: The total CO_2 emission reduction is calculated by multiplying the displaced VMT and CO_2 emission rate.

The GHG saving provided by Rule 9410 will be calculated by multiplying the VMT reduction by EMFAC factor calculated at the regional level.

g. Car Sharing Strategy

Car share program is a membership-based service that provides access to shared vehicles for shorter-term use, often by the hour where fees are typically prices on per-mile or hourly basis. It is an affordable and convenient alternative to owning a car. Car share program can benefit users by saving money on transportation costs as well as benefit communities and the environment by reducing greenhouse gas emissions and traffic congestion.

Car share program has potential to reduce greenhouse gas emissions by reducing vehicle ownership rates as households often shed one or all their vehicles by becoming car sharing members, reducing single occupancy vehicle trips, and VMT, as mode choices shift to biking, walking and transit use due to lower auto ownership rates. In addition, the car share fleets are often newer and fuel efficient than older privately-owned vehicles which are replaced by car sharing.

Fresno region is fairly newer to car sharing. A Car sharing program with 42 electric vehicles has been in Southwest region of Fresno city, which is highly air polluted area of the city[1] ([1] Ride Share E-Bikes and EVs Are Coming to Southwest Fresno https://gvwire.com/2022/03/08/ride-share-e-bikes-and-evs-are-coming-to-southwest-fresno/). Future efforts and new technology funding appropriations are expected to follow for such program in the region.

Quantification method:
Fresno COG utilized the methodology from SCS guidelines car sharing strategy, which involves the following steps:
Step 1: Identify TAZs that have sufficient residential densities to support car sharing. Conservative local residential density support rate eight (8) residential units per acre, which is a higher threshold than suggested in the guidelines. This was selected based on the study cited by the guideline and given that Fresno is relatively less dense city than those referenced in the study.

Step 2: Estimate Total Population of TAZs identified in Step 1 as having sufficient residential densities to support car sharing. Population between age of 21 to 45 residing in those eligible TAZs used.

Step 3: Identify regional car share adoption rate. Use the 10% suggested in SCS guideline as car sharing adoption rate for population of age 21-45 years old.

Step 4: Estimate car share membership population of TAZs identified as having sufficient residential densities to support car sharing (Step 2) using the car sharing adoption rate (Step 3).

$$Membership\ Population_{CS} = (Total\ Population_{CS} * \ Adoption\ Rate_{CS})$$

Membership Population$_{CS}$ =	*Number of car sharing members in region/County/City/TAZs*
Total Population$_{CS}$ =	*Total population of region/County/City/TAZs identified as having sufficient residential densities to support car sharing*
Adoption Rate$_{CS}$ =	*Car sharing adoption rate for region/TAZ*

Step 5: Estimate VMT reductions from vehicles discarded or shed by car sharing members. Use conservative estimate that shed VMT is 8,200 miles per year.

Step 6: Obtain CO2 emission rates for shed private automobiles from the EMFAC 2021

Step 7: Estimate CO2 emission reductions from private automobiles shed by car sharing members. $CO2_{shed}$ = Total VMT_{shed} x $EMFAC_{shed}$

Step 8: Estimate VMT from car share members driving car share vehicles. Use conservative estimate that each car share member drives 1,200 miles per year in a car share vehicle

Step 9: Estimate emission rates from car share members driving car share vehicles. Obtain CO2 emission rates for shed private automobiles from the EMFAC 2021 and reduce by 29%.

Step 10: Estimate CO2 emissions from car sharing vehicle operation. CO2cs = Total VMTcs x EMFACcs

Step 11: Estimate total CO2 emissions associated with car sharing in the region/TAZs. Total CO2cs = CO2shed + CO2cs

Appendix C. Transportation and Land Use

Item 6. Congestion Management Process

Fresno County

Congestion Management Process Update

Council of Fresno County Governments

September 2017

This report was funded in part through grant[s] from the Federal Highway Administration [and Federal Transit Administration], U.S. Department of Transportation. The views and opinions of the authors [or agency] expressed herein do not necessarily state or reflect those of the U. S. Department of Transportation.

Council of Fresno County Governments

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REEDLEY	Mayor Anita Betancourt
SANGER	Mayor Frank Gonzalez
SAN JOAQUIN	Mayor Pro Tem Amarpreet Dhaliwal, Chair
SELMA	Mayor Michael Derr
County OF FRESNO	Supervisor Sal Quintero

Table of Content

Chapter 1 Introduction

In June 1990, California voters approved legislation that required Congestion Management Plans (CA CMP) be developed in urbanized counties to address congestion on California's highways and roads. At the federal level, Congestion Management System (CMS) was first introduced in the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991. In 1996, CMS became the Congestion Management Process (CMP) with the Safe, Accountable, Flexible, Efficient Transportation Equity Act – A Legacy for Users (SAFETEA-LU). Fresno COG developed its first Congestion Management Program in November 1991, and it has been updated based on legislative requirements. Assembly Bill 2419 (Bowler) in 1996 allowed counties to "opt out" of the California Congestion Management Program if a majority of local governments elected to exempt themselves from the California CMP. The Fresno COG Policy Board rescinded the Congestion Management Program on September 25, 1997 at the request of the local member agencies. The 2009 Fresno County Congestion Management Process (CMP) was designed to meet the federal requirement under 23 CFR 500.109 and 450.320. The 2017 CMP is an update to the 2009 CMP based on emerging transportation planning practices such as the transportation performance measurement required under the Moving Ahead for Progress in the 21st Century Act (MAP-21) and the Fixing America's Surface Transportation Act (FAST ACT)

SAFETEA-LU, and the subsequent MAP-21 and FAST Act require that Transportation Management Areas (TMAs) – urban areas with population over 200,000 – "shall address congestion management through a process that provides for safe and effective management and operation, based on a cooperatively developed and implemented metropolitan wide strategy, of new and existing transportation facilities … through the use of travel demand reduction and operation management strategies." It further states that federal funds cannot be programmed in a carbon monoxide and/or ozone non-attainment TMA for any highway project that will result in a significant increase in single occupant vehicle (SOV) capacity, unless the project is vetted through an approved CMP.

Fresno County is designated as a non-attainment TMA for ozone, and was so designated for carbon monoxide, but the Fresno Urbanized Area was reclassified as attainment for carbon monoxide effective on June 1, 1998. However, because of the ozone non-attainment status, Fresno COG is required to comply with such requirements.

The language in 23 CFR 450.320 and 500.109 defines an effective CMP as a systematic and regionally accepted approach for managing congestion. It provides information on transportation system performance and assesses alternative strategies for alleviating congestion and improving mobility for people and goods to levels that meet State and local needs. The congestion management process should include the six elements as specified in 450.320:

- methods to monitor and evaluate the performance of the multimodal transportation system, identify the causes of congestion, identify and evaluate alternative actions, provide information supporting the implementation of actions, and evaluate the efficiency and effectiveness of implemented actions;

- a definition of parameters for measuring the extent of congestion and for supporting the evaluation of the effectiveness of congestion reduction and mobility enhancement strategies;

- the establishment of a program for data collection and system performance monitoring to define the extent and duration of congestion, to help determine the causes of congestion, and to evaluate the efficiency and effectiveness of implemented actions;

- identification and evaluation of the anticipated performance and expected benefits of appropriate congestion management strategies, such as: transportation demand management (TDM) measures, traffic operational improvements, public transportation improvements, Intelligent Transportation Systems (ITS) technologies, and additional system capacity;

- identification of an implementation schedule, implementation responsibilities, and possible funding sources for each strategy proposed for implementation; and,
- implementation of a process for periodic assessment of the efficiency and effectiveness of implemented strategies, in terms of the area's established performance measures.

The Fresno County Congestion Management Process should be an integrated part of a Metropolitan Planning Organization (MPO)'s planning process. Based on the guidebook titled "The Congestion Management Process, A Guidebook", which was issued by the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA), the Fresno County CMP is a systematic process developed with regional approaches, with strategies reflected in and throughout the Regional Transportation Plan (RTP) and the Transportation Improvement Program (TIP) process. The following diagram summarizes the major components of the Fresno County CMP and illustrates how the CMP is integrated in Fresno COG's planning process:

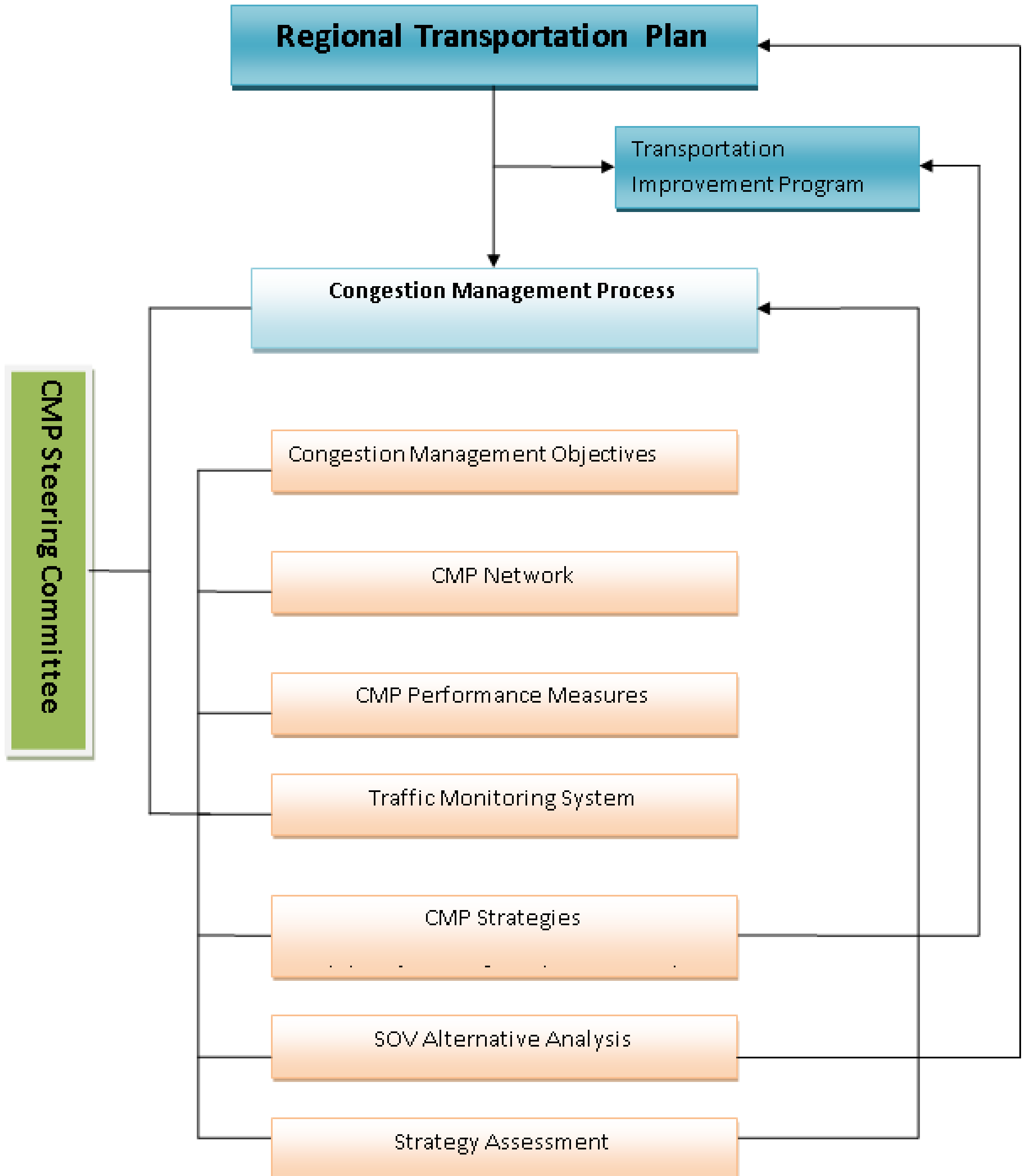

Regional Transportation Plan
Transportation Improvement Program
Congestion Management Process
CMP Steering Committee
Congestion Management Objectives
CMP Network
CMP Performance Measures
Traffic Monitoring System
CMP Strategies
SOV Alternative Analysis
Strategy Assessment

Figure 1

Chapter 2 CMP Steering Committee

The Fresno County CMP Steering Committee was formed in January 2009 and was reconvened in March 2015 for the current update. The CMP Steering Committee provided guidance for the development of the congestion management process and served as a technical advisory body for the process. The Committee comprised a broad membership that included engineers and planners from the local governments, representatives from the transit operators, State DOT, bike/pedestrian advocates and other stakeholders. Detailed CMP Steering Committee membership is as follows:

- County of Fresno
- City of Fresno
- City of Clovis
- Caltrans District 6 representatives
- Fresno Cycling Club
- City of Selma
- Fresno County Rural Transit Agency
- Fresno Area Express
- Clovis Transit
- City of Reedley
- City of Coalinga
- California State University, Fresno

COG's programming staff has been involved throughout the entire CMP process to ensure successful integration into the TIP/RTP process.

The CMP Steering Committee is instrumental in establishing CMP objectives and performance measures, selecting alternative strategies, single-occupant vehicle (SOV) alternative analysis and other CMP tasks. In addition, the Congestion Management Process also provided a forum for the members to discuss regional issues, such as sustainable development, congestion, transportation and land use planning integration, urban sprawl, active transportation, etc.

Chapter 3 CMP Objectives

The CMP Steering Committee reviewed the 2009 CMP goals and incorporated safety and other emerging technology elements in the update. Economic recovery from the Great Recession in the late 2000s has brought more jobs to the Fresno region, and the region is starting to experience some moderate delays on the urban freeways during peak hours. If not sustainably managed, the congestion would be more widespread, with greater delays expected. The updated objectives focus on operational improvements and management of the transportation facilities, emphasize sustainable land use development role in congestion management and promote the development of an integrated multi-modal transportation system. Four general objectives were established by the CMP Steering Committee:

1. Optimize the transportation facilities through efficient system management
2. Invest in strategies that reduce travel demand, improve system performance, increase safety, and provide effective incident management
3. Reduce vehicle miles traveled (VMT) by encouraging alternative modes of transportation and promotion of sustainable land use development
4. Improve public transit, expand bicycle and pedestrian system, and promote car sharing and bike sharing programs to facilitate the development of an integrated multi-modal transportation system in the Fresno region

Chapter 4 CMP Application Area and CMP Network

Fresno is the most populous county in the San Joaquin Valley, with 979,915 residents as of July 2016. The City of Fresno is the fifth largest city in California with over half a million population. There are over 600,000 people living in the Fresno-Clovis Metropolitan Area. Fresno County is also the second largest county in the San Joaquin Valley, encompassing approximately 6,000 square miles. It is home to 1.88 million acres of the world's most productive farmland, with agricultural operations covering half of the County. Agricultural commodities in Fresno were valued at $7.03 billion in 2014 and the top 10 crops were: almonds, grapes, poultry, milk, cattle & calves, tomatoes, pistachios, garlic, peaches and cotton. Fresno County is a rural county with a large metropolitan urban center. More than 60% of the population lives in the Fresno-Clovis Metropolitan areas, with about 17% in the rural unincorporated areas and the rest residing in the 13 small incorporated cities.

Congestion and its causes are of different magnitudes in the metropolitan areas relative to the rest of the more rural county. The transportation system in the urban area is designed to take people to destinations such as jobs, schools, shopping, doctors' appointments, etc. The rural roads mainly serve to transport agricultural goods. The urban areas experience more recurring congestion during the commute hours on the commute corridors, whereas in the rural areas, non-recurring congestion could take place due to foggy weather, truck traffic or other isolated accidents. The CMP Steering Committee agreed that the congestion management process should be applied countywide and selected different CMP strategies will be implemented where appropriate.

Due to the limitation of resources, the CMP Steering Committee identified and approved a refined CMP network, for which a more focused evaluation is conducted in the current update. Because of the recurring nature of the congestion on the urban freeways during the peak commute hours, the Committee decided that the urban freeways in the Fresno-Clovis Metropolitan Area will be the CMP network where the resources are directed.

The CMP network encompasses SR 41 from the SR 99 interchange to the Madera/Fresno County line, SR 99 from the Madera/Fresno County line to the Jensen Avenue interchange, SR 168 from the SR 180 interchange to the Herndon Avenue interchange and SR 180 from the SR 99 interchange to the SR 168 interchange, as shown in Figure 2 and Table 1. As discussed in Chapter 6, the Congestion Performance Monitoring Dashboard that features a live traffic speed feed for the CMP network. The Single Occupancy Vehicle (SOV) project analysis will be applied to qualified capacity increasing expansion project on the CMP network.

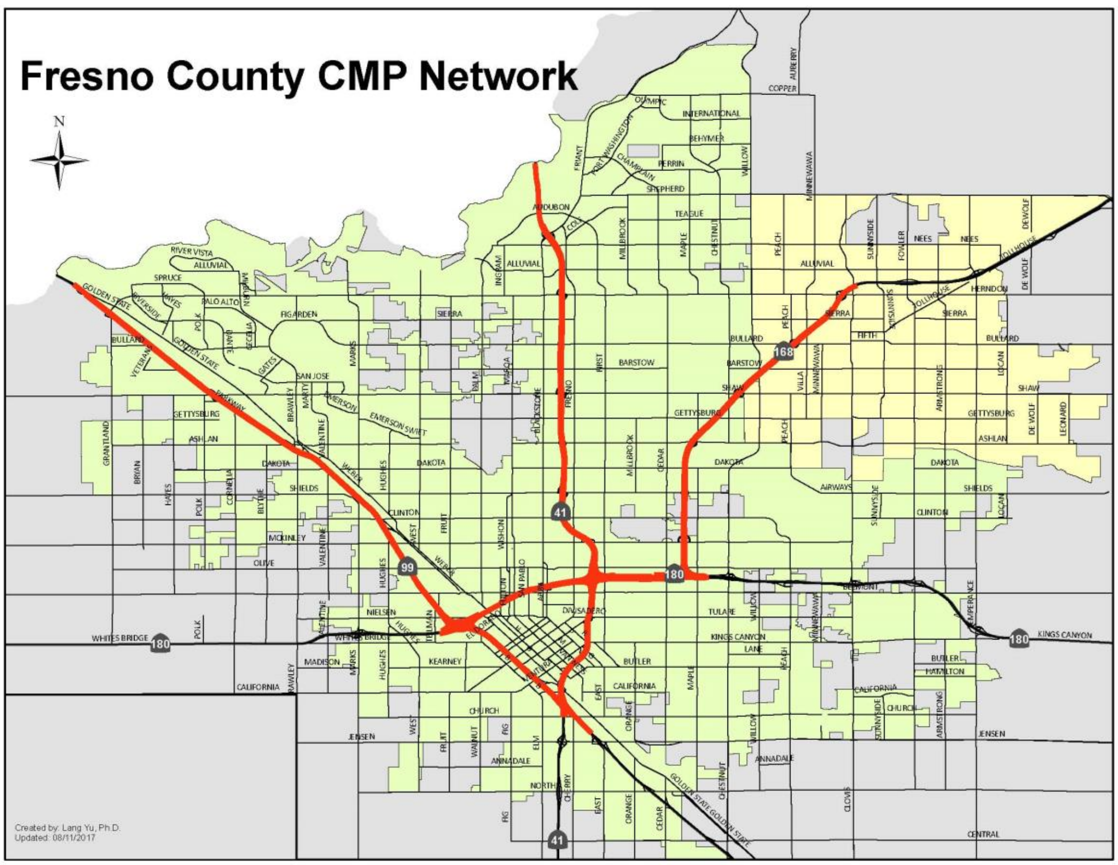


Figure 2

Route	From	To	Length
SR 99	Madera/Fresno County Line	Jensen Avenue Interchange	13 miles
SR 41	SR 99 Interchange	Madera/Fresno County Line	11 miles
SR 168	SR 168/SR 180 Interchange	Herndon Avenue Interchange	7 miles
SR 180	SR 99/SR 180 Interchange	SR 168/SR 180 Interchange	4 miles
Total			35 miles

Table 1

Chapter 5 Performance Measures

Performance measures are used to evaluate and communicate about the system performance issues. The most commonly used measures are speed, travel time, Level of Service (LOS), volume-to-capacity ratio (V/C ratio) and travel delay. Proxies such as LOS and V/C were applied in Fresno COG's 2009 CMP because data for more direct measures such as travel time and speed were not available. Since then, advances in probe data and system detection technologies have significantly reduced data collection costs. The Federal Highway Administration (FHWA) has contracted with HERE North America/Inrix and acquired national travel time dataset for use in the analysis of system performance. The probe data acquired by the FHWA, the National Performance Research Data Set (NPMRDS), has been made available to state Department of Transportations (DOTs) and Metropolitan Planning Organizations (MPOs). The NPMRDS provides a consistent historical profile on the performance of the National Highway System (NHS) for both passenger cars and truck traffic. In addition, cost for the probe data has become much less prohibitive and real-time speed and travel time data are more realistic for purchase for priority corridors.

Furthermore, MAP 21 and the subsequent FAST Act set goals to transition transportation planning into performance and outcome-based programs. One of the goals for the federal aid program is system reliability, that is, to improve the efficiency of the surface transportation system. Transportation Management Areas (TMAs) are encouraged to incorporate reliability measures into the CMP process because travel-time reliability considers both recurring and non-recurring events on delay over time. Traditionally, congestion has been referred to as recurring delays at the commute hours when too many people are trying to get through certain corridors. Non-recurring congestion was typically left out of the analysis.

Given the reduced probe data costs, and the federal system reliability goal, Fresno COG decided to move into travel time-based performance measurement that includes:

- Travel Time (min): Travel time to traverse a defined road segment
- Average Speed (mph): The length of a segment divided by travel time
- Travel Time Index (TTI): Ratio of average speed to the travel time at the reference speed
- Planning Time Index (PTI): Ratio of 95^{th} percentile of the travel time to the reference travel time
- Delay (Total Hours): Delay experienced by all vehicles (measured in hours) measured relative to a nominated reference speed

The CMP Steering Committee approved travel time index and planning time index as the reliability measures in September 2015. The FHWA finalized the system performance measures in January 2017, and here are the final FHWA measures (Freight and Congestion Mitigation Air Quality not included):

- Interstate Travel Time Reliability Measure: Percent of person-miles traveled on the interstate that are reliable, measured by Level of Travel Time Reliability (LOTTR): $80^{th}/50^{th}$ percentile of all vehicle travel times
- Non-Interstate Travel Time Reliability Measure: Percent of the person-miles traveled on the non-interstate NHS that are reliable
- Peak Hour Excessive Delay (PHED) Measure: Annual Hours of Peak Hour Excessive Delay per capita

In defining performance measures, the Committee also endorsed congestion thresholds in the traffic congestion measures. A travel time segment is considered to have excessive delay if the travel speed is equal to or slower than:

- 35 miles per hour for interstates, freeways, or expressways

- 15 miles per hour for principal arterials and all other NHS roads

Due to the timing of the publishing of the federal system performance measures and the approval of the performance measures by the CMP Steering Committee, both sets of the performance measures are applied in the analysis of system conditions within the Congestion Monitoring Dashboard, which is documented in Appendix A and in Chapter 6.

Figure 3 & 4 shows the segments in Fresno County that have excessive delays.

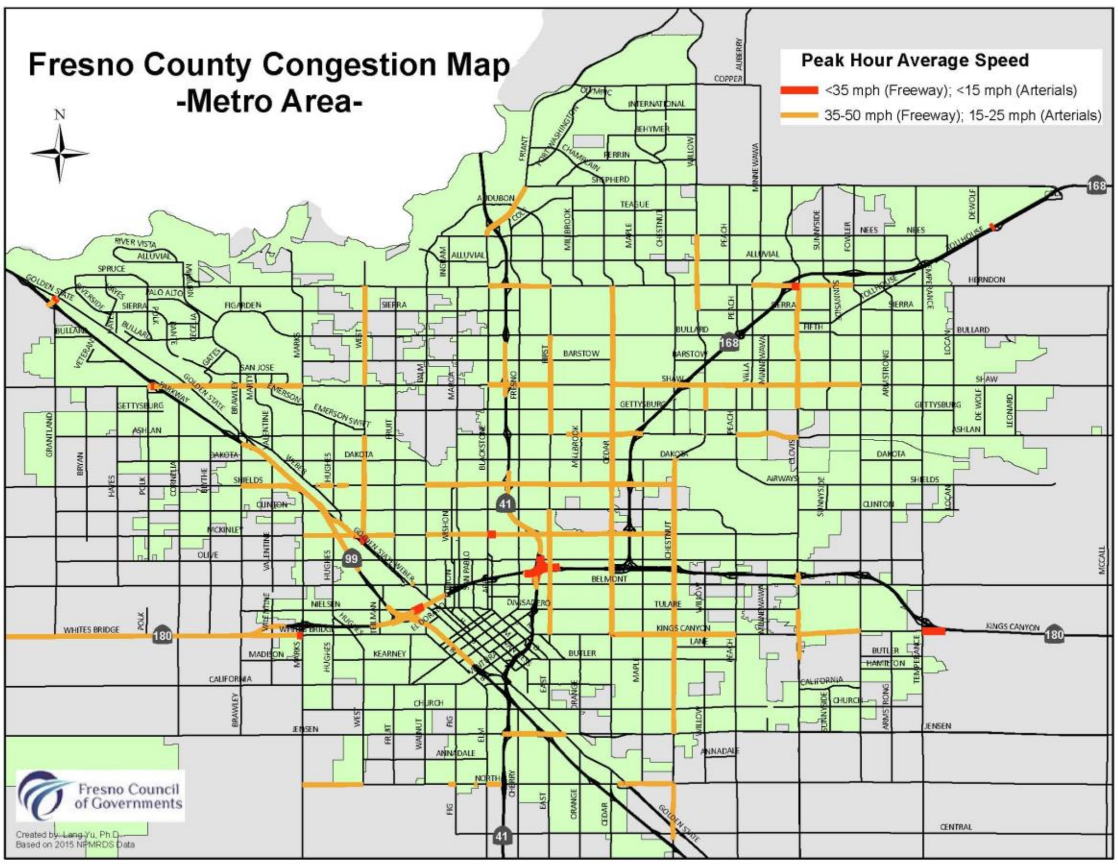


Figure 3

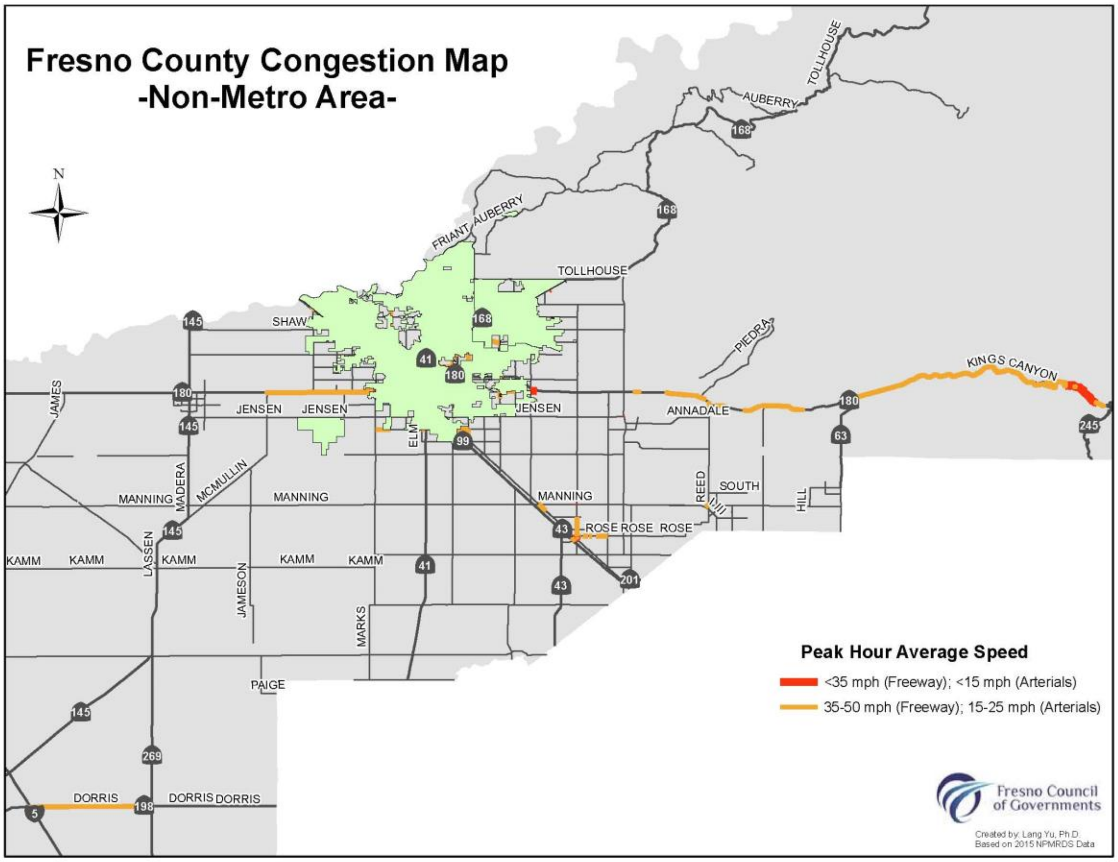

Fresno County Congestion Map
-Non-Metro Area-
N
Peak Hour Average Speed
<35 mph (Freeway); <15 mph (Arterials)
35-50 mph (Freeway); 15-25 mph (Arterials)
Fresno Council of Governments
Created by: Lang Yu, Ph.D.
Based on 2015 NPMRDS Data
TOLLHOUSE
AUBERRY
FRIANT
TOLLHOUSE
SHAW
PIEDRA
KINGS CANYON
JAMES
JENSEN
JENSEN
JENSEN
ANNADALE
ELM
MANNING
MADERA
MCMULLIN
MANNING
MANNING
REED
SOUTH
HILL
ROSE ROSE ROSE ROSE
KAMM
KAMM
LASSEN
KAMM
KAMM
KAMM
JAMESON
MARKS
PAIGE
DORRIS
DORRIS DORRIS

Figure 4

Chapter 6 Transportation System Monitoring Programs

I. Traffic Monitoring Program

Fresno COG has operated a Regional Traffic Monitoring Program since 1981. Through this program, the City of Fresno, City of Clovis and County of Fresno receive annual funding from Fresno COG to take traffic counts at COG designated count locations. Hourly counts for 24 hours are taken during typical work days from Tuesday through Thursday. Truck counts are also taken by the Fresno County on county roads. The traffic count data collected through the Monitoring Program is used by private developers, government agencies, and other entities that need traffic counts for different traffic studies. As part of the CMP update, the traffic counts are also being used to calculate total hours of delays. As an input to COG's traffic model, the traffic data is also used to interpret the region's current mobility conditions and to forecast future infrastructure needs. The Fresno COG Regional Traffic Monitoring Program provides a traffic count database that serves COG's traffic model validation and calibration needs.

As part of the current CMP update, Fresno COG underwent a review process for the count location system. The count system was originally developed in the 1980s, and the Fresno region has since grown significantly. More count locations were added in new growth areas and in the small cities. Traffic is counted at 750 locations biannually under the Fresno COG Traffic Monitoring Program. Figure 5 and 6 shows the coverage of the count locations in the region.

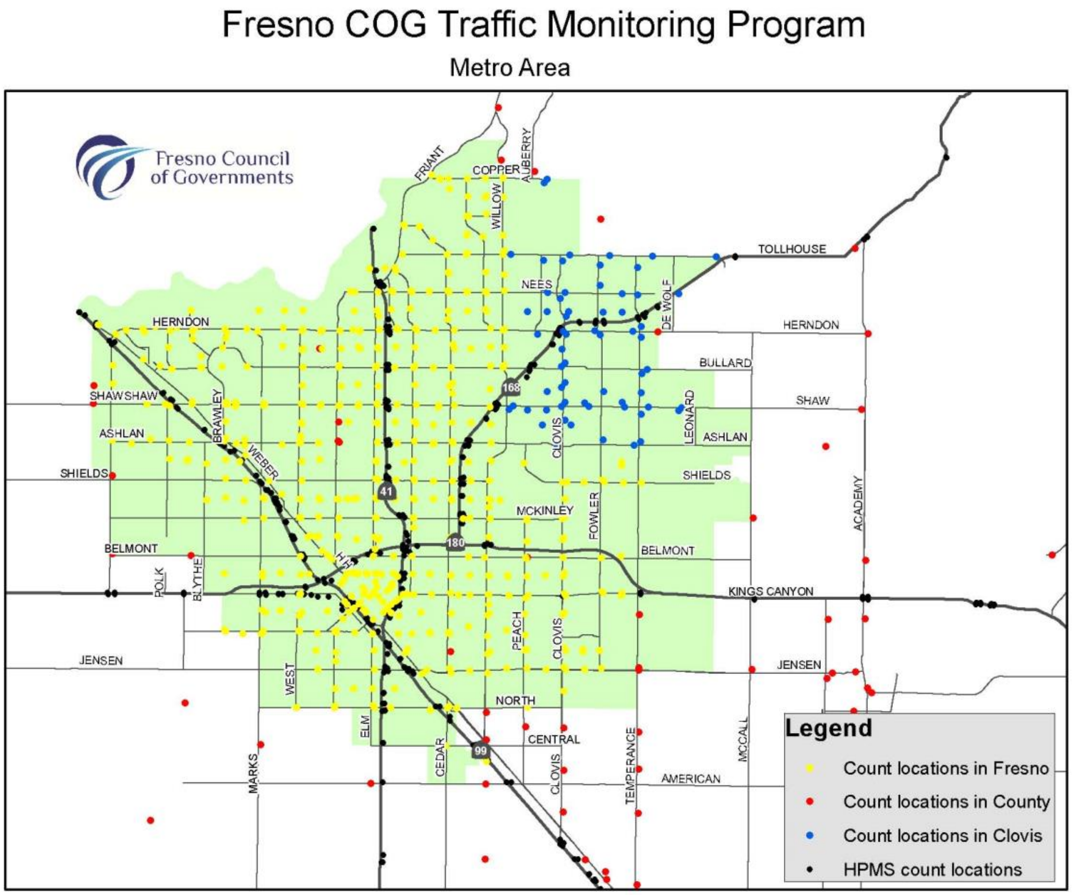

Fresno COG Traffic Monitoring Program
Metro Area
Fresno Council of Governments
FRIANT
COPPER
WILLOW
AUBERRY
TOLLHOUSE
NEES
DE WOLF
HERNDON
HERNDON
BULLARD
SHAW
SHAW SHAW
ASHLAN
ASHLAN
BRAWLEY
WEBER
LEONARD
CLOVIS
SHIELDS
SHIELDS
MCKINLEY
FOWLER
ACADEMY
BELMONT
BELMONT
POLK
BLYTHE
KINGS CANYON
JENSEN
JENSEN
PEACH
CLOVIS
WEST
NORTH
ELM
CEDAR
CENTRAL
MARKS
CLOVIS
TEMPERANCE
MCCALL
AMERICAN
Legend
Count locations in Fresno
Count locations in County
Count locations in Clovis
HPMS count locations

Figure 5

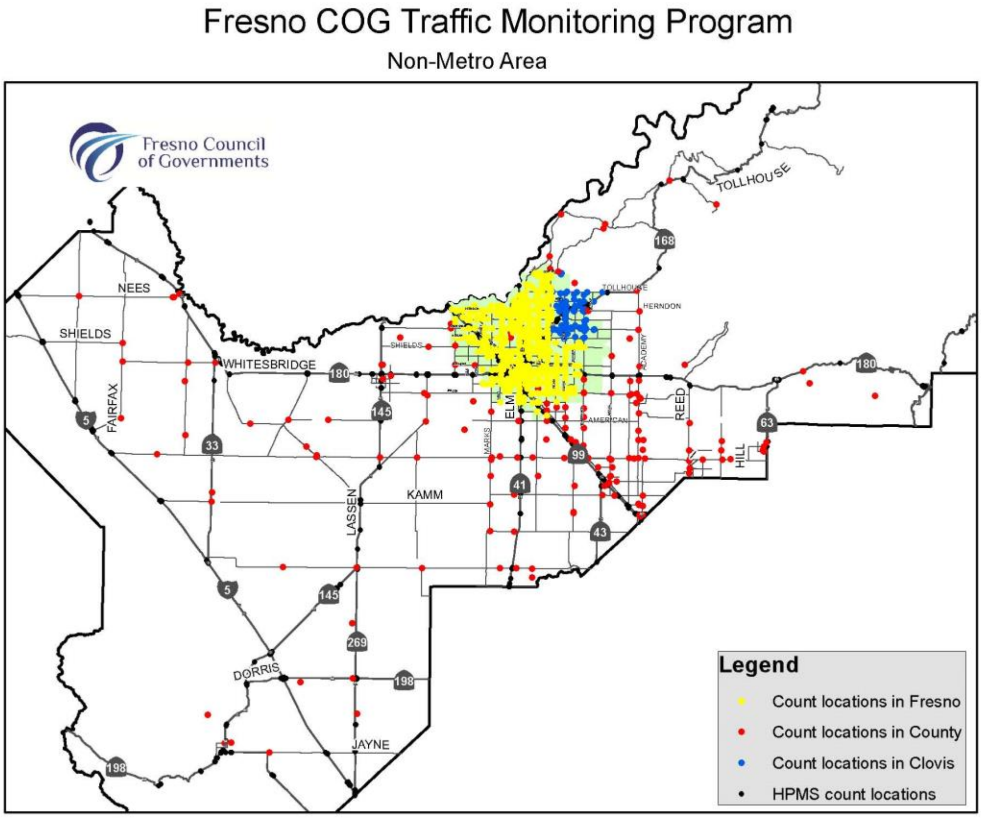

Fresno COG Traffic Monitoring Program
Non-Metro Area
Fresno Council of Governments
TOLLHOUSE
NEES
SHIELDS
WHITESBRIDGE
FAIRFAX
LASSEN
KAMM
ELM
REED
HILL
AMERICAN
HERNDON
DORRIS
JAYNE
Legend
Count locations in Fresno
Count locations in County
Count locations in Clovis
HPMS count locations

Figure 6

As discussed in Chapter 5, Fresno COG is moving into travel-time and reliability based performance measures for system congestion monitoring. A congestion monitoring dashboard has been developed to monitor the system performance. Probe data from HERE North America has been purchased to provide real time traffic performance information for the identified CMP network. The NPMRDS is used to perform historical system-wide analysis for the NHS network using performance measures developed by the CMP Steering Committee. A third application is being developed on the Dashboard to report the system-wide performance based on the final system performance measures established by the FHWA. Appendix A provides detailed information on the background, dataset, performance measures, methodology and functionality of the congestion monitoring dashboard. The dashboard can be found at: fresnocog.iteris-pems.com. Usage of the dashboard needs to be pre-authorized by Fresno COG.

II. Bike/Pedestrian Count Monitoring

Active transportation projects provide air quality and health benefits and have had an increasing role in providing transportation options for the general public, in addition to being used for recreational purposes. Assembly Bill 1358 requires cities and counties to include complete streets policies as part of their general plans so that roadways are designed to safely accommodate all users. The Active Transportation Program (ATP) provides exclusive funding sources for active transportation projects and requires before/after bike/pedestrian counts to support funding applications. In 2015, Fresno COG was selected as one of the 10 MPOs nation-wide to participate in the FHWA Bicycle & Pedestrian Count Technology Pilot Program. Fresno COG received a grant from the Pilot Program to purchase bike and pedestrian counters. Bike and pedestrian counts were taken on trails, bike lanes, sidewalk and pedestrian malls for project funding applications, usage monitoring or bike/pedestrian facility planning. Appendix B is a detailed report on the results of the Bike/Pedestrian Count Technology Pilot Program in the Fresno region.

Although the Pilot Program was completed in 2016, Fresno COG retains the bike/pedestrian counters which are loaned to the local governments and other entities on an as-needed basis. In 2017, additional bike/pedestrian counts were taken at 40 locations close to downtown Fresno, selected high schools and colleges. The bike/pedestrian counts taken in 2016/17 are used in the development of the first bike/pedestrian forecasting system in Fresno COG's Activity-Based Model (ABM). Fresno COG is evaluating a potential regional count system to monitor bike and pedestrian activities and having such counts taken regularly.

Chapter 7 CMP Strategies

SAFETEA-LU and the subsequent MAP 21 & FAST Act mandate that a CMP should identify alternative strategies such as travel demand management (TDM), traffic operational improvements, public transit, Intelligent Transportation System (ITS), and land use strategies, etc. as congestion management strategies. Although such programs have long been in place in Fresno County, the CMP process evaluated and selected alternative strategies considered appropriate and feasible for the Fresno region. This chapter provides an overview of existing CMP programs in Fresno County and summarizes the CMP strategies identified and adopted by the CMP Steering Committee for implementation.

I. Overview of Existing CMP Related Programs

Travel Demand Management

Travel demand management (TDM) programs are designed to reduce automobile usage by changing traveler behavior and encouraging alternative transportation modes besides single occupant vehicle trips. TDMs reduce demand on the system and postpone the need for capacity improvement.

Fresno COG's TDM has been predominately focused on ridesharing. TDM program staff has maintained the Valleyrides Program, which provides ride matching service within Fresno, Kings, Madera and Tulare Counties. In the last 11 years, program staff has worked with more than 1,200 worksites, and provided service/information in the four regions. Valleyrides partnered with California State University Fresno's Parking & Transportation Department and developed an online ride-matching database which has been in operation since 2003.

In 2006, Fresno County voters passed the Measure “C” Extension, a half-cent sales tax measure that programs 0.6% of its revenues to fund carpool and vanpool subsidy programs originating within Fresno County. Launched in 2009, today there are 38 regular vans and 99 farmworker vans sponsored by Measure “C”. Annually through 2027, $2 million will be available from Measure “C” to expand farm labor and commuter vanpools

CalVans provides vanpool services to farmworkers and commuters in rural counties, including: Fresno, Kern, Kings, Madera, Merced, Monterey, San Benito, Santa Barbara, Santa Cruz, Tulare, Imperial and Ventura. In 2014/15, vans out of Fresno County traveled 29 million passenger miles; in 2015/16, vans (out of Fresno County) traveled 2.6 million miles with 528,510 passengers and passenger miles reached 28.8 million, which is equivalent to 13,459 metric tons of greenhouse gas emission reduction. Nearly 500 commuter and farm labor vehicles are in service.

Public Transit

Fresno Area Express (FAX) is the transit service provider in the City of Fresno. FAX provides two types of public transportation service: the fixed-route service for the general public and Handy Ride, a demand-responsive service for those who are unable to use the regular fixed-route service because of physical or mental disabilities. With an annual operating budget of $37 million, FAX operates 17 fixed routes in the City of Fresno. The annual boarding was 17.6 million in 2016.

The City of Clovis also operates two types of public transportation service in the FCMA area: Stageline, a general public fixed-route service, and Round-up, a demand-responsive paratransit service for senior and disabled residents. Clovis Transit ridership in 2016 was 154,451 with an annual operating cost at $1.95 million.

Rural Fresno County is served by a combination of public transit providers: common carrier, general public and social service agencies. The Fresno County Rural Transit Agency (FCRTA) and the Fresno County Economic Opportunities Commission (FCEOC) are designated as the Rural Consolidated Transportation Service Agency (CTSA).

About 24% of the Measure "C" extension money, estimated to be about $412 million over 20 years, will be spent on public transit, of which 19.66% ($337 million) will be spent on expanding public transit programs, improving transit service and consolidating services among different transit providers. The remaining 4.34% ($75 million) is intended to enhance alternative transportation services through programs such as the Public Transportation Infrastructure Study (PTIS), carpool/vanpool, and farm worker vanpool programs.

Operational Improvements & ITS

Operational improvements are an effective strategy to reduce traffic delays. Such improvement projects are less costly and can be implemented in a relatively short timeframe. Projects such as signal synchronization significantly reduce wait time at intersections, which also decreases vehicle idling time, bringing considerable air quality benefits to the region. Caltrans and the cities of Fresno and Clovis have been deploying enhanced signal and traffic management strategies to manage congestion. The Fresno County Intelligent Transportation System (ITS) Strategic Deployment Plan has identified traffic operational/management projects as one of its priority strategies to address the transportation problems in the Fresno area. Some of the identified projects are as follows:

- ITS Freeway Crossings
  Traffic Signal Synchronization of Arterials and Freeway Crossings

- ITS Signal Coordination and Improvements/Upgrades
  Installation of ITS equipment (communications, upgraded controllers; cameras, detection, poles, cabinets, and vaults) and signal synchronization

- Ramp metering & communication gap closure
  Deploy additional ramp-metering capabilities along the freeway system within the Fresno County Region to improve freeway throughput and efficiency

The City of Fresno and Caltrans District 6 reached a mutually beneficial shared fiber network agreement to provide fiber connectivity to the SR 41 ramps through the Blackstone corridor segment of the fiber network. Meanwhile, the cities of Fresno and Clovis have been working together on the Fresno/Clovis Metropolitan Area Signal Coordination and Fresno/Clovis Regional ATMS Completion Project. Such ITS projects have been mapped in the cities' plans, with funding aggressively pursued at the federal, state and local levels.

Land use/Growth Management

Segregated land uses and low-density suburban development have contributed to automobile dependency among American families. Both land use planners and transportation planners have realized that congestion needs to be addressed where travel is generated. Mixed-use, compact and transit-oriented development are the neo-traditional land use patterns that encourage transit use, walking and biking. These alternative transportation modes reduce driving, helping relieve congestion. Such land use/growth management strategies have been enacted in the Fresno area as part of ongoing efforts to build sustainable communities.

Fresno COG was a key partner in the San Joaquin Valley Blueprint planning efforts. The Fresno COG Policy Board adopted a preferred scenario with features such as transit oriented development, urban centers, high intensity transit corridors, mixed uses, etc. Fresno's preferred scenario had a density of eight housing units per acre compared to the existing 3.8 units per acre. The Valley wide preferred scenario, which was stitched together among the eight Valley counties' locally selected scenarios, had an average density of 6.8 units/acre. Under California's SB 375, the Blueprint preferred scenario served as a starting point for developing the 2014 RTP's Sustainable Communities Strategy (SCS).

As mandated by Senate Bill 375, Fresno COG developed its first SCS in the 2014 RTP aimed at reducing greenhouse gas emissions through integrated transportation and land use planning. The SCS contained land use strategies such as higher density, mixed use development, infill, and allocation of growth along transportation corridors. Such land use strategies reduce the growth footprint and encourage alternative modes such as transit, biking and walking. Several cities adopted new general plans with more compact land use and other sustainable transportation strategies. Here are a few examples of the growth management efforts in the new general plans:

- The 2014 Fresno General Plan was adopted in adopted in December 2014. It envisions a balanced city with an appropriate proportion of growth and reinvestment focused in the central core, downtown, established neighborhoods and along BRT corridors. The City set a goal of directing approximately 50% of new growth towards infill areas within existing city limits, and the other half within the existing sphere of influence area by 2035. Around 20% of entire region's housing growth and 36% of new employment by 2035 is planned to take place within ½ mile of BRT corridors inside the City of Fresno. In December 2015, the City of Fresno approved a new Development code/Zoning Ordinance, which is an essential tool to implement the 2014 General Plan.

- The City of Clovis also adopted a new general plan in 2014 right after the adoption of the first SCS. Clovis' new general plan also set "goals and policies to seek to foster more compact development patterns that can reduce the number, length, and duration of auto trips." The Clovis General Plan introduced the concept of urban centers that require higher density and more mixed use around the community centers. Such density requirements gradually decrease further away from the center. The master-planned urban centers are also required to provide bike/trail connections within the communities.

The Fresno County Public Transportation Infrastructure Study (PTIS) took an integrated approach in long-range transit planning. The PTIS study identified potential high capacity transit corridors for Bus Rapid Transit (BRT) with the assumption that the land use in those corridors would be intensified. The Study identified transit-supportive land use typology along the BRT corridors and recommended land use strategies and policies for implementation. Such land use recommendations have been incorporated into the City of Fresno's 2035 General Plan; the BRT is under construction at the recommended corridors and will be operating by spring 2018.

II. Adopted **CMP Alternative Strategies**

Based on the adopted CMP objectives, the Steering Committee endorsed a list of alternative strategies that the jurisdictions in Fresno County are encouraged to implement before roadways are widened. Those strategies are categorized as follows:

- Transportation System Management Strategies
- Travel Demand Management Strategies
- ITS Strategies
- Land Use Strategies
- Public Transit Strategies
- Bicycle and Pedestrian Strategies

A Toolbox for Alleviating Traffic Congestion published by the Institute of Transportation Engineers was referenced in developing the list. The ITS strategies were incorporated from the Fresno County Intelligent Transportation System Strategic Deployment Plan.

Table 5. Fresno County CMP Strategies-Transportation System Management Strategies

Intersection Operational Improvement	Existing Traffic Signals	Equipment update & maintenance
		Timing Plan Improvement
		Interconnected & synchronized signals
		Transit Signal Priority
	Other Traffic Control	Roundabouts
		Traffic Signal Removal
Geometric changes and bottleneck alleviation	Restriping	
	Installation of turning lanes	
	Adding lanes (bottleneck removal only)	
	Realignment of intersecting streets	
Arterial Access management	Left turn restrictions; curb cut and driveway restrictions	
	Reduce conflict points	
	Eliminate parking	
	Consolidate access points	

Table 6. Intelligent Transportation System Strategies

Traffic/Freeway Management Systems	Ramp metering and communication Gap Closure
	Multi-jurisdictional interconnects
	Integrated Smart Corridors (SR41/168/180)
	Railroad/highway interface technology for railroad crossing
	Communications interties
	Integrated Surveillance stations/callbox deployment
	Regional Intersection Safety and enhancement program
Incident Management/Emergency Services	Weather Sensing/ATMS integration
	Variable speed system/smart or intelligent roadway studs
	Remote surveillance and incident scene management
	Computer Aided Dispatch Integration
	Integration of Communications channels
	Incident Management/Response Coordination Task force
Transit System	Form a Regional Transit District
	Transit Operations/Dispatch centers integration
	Transit Information System
	Transit Management System Completion/Expansion
	Implement Regional Farebox System

Table 6. Intelligent Transportation System Strategies –continued

Transportation User Information Systems	Regional transportation user information system
	Regional transit user information system
	Coordination with Valleywide/statewide information system
Regional ITS Configuration Management /Coordination/Planning	Valleywide/statewide communications linkages
	Regional Configuration Management
	Common/Standard regional/county map

Table 7. Public Transit Strategies

Modify bus routes & service modification	Add new routes
	Extend bus and feeder bus routes
	Increase bus frequency
	Limit stop or express bus routes
Provide exclusive bus lanes	
Construct bus shelters & improve passenger amenities	
Improve bicycle routes to transit facilities	
Park & Ride lots for transit & rideshare	
Provide information service for all transits	Build information center for all buses

Table 8. Travel Demand Management Strategies

Ridesharing	Carpool
	Vanpool
Telecommuting	
Alternative Work Hours	
Car sharing	

Table 9. Bicycle & Pedestrian Strategies

Provide walking infrastructure
Improve bicycle facilities at transit stations and other trip destinations
Improve safety of existing bicycle and pedestrian facilities
Provide biking infrastructure to eliminate existing gaps and expand and enhance the existing bicycle network
Link bicycle and pedestrian improvements to schools and retail developments
Road diet program
Bike share programs

Land Use Strategies

The following strategies, individually or in combination, reflect emerging and contemporary planning practices. These practices support sustainable developments that are appropriately-scaled for their environs and can provide transit-compatible densities or mixed land uses. These developments can lower traditional per capita energy demand and reduce distances traveled to work, goods and services and reduce the necessity and attractiveness of private automobile use. Further, when implemented by multiple agencies, these strategies can foster cooperative and sustainable regional policies.

The following strategies are independent of each other. A project that meets **all** the criteria of a strategy shall be considered supportive of the objectives of the Congestion Management Process.

1. Mixed-Use Development

- Projects that provide a mix of land uses -- defined as the practice of allowing more than one type of use in a building or set of buildings -- or that complement existing land uses, and with residential uses within ¼ mile of other land uses.

- Projects that provide pedestrian linkage among different land uses in the mixed use development.

- Projects that provide a range of housing choices, 70% and above of which are planned for attached residential units.

Mixed-use development in this case does not include detached single-family development with stand-alone shopping centers, stand-alone hotels with residential space or stand-alone
parking structures with ground floor retail.

2. Infill and Redevelopment

- Projects that are located in an existing urban area, defined here as served by urban services and within an existing incorporated boundary.

- Projects that are located on abandoned, passed-over or underutilized land within an existing urban area as defined above.

- Projects adjacent to and between currently developed areas.

3. Transit-Oriented Development

- Projects within a half mile of a transit stop or other COG-defined transit corridors.

- Projects that contain a mix of uses such as housing, jobs, shops, restaurants and entertainment.

- Projects that provide a range of housing choices.

- Projects that provide a strong sense of community and of place.

- Projects that increase "location efficiency" so people can walk, bike and take transit.

- Projects that encourage transit use and minimize traffic impacts.

III. Strategy Implementation

As shown in the Fresno County CMP components flowchart in Figure 1, adopted CMP strategies will be integrated and implemented through the Transportation Improvement Program (TIP) process.

In order to encourage jurisdictions to employ alternative strategies for managing congestion/mobility issues, a point system has been established in the competitive funding program in the TIP process to incentivize CMP projects that will address congestion issues. CMP projects are eligible for up to five points in the TIP scoring system. The point system takes into consideration reoccurring and non-reoccurring delays throughout the region. Recurring delays were analyzed on the National Highway System (NHS) using 2015 NPMRDS data provided by the FHWA. For roadways segments with excessive delays --which are defined as having average travel speed at the peak hour of less than 35 miles per hour (mph) on freeways or less than 15 (mph) on arterials -- the CMP projects will be awarded two points; for segments with moderate delays, -- defined as having average travel speed at peak hour at 35-50 mph on freeways or 15-25 mph on arterials -- the CMP projects will receive one point. Figure 7 shows roadways with excessive and moderate delays.

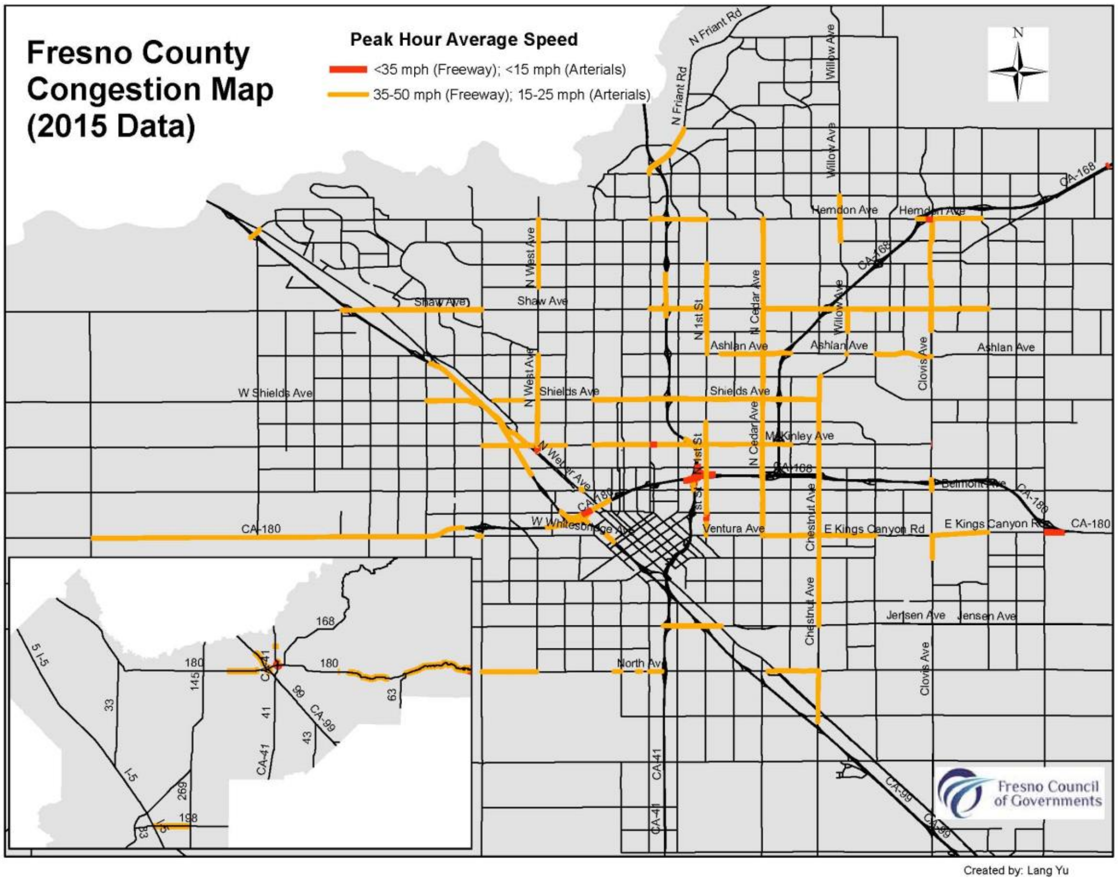


Figure 7

The non-reoccurring congestion is typically caused by traffic accidents, and collisions are used as the proxy for the non-reoccurring delay analysis in this CMP update. Transportation Injury Mapping System (TIMS) data is used in the collision analysis. The TIMS data is based on the California Statewide Integrated Traffic Records System (SWITRS). The collisions are geocoded and mapped statewide with a consistent methodology. The TIMS is housed and maintained by the Safe Transportation Research and Education Center at University of California, Berkeley. The 2009-2013 TIMS data, which was the most recent data available, was applied in Fresno COG's CMP update. CMP projects that address safety issues and fall on the segments that had the top 10th percentile in collision rates -- measured as number of collisions per 10,000 Average Daily

Traffic (ADT) -- will be awarded two points; CMP projects with safety components on locations that ranked among the top 25^{th} percentile in total number of collisions over the analysis timeframe will receive one point. Projects that meet both of the criteria will receive the maximum two points. Figure 8 illustrates the distribution of locations that will receive safety-based points.

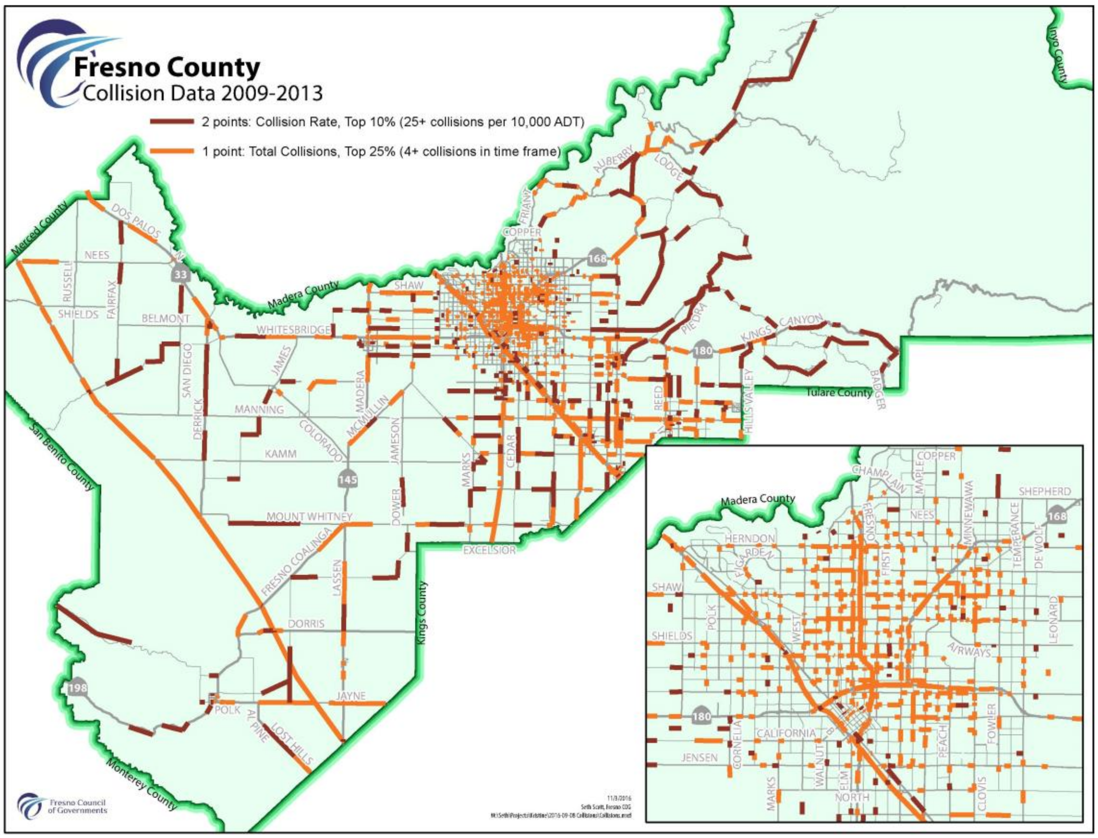


Figure 8

The delay/collision data and mapping analysis will be updated every other year so that the most up-to-date data will be provided to the project scoring process when a TIP call for projects is issued every other year. To encourage submittal of CMP project, the

Steering Committee also decided to grant one point to any CMP project regardless of the location.

CMP strategy implementation system details are documented with the TIP scoring process.

IV. Strategy Assessment

SAFETEA-LU and the subsequent MAP-21 and FAST Act require strategies to be periodically assessed to ensure their effectiveness, efficiency and consistency with the adopted performance measures. FHWA is expected to continue providing the historical NPMRDS data to the MPOs and it will be updated on the Congestion Monitoring Dashboard when it is available. Year-over-year comparisons of system performance can be analyzed on the Dashboard, which provides instant analysis results based on the performance measures.

An application will be developed in the Dashboard to analyze system performance using the final national performance measures. As discussed in the previous session, TIMS data will be updated every other year so that the most up-to-date information can be provided to the TIP process. In the meantime, collision data will be analyzed annually as part of the safety target update process. In addition, as required by the Transportation Performance Management process, system performance will be reported every four years by MPOs in the RTP updates for all the transportation performance measures, including system performance and congestion measures. Furthermore, the effectiveness of the CMP project funding mechanism can be evaluated by the number of CMP projects submitted and funded through the FTIP process. The continuous and consistent nature of this program has provided the region with a great tool to monitor changes of traffic conditions and system performance over time.

Chapter 8 Single Occupancy Vehicle (SOV) Projects Analysis

I. Legislative Requirements

SAFETEA-LU and its subsequent legislation, MAP-21 and the FAST Act, require that "in a TMA designated as a non-attainment area for ozone or carbon monoxide, federal funds may not be programmed for any project that will result in a significant increase in the carrying capacity for single occupancy vehicles (SOVs), (i.e., a new general purpose highway on a new location or adding general purpose lanes, with the exception of safety improvements or the elimination of bottlenecks), unless the project is addressed through a congestion management process."

The legislation further requires that the congestion management process shall provide an appropriate analysis of all reasonable travel demand reduction and operational improvement strategies for the corridor in which a capacity increasing project is proposed. If the analysis demonstrates that travel demand reduction and operational improvement strategies are not able to meet the demand for additional capacity, then the SOV project is warranted. In the meantime, the CMP should identify feasible alternative strategies to manage the corridors efficiently.

Fresno County is designated as a non-attainment area for ozone and is required to develop an SOV project analysis process to ensure that capacity increasing SOV projects are vetted through the CMP before they are accepted into the planning process. Since the CMP Steering Committee decided to limit the CMP network to urban freeways, the SOV analysis will be applied to the SOV projects on the CMP network.

II. Methodology

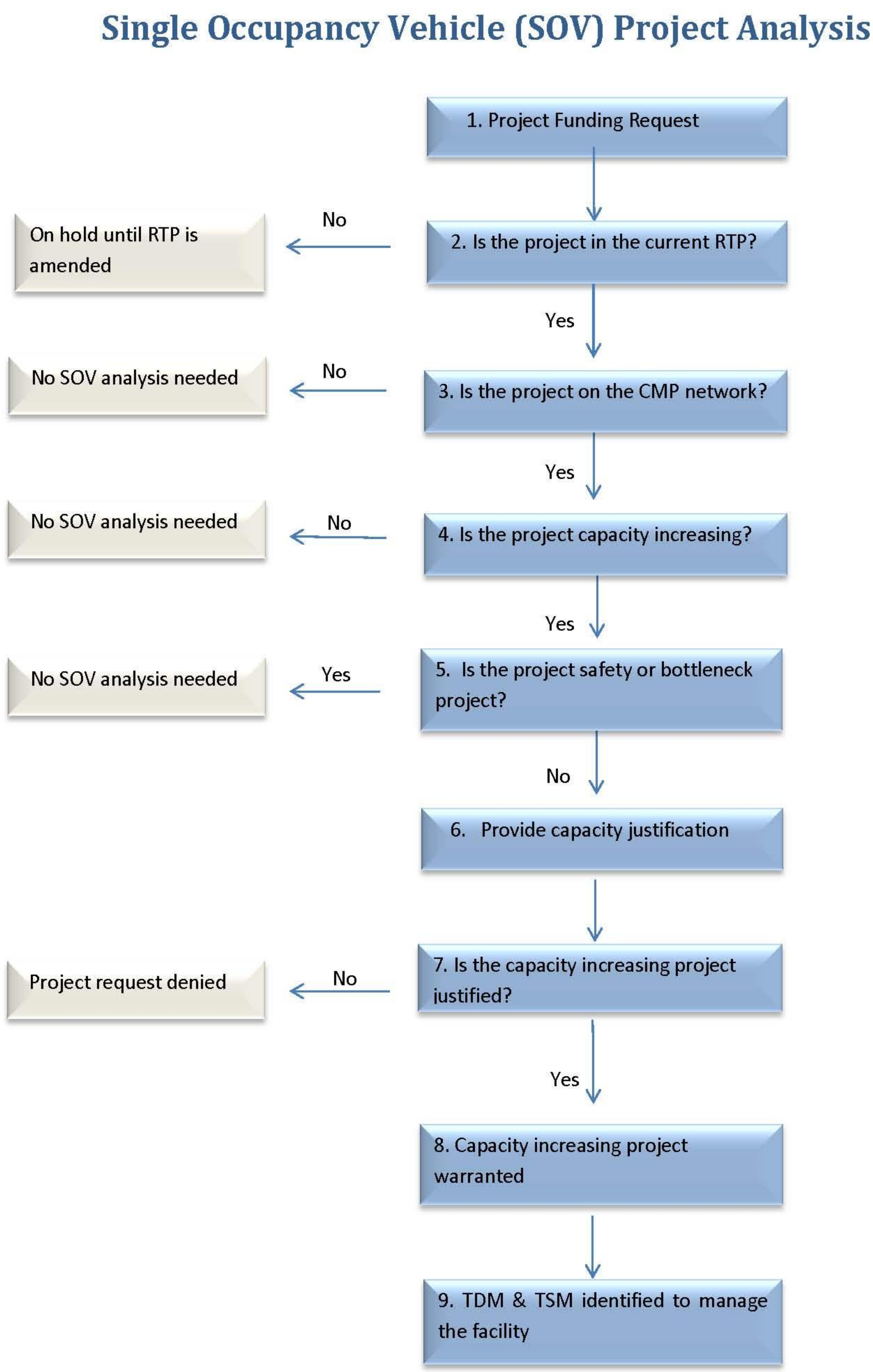


Figure 9

The SOV analysis starts with the RTP process as illustrated in Figure 9, when project funding request is initiated. If the project is not in the RTP (step 2), then it is put on hold until it is amended into the RTP. If the project is in the RTP, the project proceeds to the step 3, which determines whether the proposed project is on the CMP network. Any projects outside the CMP network are not subject to the analysis.

If the project falls on the CMP network, then it moves to step 4. At step 4, the project is tested whether it is capacity increasing, i.e. a single occupancy vehicle (SOV) project that will result in a significant increase in the carrying capacities for drive-alone auto trips. A SOV/capacity increasing project is "a new general purpose highway on a new location or adding general purpose lanes, with the exception of safety improvements or the elimination of bottlenecks" 23 CFR 450.322 (e). Auxiliary lanes are not considered capacity increasing considering they are built between interchanges to facilitate speed change, turning, weaving, truck climbing, maneuvering of entering and exiting traffic and other purposes supplemental to through-traffic movement.

Once determined to be a capacity increasing SOV project, it proceeds to step 5 to decide whether it is classified as safety or bottleneck removal. According to the CMP regulation, safety or bottleneck removal projects are exempt from the SOV analysis. A safety project is designed to address a hazardous roadway conditions or to reduce/prevent fatalities and serious injuries on the roadway system. Bottleneck removal projects address recurring localized congestion points where the number of lanes decreases at ramps and interchanges and where there are roadway alignment changes. Typical bottleneck removal projects include: restriping, adding travel lanes for a short section by reducing lane widths and converting shoulders, adding lanes to accommodate entering and exiting traffic, modifying ramps, etc. If the capacity project is not considered as safety or bottleneck removal project, then the sponsoring agency is required to provide analysis to prove that other operational improvements or travel demand reduction strategies can't meet the demand for more capacity.

The capacity justification process begins with a density analysis of the freeway/roadway segment where the capacity project is proposed. Highway Capacity Manual (HCM) methodology is applied through which factors such as volume, ramp, auxiliary lanes, truck volume, enter/exiting volume and types of drivers are included. If the density analysis demonstrates that the roadway is congested and needs extra capacity, alternative strategies such as a parallel route study, ramp metering, carpooling (increased vehicle occupancy rates) are first studied. If such operational improvements or travel demand reduction strategies can meet the demand for extra capacity, then the project is rejected; however, if the analysis shows that the alternative strategies could not solve the congestion problem, the capacity project is justified and accepted into the RTP process. The sponsoring agency then identifies all the reasonable travel demand reduction and operational improvement strategies to manage the SOV facility.

Please contact Kristine Cai at kcai@fresnocog.org or Kai Han at khan@fresnocog.org if you have any questions regarding the Fresno County Congestion Management Process.

Appendix C. Transportation and Land Use

Item 7. Transportation Performance Management

Transportation Performance Management: Target Setting and Investment Accountability

Federal Highway Administration (FHWA) defines Transportation Performance Management as a strategic approach that uses system information to make investment and policy decisions to achieve national performance goals. Different federal transportation acts like Moving Ahead for Progress in the 21st Century Act (MAP-21 2012), Fixing America's Surface Transportation Act (FAST Act 2016) along with the most recent act, Infrastructure Investment and Jobs Act (IIJA 2021) authorized the federal surface transportation spending for federal-aid highways, highway safety programs, and transit programs including other purposes.

FHWA Performance Measures

The federal performance measures defined by the Federal Highway Administration (FHWA) are categorized into three performance management (PM) focus areas. Each of the federal performance management focus areas includes an associated set of metrics for which statewide and regional targets must be set. The specific performance measures for each include:

TRANSPORTATION SYSTEM SAFETY (PM 1)

Motor Vehicle Collisions

- Number of motor vehicle collision fatalities
- Rate of motor vehicle collision fatalities per 100 million vehicle miles traveled (VMT)
- Number of motor vehicle collision serious injuries
- Rate of motor vehicle collision serious injuries per 100 million VMT

Non-Motorized Fatalities and Serious Injuries

- Number of non-motorized fatalities and serious injuries

NATIONAL HIGHWAY SYSTEM PAVEMENT AND BRIDGE CONDITION (PM 2)

NHS Pavement Condition

- Percentage of Interstate System pavement in 'good' condition
- Percentage of non-interstate NHS pavement in 'good' condition
- Percentage of Interstate System pavement in 'poor' condition
- Percentage of non-interstate NHS pavement in 'poor' condition

NHS Bridge Condition

- Percentage of NHS bridges in 'good' condition
- Percentage of NHS bridges in 'poor' condition

NATIONAL HIGHWAY SYSTEM (NHS) PERFORMANCE (PM 3)

NHS Performance

- Percent of Interstate System mileage reporting reliable person-mile travel times
- Percent of non-interstate NHS mileage reporting reliable person-mile travel times

Interstate Freight Movement

- Percent of Interstate system mileage reporting reliable truck travel times

CMAQ Program Performance

- Annual hours of peak-hour excessive delay per capita
- Total emissions reduction by criteria pollutant (PM10, PM2.5, Ozone, CO)
- Percent of non-single occupancy vehicle (SOV) travel

FTA Performance Measures

In addition to the three PM focus areas defined by FHWA, the Federal Transit Administration (FTA) established performance measures and reporting requirements for transit asset management (TAM) and transit safety.

Performance metrics for TAM focus on the maintenance of our regional transit system in a state of good repair. Transit safety performance monitoring is focused on assessment of the number of transit incidents resulting in fatalities or serious injuries and transit system reliability.
FTA issued the TAM Final Rule (49 CFR §625 et seq.), effective October 1, 2016, to implement MAP-21 transit asset management provisions. This final rule mandates a National TAM System, defines 'State of Good Repair' (SGR), and requires transit providers to develop TAM plans. The Metropolitan Transportation Planning Final Rule (23 CFR §450.206) outlines the timelines and processes by which states, MPOs, and transit providers must coordinate in the target setting process.

The FTA PM focus areas and associated metrics are as follows:

Transit Asset Management (TAM)

The FTA issued the TAM Final Rule, effective October 1, 2016, to implement MAP-21's asset management provisions. This final rule mandates a National TAM System, defines 'State of Good Repair' (SGR), and requires transit providers to develop TAM plans. The Metropolitan Transportation Planning Final Rule outlines the timelines and processes by which states, MPOs, and transit providers must coordinate in target setting.

Performance metrics for TAM focus on the maintenance of our regional transit system in a state of good repair. Transit assets to be monitored under this provision include:

- Equipment: Share of non-revenue vehicles that meet or exceed useful life benchmarks
- Rolling Stock: Share of revenue vehicles that meet or exceed useful life benchmark
- Infrastructure: Share of track segments with performance restrictions
- Facilities: Share of transit assets with condition rating below 3.0 on FTA Transit Economic Requirements Model (TERM) scale[i]

Transit Safety/ Public Transit Agency Safety Plan

On April 9, 2024, the FTA published the first major update to the Public Transportation Agency Safety Plan (PTASP) Final Rule (49 CFR §673) regulating how Chapter 53 grantees would have to implement federally mandated safety standards. The rule's effective date was May 13, 2024. The MPO's initial transit safety targets are to be set within 180 days of receipt of the safety performance targets from the transit agencies.

The MPO then revisits its targets based on the schedule for preparation of its system performance report that is part of the Metropolitan Transportation Plan (MTP). See FTA's Public Transportation Agency Safety Program page for more information about the Notice.[ii]

The final rule specifically requires transit agencies receiving federal funds to develop a safety plan and annually self-certify compliance with that plan. The National Public Transportation Safety Plan identifies four performance measures that must be included in the transit agency safety plans: number of fatalities, number of injuries, safety events, and system reliability. Each transit agency must make its safety performance targets available to MPOs to assist in the planning process and to coordinate, to the maximum extent practicable, with the MPO in selecting regional transit safety targets. The National Public Transportation Safety Plan identifies four performance measures that must be included in the transit agency safety plans:

- Number of transit-related fatalities
- Number of transit-related injuries
- Number of transit system safety events
- Transit system reliability

TRANSPORTATION SYSTEM SAFETY (PM 1)

PM1 is the annual target setting process for transportation safety. MPOs can either choose to support the statewide target or set a separate regional target. Except for the first round in 2018 when Fresno COG set its own targets, it has been simply supporting the statewide targets. COG recently finalized the ninth round of safety targets for calendar year 2026.

This year, Caltrans released the 2026 safety targets in September 2025 giving MPOs the deadline of February 2026 to either support the statewide targets or set their own targets. Caltrans set the statewide safety targets consistent with the National Highway Traffic Safety Administration (NHTSA)'s new requirement that would reflect constant targets between 2021 and 2026 five-year rolling average. This was achieved by setting the 2026 rolling average target equal to that of 2021 and using the average annual change to calculate the annual projection between 2021-2026. Based on this methodology, 2.8% and 3.7% are the annual reduction targets for number of fatalities and serious injuries respectively. Similarly, the annual reduction targets for rate of fatalities and rate of serious injuries are 4.6% and 3.7% respectively. Table 1 shows the statewide targets for 2026.

Table 1 - Safety Performance Targets

Performance Measure	FY 2026 Target (5-Year Average)	Average Annual Reduction
Number of Fatalities	3,933.2	2.84%
Fatality Rate (per 100M VMT)	1.20	4.61%
Number of Serious Injuries	16,016.9	3.69%
Serious Injury Rate (per 100M VMT)[1]	5.205	3.69%
Number of Non-Motorized Fatalities and Serious Injuries[1]	4,402.5	2.84% (Fatalities) 3.69% (Serious Injuries)

Source: California Highway Safety Improvement Program Implementation Plan. September 2025. Table 2.2 - Safety Performance Management Targets for 2026.

[1]This target setting process is the same as 2025, but the 2025 target was based on now out-dated serious injury numbers.

Each year, Fresno COG analyzes the historical crash datasets for Fresno County region and proposes different target- setting options to discuss with the safety committee. The safety committee comprises engineers and safety planners from multiple member jurisdictions in Fresno County. During the 2024 target setting process, the safety committee convened on December 21, 2023 to discuss the appropriate methodology/option for the region. Fresno COG presented two options to the committee: first, the state targets applicable to the Fresno County region and second, the best fit curve using the historical trendline of fatalities and serious injuries within Fresno County. The first option is simply using the annual percentage change for all five metrics from the state targets and projecting the 2024 numbers based on the latest available crash number for 2021. The second option is a trendline approach in which the 5-year average curve was fitted with 3rd order polynomial equation. The second option was more aggressive and less achievable compared to the first option. 2024 targets for all five metrics from this option were higher than those from the State targets option. The committee unanimously selected the statewide targets methodology as it was more reasonable and achievable considering the COVID effect on travel patterns. Table 2 shows the two options considered by Fresno COG and presented to the Safety Committee. Since the 2024 target setting methodology applies that the 2026 five-year rolling average is equal to 2021 five-year rolling average, this methodology has been simply continued to project the annual targets up until 2026. Fresno COG has been simply supporting the same targets for three consecutive years, 2024-2026. State is expected to propose a new methodology for 2027.

Table 2 - Safety Performance Targets

Safety Metrics	State Targets 2024	COG Trendline
Number of Fatalities	-2.84%	-2.3%
Rate of Fatalities	-4.61%	-10.6%

Number of Serious Injuries	-3.69%	-12.0%
Rate of Serious Injuries	-3.69%	-12.0%
Non-Motorized Fatalities and Non-motorized Serious Injuries	-2.84% for fatalities and -3.69% for Serious injuries	-2.3% for fatalities and -12.0% for Serious injuries

Safety Plan Efforts in Fresno County

1. Fresno COG Regional and Local Transportation Safety Plan

Fresno Council of Governments (Fresno COG) developed both a Regional Safety Plan (RSP) and a Multi-Jurisdictional Local Roadway Safety Plan (MLRSP) during 2021–2022 to address Fresno County's disproportionate share of statewide traffic fatalities. As part of the RSP, Fresno COG convened a regional steering committee consisting of local stakeholders to guide the planning process. This effort included:

- Preparing an existing conditions report
- Identifying proven safety countermeasures
- Developing implementation strategies
- Conducting public outreach to gather community input on safety concerns
- Designing a transportation safety education program in collaboration with consultants

The MLRSP was developed concurrently with the RSP to maximize efficiencies in data analysis, public engagement, and countermeasure development. It supported ten jurisdictions in Fresno County that did not previously have their own Local Road Safety Plans (LRSPs). By aligning with the regional framework, the MLRSP enabled participating jurisdictions to: develop city-specific LRSP, share resources and technical expertise, and coordinate safety priorities across jurisdictions.

While each local agency maintains its own goals, policies, and project priorities, the multi-jurisdictional approach provides a unified structure for advancing roadway safety improvements. Importantly, the LRSPs developed through the MLRSP made these jurisdictions eligible for California's Highway Safety Improvement Program (HSIP) funding. As a result, ten agencies in Fresno County secured HSIP funding in Cycle 11. Both the RSP and MLRSP final reports are available on the Fresno COG website.

Recent Updates and Ongoing Efforts

Fresno County continues to build on these foundational plans through several important initiatives. Fresno COG was recently awarded an SS4A grant to update the Regional Safety Plan. This effort will:
Incorporate the latest available crash data refresh the identification of high-risk intersections and roadway segments and develop a pipeline of implementation-ready safety projects for local agencies. Fresno COG is also leading a Safe Routes to School study under the SS4A grant, focusing on improving safety for students walking and biking to school. This study is expected to be completed by 2028.

Major Goals of the Plans

The RSP and MLRSP, along with ongoing initiatives, share the following key goals:

- Analyze crash data and community input
- Identify where, when, and why crashes occur across the county
- Identify effective safety solutions
- Prioritize countermeasures proven to reduce crash frequency and severity
- Promote transportation safety education

- Encourage safer behaviors and reduce crash risks
- Develop an implementation roadmap
- Guide investments toward projects that save lives and prevent injuries
- Prioritize high-risk locations
- Identify and prepare safety improvement projects for funding opportunities
- Expand funding eligibility and readiness
- Ensure all jurisdictions are positioned to secure HSIP, SS4A, and other safety funding sources

2. **Local Vision Zero and Safety Plans**

The County of Fresno, along with 9 cities, incl is updating its local safety plan under the SS4A program. Clovis and Parlier are developing their own plans. The County is expected to adopt a Vision Zero–style safety plan in summer 2026. The City of Fresno adopted a Vision Zero Plan in May 2026, committing to a goal of eliminating traffic fatalities and severe injuries through a data-driven, safe systems approach. In addition to federal and state safety programs, local jurisdictions across Fresno County have secured Office of Traffic Safety (OTS) grants, supporting enforcement, education, and safety programs aimed at reducing crashes, injuries, and fatalities.

3. **Eastside Transportation Corridor Improvement Study**

The purpose of the Fresno COG's Eastside Transportation Corridor Improvement Study (ETCIS) is to determine future transportation needs for the eastern part of the Fresno County, with a focus on the major transportation corridors that serve that area: Academy Avenue and Manning Avenue.

The goal of the study was to address mobility, access, safety, and connectivity for all modes of transportation. The ETCIS report presents safety improvements as one of the key outcomes of the project. A detailed safety analysis was conducted along the Eastside Corridors, Academy Avenue and Manning Avenue. The multimodal improvement recommendations proposed in the ETCIS are an outcome of this safety study.

4. **2024 Fresno County Regional Active Transportation Plan**

2024 Active Transportation Plan (ATP) updates the existing plan and develops the plan for 12 jurisdictions within Fresno County. Many parts of the County lack sidewalks, shared-use paths, and bike lanes thereby making walking and biking unsafe, leading to non-motorized related collisions. ATP outlines goals for supporting bicycling, walking, and other human- powered transportation within each jurisdiction that include increasing safety through engineering and facility improvements. To quantify its goals, the ATP outlines the length of each type of bikeway and the number of intersections and bicycle parking locations that would be improved through the actions outlined in the ATP.

The ATP predicts that implementing comprehensive measures throughout the County will significantly reduce crashes involving bicyclists and pedestrians. The ATP states that a 50% or greater reduction in injuries and fatalities is reasonable. Fresno COG completed the update of the ATP and published the final report in May 2024.

5. **California Safe Roads Steering Committee**

The COG participates in the California Safe Roads Steering Committee that oversees SHSP development. The steering committee establishes the strategies and processes to implement the SHSP and provides direction and oversight to challenge area teams, which evaluate and track best practices related to SHSP challenge areas. As a member of steering committee representing the Regional Transportation Planning Agencies (RTPA), the COG is privy to emerging best practices and proposed actions related to SHSP development as well as potential changes to the statewide vision for SHSP implementation.

6. **Other Programming and Funding**

Fresno COG updates its Regional Transportation Plan (RTP) every four years. While the last RTP was updated in 2022, Fresno COG is working on the 2026 RTP update concurrently with the FTIP update. While the main purpose of the RTP is to address the GHG reduction, it continues to ensure the safety and mobility for the regional road network by programming various safety and operations projects. Apart from this, there are also some federal and state funding opportunities to improve the safety of the region. Please refer to chapter six “Financial Element” on the RTP website for the different funding programs.
Three statewide funding programs dedicated to transportation safety are employed by Fresno Council of Governments including:

1. Active Transportation Program (ATP)
2. Highway Safety Improvement Program (HSIP)
3. State Highway Operation & Protection Program (SHOPP) Collision Reduction

ATP

The ATP provides funding for bicycle and pedestrian projects. Since people are more vulnerable to safety risk while walking or biking as compared to traveling in a motor vehicle, any project that promotes the safe use of bicycling or pedestrian modes is likely to generate safety benefits. The ATP further emphasizes safety by allotting points for project applications that specifically seek to reduce the rate or number of pedestrian and bicyclist fatalities and injuries.

HSIP

The HSIP directly addresses transportation safety. The program’s stated purpose is to “achieve a significant reduction in traffic fatalities and serious injuries on all public roads, including non-State-owned public roads and roads on tribal land.” Successful project applications specifically seek to reduce collision related fatalities and injuries. The program is designed to focus local investments on locations and corridors that demonstrate the greatest need for safety improvement to implement lower cost countermeasures.

SHOPP Collision Reduction

SHOPP is the State Highway System’s “fix-it-first” program that funds roadway repairs and preservation, emergency repairs, safety improvements, and some highway operational improvements on the State Highway System (SHS). SHOPP funding is limited to capital improvement projects that do not add new roadway capacity (no new highway lanes) to the SHS, though some new auxiliary lanes may be eligible for SHOPP funding.

The Collision Reduction program is one of eight categories that make up the SHOPP, and its objective is to reduce the number or severity of collisions. The SHOPP Collision Reduction category consists of four sub-programs:

- *201.010 Collision Reduction*: Reactive approach based on analysis of collision history
- *201.015 - Collision Severity Reduction*: Proactive approach targeted to reduce the potential for traffic collisions based on past performance of roadway characteristics
- *201.112 - Bridge Rail Replacement and Upgrade*
- *201.235 - Roadside Safety Improvements*

201.010 – Safety Improvements

The SHOPP Collision Reduction Safety Improvements sub-program is designed to reduce the number or severity of collisions on the SHS. Projects with a safety index above 200 qualify as a safety improvement project. Projects may be individual locations where the collision history indicates a pattern potentially correctable by a targeted safety improvement, such as unsafe traffic (school zone signals included), wet pavement corrections, curve corrections, shoulder widening, left-turn channelization, etc. All proposed projects will be verified by the Caltrans Office of Traffic Safety Programs in the Division of Traffic Operations before being certified as a safety improvement project.

This program also provides funding for safety improvements at sites identified in regional monitoring programs for the reduction of motor vehicle collisions, such as locations at high risk for wrong-way, multilane, cross-median, cross-centerline, and run-off-the-road collisions. The program also provides funding for non-motorized safety improvements, such as pedestrian and bicycle facilities.

The Safety Improvements program does not provide funding for relocating existing highways or projects that would add new through lanes or upgrade existing highways to a higher classification, such as conventional to expressway, regardless of the safety benefits. This program also does not include projects where the prime purpose is reducing congestion.

Highway improvement projects along an existing alignment to improve standards of width, grade, alignment, or other geometric improvements, are considered new highway construction and are included in the Caltrans STIP programs.

201.015 - Collision Severity Reduction

This sub-program is focused on upgrading existing highway safety features within the roadbed’s clear recovery area to reduce the number and severity of collisions. Eligible projects may include new guardrail end treatments and crash cushions, rumble strips, glare screen, rock fall mitigation, overcrossing pedestrian fencing, crosswalk safety enhancements, and improvements that prevent roadway departure.

The Collision Severity Reduction program is designed to be proactive in enhancing safety on the State Highway System. As such, this program is not subject to a safety index analysis but will define projected collision severity reduction performance quantitatively. Projects will be prioritized based on the projected collision severity reduction benefits provided. Safety improvements under this program must be consistent with the California SHSP goals and may include treatments such as guardrail upgrades, shoulder widening, or other improvements that reduce the potential for high-severity crashes.

2026 SHOPP Collision Reduction Numbers (Statewide)

A total of 593 projects are included in the 2026 SHOPP. The 2026 SHOPP is valued at $17.86 billion, which includes reservation amounts for several programs, including the Collision Reduction Program. The SHOPP

Collision Reduction Program currently has 103 programmed safety projects totaling $1.6 billion**.** The SHOPP reserves $435 million for the 201.010 Safety Improvement program. The reserved amount will address future safety improvements as they are identified.

Surface Transportation Block Grant Program (STBG)

To encourage projects funded through STBG that address safety concerns, Fresno COG implemented a ranking criterion that prioritizes projects that have a safety component, which accounts for 10 percent of the total score. Twenty-two projects were awarded funding under the most recent call for projects in January 2024, all of which included a safety aspect.

Measure ‘C’ Safety Projects

Fresno COG partnered with Caltrans and Fresno County Transportation Authority (FCTA) to identify a funding plan for construction of our SR 41 Excelsior Expressway project. The SR 41 Excelsior Expressway project will construct a 4-lane divided expressway from an existing 2-lane expressway and close a 6-mile unimproved gap. Over the last decade, this six-mile gap has recorded 146 collisions and 19 fatalities, accounting for 35% of deaths on the entire 44-mile stretch of SR 41 in Fresno County. Total project costs are estimated at $95 million, with funds coming from Measure ‘C’ ($15 million), Local Partnership Program ($4 million) and, and Caltrans programmed the remainder in their Interregional Transportation Improvement Program. Construction is began in the Spring 2026, with a 2029 anticipated date of completion. Table 3 below shows the summary of the safety projects in the 2027 FTIP.

Table 3 - Safety Projects in the 2027 FTIP

Category	Number of Projects	% of Projects	Total Project Cost (All Years)	% of Total Project Cost	Funding in the 4-Year Element	% of Funding in the 4-Year Element
Primarily Safety Projects	20	7.33%	$325,455,000	21.3%	$306,154,800	43.6%
Other Projects with Safety Components*	106	38.83%	$269,280,000	17.6%	$521,955,000	18.5%
Non-Safety Projects	147	53.85%	$934,088,200	61.1%	$265,993,200	37.9%
Total FTIP Investments	273	100.0%	$1,528,824,000	100.0%	$702,111,000	100.0%

While some projects are primary safety projects, others include a peripheral safety element. In this round of FTIP, 20 projects are primarily the safety projects, and 106 projects are secondary safety projects (with safety components). 147 of the total FTIP projects are not related to safety at all. Altogether, there are 273 projects with a total project cost of approximately $1.5 billion while total funding available in the 4-years element of the FTIP is only $702 million. Hence, there is a deficit of approximately $800 million funding.

Table 4 shows the breakdown of all the FTIP projects, by funding type. 7% of the projects are funded by three major sources, ATP, HSIP, and SHOPP. The remaining 93% of projects are funded through other programs. The majority of ATP and HSIP projects in the region are funded with state only funds, and therefore are not included in the FTIP.

Table 4 - Fresno Council of Governments Safety Funding Programs

Fund	Number of Projects	% of Number of Projects	Total Project Funding (All Years)	% of Total Project Funding	Funding in the 4-Year Element	% of the 4-Year Element
ATP	6	2.2%	$11,824,000	0.8%	$4,658.000	0.7%
HSIP	3	1.1%	$11,121,800	0.1%	$2,167,000	0.2%
SHOPP	11	4.0%	$302,510,000	19.8%	$290,465,000	41.4%
Total Safety (ATP, HSIP, SHOPP)	20	7.3%	$361,042,000	21.0%	$282,854,000	43.6%
Other Programs	253	92.7%	$1,203,368,200	78.7%	$395,956,200	56.4%
Total	**273**	**100.0%**	**$1,528,824,000**	**100.0%**	**$702,111,000**	**100.0%**

Safety Project Highlights

In Fresno County, several HSIP-funded safety projects are being implemented to address needs identified in the LRSP. Two site-specific rural safety projects in the foothill area are advancing at prioritized LRSP locations. At Auberry Road and Frazier Road, the County will reconstruct the intersection and improve roadway geometry by flattening the horizontal curve, adding right- and left-turn pockets, widening shoulders, improving sight distance, and installing a painted median. At Millerton Road and Marina Drive (FRE230007), the County will construct a roundabout at an intersection where more than a dozen fatalities have occurred in recent years. In addition, Fresno County is advancing a systemic rural intersection safety project at 10 LRSP-identified locations. Planned improvements include lighting, larger signage, upgraded pavement markings, transverse rumble strips, sight-distance improvements at all 10 intersections, and left-turn lanes at two intersections.

- On State Highway 180 near the community of Squaw Valley, from east of George Smith Road to Elwood Road; Caltrans District 6 is constructing a two-way left turn lane. (LSTMP754)
- On State Highway 180 near Mendota and Kerman, from West Belmont Avenue to Modoc Avenue; also, near Rolinda, from 0.2 mil east of Goldenrod Avenue to 0.3 mile west of Brawley Avenue, Caltrans is reconstructing centerline and shoulder rumble strips, and replace signs, and sensor loops. (LSTMP863)

NATIONAL HIGHWAY SYSTEM PAVEMENT AND BRIDGE CONDITION (PM 2)

NHS Pavement and Bridge Condition (PM 2) Targets

The objective of the PM 2 performance measures is to assess the overall health of the transportation system and identify investments to maintain highways, roadways, and bridges in a state of good repair.

The benefits of a properly maintained transportation system include multiple direct and indirect effects on safety, economic vitality and quality of life:

- Increased safety, as poor roadways can lead to a higher accident rate.
- A reduction in incident-related congestion leading to greater travel time reliability.
- Reduced maintenance costs over time. Since roadways become increasingly more expensive to repair as the condition deteriorates, investing in continual maintenance is the best approach for long-term fiscal health.
- Less wear and tear on vehicles, resulting in economic benefits for roadway users.

To this end, FHWA published the Bridge and Pavement Performance Management Final Federal Rule establishing performance measures for state DOTs to use in assessing the performance of the Interstate Highway System (HIS) and non-HIS portions of the National Highway System (NHS). The federally mandated performance measures are (1) Percent of HIS pavement in Good condition; (2) Percent of HIS pavement in Poor condition; (3) Percent of non-HIS NHS pavement in Good condition; (4) Percent of non- HIS NHS pavement in Poor condition; (5) Percent of NHS bridges (by deck area) in Good condition; and (6) Percent of NHS bridges (by deck area) in Poor condition. Good condition is defined as, "Suggests no major investment is needed." Poor condition is defined as, "Suggests major reconstruction investment is needed." Further guidance on assessing bridge and highway conditions is provided in the Final Federal Rule.

Fresno County residents have continued to consistently express a strong preference for prioritizing the maintenance of roadways and bridges throughout the region. In response, FCOG has incorporated preservation-focused criteria into its Surface Transportation Block Grant Program (STBG). Specifically, projects emphasizing rehabilitation, reconstruction, and replacement account for 40 percent of the total competitive project score.

To further support data-driven decision-making, Fresno COG implemented a multi-jurisdictional Pavement Management System (PMS) in 2018 for nine cities that previously lacked such a program. In 2024 and 2025, the PMS was updated and expanded to include fifteen member agencies. This effort enhanced roadway inventory records, identified maintenance and repair needs, developed cost estimates, established project prioritization lists, and supported budget planning. The PMS provides objective, consistent, and defensible data to help local agencies optimize pavement preservation strategies and improve overall roadway network conditions.

To implement the PM 2 framework established by FHWA, Caltrans developed the Transportation Asset Management Plan (TAMP) in July 2022. This TAMP assesses the current conditions of California's transportation assets, establishes performance measures, and identifies statewide investment strategies to achieve performance measures. Transportation assets in California are subject to the new performance measures including 59,514 lane miles of pavement and 10,905 bridges. The 2026 TAMP is drafted in January 2026. The 2026 TAMP is currently pending FHWA and CTC approval. Caltrans is expecting Commission Adoption of Final TAMP in August 2026. Until the 2026 TAMP is finalized and released, MPOs will continue to rely on the most recently approved TAMP (2022) and its associated performance targets and asset condition data. Below are the Caltrans 2 years and 4 years statewide targets from 2022 TAMP, set to evaluate the progress made towards the 10-year TAMP targets. This is required by FHWA as a part of separate performance management rule.

Statewide Expected Targets				
Pavement and Bridge Performance Measures	2-Year NHS Targets (1/1/2022 - 12/31/2023)		4-Year NHS Targets (1/1/2022 - 12/31/2025)	
	Good	Poor	Good	Poor
Pavements on the NHS				
Interstate	47.2%	1.9%	49.2%	1.7%
Non-Interstate	21.7%	10.5%	28.2%	9.0%
Bridges on the NHS	49.1%	5.9%	47.3%	4.4%

Similarly, Table 5 below shows the Fresno COG regional targets. This 10-year TAMP targets established in 2022 for locally owned National Highway System (NHS) pavements and bridges served to set the statewide targets.

Table 5: PM2- 10-year TAMP targets for locally owned National Highway System Pavement and Bridge Condition

Performance Measure	Target
Percentage of Interstate System pavement in 'Good' condition	22.4%
Percentage of non-interstate NHS pavement in 'Good condition	22.4%
Percentage of Interstate System pavement in 'Poor' condition	3.9%
Percentage of non-interstate NHS pavement in 'Poor' condition	3.9%
Percentage of NHS bridges in 'Good' condition	33.6%
Percentage of NHS bridges in 'Poor' condition	0.8%

For information only, below are Caltrans'2 years and 4 years targets, identified in the draft 2026 TAMP, between 1/1/2026 and 12/31/2029.

Statewide NHS Expected 2- and 4-Year Targets				
Pavement and Bridge Performance Measures	2-Year NHS Targets (1/1/2026 - 12/31/2027)		4-Year NHS Targets (1/1/2026 - 12/31/2029)	
	Good	Poor	Good	Poor
Pavements on the NHS				
Interstate	48.0%	2.3%	49.0%	2.3%
Non-Interstate	26.0%	7.5%	26.7%	7.5%
Bridges on the NHS				
State and Local	41.4%	6.2%	40.2%	5.8%

Fresno COG along with all other MPOs in California worked with the State on the Transportation Asset Management Plan (TAMP) process and reported the financial information for pavement and bridges to Caltrans in 2021. This financial information was paired with statewide deterioration rates and statewide unit costs to estimate appropriate targets. Hence multiple alternatives along with 4 and 10 years invested/uninvested scenarios were developed, and 10 years targets were set in 2021. The excel tool developed by Caltrans was used to calculate the necessary funding needed to maintain the pavement and bridge assets. Figures 1 and 2 show the comparison of the asset condition for pavement and bridge respectively. For pavement in Fresno County, the existing status of good and poor conditions are 8% and 16.6% respectively. With no spending at all in the next 10 years, the pavement will deteriorate very badly with good condition reaching the rock-bottom of 0.6% while poor condition peaking at 25.7%.

Since the 10-year target is more aggressive than that of 10-year investment scenario, more funding and resources are needed to meet the targets. For bridges in Fresno County, the existing status of good and poor conditions are 52.3% and 1.6% respectively. With no spending at all in the next 10 years, the bridge will deteriorate to good condition of 26.2% while poor condition peaking at 4.8%. The 10-year target for good condition bridge is higher than that from the investment scenario. Hence, more funding and resources may need to be dedicated to converting some of the fair condition bridges to good condition.

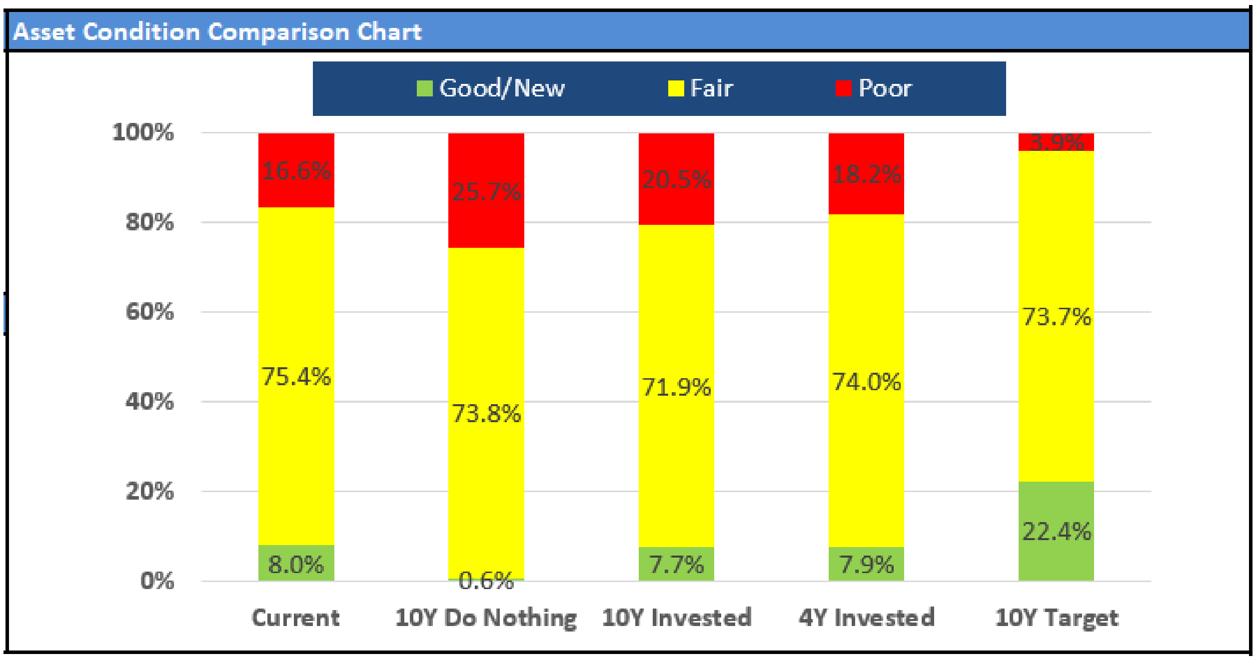


Figure 1: Funding scenarios and asset condition for Pavement

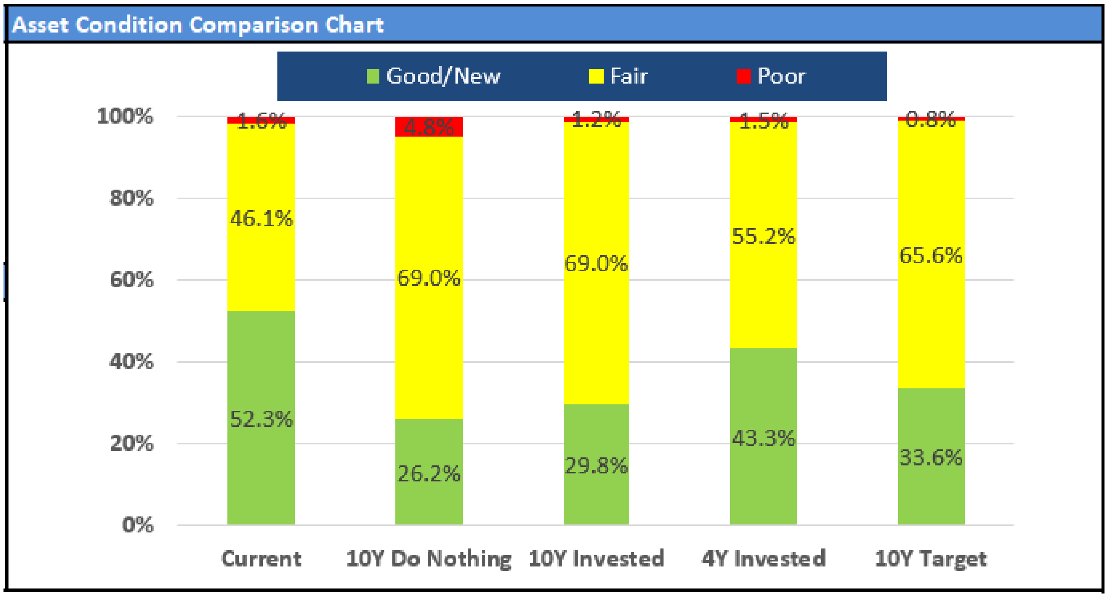


Figure 2: Funding scenarios and asset condition for Bridge

Table 6 and 7 show the 10-year needs assessment for pavement and bridge respectively. For pavement, while approximately $55 million is available for the investment, there is a funding gap of $109 million to meet the total cost needs of $164 million. The cost gap is about two times the invested amount, which is a big difference. Similarly, while approximately $11 million dollars is invested in the bridge in the next 10 years, there is still a funding gap of $10 million to reach the total investment needs of $26 million.

Table 6: 10 years Need Assessment for Pavement

10Y Needs Assessment			
	Total Cost of Work		
Treatment	Invested	Cost Gap	Total
Fix Fair to Good	$ 8,140,084	$ -	$ 8,140,084
Fix Poor to Good	$ 33,115,357	$ 109,248,156	$ 142,363,513
Add New	$ 5,902,368	$ -	$ 5,902,368
Risk Mitigation	$ -	$ -	$ -
Maintenance	$ 7,336,427	$ -	$ 7,336,427
Total	$ 54,494,236	**$ 109,248,156**	$ 163,742,392

Table 7: 10 years Need Assessment for Bridge

10Y Needs Assessment			
	Total Cost of Work		
Treatment	Invested	Cost Gap	Total
Fix Fair to Good	$ -	$ 9,054,257	$ 9,054,257
Fix Poor to Good	$ 11,202,652	$ 1,279,757	$ 12,482,409
Add New	$ -	$ -	$ -
Risk Mitigation	$ -	$ -	$ -
Maintenance	$ -	$ -	$ -
Total	$ 11,202,652	**$ 10,334,014**	$ 21,536,666

The following section describes the funding sources and programs that have been used to fund PM 2 related projects in the Fresno COG region.

Local Funds

Cities and counties spend billions of dollars each year maintaining local roads and bridges. Funding for these efforts is derived from a myriad of sources. In a survey of California jurisdictions, for local funds alone, there are more than a hundred different sources of taxes and fees reported that are used on pavement improvement projects.[iii] Some examples of local funding sources include:

- Local sales taxes
- Development impact fees
- General funds
- Various assessment districts – lighting, maintenance, flood control, special assessments, community facility districts
- Traffic impact fees
- Traffic safety/circulation fees
- Utilities (e.g., stormwater, water, wastewater enterprise funds)
- Transportation mitigation fees
- Parking and various permit fees
- Flood control districts
- Enterprise funds (solid waste and water)
- Investment earnings
- Parcel/property taxes
- Indian reservation roads
- Indian gaming funds
- Vehicle registration fees
- Vehicle code fines
- Underground impact fees
- Transient occupancy taxes
- Capital Improvement Program (CIP) reserves/capital funds

Local Funds are typically used for non-regionally significant road maintenance, safety, and bridge projects. However, a portion of PM 2 projects in the FTIP also rely on these funding sources.

State Funds

HUTA

The Highway Users Tax Account (HUTA), commonly referred to as the state gas tax, remains the largest single source of transportation funding for cities and counties and is a key resource for roadway and bridge maintenance.

SB 1

California doubled down on PM 2 when it approved Senate Bill 1 on April 28, 2017. SB 1 increased several taxes and fees to raise more than $5 billion annually in new transportation revenues. Moreover, SB 1 provides for inflationary adjustments, so that purchasing power does not diminish as it has in the past. SB 1 prioritizes funding towards maintenance, rehabilitation, and safety improvements on state highways, local streets and roads, and bridges and to improve the state's trade corridors, transit, and active transportation facilities.

Many SB 1 funds are not captured in the FTIP because this document focuses on federally funded and regionally significant projects, while SB 1 is a non-federal fund source that tends to pay for non-regionally significant road maintenance, safety, and bridge projects. Even so, some of the PM 2 projects in the FTIP are funded through SB 1.

Federal Funds

HBP

The Local Highway Bridge Program (HBP) provides federal aid to local agencies to replace and rehabilitate deficient, locally owned, public highway bridges. The HBP is intended to remove structural deficiencies, the Bipartisan Infrastructure Law (BIL) revises the terminology to "classified in poor condition," from existing local highway bridges to keep the traveling public safe.[iv] The HBP provides about $288 million annually for bridge projects. Off Federal-Aid system bridges are funded at 100%, while On Federal-Aid system bridges are funded up to 88.53%.

BFP

Bridge Formula Program (BFP) is a new program established under the Bipartisan Infrastructure Law (BIL) to provide funding to replace, rehabilitate, preserve, protect, and construct bridges. It is a complement to the discretionary Bridge Investment Program (see below). The Bridge Formula Program under BIL provides $4.25 Billion to the State of California, of which States are required to reserve 15 percent of their BFP funds under this program for use towards Off Federal Aid bridges. For these Off Federal-Aid System BFP funds, the Federal share is 100%.

SHOPP

The SHOPP was described in the section above under PM 1. Two of the eight categories of the SHOPP that address PM 2 are Bridge Preservation and Roadway Preservation.

Although the SHOPP is a program, it is often thought of as a fund source as well. The FTIP lists the fund source for most SHOPP projects as "SHOPP Advance Construction." Caltrans blends funds from HUTA, SB 1, and federal highway funds into SHOPP, and the "SHOPP Advance Construction" designation serves as a placeholder for what may be federal or state funds.

SHOPP Roadway Preservation

The SHOPP Roadway Preservation category includes the following programs:

- 201.120 – Roadway Rehabilitation
- 201.121 – Pavement Preservation
- 201.122 – Pavement Rehabilitation
- 201.151 – Drainage System Restoration
- 201.170 – Signs and Lighting Rehabilitation

The 2026 SHOPP has 264 Roadway Preservation projects totaling $10 billion which includes future need/contingency dollars. The SHOPP does not have a reservation for Roadway Preservation.

SHOPP Bridge Preservation

The SHOPP Bridge Preservation category includes the following programs:

- 201.110 – Bridge Rehabilitation and Replacement

- 201.111 – Bridge Scour Mitigation
- 201.113 – Bridge Seismic Restoration
- 201.114 – Bridge Widening
- 201.116 – Bridge Formula Program
- 201.119 – Bridge Preventative Maintenance
- 201.322 – Transportation Permit Requirements for Bridges

The 2026 SHOPP has 88 Bridge Preservation projects totaling $3.1 billion which includes future need/contingency dollars. The SHOPP does not have a reservation for Bridge Preservation.

PM 3 System Reliability, Freight, Congestion, and Air Quality

Fresno COG has consistently prioritized system reliability and mobility within the region's transportation system. A properly functioning, well-maintained streets and highway system is critical for public safety and mobility, emergency responders, law enforcement, the trucking industry and those dependent on farm-to-market commerce. Economic development experts tell us that regional mobility and access are key requirements of business and industry for job creation and retention. Fresno County being a farming prominent area with a significant truck traffic, needs a very good freight infrastructure to meet the farming needs and maintain the economy. A side benefit is that it has an overall positive effect on property values in an area, effectively raising the value of our homes and businesses. For these reasons, Fresno COG recognizes the need to preserve our local streets and roads to maintain our regional mobility.

The second round of PM3 (1/1/2022 – 12/31/2025) was set in May 2023. Caltrans established the 2-year and 4-year statewide targets on December 16, 2022, after the coordination between Caltrans and MPOs that consisted of two virtual workshops. Caltrans then gave MPOs 180 days to either adopt the statewide targets by contributing towards the accomplishment of it or set its own regional targets. Caltrans also coordinated with MPOs in September of 2024 during the mid cycle performance review period to monitor and adjust the 4 years targets. Looking at the 2023 performance, Caltrans and Fresno COG did make some adjustment to the 4 year targets.

Table 8 shows the updated statewide four years targets adopted by Fresno COG after the mid cycle performance period. Targets for the Interstate and the non-interstate NHS mileage share with reliable person-mile travel times were matched to the baseline 2022 in order to make it more realistic and achievable. The Truck Travel Time Reliability Index measures the ratio of peak travel periods to normal travel periods for the truck. The target is equal to that of baseline. All these reliability measures are computed from NPMRDS Analytics Tool. Among the CMAQ measures, two performance measures that are applied to Fresno County region this round are peak hour excessive delays per capita and non-single occupancy travel which are 6.4 hours and 21.3% respectively. 4 year target for the peak hour excessive delays per capita was achieved so it was not adjusted and still set to baseline 2022. Caltrans did adjust the non-single occupancy travel to reflect the ACS 5-year average metrics. The original 2 and 4-year targets were established based on the ACS 1-year average when California originally submitted the BPP for Cycle 2. However, the emissions reductions for the pollutants were unchanged. Even though the 2 year targets were not met, progress is still being made in reducing air pollutants. As applicable, California's Metropolitan Planning Organizations (MPOs) will continue to plan and program Congestion Mitigation and Air Quality (CMAQ) Improvement Program-funded transportation projects that contribute toward the accomplishment of regional, and statewide targets.

Comparing the overall targets of the second round to those from first round, except the emissions reduction by criteria pollutants, targets are set higher since the performance measures have improved. Although the baseline 2022 showed significant jump in the performance compared to 2017 used in last round, the recent performance data of 2023 were not following the baseline 2022 due to return to work policy after the COVID and people starting to drive in the pre-COVID level. Caltrans is expected to start the new PM3 cycle (2026-29) this year and set the new targets.

As such, Fresno COG has a 38-year history of local investment in transportation infrastructure via Measure C, the local ½-cent sales tax for transportation. This progress in local investment continues in the 2027 FTIP and by leveraging local and state funds to build many of the major streets, highways, and freeways that maintain and enhance system reliability and mobility in Fresno County. However, with a sunset of current cycle of Measure C in 2027, investment from this source beyond 2027 will be decided by the voters in near future.

Table 8: PM3 Targets for Reliability, Mobility, and CMAQ Performance

PM 3 - NHS Performance, Interstate System Freight Movement, and CMAQ Program Performance	
Performance Measure	**Target**
NHS Performance	
Percent of Interstate System mileage reporting reliable person-mile travel times	73.80%
Percent of non-Interstate NHS mileage reporting reliable person-mile travel times	83.70%
Interstate Freight Movement	
Percent of Interstate system mileage reporting reliable truck travel times (Truck Travel Time Reliability Index)	1.6
CMAQ Program Performance	
Annual hours of peak-hour excessive delay per capita	6.4 Hours
Total emissions reduction by criteria pollutant (PM10, PM2.5, Ozone, CO)	
PM10 (kg/day)	4,305
PM2.5 (kg/day)	3,659
Nox (kg/day)	8,635
VOC (kg/day)	5,724
CO (kg/day)	25,596
Percent of non-single occupancy vehicle (SOV) travel	21.30%

The Congestion Mitigation and Air Quality Improvement (CMAQ) program funds transportation projects or programs that contribute to attainment or maintenance of the national ambient air quality standards (NAAQS), including those that reduce ozone precursor emissions (including nitrogen oxides (NOx), volatile organic compounds (VOC), carbon monoxide (CO), and particulate matter (PM) emissions or PM precursor (e.g. NOx) emissions from transportation. The CMAQ program enables communities to build public awareness about the link between transportation and air quality, fund technological applications to improve transportation systems, or increase transit services, as a few examples. Most of the CMAQ project categories include a wide variety of measures to decrease vehicle emissions. Projects that add new capacity for single occupancy vehicles (SOVs) are ineligible for CMAQ funding unless construction is limited to high-occupancy vehicle (HOV) lanes. Policy considerations ***exclude*** highway maintenance and reconstruction projects because these activities preserve existing levels of service and are unlikely to contribute to further improvements in air quality. Projects nominated for CMAQ funding ***must*** show positive air pollution emission reductions.

The following are funding sources and programs that help fund Non-Interstate and Interstate improvement projects:

SHOPP Mobility

The SHOPP Mobility category includes following three programs:

201.310 – Operational Improvements

201.315 – Transportation Management Systems

201.321 – Commercial Vehicle Enforcement Facilities & Weigh-In-Motion Scales

201.310 – Operational Improvements

The primary purpose of this program element is to improve traffic flow on existing State highways by reducing congestion and operational deficiencies at spot locations. Operational improvement projects do not expand the design capacity of the system.

Examples of Operational Improvements projects include, but are not limited to:

- Interchange modifications (not to accommodate traffic volumes significantly larger than what the existing facilities were designed for)
- Ramp modifications (acceleration - deceleration/weaving)
- Auxiliary lanes for merging or weaving between adjacent interchanges
- Curve corrections/improve alignment
- Signals and/or intersection improvements
- Two-way left-turn lanes
- Channelization
- Turnouts
- Shoulder widening
- HOV Degradation Mitigation
- TSMO

201.315 – Transportation Management Systems

The primary purpose of this program element is to improve traffic flow on existing State highways by addressing system-wide congestion through system management techniques. Transportation Management Systems (TMS) reduce highway user delays, enable optimization of traffic flow, provide traveler information and safety alerts, collect information on traffic behavior and contribute to the reduction of greenhouse gas emissions. TMS facilitate the real time management of the State highway system by providing accident and incident detection, verification, response, and clearance. These systems provide State highway system status information for system operators, system planners, and travelers.

Examples of Transportation Management System projects include, but are not limited to:

- Traffic signals
- Changeable message signs
- Close circuit television cameras
- Freeway ramp meters
- Traffic monitoring detection stations
- Communications systems
- Highway advisory radio
- Traffic signal interconnect projects
- Traffic management systems housed in Transportation Management Centers (TMCs), including the necessary software and hardware (excluding facilities)

201.321 – Commercial Vehicle Enforcement Facilities & Weigh-In-Motion Scales

The primary purpose of this program element is to provide for Commercial Vehicle Enforcement Facilities (commonly called Weigh Stations) and Weigh-in-Motion (WIM) systems. Weigh Stations are needed to support the Commercial Vehicle Enforcement Plan; Truck safety, size and weight regulations are enforced by the California Highway Patrol, reducing truck related crashes or incidents and protecting our highways from premature damage. The WIM sites provide data for federally mandated data systems and special studies, design and maintenance strategies, size and weight policies, enforcement and planning strategies, and the traffic and truck volumes publications. WIM systems are integral to the CVEF bypass program which is a public/private partnership that prescreens commercial trucks, reducing congestion at weigh stations and promotes freight mobility.

The 2026 SHOPP features 27 Mobility projects programmed totaling $674.3 million which includes future need/contingency dollars. The SHOPP does not have a reservation for Mobility.

SB 1 Trade Corridor Enhancement Program (Including National Highway Freight Program)

The purpose of the Senate Bill 1 (SB 1) Trade Corridor Enhancement Program (TCEP) is to provide funding for infrastructure improvements on federally designated Trade Corridors of National and Regional Significance, on California's portion of the National Highway Freight Network as identified in California Freight Mobility Plan, and along other corridors that experience high volumes of freight movement. The Trade Corridor Enhancement Program also supports the goals of the National Highway Freight Program, the California Freight Mobility Plan, and the guiding principles in the California Sustainable Freight Action Plan.

This statewide, competitive program will provide approximately $300 million per year in state funding and approximately $135 million in National Highway Freight Program (NHFP) funds. The NHFP is authorized under the IIJA through FFY 2026.

Eligible applicants apply for program funds through the nomination of projects. All projects nominated must be identified in a currently adopted regional transportation plan (RTP). The Commission is required to evaluate and select submitted applications based on the following criteria:

- Freight System Factors – Throughput, Velocity, and Reliability
- Transportation System Factors – Safety, Congestion Reduction/Mitigation, Key Transportation Bottleneck Relief, Multi-Modal Strategy, Interregional Benefits, and Advanced Technology
- Community Impact Factors – Air Quality Impact, Community Impact Mitigation, and Economic/Jobs Growth
- The overall need, benefits, and cost of the project

- Project Readiness – ability to complete the project in a timely manner
- Demonstration of the required 30% matching funds
- The leveraging and coordination of funds from multiple sources
- Jointly nominated and/or jointly funded

Truck Travel Discussion

Truck travel mobility, and the goods movement that it provides, is essential to the economic vitality in the central San Joaquin valley. The majority of the freight movement in the Central Valley is provided by trucks. For Fresno County, the majority of the rural roads serve as a farm roads. Therefore, a reliable and efficient good movement systems is necessary to support economic vitality in Fresno County and the greater San Joaquin Valley. As such, transportation projects that support efficient truck travel, such as shoulder improvements, auxiliary lanes, traffic flow improvement, dedicated truck lanes and routes, and intelligent transportation systems (such as signal synchronization of the urban areas) are important to keep the reliable freight movement going. While some of these projects had been included in the 2023 FTIP to support our freight mobility, none of these kinds of projects were programmed in 2025 FTIP. However, this is consistent with the new targets as the 2 years and 4 years reliable truck travel time targets are same as the baseline 2022 data. Nevertheless, Fresno COG continually looks for ways to prioritize investment improvements and strategies to increase the efficiency and reliability of the region's goods movement system.

CMAQ

The Congestion Mitigation and Air Quality (CMAQ) program supports improving air quality and relieving roadway congestion. The purpose of the CMAQ program is to fund transportation projects or programs that will contribute to attainment or maintenance of the National Ambient Air Quality Standards (NAAQS) for ozone, carbon monoxide (CO), and particulate matter (both PM10 and PM2.5).

Table 9 below shows the summary of the NHS Performance, Interstate System Freight Movement, and CMAQ Program Performance Projects in the 2027 FTIP. Out of 273 FTIP projects, 98 of them are related to PM3. While the total project cost for those PM3 projects is approximately $386 million, the funding available in the 4 year element is only $168 million. Hence, there is a deficit of about $218 million. One important thing to note in this table is that while approximately 36% of the total projects are PM3, they only take 25% of the total project cost and 24% of the total funding. Although the number of PM3 projects are lesser than safety projects, the PM3 attributes get some boost from the safety projects in terms of travel time reliability and emissions.

Table 9: NHS Performance, Interstate System Freight Movement, and CMAQ Program Performance Projects in the 2027 FTIP

Category	Number of Projects	% of Projects	Total Project Cost	% of Total Project Cost	Funding in the 4-Year Element	% of Funding in the 4-Year Element
Interstate Reliability Projects	4	1.47%	$217,573,000	14.23%	$70,700,000	10.07%
Non-Interstate Reliability Projects	4	1.47%	$6,497,000	0.42%	$5966,000	0.85%
Truck Travel Time Projects	0	0.00%	$0	0.00%	$0	0.00%
CMAQ Projects	90	32.97%	$161,918,000	10.59%	$91,574,000	13.04%
Total PM 3 Projects	98	35.90%	$385,988,000	25.25%	$168,240,000	23.96%
Non-PM 3 Projects	175	64.10%	$1,142,836,000	74.75%	$533,871,000	76.04%
Total FTIP Investments	273	100.00%	$1,528,824,000	100.00%	$702,111,000	100.00%

TRANSIT ASSET MANAGEMENT (TAM)

The TAM targets for Fresno County were developed collaboratively with regional transit agencies based on the agency's TAM plans and local targets. In developing the targets, Fresno COG reviewed and considered the transit operators' TAM plans (including identified goals, objectives, measures, and targets), thereby incorporating them into the metropolitan planning process.

Transit Asset Management Performance

The FTIP includes funding from multiple FTA sources for projects that support Transit Asset Management. Examples of these projects include rural and urban capital assistance programs; rolling stock acquisition, maintenance, and overhauls; bus fleet rehabilitation and replacement; track and rail yard maintenance and improvements; and maintenance of passenger facilities. Table 10 provides a summary of the performance measures designated as TAM.

Table 10: Performance measures designated for Transit Asset Management (TAM)

Transit Asset Management Performance Measures		
Asset Category	**Performance Measurement**	**Asset Class Examples**
Rolling Stock - (revenue service vehicles) (Age)	Percentage of revenue vehicles within a particular asset class that have met or exceeded useful life benchmark (ULB).	40-foot bus, 60-foot bus, vans, automobiles, locomotives, rail vehicles
Equipment – (non-revenue) service vehicles (Age)	Percentage of vehicles that have met or exceeded their ULB.	Cranes, prime movers, vehicle lifts, tow trucks, vans, automobiles
Infrastructure-rail fixed-guideway track, signals, and systems (Condition)	Percentage of track segments, signal, and systems with performance restrictions.	Signal or relay house, interlockings, catenary, mechanical, electrical and IT systems
Stations/Facilities (Condition)	Percentage of facilities within an asset class, rated below 3 on the Transit Economic Requirements Model scale.	Stations, depots, administration, parking garages, terminals, shelters

MPOs are required to establish annual TAM targets specific to the MPO planning area for the same performance measures for all public transit providers in the MPO planning area within 180 days after the transit providers establish their targets. Fresno Area Express (FAX), Clovis Transit, and the Fresno County Rural Transit Agency (FCRTA) have adopted Transit Asset Management plans, which are available from transit operators. Clovis Transit has recently started developing its own TAM plan. Fresno COG developed the 2023/24 regional TAM targets by weighing the targets set by the local transit providers. The infrastructure performance measure does not apply to the Fresno region since there is no rail transit in Fresno County. Each transit agency is encouraged to apply for funding through the various competitive funding programs and has been successful in acquiring a portion of these funds to help meet TAM targets.

This section presents the TAM performance measures and targets adopted by FAX, Clovis Transit, and FCRTA in the Fresno COG or Fresno County region. Targets are the threshold for the maximum percentage of assets at or exceeding acceptable standards. In most cases for the target-setting process, providers set targets that were approximately equivalent to their current performance. Performance metrics for TAM focus on regional transit system maintenance in a state of good repair. Table 11 below shows the TAM targets for the individual transit agencies as well as the average regional targets for the Fresno COG region. The TAM targets were produced collaboratively with transit agencies based on their agency TAM plans and local targets. Rolling stock consists of three types of vehicles: Bus, Cutaway, and Automobiles in the Revenue vehicles category. Bus and Automobile targets within Revenue vehicles are available only for FAX and FCRTA. Equipment consists of two types of vehicles: Automobile and Trucks & other Rubber Tire in the Service vehicles category. Automobile target within the service vehicles is available only for FAX. Facilities for all three transit agencies have very aggressive (0%) targets. Transit Economic Requirements Model (TERM) scale refers to the condition of Station/Facilities. Infrastructure target is not applicable to Fresno COG region as it measures the Share of track segments with performance restrictions, mostly applicable to Rail Transit.

In developing the regional targets, Fresno COG reviewed and considered the various local and regional transit operators' TAM plans (including identified goals, objectives, measures, and targets), thereby incorporating them into the metropolitan planning process. Fresno COG took the weighted mean of the targets against the inventories of FAX, Clovis Transit, and FCRTA to come up with the regional targets. While the Rolling Stock target for FAX is the most aggressive among the transit agencies, it has the least aggressive equipment targets. FAX's targets for these two metrics are similar to the last regional targets. FCRTA's targets are slightly flexible this time. Clovis Transit's targets are somewhere between FAX and FCRTA's and are also very close to the regional targets.

Table 11: Transit Asset Management Targets

Transit Asset Management (TAM) Targets				
Reporting Entity	Rolling Stock (Pct of revenue vehicles > ULB)	Equipment (Pct of non-revenue vehicles > ULB)	Facilities (Pct of facilities < TERM scale 3)	Infrastructure (Pct of track segments with restrictions)
FAX	33%	30%	0%	NA
Clovis Transit	52%	29%	0%	NA
FCRTA	67%	0%	0%	NA
Regional Target based on Weighted Avgs.	**49%**	**28%**	**0%**	**NA**

The three public transportation reporting entities provided their targets to Fresno COG as shown above. The Fresno COG regional targets are presented in tabular form to account for the differences in targets and standards among the providers of public transportation. Targets represent the thresholds for the maximum percentage of assets at or exceeding acceptable standards.

The FAX data is based upon FAX's specific operational requirements; hence these ULBs differ from the FTA provided default values. Bus uses 14 years or 350,000 miles, Automobile 8 years or 150,000 miles, and non-revenue vehicles uses 7-10 years or 75,000-150,000 depending upon vehicle classification. As the ULBs have been adjusted downward for rolling stock buses, FAX had aggressively pursued zero emission grant opportunities to address their aging fleet and work towards a state of good repair. This proved to be an insurmountable challenge considering the increased cost of the zero emission buses. FAX's goal is to continue to leverage their agency-specific Zero Emission Vehicle Transition Plan and their battery-electric bus infrastructure, entering final acceptance, to increase application appeal and competitiveness.

FAX has been successful in acquiring new revenue vehicles to replace its aging fleet. FY24 saw the delivery of 7 battery electric buses and in FY25, FAX received 12 CNG buses and 2 hydrogen fuel cell buses. Additionally, in FY25 FAX is slated to receive 14 cutaway vehicles for its paratransit fleet. The addition of these vehicles should significantly better the state of good repair and position FAX to meet the California 2040 transition mandate to zero emission vehicles. FAX anticipates increased efficiencies with continued relaxing of pandemic protocols, as city employees have returned to the office full time and resumed normal duties. This is in addition to an added FAX fleet specialist, who was hired to accelerate purchasing and onboarding of new vehicles. Through these changes in circumstances, FAX continues to work towards a better position for more robust performance targets during the next reporting period. FCRTA replaced three vehicles that exceeded their ULB during the reporting period. Extensive growth in the service area generated a 14% increase in ridership because of a new shopping center and manufacturing plant that were opened. Because of this growth, agency is initiating a new transit route in FY 2023, which will require an additional new vehicle to provide revenue service.

The FCRTA EV Bolt vehicles are still in operational service but are being used less due to their increasing mileage. These vehicles will be eventually replaced but not before 6/30/26. No plans to replace most of the bus by 6/30/25. But some of the buses most used may be replaced after 6/30/26. Most of the FCRTA's 67 cutaway vehicles are being operated in reserve or back up vehicle roles. FCRTA plans on acquiring 25 Electric vehicles to replace 25 of these vehicles by 6/30/2026. Clovis Transit followed the last year's performance to set the targets.

TAM category projects may also be supported by state, local, and other federal funding sources (e.g., FTA Section 5337 State of Good Repair, FTA 5307, FTA 5339 formula funds, and FHWA flexible funds such as CMAQ and STBG). The funding and the program of projects in the FTIP will enable FAX, Clovis Transit, and FCRTA to achieve their respective transit asset management performance targets. The TAM Final Rule also requires that, in the future, the FTIP describe the anticipated effect toward achieving the TAM targets set in the RTP, linking investment priorities to those targets (23 CFR 450.326(d)). Each transit agency is encouraged to apply for funding through our various competitive funding programs, and have been successful in acquiring a portion of these funds to help meet TAM targets. Fresno COG meets with each transit agency biannually to discuss and identify other funding sources and transit projects for inclusion on the FTIP that also help to meet TAM targets. Fresno COG will continue to work with the region's transit operators to seek ways to improve the methodology, data collection, and analysis for future RTP updates, and to continue engaging in a regional discussion about transit state of good repair and the need for additional funding.

Public Transportation Agency Safety Targets

The National Public Transportation Safety Plan identifies four performance measures that must be included: fatalities, injuries, safety events, and system reliability. Definitions for transit safety performance measures are as described in the NTD Safety and Security Manual. Transit providers may choose to establish additional targets for safety performance monitoring and measurement. Transit safety targets must be set every four years and be included in the MPO Regional Transportation Plan (RTP). The goals, objectives, performance measures, and targets from the transit providers' safety plans must also be integrated into the RTP, either directly or by reference.

There are three transit agencies in Fresno County (Fresno COG region), Fresno Area Express (FAX), Clovis Transit, and Fresno County Rural Transit Agency (FCRTA). However, FCRTA is exempted from the PTASP requirements as they do not receive the FTA's Urbanized Area Formula Grants. Hence, the regional annual transit safety targets would be calculated by combining FAX and Clovis Transit targets. Fresno COG communicates with these two transit agencies regularly and receives the transit targets whenever the PTASP is updated so that the COG can incorporate the changes in its regional plans and targets. FAX and Clovis Transit updated their PTASP targets in 2025.

Table 12 documents existing performance targets set by the two transit agencies in the Fresno COG region. FY25 targets represent a 10% reduction of FY24 actuals for the respective transit agency. While FY25 refers to July 2024- June 2025, FY24 is July 2023 - June 2024. FY25 VRM (Vehicle Revenue Miles) are projected to increase 10% in FY24's VRM. Regarding the mode of service, Fresno County has only bus service as public transit. System Reliability is the distance between Mechanical Failures (in miles). Regional targets are established as the weighted averages of individual agency's targets based on their respective VRMs. Although few agencies have been providing Paratransit and limited carpool/vanpool services in the region, the safety targets have not been set for those categories.

The target setting approach for PTASP is different than the FHWA performance measures which are generally developed by the State DOT and shared with the MPOs (top down). The transit performance targets are developed by the transit agencies and MPOs, and sent to the state DOT (bottom-up approach).

Table 12: Public Transportation Agency Safety Plan (PTASP) Targets

Public Transportation Agency Safety Plan (PTASP) Targets							
Mode of Service	Fatalities	Fatalities (per 10 million VRM)	Injuries	Injuries (per 10 million VRM)	Safety Events	Safety Events (per 10 million VRM)	System Reliability
FAX	0	0	58	98.34	0	0	7,997
Clovis Transit	0	0	1	33.33	0	0	40,000
FCRTA	NA	NA	NA	NA	NA	NA	NA
Regional	0	0		95.19	0	0	9,546

[i] The TERM scale is a measure of condition used in the National Transit Database (NTD). This is the five-point scale that agencies use to report the condition of their facility assets. An asset is deemed to be in good repair if it has a rating of 3, 4, or 5 on this scale.
[ii] Final Rule: Public Transportation Agency Safety Plans (PTASP), FTA (https://www.transit.dot.gov/regulations-and-programs/safety/public-transportation-agency-safety-program/final-rule-public)
[iii] California Statewide Local Streets and Roads Needs Assessment, October 2018, pg. 39. https://www.savecaliforniastreets.org/wp-content/uploads/2018/10/2018-Statewide-Final-Report-1.pdf
[iv] Chapter 6 Highway Bridge Program, January 2019. https://dot.ca.gov/-/media/dot-media/programs/local-assistance/documents/lapg/g06.pdf

Appendix C. Transportation and Land Use

Item 8. SCS Alternative Scenarios

Scenario Development Overview

The scenario development process for the 2026 Sustainable Communities Strategy (SCS) began with the establishment of ten transportation priorities, five other co-benefits, and five land use strategies that would establish clear and quantifiable guidelines for the formation of unique scenarios. The transportation priorities and other co-benefits were represented through varying levels of investment across transportation modes, which influenced the projects included in each scenario's financially constrained project list based on established scoring criteria. The land use strategies dealt primarily with land-use decisions and would influence the growth pattern of each scenario.

The Scenario Development

In 2025, Fresno COG developed five scenarios using the 2022 RTP as a foundation. Each scenario was defined by a specific focus, followed by the selection of transportation strategies and land use approaches aligned with that focus. For example, a scenario emphasizing mobility would include higher investment in roadway capacity and operations, supported by complementary land use strategies. The scenarios were presented to the RTP Roundtable and approved prior to advancing into detailed analysis and public outreach.

Transportation Priorities

- Maintain existing streets and roads
- Enhance operation efficiency and TDM strategies
- Improve bike and pedestrian infrastructure
- Provide an efficient, reliable, and safe roadway system for movement of goods
- Improve transit and shared mobility
- Innovate and modernize travel and infrastructure
- Improve traffic safety
- Improve intra-model accessibility and connectivity
- Improve transportation equity
- Decrease congestion

Other / Co-Benefits

- Encourage shifts away from SOV
- Increase climate resiliency
- Improve air quality
- Support work-from-home
- Improve economic, environmental, and public health outcomes for disadvantaged communities

These priorities and co-benefits were carried forward from the previous RTP to allow for both the prioritization of certain transportation modes as a whole (e.g. "Maintain existing streets and roads"), as well as underlying strategies that apply to multiple modes (e.g. "Improve traffic safety"). To implement these priorities, Fresno COG staff evaluated and scored projects using defined criteria, as described in Appendix B (Item 3). Scenario-specific investment levels were then applied to develop distinct financially constrained project lists for each scenario.

Land Use Strategies

Each trade-off strategy provided a mechanism by which the land-use pattern could be influenced in specific ways and with various degrees of aggressiveness, using the 2022 SCS land-use pattern for reference. The five land use strategies and their use in land use modeling process are described as follows:

- **Limit growth footprint:** A certain percentage of the parcels exhibiting the highest potential for development were assigned development types that were more aggressive with respect to the relevant criteria to without violating the guidelines specified in the respective agency's land use planning literature. Parcels near transit corridors and in downtown were favored.
- **Support efficient land uses and livable communities**: Parcels with high potential for development were assigned mixed used type development in accordance with the corresponding agency's land use planning.
- **Encourage equitable redevelopment**: Parcels that were already built but showed a potential of development with higher density were assigned new development types.
- **Provide a range of housing options across different income levels:** Parcels with development type that included higher share of multi-family affordable housing units were prioritized in allocating growth.
- **Conserve resource land:** Parcels that contained resources such as important farmland, groundwater recharge, etc. were pushed down in the priority of parcel development.

The five scenarios as developed are attached.

Scenario A

Overview

Scenario A represents a strategy focused on enhancing system performance and accessibility through infrastructure investment while continuing the region's existing land use and development trajectory. It emphasizes improving regional connectivity and mobility through investments in roadway capacity, while generally maintaining existing development patterns. This scenario prioritizes the highest level of funding toward roadway capacity enhancements to reduce congestion, improve travel reliability, and provide more direct access to key destinations across the region. The scenario maintains a strong commitment to roadway maintenance to preserve the existing transportation system in a state of good repair. It also includes significant investment in operational strategies that improve system efficiency, such as intersection improvements and traffic management measures.

From a land use perspective, Scenario A maintains current growth trends, supporting a mix of development across both established activity centers and suburban areas. A variety of housing options are included to accommodate future population growth, reflecting expansive distribution of development rather than a concentrated infill approach.

Scenario B

Overview

Scenario B focuses on maintaining and optimizing the performance of the existing roadway system, emphasizing long-term reliability and resilience. This scenario prioritizes the highest level of investment in roadway operations compared to other scenarios. These investments are complemented by strong capacity enhancements to address congestion and improve connectivity where needed, while continuing to preserve the system in a state of good repair.

From a land use standpoint, Scenario B supports maintaining current urban densities while incorporating moderate redevelopment and more efficient use of land. Growth is distributed across both established centers and suburban areas, balancing continued expansion. Overall, this scenario reflects an approach that enhances system performance through operational improvements and some capacity investments while supporting a more efficient and adaptable development pattern.

Scenario C

Overview

Scenario C emphasizes improving mobility through enhanced transit investment while supporting smart, sustainable land use patterns. This scenario prioritizes increased funding for transit services and infrastructure to expand travel options and improve access to jobs and destinations. Investment in road maintenance is strong while investments in roadway capacity and operations are maintained at moderate levels.

From a land use angle, Scenario C promotes higher-density, mixed-use development concentrated in existing centers and established areas. This approach supports more efficient land use, encourages redevelopment, and enhances proximity between housing, employment, and services. Growth is directed toward areas with existing infrastructure and transit access, while also recognizing the importance of preserving resource lands.

Scenario D

Overview

Scenario D focuses on strengthening regional connectivity through significant investments in transit, with an emphasis on linking major activity centers to the high-speed rail station and airport via a new light rail system. This scenario prioritizes substantial transit funding to expand mobility options and improve access along key corridors, while also maintaining strong investment in roadway maintenance to preserve the existing system.

Land use wise, Scenario D promotes transit-oriented development and compact growth patterns concentrated along transit corridors and within established urban areas. This approach encourages higher-density, mixed-use development, and redevelopment to support increased transit use and improve accessibility. Growth is directed toward infill and redevelopment areas to maximize the benefits of transit investments, while supporting more efficient land use and reducing reliance on auto travel.

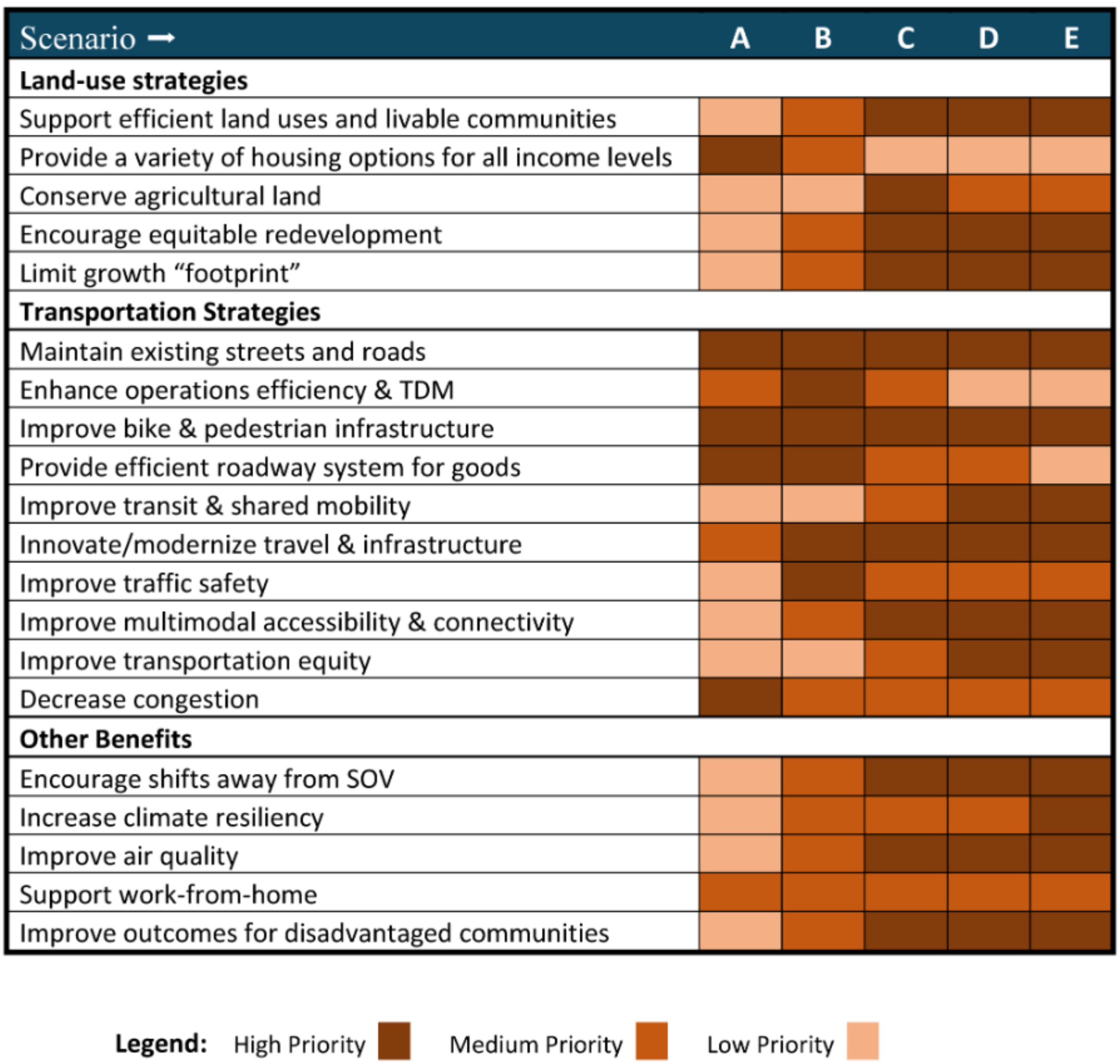
Scenario E

Overview

Scenario E emphasizes strong regional connectivity through significant investment in commuter rail, linking cities and key destinations across the region. This scenario prioritizes the highest level of funding for transit improvements, with a particular focus on developing a regional rail network to provide efficient, long-distance travel options. At the same time, it places the least emphasis on roadway capacity expansion compared to other scenarios, instead relying on transit and multimodal strategies to meet future mobility needs.

From a land use perspective, Scenario E supports compact, high-density development patterns centered around transit corridors and stations. The scenario promotes infill development and transit-oriented growth, encouraging redevelopment in core areas to maximize the efficiency of existing infrastructure. By directing growth into established areas and along key transit lines, Scenario E strengthens connections between communities while supporting a more sustainable and integrated land use and transportation system.

Figure: Comparison heat map of strategies between scenarios



Appendix C. Transportation and Land Use

Item 9. Developing Land Use Scenarios

Developing Land Use Scenarios

Fresno COG used a custom developed application for allocating future growth based on suitability of each parcel and that value is used to meet the growth targets for each jurisdiction's sphere of influence.

The steps involved in Fresno COG's approach in developing land-use scenarios are:

1. Update base year land use data
2. Generate land use development capability
3. Generate jurisdiction specific control totals from the demographic forecast for new growth from 2023 to 2035
4. Generate parcel-level development allocations for new growth utilizing Fresno COG land use model.

Base year land use data updates

Fresno COG updated the base year to 2023 in the land use model incorporating parcel-level housing unit and employment data. Housing unit estimates were developed by integrating multiple data sources, including 2020 Census block-level counts from the United States Census Bureau, parcel-level records from the Fresno County Assessor, the Census Bureau's Housing Unit Change Viewer, and local jurisdictions' housing development tracking tools. These sources were reconciled to produce consistent parcel-level estimates reflecting recent development activity. Employment data were compiled using confidential Quarterly Census of Employment and Wages (QCEW) data from the California Employment Development Department, supplemented with business establishment data from Data Axle for Fresno County. These datasets were processed and allocated to parcels to represent current employment distribution across the region.

Generating land use development capability

The latest General Plan land use designation from each local jurisdiction were collected to establish land use development capacity. Land use designation categories from each jurisdiction were converted to a standardized set of regional development types below, for use in the land use model. Because land use designations typically allow a range of densities, each parcel was assigned three development intensity categories—"Low," "Mid," and "High"—to reflect its potential capacity under different scenarios.

Development Types

Each parcel with potential for development was assigned three development types based on the parcel's land use designation in the relevant agency's general or specific plan. These development types represented a spectrum of potential development—including low intensity, medium intensity, and high intensity—all consistent with the range of development allowed by the agency for that area.

The following development types were used in the RTP-SCS for the Fresno County region:

Development Types	Density			Housing Mix			Employment Mix							
	Population / Gross Acre	Housing Units / Gross Acre	Jobs / Gross Acre	Housing Unit Percent by Type			Employment percent by Type							
				Single Family	Multi-Family	Other	Educational	Food	Government	Industrial	Medical	Office	Retail	Other
Activity Center	-	-	19.05	-	-	-	9.90%	17.10%	6.60%	-	41.40%	11.10%	13.90%	
Arterial Commercial	-	-	12.94	-	-	-	5.70%	33.60%	3.70%	-	23.40%	6.20%	27.40%	
Compact Neighborhood	30.062	8.6	-	93.95%	6.05%	-	100.00%	-	-	-	-	-	-	
Compact Neighborhood High	43.226	14	-	42.26%	57.74%	-	100.00%	-	-	-	-	-	-	
Downtown	29.106	11.42	105.13	-	100.00%	-	11.60%	11.00%	7.60%	-	48.00%	12.80%	9.00%	
Downtown Residential	109.8	39.64	22.58	-	100.00%	-	5.70%	33.60%	3.70%	-	23.40%	6.20%	27.40%	
Educational	-	-	2.98	-	-	-	100.00%	-	-	-	-	-	-	
Existing Population Growth	11.44	3.04	0	79.54%	15.82%	4.64%	100.00%							
Industrial	-	-	9.53	-	-	-	-	-	-	70.00%	-	-	-	30.00%
Institutional	-	-	2.56	-	-	-	-	-	100.00%	-	-	-	-	-
Large Lot Residential	7.416	2.08	-	100.00%	-	-	100.00%	-	-	-	-	-	-	-
Main Street	17.6	6.27	32.04	-	100.00%	-	5.70%	33.60%	3.70%	-	23.40%	6.20%	27.40%	-
Mixed-Use Corridor	40.523	14.27	37.51	-	100.00%	-	11.60%	11.00%	7.60%	-	48.00%	12.80%	9.00%	-
Neighborhood Center	34.356	13.34	19.31	6.28%	93.72%	-	9.90%	17.10%	6.60%	-	41.40%	11.10%	13.90%	-
Office Park	-	-	33.84	-	-	-	14.50%	-	9.50%	-	60.00%	16.00%	-	-
Open Space	-	-	-	-	-	-	100.00%	-	-	-	-	-	-	-
Regional Retail	-	-	10.56	-	-	-	-	-	-	-	-	-	100.00%	-
Rural Residential	1.747	0.49	-	100.00%	-	-	100.00%	-	-	-	-	-	-	-
Suburban Multifamily	64.067	22.48	-	-	100.00%	-	100.00%	-	-	-	-	-	-	-
Suburban Office	-	-	19.14	-	-	-	14.50%	-	9.50%	-	60.00%	16.00%	-	-
Suburban Residential	13.769	3.86	-	100.00%	-	-	100.00%	-	-	-	-	-	-	-
Town Center	56.225	19.75	50	-	100.00%	-	11.60%	11.00%	7.60%	-	48.00%	12.80%	9.00%	-
Town Neighborhood	34.088	11.69	2.42	38.56%	61.44%	-	5.70%	33.60%	3.70%	-	23.40%	6.20%	27.40%	-
Urban Multifamily	102.014	38.99	-	-	100.00%	-	-	-	-	-	-	-	-	-
Suburban Residential ADU	25.698	7.72	-	100.00%	-	-	100.00%	-	-	-	-	-	-	-
Large Lot Residential ADU	13.848	4.16	-	100.00%	-	-	100.00%	-	-	-	-	-	-	-
Rural Residential ADU	3.262	0.98	-	100.00%	-	-	100.00%	-	-	-	-	-	-	-
Medical Facility			100	-	-	-	-	-	-	-	96.00%	4.00%	-	-
Suburban Multifamily-high density	76.9581	27	0	-	100.00%	-	100.00%	-	-	-	-	-	-	-
Very low density	0.666	0.2	0	100.00%	-	-	100.00%	-	-	-	-	-	-	-
Trailer Park	26.8	10	0	-	-	100.00%	100.00%	-	-	-	-	-	-	-
Agriculture	0.166	0.05	0.05	100.00%	-	-	-	-	-	-	-	-	-	100.00%
Urban Multifamily-Maximum density	112.500	43	0	-	100.00%	-	-	-	-	-	-	-	-	-
Rural community	2.915	1	2.42	38.56%	61.44%	-	5.7%	33.6%	3.7%	0	23.4%	6.2%	27.4%	-
Commercial Service			10.56										50%	50%

Downtown Residential

Downtown residentials are mixed-use development type providing multi-family housing opportunities. They also include mainly food, retail, medical, and other type of employment.

Town Center

Town Centers are employment centric, though they also provide multi-family housing opportunities located very close to jobs and services. Buildings are typically 5 stories or less. Such communities are highly walkable and benefit from high-capacity transit and bus facilities.

Downtown

Downtown represent employment centric located in downtown area. These provide multi-family housing opportunities as well. Buildings include mixed uses and include employments such as educational, medial, office, food, and retail. One example of these development types would be within Fresno downtown planning area.

Neighborhood Center

Neighborhood Center serves as a walkable center for small community or neighborhood services including retail and offices. Buildings are about two to three stories tall and can include mixed uses, including live-work developments. This development type also includes residential development such as duplexes and townhouses.

Town Neighborhood

Downtown Neighborhoods include areas with apartments, condos, and townhouses. There may be some mixed-use buildings with retail on the ground floor. Street connectivity is relatively favorable, allowing for a walkable environment and transit options.

Mixed Use Corridor

Mixed Use Corridor refers to a mix of new and older development in a linear fashion along corridors that are often served by transit. They are usually pedestrian-oriented with a mix of housing, retail and office amenities.

Main Street

Main Streets include a mix of uses and interconnected street network. Main Streets primarily function as service destinations rather than centers of employment. Buildings typically stand one to three stories tall and include townhouses or apartments above storefronts.

Office Park

Office Parks are comprised of low to medium density office buildings surrounded by surface parking. Generally located near highways for easy auto-access, transit and walking options are limited. Office parks lack residential, or retail uses.

Suburban Office

Suburban Office complexes generally contain low-density, single-story office buildings, and can be found in suburban areas. The development type is on average about half the density of Office Park.

Activity Center

Activity centers include an agglomeration of large-scale retail buildings, office buildings and multifamily housing. Land uses are separated from each other by parking areas, freeways or arterials. Activity centers are usually positioned at intersections of highways or arterials, sometimes along major transit corridors.

Arterial Commercial

Arterial commercial development takes a linear form along both sides of a major road or highway. Connections in this development type consist mostly of highways and frontage roads.

Regional Retail

Regional Retail development is generally characterized by low-density commercial such as pharmacies, grocery stores, and large format retail. It lacks any residential use.

Educational

Educational development refers to schools, universities, and other learning institutions. Such campuses generally contain significant amounts of open space or parks for recreational use.

Institutional

The Institutional development type can contain a mix of government and quasi-government uses, such as museums, government facilities, and the like. Such campuses are often low-density office and educational.

Industrial

(Avg. Density: 2-10 jobs/acre)

The Industrial development type is made up of a mix of low and medium density industrial buildings. This type often consists of industrial yards and campuses separate from other uses due to the nature of the industrial use. This development type is often near highways with large surface parking for autos and trucks.

Urban Multifamily

Urban Multifamily is characterized by high-density apartment complexes located in central urbanized areas and city centers. Units are generally small, multifamily rental dwellings. Buildings are typically no more than 4 stories.

Suburban Multifamily

Suburban Multifamily development refers to medium-high density apartment complexes located in suburban areas. Buildings can be multi-storied but are characterized by single story dwellings. Such development can accommodate on average about half the number of units per acre as Urban Multifamily.

Compact Neighborhood High

This development type can contain a mix of residential uses, including single-story multifamily rentals, attached single-family units such as duplexes and townhomes, and small-lot urban single-family units.

Compact Neighborhood

Compact Neighborhoods are medium-density residential areas comprised of small lot single-family dwellings, townhomes and duplexes. Street connectivity is relatively favorable, allowing for a walkable environment and transit options.

Suburban Residential

Suburban residential includes a mix of single-family, detached homes. Street networks include many cul-de-sacs, which is typical of post-World War II suburbs. Suburban residential areas are designed for automobile travel. Street connectivity and walkability are generally low.

Large-Lot Residential

Large-lot residential subdivisions consist entirely of single-family, detached homes. Large-lot subdivisions are typically isolated or far from employment and retail services. With one acre lots and larger, this development type is characterized by very large residences without sidewalks. Travel to and from destinations is usually by automobile.

Rural Residential

Such development consists of detached single-family dwellings on large, rural lots. Rural residential lots are on average four times the size of those in Large-Lot Residential and can be several miles from the nearest town or community center.

Medical Facility

Large-scale, integrated healthcare land use consisting of a full-service hospital and associated medical, administrative, and support functions operating as a unified campus. This designation is intended for high-intensity healthcare environments that serve regional populations and provide both inpatient and outpatient services.

Trailer Park

Residential land use consisting of manufactured or mobile homes placed on individual pads within a single managed site. Residents are considered as group quarters population rather than traditional households

Agriculture

Areas for commercial and non-commercial agricultural production with minimal non-agricultural development.

Rural community

Areas intended for small-scale, self-contained settlements in a rural setting that accommodate a mix of residential uses and local-serving employment opportunities. These areas function as focal points for surrounding rural populations, providing housing, services, and limited economic activity while maintaining a predominantly low-density, open character.

Commercial Service

Land use for businesses that provide services directly to customers with a moderate level of employment. It includes uses such as restaurants, personal services, repair shops, and small retail

Generating Controls

Growth totals are controlled at the regional and jurisdictional (i.e., spheres of influence) levels, with the growth allocation tool affecting the growth pattern within each jurisdiction.

Fresno COG updated Fresno County Growth Projections in 2024 with 2020 Decennial Census, the latest demographic and employment statistics, and consultation with local jurisdictions. The report is published on Fresno COG Demographic Data webpage (https://www.fresnocog.org/project/demographic-data/). This report updates the growth projections for Fresno County and the spheres of influence of each of its cities previously published in 2020. The new projections utilize a base year of 2022.

In September 2024, the DOF Demographic Research Unit released the Population Projections, 2020-2070, indicating slower growth compared to earlier projections. The 2023 Baseline release (September 23, 2024) indicates that Fresno County's population is projected to be approximately 7 percent lower in 2035 and 9 percent lower in 2050 than projected in the 2019 DOF release (used in FCOG 2022 RTP). FCOG staff have calibrated the county-level population projection to align with DOF’s most recent release available at the time this report was completed. The resulting countywide population projections are within ±1.5 percent of DOF’s projections.

Population: The primary method used for population projection is the cohort component projection method, which calculates the population by previous population plus births minus the deaths, plus the net migration. This process is applied to each age cohort and race ethnicity group.

The base demographic inputs used in the cohort-component projection include:

(1) 2022 population estimation by jurisdiction sphere of influence (SOI);
(2) 2020 Census data on age by race at 1-year intervals by jurisdictions;
(3) Birth rates by race from California Department of Public Health; and
(4) Death rates by age, sex, and race from CDC WONDER (Wide-ranging ONline Data for Epidemiologic Research) database.

Annual Fresno County population totals from the DOF Population Projections (September 23, 2024 release) were used as countywide control totals to calibrate the projection.

A gravity model was applied to allocate countywide population growth to each SOI. For the 2022–2025 period, allocation factors are based on DOF E-5 data for the 2022–2024 period. For SOIs that exhibited negative growth, a minimum allocation factor of 0.001 was applied, and the remaining SOIs were prorated to sum to 100 percent. This technical adjustment was applied to avoid the projections showing continued negative growth and also because the E-5 data shows continuous negative growth for the unincorporated areas, probably driven to some extent by annexations. The 2026-2030 period is based on DOF E-5 figures for the 2015-2024 period. A similar convention was used as above for the few jurisdictions that had negative growth during this longer period. The third period, 2031-2040, uses the average of the first two allocation periods combined with the existing 2022 population distribution. This approach gradually redistributes growth toward smaller SOIs and the unincorporated area while maintaining consistency with countywide controls. The final two projection periods retain this same distribution.

For each projection year, the model reconciles the annual demographic growth with the topline county growth and the gravity model growth factors of the appropriate time periods for each SOI. Differences are ascribed to net migration.

DOF P-4 projections were used to derive jurisdiction-level factors distinguishing household population from group quarters population, allowing calculation of household population for each jurisdiction.

Employment: The 2022 baseline employment data by jurisdiction sphere of influence (SOI) were developed by FCOG staff using confidential Quarterly Census of Employment and Wages (QCEW) data from California Employment Development Department, and Fresno County Business data from Data Axle. Employment was categorized using EDD job sector classifications, mapped to FCOG model categories and NAICS sectors as shown in Table below:

EDD Job Sector Categories	FCOG Model Categories	NAICS Sector
Farm	Other	11
Natural Resources and Mining	Other	21
Manufacturing	Industrial	31-33
Trans, Warehousing	Industrial	48-49
Wholesale Trade	Industrial	42
Utilities	Industrial	22
Construction	Other	23
Retail Trade	Retail	44-45
Information	Office	51
Financial Activities	Office	52, 53
Professional & Business Services	Office	54,55,56
Educational Services	Educational Services	61
Health Care & Social Assistance	Health/Medical	62
Arts, Entertainment, and Recreation	Services	71
Accommodation & Food Service	Food	72
Other Services	Services	81
Government	Government	92

Employment projections grouped sectors into two categories:

1. Economic base sectors (Farm; Natural Resources and Mining; Manufacturing; Transportation and Warehousing; Wholesale Trade), and

2. Non-basic sectors (Utilities; Construction; Retail Trade; Information; Financial Activities; Professional and Business Services; Educational Services; Health Care and Social Assistance; Arts, Entertainment, and Recreation; Accommodation and Food Services; Other Services; and Government).

Annual growth rates for economic base sectors were derived from Woods & Poole (W&P) projections and applied to project economic base employment. For non-basic sectors, the job figures are calculated with Business to Business (B2B) multipliers and population multipliers.

At the SOI level, the economic base sectors, Industrial and Other, were projected based on each jurisdiction's 2022 sectoral share, with flexibility to vary assumptions across three time periods: 2022–2025, 2026–2035, and 2036–2060. Aggregate non-basic employment growth was allocated using a formula attributing 25 percent of growth to economic base employment growth and 75 percent to population growth. This allocation reflects observed relationships between population growth and service-sector employment in Fresno County and is consistent with prior FCOG modeling practice.

Component non-basic sectors were projected using county-level growth rates adjusted for SOI-specific non-basic growth. Office employment was treated as a remainder sector to ensure sector totals matched non-basic employment totals for each SOI. The unincorporated area was treated as a remainder jurisdiction to ensure countywide control totals were maintained.

Final employment projections were summarized at five-year intervals by sector for use in the FCOG land use and travel demand models.

Household size: The base year household size by jurisdiction was derived from California Department of Finance E-5 reports. Then it calculates projected household sizes for 2025-2060 based on Woods & Poole (W&P) county projections. W&P Persons per Household (PPH) is only available at County level, though its advantage is the specific projections for various years in the future. DOF city-to-county relationships were used to calibrate W&P for each jurisdiction and each future year.

Household income: Base year average household income was sourced from Census Bureau American Community Survey 2022 1-year estimates for Fresno County. The growth rates were calculated from Woods & Poole (W&P) Average Household Income projections for Fresno County.

Housing units: 2022 Vacancy rates and housing units from DOF E-5 report are used as base year 2022 data. The Target Healthy Vacancy Rates for each jurisdiction were calculated using the following approach: Jurisdiction overcrowding rate - average for comparable regions (4.37%, identified by HCD, 6th cycle RHNA) + Vacancy rate (if vacancy rate <5%, use standard 5% by HCD, 6th cycle RHNA). The dwelling unit growth then is calculated based on vacancy rates plus a DU replacement factor of 0.5%, also taken from HCD's RHNA methodology. It should be noted that the resulting vacancy factor increases the projections of housing units in relation to household growth. Also, the household projections do not account for any increased households due to less overcrowding.

Future single-family and multi-family housing splits were estimated using HCD pipeline data (2018–2022) and historical trends (2014–2024) for the 2023–2030 period. For later periods, jurisdiction General Plan land use assumptions were incorporated where available. In addition, the factors are averaged over time to simulate a smooth trend toward the long term General Plan housing distribution.

Household and housing unit projections in this report should not be directly compared to the 6th Cycle RHNA allocation for the 2023–2031 period, as this analysis incorporates updated DOF population projections reflecting slower growth. Under the updated population assumptions, the population level underlying the 6th Cycle RHNA is not projected to be reached until approximately 2049–2050. While the time horizons differ, the projection methodology generally follows RHNA assumptions. When evaluated at an equivalent population level, the model estimates approximately 54,916 additional housing units; when combined with the RHNA Cost Burden Adjustment of 3,505 units, this yields a total of approximately 58,421 units, which is broadly consistent with the 6th Cycle RHNA requirement of 58,298 units.

After completion of the draft projections, Fresno COG staff consulted with planning staff from each jurisdiction and made minor adjustments based on updated development pipelines and local planning assumptions. The agency (sphere of influence) level growth controls were used to generate growth patterns across scenarios.

Determining Development Patterns

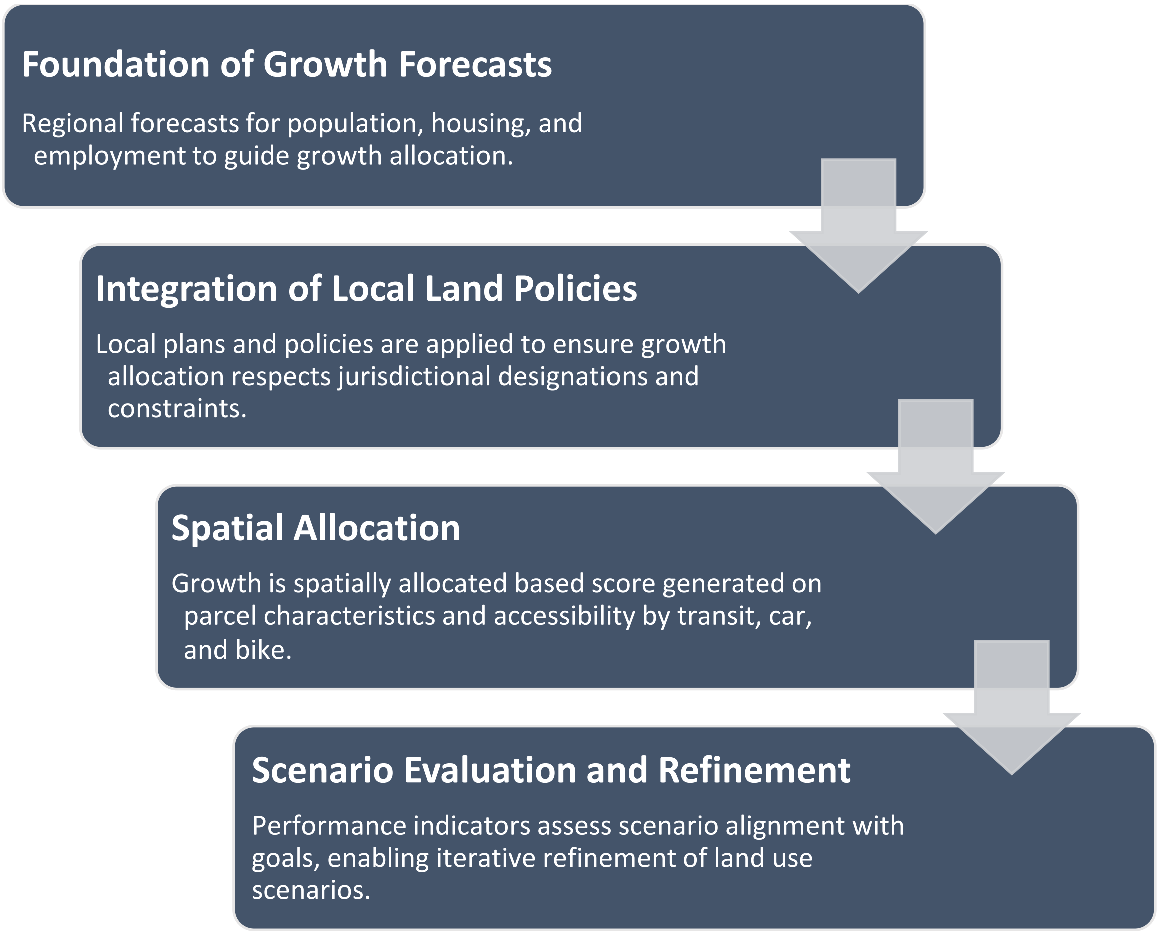
Land Use Model

Fresno COG developed and applied an in-house land use modeling tool to support development of land use scenarios for the RTP. The tool is designed to allocate regional population, housing, and employment growth in a policy-sensitive manner, ensuring consistency with adopted demographic forecasts while responding to transportation accessibility and regional planning objectives. The script is hosted on GitHub (https://github.com/fresnocog/futuregrowth), with more detailed technical documentation available in its wiki. The process begins with regional growth forecasts, which are translated into control totals at spheres of influence and jurisdiction level. These control totals establish how much growth must be accommodated within each jurisdiction planning area. Growth is then distributed spatially based on a scoring process that considers transportation accessibility, parcel characteristics, and redevelopment potential. During allocation, the model is structured to follow adopted local land use policies, including city and county general plans, specific plans, and other applicable planning documents provided by local jurisdictions.

Accessibility measures—derived from the regional activity-based travel demand model—reflect relative access by transit, automobile, and bicycle. These measures are combined with parcel-level attributes to generate development suitability scores. Parcels with higher scores are given priority in the allocation process, subject to local growth controls, planning boundaries, and adopted land use policies.

Growth is allocated using a set of generalized development types (devtypes) that describe land use intensity and mix. These devtypes were inspired by the Envision Tomorrow framework used in previous RTP and Sustainable Communities Strategy efforts, providing consistency with prior regional scenario development while allowing flexibility in testing alternative policy assumptions such as infill development and transit-supportive growth.

Once growth is allocated, updated MAZ- and TAZ-level socioeconomic data are produced and used as inputs to the regional travel demand model. The resulting land use pattern is evaluated using a set of performance indicators, including measures related to infill development, proximity to transit, density, and farmland impacts. This integrated approach allows Fresno COG to iteratively develop and assess land use scenarios that align transportation investments with regional and local planning goals. A summary of this process is illustrated in the workflow diagram below.



Parcel development score

The land use module developed by Fresno COG uses a score-based approach to flag parcels for development. An aggregate score is determined for each parcel depending on several factors. The suitability score considered several factors as detailed in table below:

Growth Model Parameters

Parameter	Description
High Density Factor	The percentage of new growth that represents "high density" growth, i.e. densities at the higher range of planned land use designations
Minimum Redevelopment Density	Minimum net density gain between existing and proposed land uses for a parcel to be considered for new growth potential
Infill Index	The normalized, inverse distance of a parcel from a city limit or rural community boundary
Conservation Index	The percentage of a parcel's land that is not covered by a conservation layer (e.g. important farmland, groundwater recharge areas, etc.)
Density Index	The net density of a developed or redeveloped parcel, normalized for the region
VMT Index	Whether the parcel falls within a low-, moderate-, or high-VMT area for SB 743 purposes
Accessibility Indexes, by Mode*	Normalized skim results from Fresno ABM representing accessibility to destinations, by mode (SOV, bike, ped, transit)
Calibration Factors	A set of coefficients used to calibrate regional growth characteristics such as infill development, mixed-use share, residential density, unit share by type, redevelopment share, etc.

The calculation of a given parcel's score can be generally represented as follows:

$$S = K_1 S_{Cons} + K_2 S_{Infill} + K_3 S_{Den} + K_4 S_{Bike} + K_5 S_{Transit} + K_6 S_{SOV} + K_7 S_{DT} + K_8 S_{TOD} \ldots$$

Where:

$K_1, K_2, K_3, \ldots, K_8$ ..= adjustment factors (adjusts to favor scores and planned development)
S_{Cons}, S_{Infill} , S_{Den} , S_{Bike}, $S_{Transit}$, S_{SOV} , S_{DT} , S_{TOD} .. = Indexes and parameters to capture planning assumptions and generate realistic growth patterns (as detailed in table above)

After calculating the development scores for each parcel, the land use module sorts the parcels in descending order for each agency. The parcels are then allocated with development within agency until the targets for housing and employment are met.

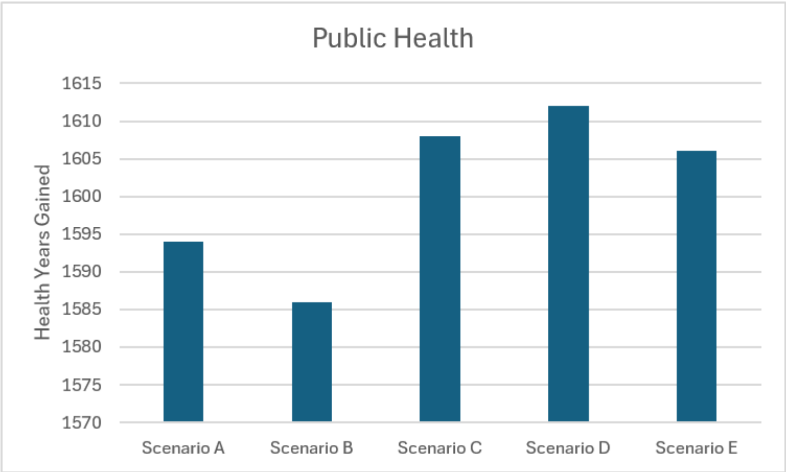
The adjustment factors ($K_1, K_2, K_3, \ldots, K_8$) that comprise the total development scores were adjusted to calibrate land-use development to mirror the 2022 SCS development pattern. Then, different permutations of adjustment factors were used to reflect alternate development patterns based on scenario-specific priorities. Details about scenario-specific priorities are documented in Appendix C-8 SCS Alternative Scenarios.

Appendix C. Transportation and Land Use

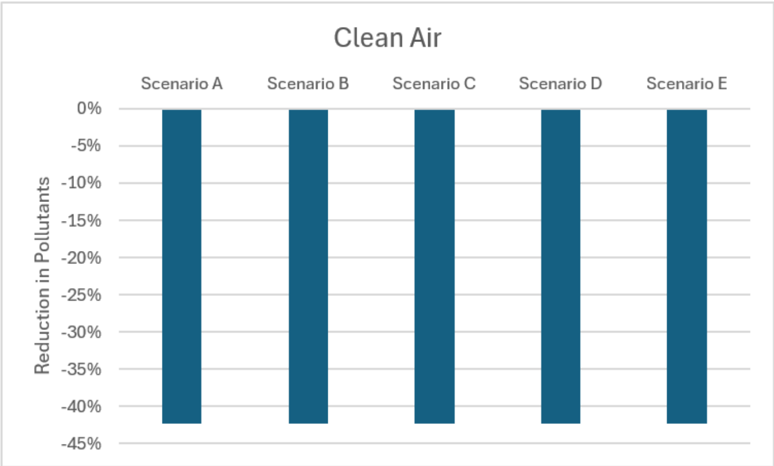
Item 10. SCS Indicator Results

2026 SCS INDICATOR RESULTS

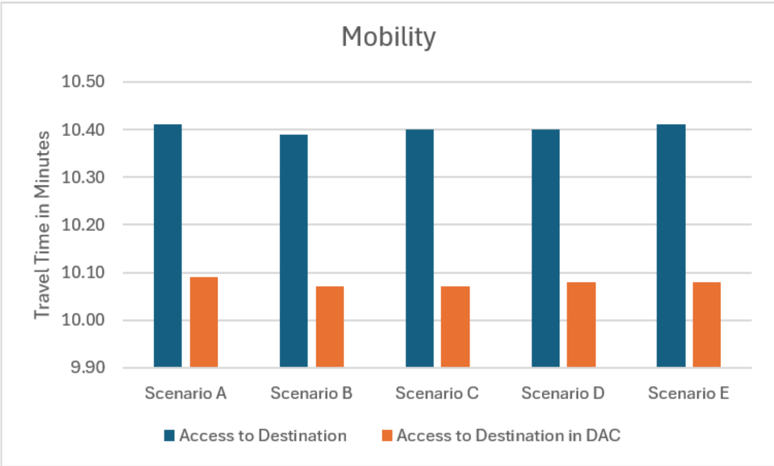
PUBLIC HEALTH



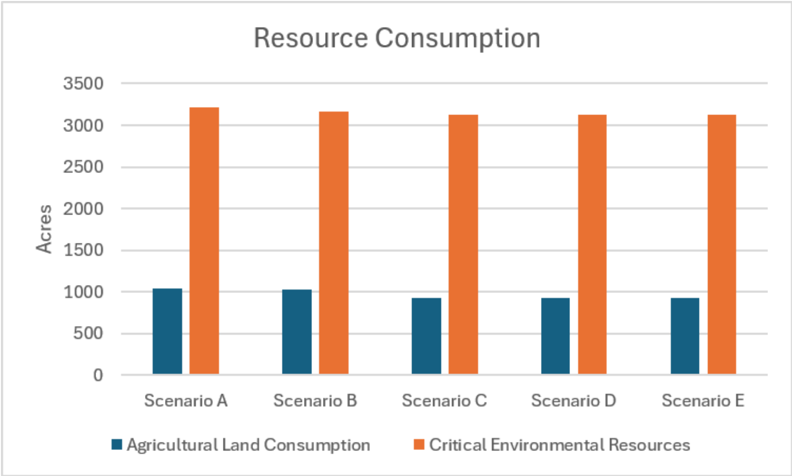
CLEAN AIR



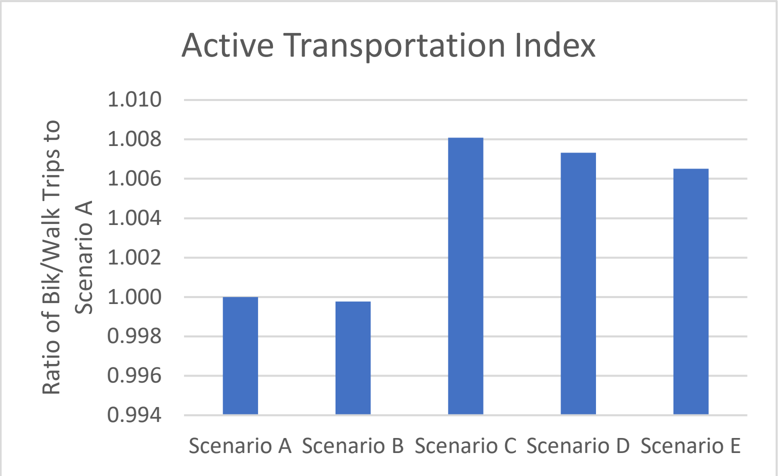
ACCESS TO JOBS & SERVICES



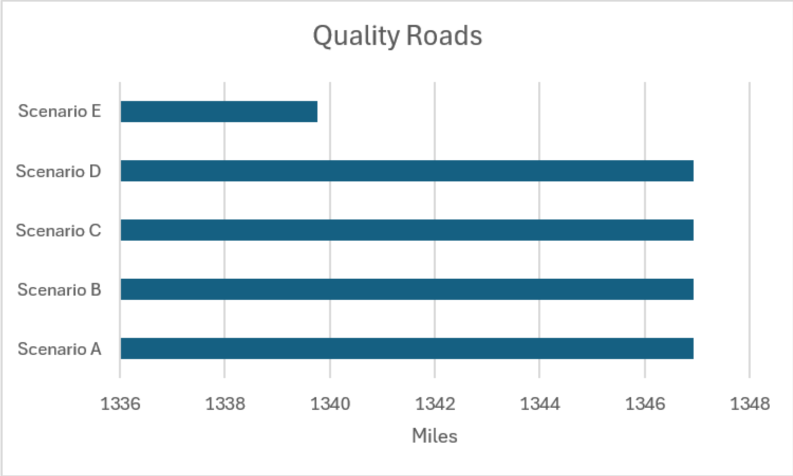
CRITICAL RESOURCES



BIKE AND WALK ACTIVITIES

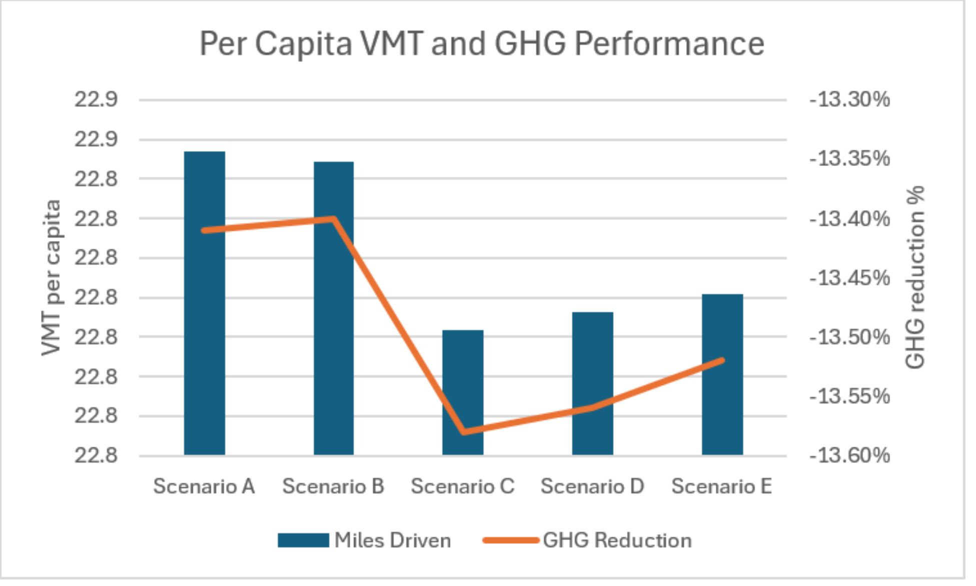


QUALITY ROADS

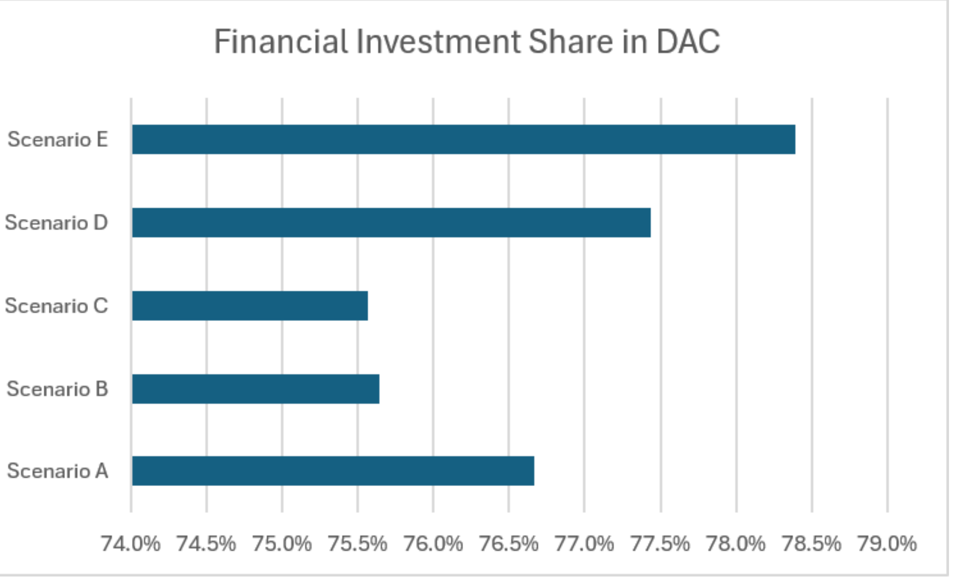


2026 SCS INDICATOR RESULTS

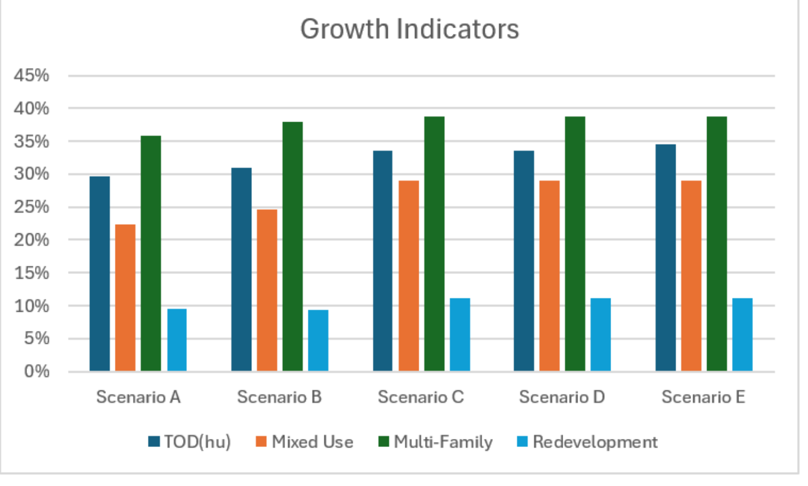
MILES DRIVEN AND GHG REDUCED

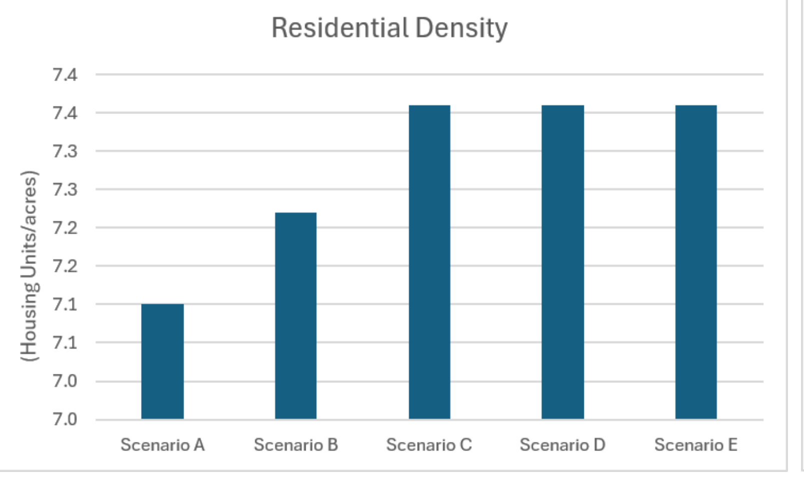


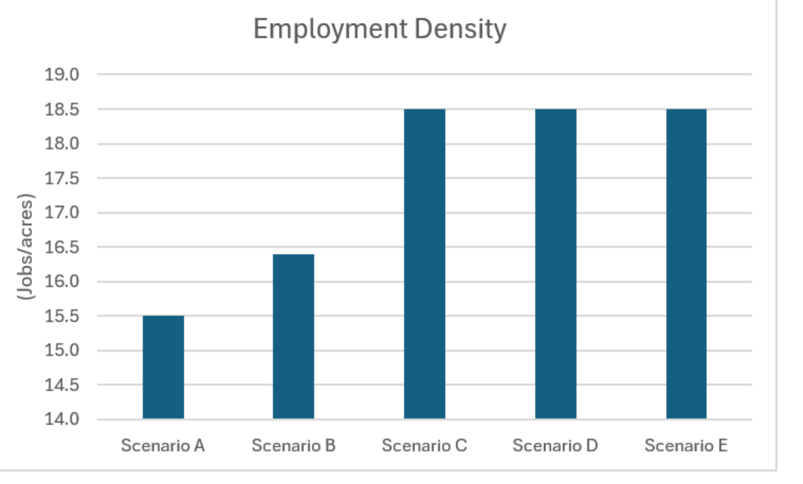
INVESTMENT IN EJ COMMUNITIES



URBAN DEVELOPMENT PATTERN







Appendix C. Transportation and Land Use

Item 11. Technical Methodology to Estimate Greenhouse Gas Emission Reduction

Technical Methodology to Estimate Greenhouse Gas Emission Reduction for Fresno COG's 2026 RTP/SCS

June 2026

Table of Contents

I. Introduction

Pursuant to Government Code § 65080(b)(2)(J)(i), the Metropolitan Planning Organizations (MPOs) are required to submit a technical methodology to the California Air Resource Board (CARB) prior to starting the Sustainable Communities Strategy (SCS) public process. The technical memo serves as the starting point of the consultation process between the MPO and the CARB regarding the MPO's approach and methodology to estimate the GHG emission reduction from the Regional Transportation Plan (RTP)/Sustainable Communities Strategy (SCS). It is understood that the development of SCS is a multi-year public process, and the information in the technical memo will be updated as the SCS development moves along the process. Fresno COG is committed to providing updated information to the CARB as it becomes available.

Fresno COG and the other seven MPOs in the San Joaquin Valley were given 5% & 10% reduction targets for 2020 and 2035 respectively for the first and second SCSs. Fresno COG was able to achieve 9% reduction for 2020 and 11% reduction for 2035 from the 2014 RTP/SCS, and 5% (2020) and 10% (2035) reduction from the 2018 RTP SCS. In the spring of 2018, the CARB Board adopted new targets for MPOs for their third SCS. Based on Fresno COG's recommendation, the CARB Board approved 6% reduction target for 2020 and 13% for 2035 for Fresno COG's third (2022) and fourth (2026) RTP/SCS. Fresno COG was able to reach & exceed the targets set for its 2022 RTP/SCS.

RTP/SCS is a long-range plan that provides transportation investment guidance for the region for the next 20+ years. The SCS contained in the RTP demonstrates how the region is going to achieve the GHG reduction targets, if the plan is implemented, through integrated transportation and land use planning. Fresno COG's 2026 RTP/SCS will have 2049 as the horizon year. 2023 will be the base year, and 2020 and 2035 will be the GHG target years in the SCS. While 2035 GHG targets will be demonstrated by modeling analysis, 2020 GHG targets demonstration will be based on ground data. As recommended by CARB, 2005 assumptions will be kept consistent with the assumption made when the 2014 RTP/SCS was developed. Fresno COG is applying the updated Activity-based Mode (ABM) in the 2026 RTP/SCS development. The base year for the Fresno ABM is 2023. The 2023 base year was developed and validated in 2025/26 (report). The reason behind selecting 2023 as the base year is that it captures the post COVID travel trends and characteristics of new transportation behavior observed after the COVID. In addition, Fresno COG led the 2022-23 Central California Travel Survey (CCTS) in the San Joaquin Valley that accurately captures the post COVID movement of people. The CCTS survey along with the 2024 Transit Onboard Survey helps to calibrate and validate the base year 2023 which will be a good foundation for the future year VMT and GHG forecasting. Although the ABM is being applied in the 2026 RTP/SCS, it is inappropriate to use the ABM to back cast to 2005 condition as it is based on the 2022-23 CCTS as a primary dataset. Also, the workers flow and the American Community Survey (ACS) datasets were pulled from 2022 and 2023 respectively, along with Transit On-board Survey from 2024. The travel characteristics in 2005, which is a pre-Great Recession year, is vastly different from the post-recession as well as the post-COVID travel behaviors. Ideally, the 2005 condition should be estimated with an ABM that is based on the household travel survey conducted in 2000/2001. Unfortunately, such an ABM does not exist. Instead of trying to have the current ABM perform an inappropriate back casting to 2005, Fresno COG decided that the 2005 VMT/GHG numbers produced by COG's MIP 1 model, which was based on the 2000/2001 household survey, is still valid.

Table 1: Analysis Years Considered in RTP/SCS

Year	Purpose
2005	Base Year for SB 375 GHG emission reduction calculation
2023	Base year for ABM traffic model
2023	Base Year for RTP
2020	SB 375 GHG target year
2035	SB 375 GHG target year
2049	Horizon year

Fresno COG will use the observed data sources (e.g., 2022 regional progress report indicators, HPMS VMT or other locally collected data) to demonstrate that the region met its 2020 target.

Fresno COG's 2026 RTP/SCS development process was launched in June 2024. Public outreach started in September/October. The preferred SCS scenario was selected by the Policy Board in March of 2026, and the RTP/SCS will be adopted in September 2026.

Here is how Fresno COG plans to address CARB's recommendation in the 2022 RTP/SCS draft approval letter:

- Fresno COG plans to upgrade the DaySim model to ActivitySim in 2027, which will include an update of the day pattern.

- Fresno COG's ABM is able to address short-term induced demand due to increased capacity. Such short-term latent demand includes mode switching, route changing, time of day switching, destination change and more frequent trips. In order to address longer term induced travel demand caused by land use changes due to expanded transportation capacity, COG explored multiple approaches. COG had been working on an iterative methodology for creating feedback between land use growth allocation in the land use model and transportation improvements (as part of the accessibility index in the ABM). Please refer to the "Induced Demand Methodology" section for more detailed explanation. However, before the integrated land use and transportation modeling process is validated and finalized, the hybrid approach that utilizes both the ABM and the elasticities of the National Center for Sustainable Transportation (NCST) tool will be employed to estimate the induced VMT due to capacity increasing projects planned in the 2026 RTP/SCS.
- In the 2026 RTP/SCS, Fresno COG will refer to CARB's SCS Review Guidelines for guidance when feasible for off-model GHG reduction strategy quantification. More efforts will be put into data collection and inter-agency collaboration as recommended by CARB. Fresno COG has improved its database for rideshare and vanpool programs and should be able to provide better data support for such strategies. All data that supports the off-model quantification of GHG emission reduction strategies will be made available to CARB when it is available.
- As recommended by CARB, Fresno COG staff implemented the Telecommute model within its ABM. Telecommute models can be turned on by adjusting the configurations in the DaySim module. The telecommute model was calibrated and validated with the help of 2022/23 CCTS datasets that includes the information about the working from home frequency and duration. Some other data sources like the Census Bureau American Community Survey Commuting Characteristics and Bureau of Labor Statistics (BLS) Labor Force Statistics Telework Rate were also utilized to carry out the validation of the model. The 2026 SCS will no longer use the telecommute as an off-model strategy. Instead, telecommute will be incorporated as an on-model strategy within the model. Fresno COG staff will monitor and analyze the results from the US Survey of Working Arrangement and Attitudes (SWAA) to estimate future telecommute rates and feasibility.
- Fresno COG will provide data to illustrate the progress of the SCS strategy implementation. Data that could be provided include but is not limited to: miles of bike lanes/trails and sidewalks built since 2022, housing permit by type (HCD website), EV chargers built/funded, electric buses purchased,

additional transit routes/mileage added, transit ridership, funding amount provided through the TOD program, carpool/vanpool numbers, numbers of vans sponsored, etc.

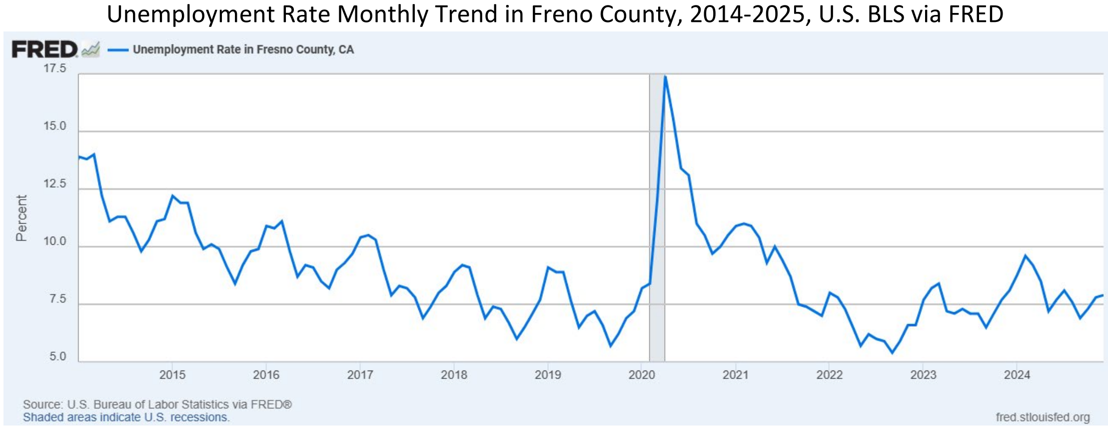
II. Overview of Existing Conditions

II a. Notable Changes to Existing Regional or Local Planning Contexts

Based on recent population estimates, Fresno region is experiencing a quick population recovering from COVID-19 pandemic as a higher than usual net migration was observed in 2023.

The unemployment rate and total employment have recovered to the pre-pandemic level since fall of 2022. A stable employment growth assumption was applied in the projection.

Unemployment Rate Monthly Trend in Freno County, 2014-2025, U.S. BLS via FRED



In September 2024, the California Department of Finance (DOF), Demographic Research Unit released the Population Projections, 2020-2070 that incorporated the latest historical population, birth, death, and migration data available as of July 2023, and are informed by the 2020 Census data products. Compared to the Vintage 2019 release, the 2023 Baseline (Vintage 2024) release projected that Fresno County would have 7% less population in 2035, 9% less population in 2050, and 53% less population growth from 2020 to 2035, 45% less population growth from 2020 to 2050. Please refer to Section III for more detailed information about the socio-economic forecast updates. The decreased population growth projection brings a challenge to achieving the per capita based GHG reduction target. Although the regional total GHG emission would decrease because of the smaller projected population, the region will have less housing units that can be planned as higher density housing development, which has otherwise proven to be an effective strategy to reduce per capita GHG emission.

With the implementation of Sustainable Groundwater Management ACT (SGMA), the Public Policy Institute of California (PPIC) study estimated a loss of close to 1 million acres of farmland in the San Joaquin Valley by 2040. Around 25% of Fresno County's employment is related to ag production. It is anticipated that the SGMA will have a profound social economic impact on Fresno County in areas such as employment, air quality, housing affordability, rural poverty, etc.

SB 743 is another legislation that has a significant impact on how growth will be shaped in the region. After the initial study of VMT mitigation program in 2023, the Fresno COG is now working on establishing VMT mitigation programs in 2026/27, which are expected to lead to VMT mitigation fees that developments will have the option of paying into if the projects have significant VMT impacts. The city of Fresno is implementing their VMT mitigation program early 2026. SB 743 is expected to have more impact on the small cities and the rural areas in the County, where residents tend to make longer daily commutes than people living in the Metro area. Fresno COG's land use model takes into consideration the low VMT areas in the County in various scenarios.

Several large distribution centers have started operation in south Fresno since 2020. Alta and Amazon brought close to 3000 jobs to the region. The City of Selma has three major development projects facilitated by the sewer infrastructure construction, which will provide 2,000 – 2,500 construction jobs. T-Mobile opened its call center in Kingsburg in 2022, which provided 1,000+ new jobs. The first BRT line in Fresno that started its operation in 2018 had been enjoying steady ridership until March 2020. Starting April 2020, the BRT as well as the other transit routes in the region had been operating at about 50% ridership compared to its pre-COVID level. However, by late 2024, the ridership is up at 90% compared to pre-COVID level. Fresno Area Express (FAX) also realigned a few routes such as Route 3, Route 12, Route 20, Route 45, and Route 58 to better serve the riders. FAX also has increased the frequency on some routes like Route 28 and Route 39. In addition, FAX launched a new route 29 operating along Church Avenue in August 2025. Fresno COG, in partnership with Fresno County Rural Transit Agency (FCRTA), has secured a grant from Caltrans to assess the feasibility of regional rail corridors connecting rural and suburban cities to Fresno. Also, Fresno COG will be working with FAX on the feasibility assessment of Light Rail Transit (LRT) connecting north Fresno and airport to the high-speed rail station. The city of Fresno has streamlined its planning process for development in the downtown and the BRT corridor, both of which are the infill development areas, and updated its zoning ordinances to facilitate the implementation of the updated general plan. It's the City of Fresno's policy to "Emphasize infill development and a revitalized central core area as the primary activity center for Fresno and the region by locating substantial growth near the Downtown core and along the corridors leading to the Downtown."

The City of Clovis created the award winning "Cottage Home Program", which was originally created to encourage residential infill development in the Clovis Old Town area, but due to its popularity, has been expanded citywide. The City of Coalinga applied for a SB 2 Planning Grant to develop a similar cottage home program, and many other local governments are also considering such a program.

Several small cities have also gone through general plan updates. The City of Kerman and City of Sanger adopted their General Plan Updates in 2020. The Cities of Fowler adopted its General Plan updates in 2023. And the County of Fresno adopted its General Plan in 2024. In April of 2019, the City of Clovis expanded their sphere of influence by 1,035 acres. Clovis' General Plan identified this area for significant job generation, designating over 500 acres for jobs, 225 acres of open space, and 325 acres for residential uses. The cities of Reedley, Huron, and Kerman have also recently updated their spheres of influence, mostly to accommodate residential development and public facilities. All annexations are reviewed by Fresno LAFCo to ensure orderly development. In 2023 and 2024, all jurisdictions in Fresno County updated their 2023-2031 Housing Elements. A growing number of jurisdictions in Fresno County have adopted general plans, housing elements, and zoning ordinances that promote strategies such as infill development, mixed-use types, transit-oriented development, increased density, conservation of farmland and other resource areas, etc.

Fresno COG completed a Transportation Network Vulnerability Assessment in 2020. The Transportation Network Vulnerability Assessment provides local jurisdictions information regarding local climate risks and strategies to increase the resiliency of the transportation network. This information will be useful for local jurisdictions as they update their Safety Elements to incorporate climate adaptation. Fresno COG is continuing to help plan and prepare for climate resiliency for the region. We recently completed the Fresno County Climate Resiliency Plan, which is a subsequent plan to the Transportation Network Vulnerability Assessment. The Climate Resiliency Plan will identify specific transportation improvement projects for the most vulnerable transportation assets identified in the vulnerability assessment and conduct climate risk assessments for the projects. We are working with other San Joaquin valley MPOs in assessing the climate change vulnerabilities of the SJV corridor and resiliency connectors. This study is scheduled to be completed in 2027. These plans and recommended transportation improvement projects will help inform the jurisdictions' project submittals and the COG submittal process for future RTPs and call-for-projects. Climate adaptation will be added as a project scoring criteria to the 2026 RTP/SCS to incentivize the local governments to consider climate adaptation in project submittal. In addition, an EV Readiness Plan has been completed, which provides guidance for the development of EV infrastructure in the Fresno region. The Comprehensive Climate Action Plan (CCAP) identifies GHG emissions and sinks throughout the County from various sectors which include but are not limited to: transportation, waste/wastewater management, residential/commercial buildings, energy generation, and agriculture. This plan will help the agencies acquire critical funding to embark on mitigation measures and strategies in construction or policy implementation.

The TradePort California project envisions an inter-modal goods movement system linked by inland ports (or trade ports) located in the Central Valley. The cargo will be shipped from the ports via rail into the trade ports in the Central Valley as opposed to by medium and heavy-duty diesel trucks. The goods will then be transported by clean energy fueled trucks (hydrogen/electric). The trade ports will serve as logistics hubs that will house distribution centers in Fresno County and other counties in the Central Valley. The project scope embraces a system with clean transportation, technology, and innovation that will reduce GHG emissions and other criteria pollution from State Route 99, one of the most heavily utilized freight corridors in the State (ranked 3rd in California).

The Fresno County Mobility Hub Feasibility Study conducted in partnership with the three transit agencies (FCRTA, FAX, and Clovis Transit) will identify four mobility hub sites in Fresno County. Each site will have different characteristics but regardless will advance mobility and contribute to a more sustainable and connected transportation network that will provide seamless connections among various transportation modes.

Assembly Bill 101 (2018) established the Regional Early Action Planning (REAP) program to assist in developing an improved methodology for sixth-cycle Regional Housing Needs Assessment (RHNA) process and to further housing production efforts throughout the state. The eight-county San Joaquin Valley was one of two regions in the state granted additional funds to work together toward mega regional solutions to the housing crisis. In 2021, REAP 2.0 was established and sought to accelerate progress towards state housing goals and climate commitments through a strengthened partnerships among the state, its regions, and local entities to accelerate infill development, housing, and VMT reductions in ways that advance equity. Fresno COG received $13.6 million in funding for projects in the region that meet REAP 2.0 objectives

In 2023, Fresno COG finalized the Regional Vehicle Miles Traveled (VMT) Mitigation Program Feasibility Study that explored options that would be most effective in providing the pathways for VMT reduction in the Fresno region. Several different frameworks for VMT mitigation were evaluated, including a VMT mitigation bank, VMT mitigation exchange, and a regional VMT impact fee. As a follow-up to the feasibility study, staff are moving forward with a Regional VMT Mitigation Program Implementation Plan which seeks to establish a regional VMT mitigation program in Fresno County.

In January 2025, Fresno COG began the Fresno-Clovis Metropolitan Area Managed Lane Study by releasing the Request for Proposal (RFP) with an expected completion date of June 2026. This study will help determine if current and future travel demand in the Fresno-Clovis area would deem managed lanes to be an effective solution to reduce congestion and reduce VMT. The study will recommend alternatives for managed lanes locations, and a timeline for phased implementation. Managed lanes provide a solution to managing traffic congestion and improving safety on urban freeway networks and are utilized widely throughout the state. Managed lanes are consistent with the RTP/SCS goals for VMT/GHG reduction and will further the state's climate goals and the other overarching goals such as safety and efficiency in the California Transportation Plan.

II b. Key Regional Issues Influencing RTP/SCS Policy Framework and Discussions

The key issues that have influenced the 2026 RTP/SCS policy discussion include, but not limited to: transit ridership post COVID; job growth especially distribution center jobs, which leads to goods movement infrastructure needs; how to promote infill/redevelopment given that cost for such development is more expensive and rent structure in Fresno does not support such higher cost development; social equity issue given that a large percent of our population live in disadvantaged communities; air quality and public health continue to be serious challenges in the region; how to preserve important farmland; safety issues on our transportation system; how to help our existing rural communities continue to support themselves and thrive, etc.

III. Demographic Forecast

Fresno COG has updated the population and employment projection for the 2026 RTP/SCS. The update incorporates the post COVID-19 pandemic conditions, as well as the new planning context mentioned in section II. The methodology mirrors that of the forecast that was applied in the 2022 RTP/SCS with notable changes coming primarily from updates in observed data and trends.

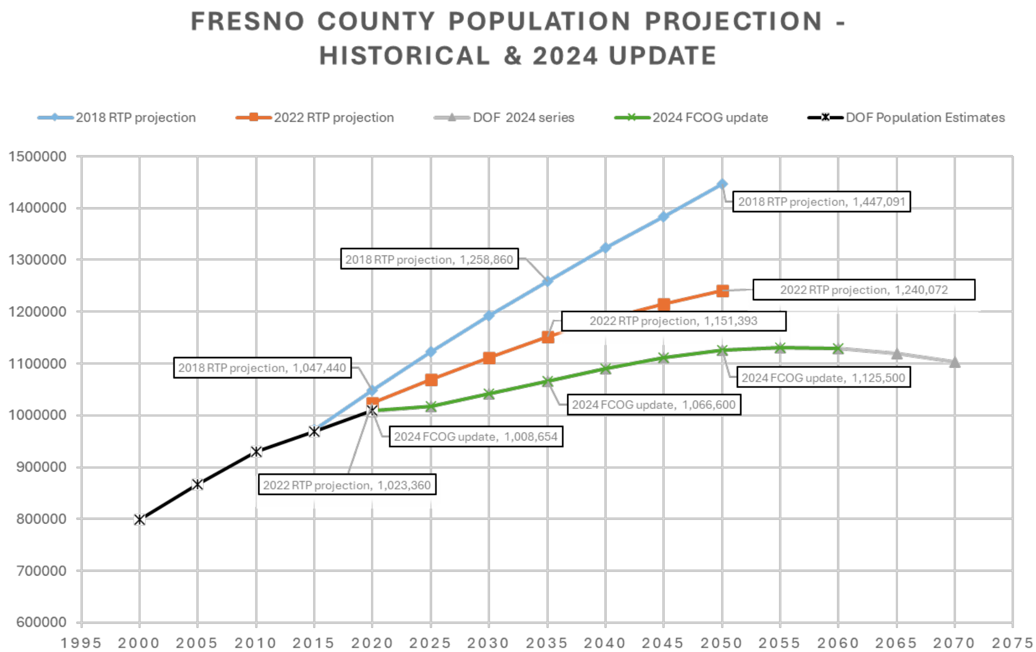
Table 2: Demographic Forecast Changes

	2023	2035 (2018 SCS)	2035 (2022 SCS)	2035 (2026 SCS)
Population	1,012,524	1,258,860	1,151,390	1,066,610
Households	328,642	375,290	359,090	351,580
Employment	415,596	460,100	444,800	442,660

As demonstrated in Table 2, population projection have been reduced significantly compared to the last plan. This downward adjustment is mainly attributed to the 2020 decennial Census results used as new benchmark, impact of COVID-19, declining fertility, and an aging population.

Fresno COG updated Fresno County Growth Projections in 2024 with 2020 Decennial Census, the latest demographic and employment statistics, and consultation with local jurisdictions. The report is published on Fresno COG Demographic Data webpage (https://www.fresnocog.org/project/demographic-data/). This report updates the growth projections for Fresno County and the spheres of influence of each of its cities previously published in 2020. The new projections utilize a base year of 2022.

In September 2024, the DOF Demographic Research Unit released the Population Projections, 2020-2070, indicating slower growth compared to earlier projections. The 2023 Baseline release (September 23, 2024) indicates that Fresno County's population is projected to be approximately 7 percent lower in 2035 and 9 percent lower in 2050 than projected in the 2019 DOF release (used in FCOG 2022 RTP). FCOG staff have calibrated the county-level population projection to align with DOF's most recent release available at the time this report was completed. The resulting countywide population projections are within ±1.5 percent of DOF's projections.



Population: The primary method used for population projection is the cohort component projection method, which calculates the population by previous population plus births minus the deaths, plus the net migration. This process is applied to each age cohort and race ethnicity group.

The base demographic inputs used in the cohort-component projection include:

(1) 2022 population estimation by jurisdiction sphere of influence (SOI);
(2) 2020 Census data on age by race at 1-year intervals by jurisdictions;
(3) Birth rates by race from California Department of Public Health; and
(4) Death rates by age, sex, and race from CDC WONDER (Wide-ranging ONline Data for Epidemiologic Research) database.

Annual Fresno County population totals from the DOF Population Projections (September 23, 2024 release) were used as countywide control totals to calibrate the projection.

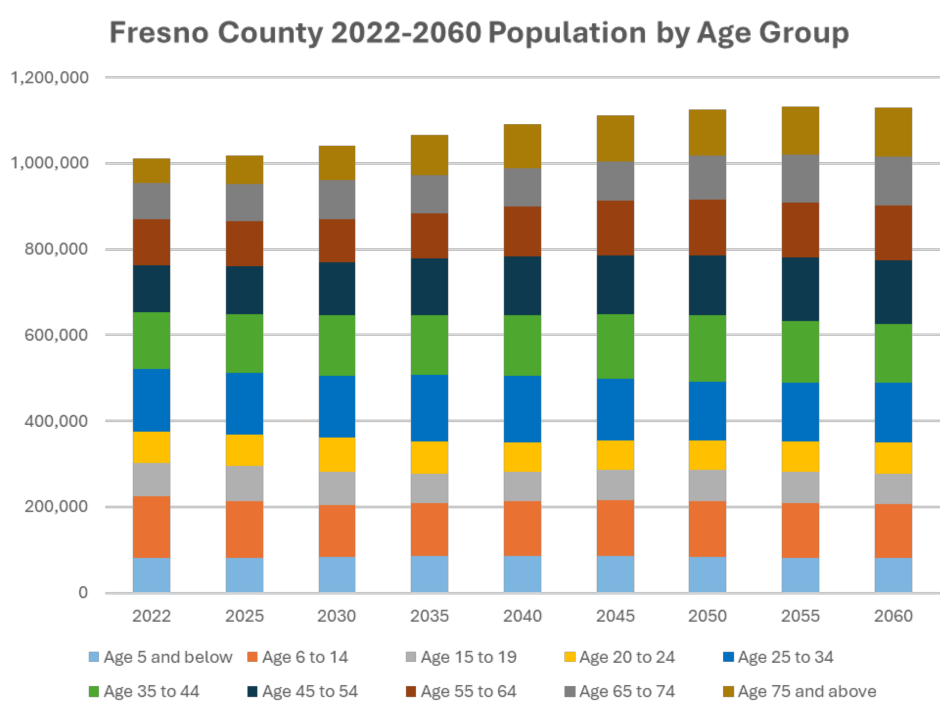
A gravity model was applied to allocate countywide population growth to each SOI. For the 2022–2025 period, allocation factors are based on DOF E-5 data for the 2022–2024 period. For SOIs that exhibited negative growth, a minimum allocation factor of 0.001 was applied, and the remaining SOIs were prorated to sum to 100 percent. This technical adjustment was applied to avoid the projections showing continued negative growth and also because the E-5 data shows continuous negative growth for the unincorporated areas, probably driven to some extent by annexations. The 2026-2030 period is based on DOF E-5 figures for the 2015-2024 period. A similar convention was used as above for the few jurisdictions that had negative growth during this longer period. The third period, 2031-2040, uses the average of the first two allocation periods combined with the existing 2022 population distribution. This approach gradually redistributes growth toward smaller SOIs and the unincorporated area while maintaining consistency with countywide controls. The final two projection periods retain this same distribution.

For each projection year, the model reconciles the annual demographic growth with the topline county growth and the gravity model growth factors of the appropriate time periods for each SOI. Differences are ascribed to net migration.

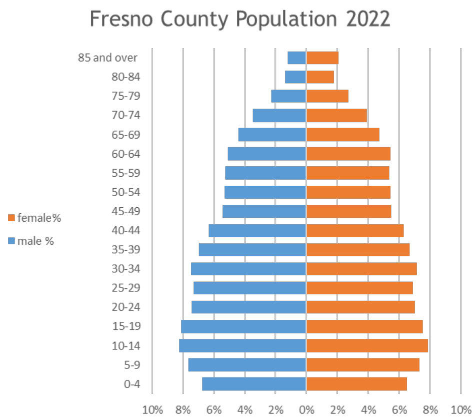
DOF P-4 projections were used to derive jurisdiction-level factors distinguishing household population from group quarters population, allowing calculation of household population for each jurisdiction.

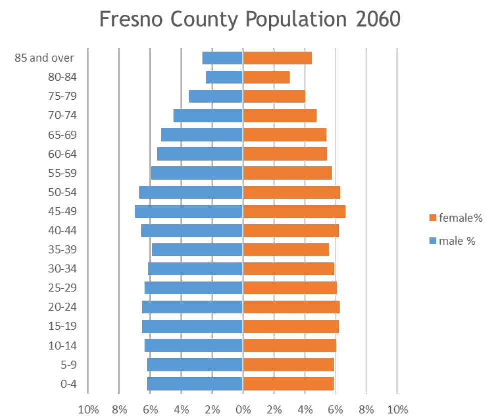
One significant contributor to the downward revision in projected population growth is declining fertility. Birth rates have been decreasing since approximately 2000, preceding the COVID-19 pandemic. With updated birth rate data incorporated, projected population growth is lower than in prior forecasts.

As growth slows, the Fresno region is projected to experience population aging. Older age cohorts, particularly those aged 45 and above, are projected to grow more rapidly, with the population aged 65 and over increasing from 13.9 percent today to approximately 20.0 percent by 2060. In contrast, younger age groups between 6 and 34 years are projected to decline.



The current population structure resembles a stationary population pyramid, while the 2060 projection exhibits a constrictive pyramid shape, characterized by a narrower base and a larger share of older adults. This shift reflects sustained fertility decline and increasing longevity and is consistent with statewide demographic trends identified in recent DOF projections.





Employment: The 2022 baseline employment data by jurisdiction sphere of influence (SOI) were developed by FCOG staff using confidential Quarterly Census of Employment and Wages (QCEW) data from California Employment Development Department, and Fresno County Business data from Data Axle. Employment was categorized using EDD job sector classifications, mapped to FCOG model categories and NAICS sectors as shown in Table below:

Table 3: Employment by job sector for Fresno County

EDD Job Sector Categories	FCOG Model Categories	NAICS Sector
Farm	Other	11
Natural Resources and Mining	Other	21
Manufacturing	Industrial	31-33
Trans, Warehousing	Industrial	48-49
Wholesale Trade	Industrial	42
Utilities	Industrial	22
Construction	Other	23
Retail Trade	Retail	44-45
Information	Office	51
Financial Activities	Office	52, 53
Professional & Business Services	Office	54,55,56
Educational Services	Educational Services	61
Health Care & Social Assistance	Health/Medical	62
Arts, Entertainment, and Recreation	Services	71
Accommodation & Food Service	Food	72
Other Services	Services	81
Government	Government	92

Employment projections grouped sectors into two categories:

1. Economic base sectors (Farm; Natural Resources and Mining; Manufacturing; Transportation and Warehousing; Wholesale Trade), and
2. Non-basic sectors (Utilities; Construction; Retail Trade; Information; Financial Activities; Professional and Business Services; Educational Services; Health Care and Social Assistance; Arts, Entertainment, and Recreation; Accommodation and Food Services; Other Services; and Government).

Annual growth rates for economic base sectors were derived from Woods & Poole (W&P) projections and applied to project economic base employment. For non-basic sectors, the job figures are calculated with Business to Business (B2B) multipliers and population multipliers.

At the SOI level, the economic base sectors, Industrial and Other, were projected based on each jurisdiction's 2022 sectoral share, with flexibility to vary assumptions across three time periods: 2022–2025, 2026–2035, and 2036–2060. Aggregate non-basic employment growth was allocated using a formula attributing 25 percent of growth to economic base employment growth and 75 percent to population growth. This allocation reflects observed relationships between population growth and service-sector employment in Fresno County and is consistent with prior FCOG modeling practice.

Component non-basic sectors were projected using county-level growth rates adjusted for SOI-specific non-basic growth. Office employment was treated as a remainder sector to ensure sector totals matched non-basic employment totals for each SOI. The unincorporated area was treated as a remainder jurisdiction to ensure countywide control totals were maintained.

Final employment projections were summarized at five-year intervals by sector for use in the FCOG land use and travel demand models.

Household size: The base year household size by jurisdiction was derived from California Department of Finance E-5 reports. Then it calculates projected household sizes for 2025-2060 based on Woods & Poole (W&P) county projections. W&P Persons per Household (PPH) is only available at County level, though its advantage is the specific projections for various years in the future. DOF city-to-county relationships were used to calibrate W&P for each jurisdiction and each future year.

Household income: Base year average household income was sourced from Census Bureau American Community Survey 2022 1-year estimates for Fresno County. The growth rates were calculated from Woods & Poole (W&P) Average Household Income projections for Fresno County.

Housing units: 2022 Vacancy rates and housing units from DOF E-5 report are used as base year 2022 data. The Target Healthy Vacancy Rates for each jurisdiction were calculated using the following approach: Jurisdiction overcrowding rate - average for comparable regions (4.37%, identified by HCD, 6^{th} cycle RHNA) + Vacancy rate (if vacancy rate <5%, use standard 5% by HCD, 6^{th} cycle RHNA). The dwelling unit growth then is calculated based on vacancy rates plus a DU replacement factor of 0.5%, also taken from HCD's RHNA methodology. It should be noted that the resulting vacancy factor increases the projections of housing units in relation to household growth. Also, the household projections do not account for any increased households due to less overcrowding.

Future single-family and multi-family housing splits were estimated using HCD pipeline data (2018–2022) and historical trends (2014–2024) for the 2023–2030 period. For later periods, jurisdiction General Plan land use assumptions were incorporated where available. In addition, the factors are averaged over time to simulate a smooth trend toward the long-term General Plan housing distribution.

Household and housing unit projections in this report should not be directly compared to the 6th Cycle RHNA allocation for the 2023–2031 period, as this analysis incorporates updated DOF population projections reflecting slower growth. Under the updated population assumptions, the population level underlying the 6th Cycle RHNA is not projected to be reached until approximately 2049–2050. While the time horizons differ, the projection methodology generally follows RHNA assumptions. When evaluated at an equivalent population level, the model estimates approximately 54,916 additional housing units; when combined with the RHNA Cost Burden Adjustment of 3,505 units, this yields a total of approximately 58,421 units, which is broadly consistent with the 6th Cycle RHNA requirement of 58,298 units.

School Enrollment: K–12 school enrollment was calculated at five-year intervals. School participation rates through 2045 were derived from DOF's California Public K–12 Graded Enrollment and High School Graduate Projections by County — 2023 Series. For years beyond 2045, participation rates were assumed to remain constant at 2040–2045 levels. These rates were applied to projected populations aged 5–18 to estimate school enrollment through 2060.

After completion of the draft projections, Fresno COG staff consulted with planning staff from each jurisdiction and made minor adjustments based on updated development pipelines and local planning assumptions.

IV. Modeling Approaches

Fresno ABM: Fresno COG will apply an updated version of the activity- based model in the 2026 RTP/SCS development. It runs on Daysim and has a bike/ped component. The Fresno COG activity-based model system uses micro-zones, which are based on census blocks, as the fundamental spatial unit for generating travel demand. Use of micro-zones improves the sensitivity of the model system to land use, fine-grained urban form and accessibility attributes. The model system is capable of addressing policies such as compact and mixed-use development, active transportation, transit, and pricing. The model is credible for forecasting demand for highway alternatives such as new river crossings and corridor improvements, and appropriately sensitive to land-use changes such as new planned developments and provide useful information for traffic impact studies.

The updated ABM has a base year of 2023. The model inputs such as socioeconomic datasets, Auto Operating Cost (AOC), and interregional trips were updated. The interregional trip estimation has been updated, adopting the hybrid approach. California Statewide Travel Demand Model (CSTDM) was utilized to establish the interregional trips for base year 2023. The model years, 2020 and 2040 from the State model was used for the subarea analysis in the Fresno County and was interpolated for 2023. For the future years, the population growth rate was applied on the base year trip tables. The Central California Travel Survey conducted in 2022/23 was used to calibrate the model. Along with the inputs, a few model enhancements including managed lanes, TNC, telecommute, and truck restriction modules were also incorporated. Please refer to the model documentation for the details of the update.

Telecommute Strategy: In 2020, telecommute became unplanned reality due to COVID pandemic. According to the 2023 American Community Survey (ACS) and American Time Use Survey (ATUS) data, there is a decline in the telecommute or work from home workers from 2020, but their share continued to be maintained at a high level. While the telecommute strategy was handled off-model in last SCS, it will be analyzed within the model for 2026 SCS.

The updated model includes a telecommute sub-model which allows resident workers to make the choice to telecommute (different from working from home and having no out-of-home work location). This was calibrated using the 2022-23 Central California Travel Survey (CCTS), which was collected within San Joaquin Valley (SJV) with Fresno COG's lead. SJV consists of eight counties, Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare. The CCTS sampling plan was based on the 2015-2019 American Community Survey (ACS) 5-year estimates, and the survey was expanded (weighted) to the 2019 ACS Public Use Microdata Sample (PUMS) 1-year data to match the survey data to key household and person demographic variables. To support the 2023 base year model update, targeted refinements were applied to the CCTS survey weights of Fresno households to better represent 2023 travel conditions, and the survey data was reformatted to support the calibration efforts. Please refer to the model documentation for the CCTS data formatting and calibration used to setup a Telecommute model.

To capture the emerging "new normal" telecommute trend for future years, Fresno COG will monitor and analyze the results from US Survey of Working Arrangement and Attitudes[i] (SWAA, https://wfhresearch.com/data/) to estimate the work from home rate after the pandemic. The SWAA survey is an ongoing monthly survey run jointly by the University of Chicago, ITAM, MIT, and Stanford University. The survey result is available by month from May 2020. Fresno COG staff plans to use the general telework decline trend at national level and base year telecommute rate and frequency observed by local household travel survey, to estimate future telecommute acceptance and feasibility in Fresno region.

The telework rate declined sharply before 2022 and has since entered a relatively stable plateau. A preliminary projection through 2035 suggests that there will be around 19% telework which is similar to base year 2023 assumption.

Data sources:

US Survey of Working Arrangement and Attitudes (SWAA) is used to estimate the decline trend of work from home rate. 2022-2023 Central California Travel Survey is the data source for calibrating the telecommute module in Fresno ABM, like work from home rate and frequency by area, industry, and income level .

Quantification method:

Fresno COG will use the following steps to calculate the emission reductions from the telecommute strategy:

Step 1: Estimate the national work from home trend

(1) Based on 65 monthly points of work from home rate by SWAA from May 2020 to September 2025, staff built an Exponential decay with floor

Model:

$$Y_t = C + (K - C)\, e^{-\lambda t}$$

(t = months since May-2020; Y in percent, not proportion)

Table 4: Telecommute projection modeling parameters

Symbol	Description	Value
C	floor (long-run minimum)	27
K	ceiling	57.87891666
Lamda	decay	0.119214109
SSE	Sum of Squared Errors	190.6227099
R2		0.938943082

(2) Predict the 2035 work from home rate using the model above

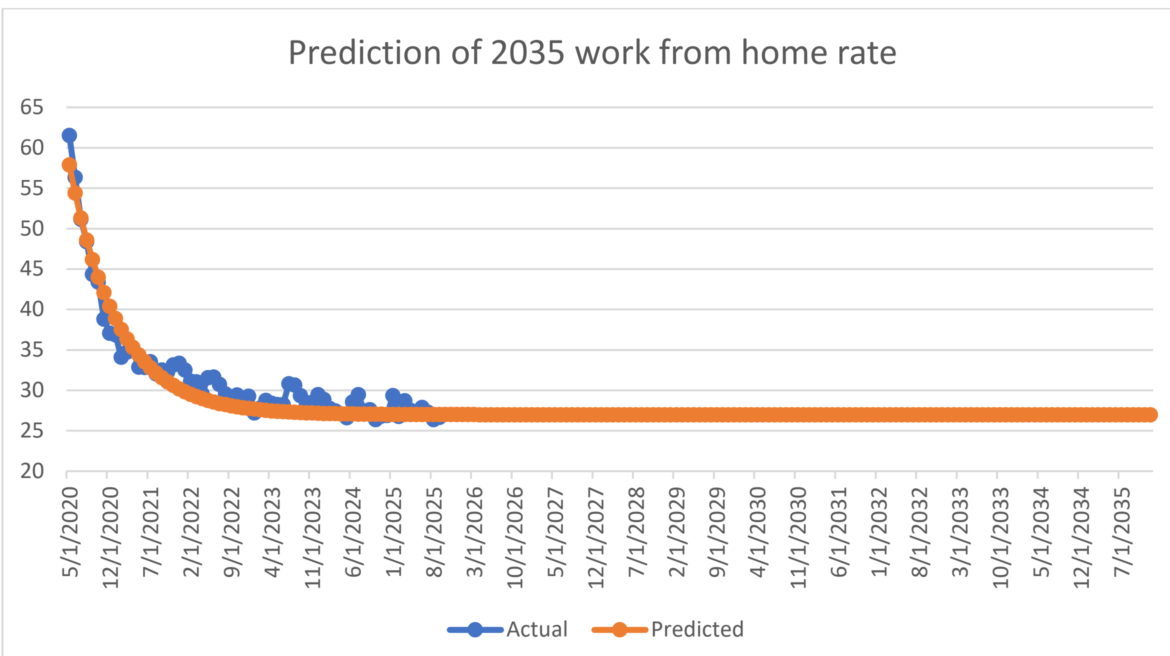


Figure 1: National telecommute trend projection through 2035

Step 2: Calculate Fresno region telecommute rate

(1) WFH decline rate 2022 to 2035 = 2035 average projected national rate / 2022 average projected national rate
(2) Fresno 2035 = WFH decline rate 2022 to 2035 * Fresno 2022 WFH rate = 27/28.61 * 26.2

Year	SWAA	Fresno Target
2022	28.6	26.2
2035	27	24.7

(3) 2022 Fresno region's work from home rate is 5.1%. Assuming the Work from Home rate in Fresno Region keep consistent through 2035, the telecommute work rate in 2035 = 24.7% - 5.1% = 19.6%

Step 3: Apply the 2035 work from home/ telecommute rate to Fresno ABM

Please find the details in Fresno ABM documentation. As the telecommute module was calibrated with Fresno region's travel survey data, the model is designed to reflect the rebound effect of additional non work trips generated by workers on their telecommute day or work from home. The day pattern model within ABM predicts whether a person makes at least one tour for each of the seven home-based tour purposes (excluding work-based tours), and whether the person makes any intermediate stops on these tours. The model includes variables for work-from-home workers and telecommuters to capture their travel behavior, which includes a lower likelihood of making tours and a higher likelihood of making non-work tours compared to all other workers, i.e., out-of-home workers.

Induced Demand: As mentioned in Section I, Fresno COG ABM is sensitive to short term induced demand due to increased transportation network capacity. Such short-term latent demand includes mode switching, route changing, time of day switching, destination change and new trips. In order to address longer term induced travel demand generated from land use changes due to added capacity on the transportation system, Fresno COG will continue to use the hybrid approach that was employed in the 2022 SCS. The hybrid approach uses the National Center for Sustainable Transportation (NCST) calculator in tandem with the ABM to estimate the long-term induced demand. Although Fresno COG tested an iterative methodology for creating feedback between the land use growth allocation tool and the ABM to allow for induced demand feedback between the two models, it was not ready to be used in this SCS cycle.

Methodology

Fresno COG performed sensitivity tests to capture ABM's reaction to network capacity changes. The resulting elasticity represents the short-term induced demand. This portion of the induced demand reaction is built into the ABM model, therefore it is considered in-model calculation. The long-term induced VMT that is caused by land use and socioeconomic changes is captured by employing NCST calculator. In the process the elasticity results provided by NCST calculator coalesced with ABM elasticity results and ensure no double-counting of the short-term induced demand.

Key assumptions:
Due to the fact that induced travel demand includes VMT made by all vehicle classes, and SB 375 is only concerned about passenger cars and light duty trucks, it is appropriate to adjust the total VMT input through the EMFAC instead of simply applying a post-processing off-model GHG adjustment.

Data sources:
Fresno COG used the NCST Induced Travel Calculator, which is available on-line at: NCST Tool.

Quantification method:
Freson COG conducted base year model sensitivity analyses, in which general purpose lanes were reduced and increased to respective roadway sections. The resulted elasticities were used as short-term induced demand response from the model. The NCST calculator is applied to facilities with Federal Highway Administration (FHWA) functional classifications of 1, 2 or 3. That corresponds to interstate highways (class 1), other freeways and expressways (class 2), and other principal arterials (class 3). The elasticities from the NCST include both short term and long term induced demand.

Long-term induced demand calculation involves tallying capacity increasing projects by lane miles increased, by year, and by road categories. The long-term induced VMT elasticity is calculated by deducting short-term elasticity from the model from the reported NCST elasticity. And subsequently, the long-term induced VMT is calculated by multiplying the increased lane miles by facility types by the respective elasticities. The resulting induced VMT is then added to the model-reported VMT and fed into the EMFAC model for GHG emission calculation.

PopulationSim: Fresno COG uses the PopulationSim to generate synthetic population for the ABM. Regional controls for the synthetic population include household counts by micro zone, households by income, size, number of workers, marital status, presence of children, unit type, and age of householder; household population and group quarters population by age, gender and minority status; and workers by occupation. Demographic distributions come from PUMS and are adjusted to conform to projected forecasts.

External Trips: As mentioned in the Introduction section, Fresno COG used the existing California Statewide Travel Demand Model (CSTDM), to estimate the interregional trips for the base year 2023. Fresno COG also looked into the latest version of CSTDM released by Caltrans in early 2026 but discovered some potential volume issues in the highway network. Caltrans was made aware of this issue and had no clear direction on the potential fix as well as the timeline. Hence Fresno COG decided to use the available version of CSTDM with a base year 2015. The California Statewide Model system includes a highway network, peak-hour demand by time-period, vehicle and trip type, and other inputs necessary for running highway assignment. In order to generate demand specific to the Fresno region, a sub-area analysis with the statewide model will be created using a sub-area network developed for the Fresno model region. To disaggregate the statewide OD matrices into the Fresno zones, the future year land use will be used. Although the model shows the reasonable growth in IX (internal-external)/XI (external-internal) trips and VMT, the XX (external-external) trips and VMT for 2035 went down compared to 2023. So, a hybrid approach has been utilized to compute the external demand tables. The population growth factors have been derived from the 2025 DOF forecasts for external trips. While Fresno and surrounding counties (Tulare, Kings, Madera, Monterey) were considered for the IX/XI growth, overall growth in California was used for the XX growth. This is because the IX and XI trips happen between Fresno and the neighboring counties and are determined by the change in population within these areas. However, for the XX trips, all the people within the State can travel on the two major highways of Fresno County i.e. I-5 and SR-99, and are not restricted within the surrounding counties. Although we looked at the household growth along with the population, the population growth seemed more reasonable for this effort as people make trips and changes in trips are determined by the changes in the people living in those areas. The population growth factors were applied on the base year trip tables to compute the external trip tables for all the future years, as shown in Table 5 below.

Table 5: Growth factors for External Trip Tables

	HH Growth from 2023			Population Growth from 2023		
Year	Fresno	Surr+Fresno	California	Fresno	Surr+Fresno	California
2023	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2027	4.82%	4.29%	3.04%	1.64%	1.66%	0.82%
2029	6.32%	5.63%	4.25%	1.97%	2.17%	1.16%
2031	7.76%	6.85%	5.29%	2.61%	2.78%	1.56%
2032	8.54%	7.48%	5.79%	2.92%	3.06%	1.80%
2035	10.78%	9.24%	7.19%	3.82%	3.79%	2.51%
2037	12.20%	10.33%	8.06%	4.42%	4.23%	2.92%
2046	20.22%	16.85%	13.26%	6.32%	5.01%	4.19%
2049	23.34%	19.43%	15.31%	6.47%	4.70%	4.33%

Sensitivity Test: When the ABM was updated to a new base year, the sensitivity test was conducted for the auto operation cost, transit fares, new transit service and new employment centers, similar to the last base year. In addition, the transit frequency test was also incorporated. The test results can be found in Chapter 4 of the Fresno COG ABM Report. Sensitivity testing assesses the model's sensitivity to changing model inputs like fuel prices, transit fares, varying transit frequencies and services, new land uses, or new infrastructure. For each test, shadow pricing is either turned on or off depending on the expected effect of the project. For example, small changes in the highway or transit network are not expected to have large effects on work and school location choice. For these types of tests, stable shadow prices from the base run are used. For cases where there are very broad changes in the travel system like changes in auto-operating costs, the shadow pricing loop is turned on to generate shadow prices for the new scenario. The 'model setup' section in each test description will indicate whether or not shadow prices are re-calculated.

Land Use Growth Allocation: Fresno COG has developed an application for future growth allocation that estimates each parcel's development suitability and uses that value to meet growth targets for each jurisdiction's sphere of influence. The suitability score considered several factors, detailed in Table 5. Fresno COG may add or remove parameters throughout the modeling process to capture new planning assumptions or generate more realistic growth patterns.

Growth totals are controlled at the regional and jurisdictional (i.e. spheres of influence) levels, with the growth allocation tool affecting the growth pattern within each jurisdiction. To summarize the characteristic differences in growth patterns across scenarios, COG will report regional and jurisdictional growth totals, as well as by the following regional growth areas:

- Corridor/Center Communities (within downtowns, or within a half-mile of BRT)
- Established Communities (within contiguous city limits and rural community planning boundaries)
- Developing Areas (within city spheres of influence)
- Rural Growth

The characteristics of new growth for applicable parcels are based on Fresno COG's Envision Tomorrow model, which designates development types based on region-specific urban form as well as the general and specific plans in the region. Certain high-quality parcels may be assigned higher density development types, depending on model parameters, that are still consistent with planned land use designations but represent densities that are on the aspirational side.

Table 5: Growth Model Parameters

Parameter	Description
Cube Land Factor	How much weight is given to the TAZ-level growth totals allocated by the Cube Land model
High Density Factor	The percentage of new growth that represents “high density” growth, i.e. densities at the higher range of planned land use designations
Minimum Redevelopment Density	Minimum net density gain between existing and proposed land uses for a parcel to be considered for new growth potential
Infill Index	The normalized, inverse distance of a parcel from a city limit or rural community boundary
Conservation Index	The percentage of a parcel’s land that is not covered by a conservation layer (e.g. important farmland, groundwater recharge areas, etc.)
Density Index	The net density of a developed or redeveloped parcel, normalized for the region
VMT Index	Whether the parcel falls within a low-, moderate-, or high-VMT area for SB 743 purposes
Accessibility Indexes, by Mode	Cumulative opportunities (job) accessible based on skim results from Fresno ABM, by mode (SOV, bike, ped, transit)
Calibration Factors	A set of coefficients used to calibrate regional growth characteristics such as infill development, mixed-use share, residential density, unit share by type, redevelopment share, etc.

REMI. Fresno COG has partnered with MTC/ABAG to access the REMI economic forecasting model. This tool will be used to estimate many of the exogenous model variables referenced, as well as the results of various strategies and policies within the purview of the SCS scenarios.

EMFAC. Fresno COG is using CARB's emissions modeling software EMFAC2014 to complete the on-model GHG emissions estimates for the SCS. The latest version of the emission model, EMFAC 2021, will be applied in the GHG quantification process for the off-model strategies.
EMFAC was designed and developed by the CARB to specifically calculate emission inventories from motor vehicles operating on roadways in California. EMFAC is

regularly updated by the CARB to reflect the latest planning assumptions (such as vehicle fleet mix) and emission factors. In addition, SB 375 legislation indicates that MPOs may not take credits for GHG reductions from state programs such as improved vehicle emission standards, fuel efficiency and other state programs such as the Advanced Clean Cars (ACC) and the Low Carbon Fuel Standards (LCFS). Therefore, an EMFAC adjustment methodology was developed by the CARB to normalize the effect of the different versions of EMFAC. Fresno COG will apply the adjustment factors to the EMFAC 2014 results based on the methodology recommended in the SCS Review Guideline adopted in 2019 by the CARB.

V. Modeling Assumptions:

The exogenous variables in the ABM are outlined in Table 6. These variables may be altered or updated as new data becomes available throughout the modeling process.

Table 6: Exogenous Variables

	Source(s)	2023	2035
Total Population	Fresno COG Demographic Forecast	1,012,524	1,066,610
Total Jobs	Fresno COG Demographic Forecast	415,596	442,660
Auto-Operation Cost (2019$)	2025 AOC Forecast Update by Trinity	27.26 (cents/mile)	27.26 (cents/mile)
HH by Size	PUMS, Fresno COG Demographic Forecast	3.0(mean)	3.0 (mean)
HH by Income (2022$)	PUMS, Fresno COG Demographic Forecast	$93,576 (mean)	$102,970 (mean)
HH by Presence of Children	PUMS	35.6% w/children	35.6% w/children
HH by Number of Workers	PUMS	1.28 (mean)	1.28 (mean)
School Enrollment	Fresno COG Demographic Forecast	202,610	185,207
Workers by Occupation	Fresno COG Demographic Forecast	41% population in workforce	41% population in workforce

Auto Operation Cost (AOC). As part of the San Joaquin Valley Auto Operation Cost (AOC) update for the 2026 RTP/SCS, Fresno COG worked with Trinity consultant to update the AOC assumption used in the modeling by incorporating the latest fuel forecast, fuel efficiency, and various taxes in California. Auto operating costs were updated for the 2026 RTP/SCS consistent with CARB's SCS Program and Evaluation Guidelines' Appendix D[1] to account for operation costs associated with both petroleum-fueled (e.g., gasoline and diesel) and alternative fuel vehicles (e.g., electric and plug-in hybrids). The underlying assumptions related to petroleum fuel price forecast and vehicle fuel efficiency were updated as detailed below.

The 2023 Annual Energy Outlook (AEO) data[2] was used to update future gasoline and diesel fuel price projections from 2023 to 2049. Specifically, the average projections between high and low oil scenarios of the AEO were used to develop fuel forecast factors that were then applied to 2023 California average retail fuel prices as reported by the EIA. Electricity costs were based on 2023 Transportation Energy Demand Forecast[3] published by the California Energy Commission (CEC) and linearly forecasted between 2035 through 2049 since CEC data was not available post 2035.

Non-fuel costs associated with vehicle maintenance were updated based on 2023 "Your Driving Costs" report[4] from AAA depending on vehicle type and extrapolated through 2049, assuming 2% increase per year. All costs were then converted to 2019 dollars consistent with the travel model validation year.

Fuel efficiency inputs for gasoline, diesel, and plug in hybrid vehicles were obtained from EMFAC2021. Fuel efficiency for electric vehicles was obtained from CARB's Auto Operating Cost Calculator[5]. The resulting values for years ranging from 2010 to 2049 for Fresno COG are shown in Appendix A.

Quantification of GHG reduction. Fresno COG plans to use both the traffic model and off-model tools to quantify the GHG reductions from the SCS strategies. CARB's recommended methodology for off-model GHG quantification will be referenced and considered in the process. Table 7 provides a preliminary list of strategies with the planned quantification approach.

[1] Final Sustainable Communities Strategy Appendices (ca.gov).
[2] U.S. Energy Information Administration - EIA - Independent Statistics and Analysis
[3] CA_Planning_Library_2022_IEPR_Fuel_Price_Forecast_ada.xlsx.
[4] https://newsroom.aaa.com/wp-content/uploads/2023/08/YDC-Brochure_2023-FINAL-8.30.23-.pdf.
[5] CARB AOC tool can be downloaded from SCS Evaluation Resources | California Air Resources Board.

Table 7: RTP/SCS Strategies

Strategy	Category	Quantification Approach	Status
Infill, compact development, transit-oriented development, mixed-uses and allocation of growth along transportation corridors	Land use	Traffic model	Present in last plan*
ADUs	Land use	Traffic model	Present in last plan*
Allocation of growth in low-VMT areas	Land use	Traffic model	Present in last plan*
Allocation of growth in areas with higher access to bike, ped, and transit	Land use	Traffic model	Present in last plan*
Transit capital projects, bike projects	Transportation	Traffic model	Present in last plan*
Pedestrian infrastructure improvement, operational improvements (Transportation System Management), ITS	Transportation	Off model	Present in last plan*
Carpool, vanpool	Travel Demand Management (TDM)	Off model	Present in last plan*
Telecommute	Transportation	Traffic model	Present in last plan*
Employer- based trip-reduction programs (Rule 9410)	Travel Demand Management (TDM)	Off model	Present in last plan*
Additional regional/local EV infrastructure (charger & micro-grid system) program	Technical improvement	Off model	Present in last plan*
Car Sharing	Travel Demand Management (TDM)	Off model	Present in last plan*
Local EV Incentive program	Technical improvement	Off model	Newly added in this plan

** Some carry-over strategies may be further emphasized compared to the last plan*

VI. Off-model Strategies

Fresno COG will generally follow the guidelines detailed in the Appendices of CARB's Final SCS Program and Evaluation Guidelines Report and supplement with local data as much as possible. Off-model strategies that are currently being considered by Fresno COG include:

a. Carpool/Vanpool

<u>Key assumptions:</u>
Fresno County Measure C carpool program is funded by Fresno County's ½ cent sales tax, Measure C. It provides incentives to carpooling commuters. It is assumed that the level of participation in this program will continue into the future at the rate as reported in the most recent year, with the assumption that a new measure similar to Measure C will pass in 2026.

CalVans provides vanpool services to farm workers and commuters in the rural counties in California, including Fresno County. CalVans has multiple funding sources. In addition to Federal and State funding, such as AHSC Grant, CalVans also receives local funding from Fresno County Measure C, which provides funds for vanpool programs to encourage, facilitate, and help fund new vanpools and offer financial assistance to existing vanpools to ensure their viability.

In recent development of events related to CalVans financial issues, Fresno COG has withdrawn from the Joint Power Agreement of CalVans, which resulted in our not taking vanpool credit in CalVans. However, Enterprise Van Pool operating in Fresno County, which has received subsides from Measure C, is still included in the vanpool calculation using a growth forecast developed for CalVans.

<u>Data sources:</u>
Fresno COG has an improved database for carpool & vanpool programs. The database provides information such as trip length, vehicle occupancy rate, OD addresses, etc. Fresno COG plans to use the information in the database to quantify the VMT/GHG reduction from such programs. The carpool VMT data is sourced by Fresno COG carpool program, and vanpool VMT data is sourced by CalVans and Fresno COG vanpool program. CalVans has been documenting its growth over the years, as shown in the Figure 1 below. Last cycle, CalVans predicted that the strong growth will continue in the future, which will be updated with the availability of the new dataset. Fresno COG's vanpool projection for the 2026 RTP/SCS will carry on the 2022 RTP/SCS methodologies with an updated forecast base year of 2023-2024. Similar growth rates will be applied as

the last round of RTP/SCS which vary between 12% and 6% with the growth rate trending lower as it goes into the future years. Fresno COG's vanpool assumptions also include other vanpool programs such as Enterprise Van Pool, which also receive funding from Fresno COG and complements CalVans service in the region.

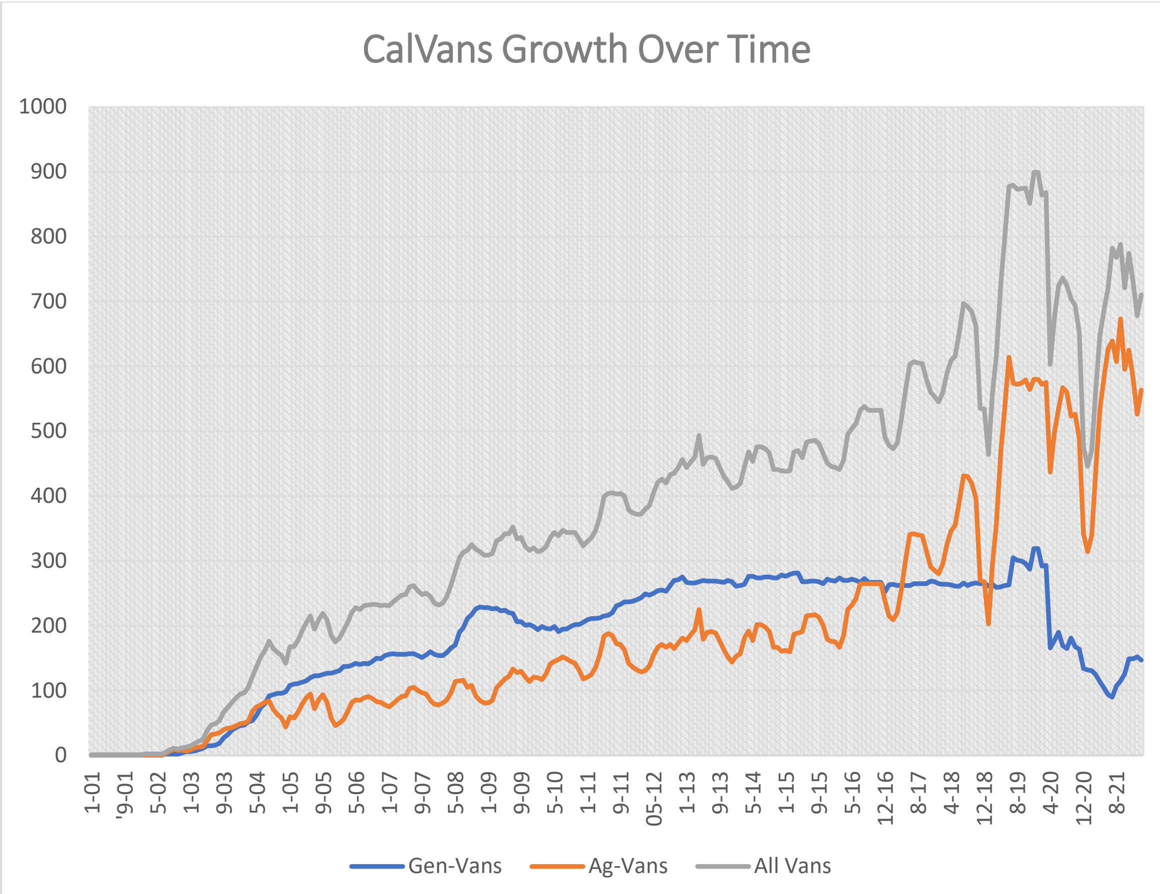


Figure 2: Historical Trend of Vanpools in the region

Quantification method:

Although Fresno COG is not claiming credit from CalVans, we use CalVans data for off-model calculations. CalVans reports number of vans operated and passenger counts by county. Average riders per van was calculated based on these figures to be used as input to the San Joaquin Valley 2026 RTP/SCS Off-model Strategy Analysis (v2.0) spreadsheet developed by Trinity Consultants. Other vanpool programs which receive subsidies from Fresno COG, such as Enterprise Vanpool, report their VMT to Fresno COG vanpool program administrator. Measure C carpool program also reports daily commute carpool VMT. Fresno COG will use these datasets as the basis to forecast future carpool/vanpool GHG reductions.

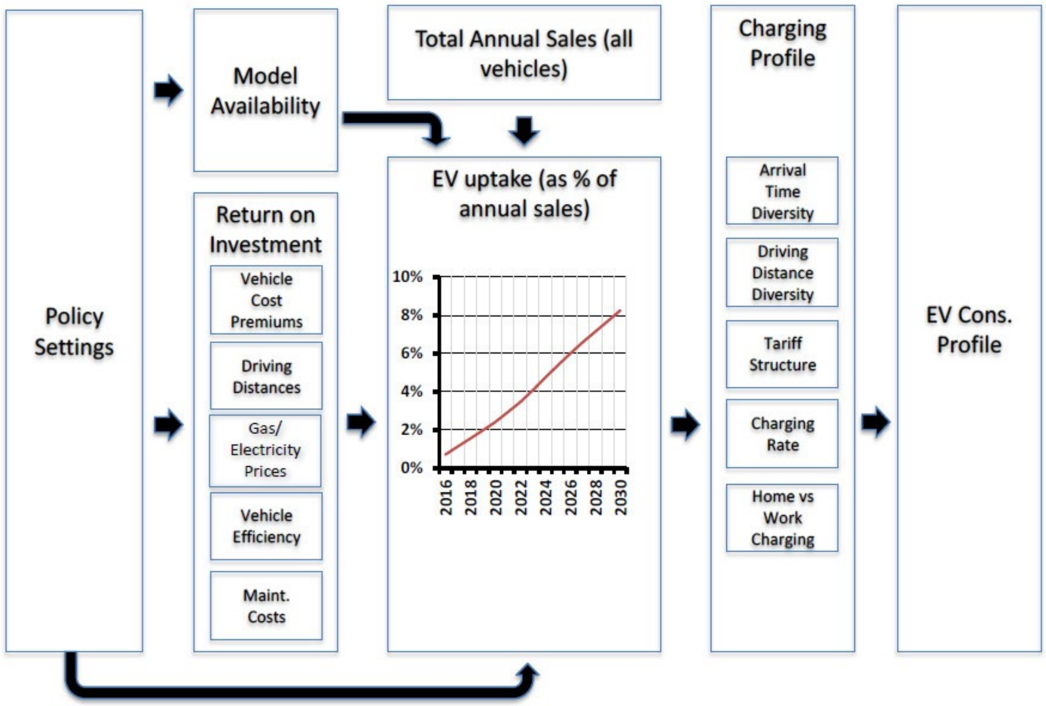
Fresno COG utilized SJV valley-wide off-model spread sheet to calculate the GHG savings provided by vanpool strategy. In light of no new vanpool data update available, a similar projection methodology like the last round of RTP/SCS is adopted, in which in year 2024-2025, the growth rate is assumed to be 12% per year. Then the annual growth rates decrease gradually over the years from 10% in 2026 to 6% in 2036.

Fresno COG is continuing its effort to promote the carpool program. It is assumed that the level of participation in this program will continue at the rate reported in the most recent year and scaled up to reflect county employment growth into the future. The GHG saving provided by the carpool programs will be captured by multiplying VMT reduction by EMFAC emission factors calculated at the regional level.

b. Electric Vehicle Charging Infrastructure (charger & micro-grid system) Program

Key assumptions:
Fresno COG completed Regional Electric Vehicle Readiness Plan (EVRP), which identified funding sources for charging infrastructure and EV incentives that can be used to quantify the VMT/GHG reductions. Funding sources include federal, state, regional and local sources (Measure C, local sales tax aimed at improving the overall quality of Fresno County's transportation system). Fresno COG's New Technology Grant Program through the local sales tax measure (Measure C) and FTA's Low or No Emissions Program has funded several grants to deploy electric buses in charging infrastructure.

Data sources:
In the EVRP, Energeia's personal electric vehicle (PEV) uptake model, depicted below, forecasts the adoption of PEVs by segment based on policy, model availability and financial drivers. It was configured based on current and forecast conditions in Fresno County over the next 10 years. The model is configured for a given market using regression to identify the correct factor parameterization.



The plan recommended installing 4,983 level 2 public charging ports sited within incorporated Fresno County cities by 2030. PHEV drivers in Fresno County would be able to drive a larger share of miles in electric mode because of accessibility to public chargers, instead of shifting to gasoline-powered mode when battery run out. The Electric Vehicle Charging Infrastructure strategies can reduce GHG emissions as the PHEV cVMT be replaced by eVMT.

Table 8- Regional EV Charger Program Calculation Parameters

Parameter	Value	Source
PHEV population	21,283	EMFAC 2021, 2035 calendar year, FCOG region
# of new EV chargers	4,983	Fresno COG, Electric Vehicle Readiness Plan
cVMT to eVMT	13 miles/PHEV/day	SCS guidelines Appendix E
PHEV emission rate – gasoline	283.4 grams/mile	EMFAC 2021, 2035 calendar year, FCOG region

Quantification method:
Fresno COG follows the Method a) in SCS guideline: Estimate CO_2 emission reductions from PHEV eVMT based on estimated average VMT shift per PHEV from gasoline to electricity (cVMT to eVMT) as a result of increased workplace and public charges. The steps are as follows:

Step 1: Identify number of public EV chargers to install in the region as part of strategy based on funding commitment and/or policies.

- The EVRP recommended 4,983 new public chargers by 2030.

Step 2-3: Identify the number of PHEVs in the region that could use EV chargers installed as a result of the strategy.

- Assuming 7 PHEVs per charger installed, the new public chargers in EVRP would be able to serve 7 * 4,983 = 34,881 PHEV.
- The 2035 Fresno region PHEV population acquired from EMFAC 2021 is 21,283. The reason EVRP has more chargers than region total PHEV needs is that Fresno COG' EVRP considered the charging need for BEVs.
- As the SCS EV charging infrastructure strategy is for PHEV benefits, we only include regional PHEV population from EMFAC 2021 data (21,283 PHEVs) for SCS off-model calculation.

Step 4-5: Estimate the total increased PHEV eVMT in the region resulting from strategy implementation.
- Assume an average of 13 eVMT increased per day per PHEV using a workplace EV charging connector (SCS guidelines Appendix E).
- Estimate the total increased PHEV eVMT: 21,283 * 13 = 276,679 miles

Step 6-7: Determine total regional GHG emission reductions due to the shift in PHEV operating mode from gasoline to electric.

- Obtain average emission factor for decreased PHEV gasoline consumption (Emission FactorGas) as PHEV operating mode is shifted from gasoline to 100% electric through increased workplace EV charging as a result of strategy implementation. Assume 198 grams of CO_2 is avoided for each PHEV mile transferred from gasoline to electric operation.
- Total reductions in regional CO_2 emissions = 276,679 * 198 gram/day

c. Electric Vehicle Incentive

Key assumptions:

The proposed Measure C electric vehicle incentive program would provide approximately $2 million annually to support electric vehicle adoption. The analysis assumes the program will provide a $1,000 incentive for 2,000 first-time battery electric vehicle (BEV) purchases per year through 2035. The program is expected to complement existing incentive programs, including California's Clean Vehicle Rebate Project (CVRP) and the San Joaquin Valley Air Pollution Control District's Drive Clean Rebate Program.

Data sources:

The Measure C Revenue Forecast allocates 4.0 percent of projected sales tax revenues to the Access and Innovation category, representing approximately $5.17 million in 2027 and increasing to approximately $7.08 million by 2035. For this analysis, it is assumed that approximately $2 million annually from this category will be dedicated to an electric vehicle incentive program.

The analysis also assumes that the California Clean Vehicle Rebate Project (CVRP) and the San Joaquin Valley Air Pollution Control District's Drive Clean Rebate Program remain available through 2035, providing rebates of $2,500 and $2,000 per battery electric vehicle purchase, respectively.

Quantification method:

Fresno COG follows the steps of Electric Vehicle Incentive Strategy in the SCS guideline: Estimate CO2 emission reductions from new non-ZEV's replaced by new ZEV's purchased through the incentive program. The steps are as follows:

Step 1: Identify the total funding (Total Program Funds) allocated for the subsidy/rebate program established by the MPO

The project is assumed to provide a $1,000 incentive for 2,000 new battery electric vehicle purchases annually. Because the renewed Measure C program is projected to take effect in mid-2027, the analysis assumes the incentive program becomes fully operational at the beginning of 2028. Benefits are calculated through the beginning of 2035, resulting in seven full years of program implementation (2028–2034).

Total funding allocated for the subsidy/rebate by 2035

= 2,000 vehicles/year * $1,000/vehicle * 7 years

Step 2: Identify the individual ZEV subsidy/rebate amount (Subsidy/Rebate Amount) for the subsidy/rebate program established by the MPO

Individual ZEV subsidy/rebate amount proposed is $1,000

Step 3: Estimate the number of new ZEV's (Total Program ZEV) that could be purchased through the subsidy/rebate program established by the MPO

Total Program ZEV = Total Program Funds/ (Subsidy/Rebate Amount)

Step 4: Identify the average trip length (Average Trip Length). Use the daily usage for a vehicle (miles per day per vehicle) from EMFAC.

EMFAC 2021 estimates an average vehicle travel distance of 37 miles per vehicle per day for light-duty vehicles in Fresno County.

Step 5: Calculate the average total eVMT from all trip purposes (ZEV VMT) associated with new ZEV's purchased through the incentive program.

ZEV eVMT = Total Program ZEV x Average Trip Length

Step 6: Obtain the average regional GHG emission factors for new non-ZEV's (Non ZEV EF) replaced by new ZEV's purchased through the incentive program from the most recent version of EMFAC.

Emission Factor for new-non-ZEVs in Fresno region is 215.28 g/mi in EMFAC 2021.

Step 7: In addition to MPOs incentive program, if other rebate or incentive programs are utilized for the Electric Vehicle Incentive strategy (e.g., CVRP), calculate the MPO's fraction of overall EV incentives provided.

Consistent with the SCS Guidelines, only the MPO's proportional share of the total incentive package is credited toward GHG reductions to avoid double-counting benefits associated with other funding sources. The calculation considered the funding from California's Clean Vehicle Rebate Project (CVRP) $2,500 for battery electric vehicles, and San Joaquin Valley Air Pollution Control District' Drive Clean Rebate Project $2,000 for battery electric vehicles

MPO Electric Vehicle Incentive Strategy Fraction

= MPO Electric Vehicle Incentive Amount / Total Incentive Amount

= $1,000 / ($1,000 + $2,500 + $2,000)

= 0.18

Step 8: Calculate GHG emission reductions from new non-ZEV's replaced by new ZEV's purchased through the incentive program. For this strategy a battery electric vehicle is required to be purchased, thus the ZEV EF can be assumed to be 0 g/mi.

GHG Reductions = ZEV eVMT x MPO Electric Vehicle Incentive Strategy Fraction x (Non ZEV EF - ZEV EF)

d. Pedestrian Infrastructure Improvement

Key assumptions:
Many projects have been proposed in this SCS planning cycle in the Fresno COG region to improve the infrastructure and promote walking and biking. Although Fresno COG's ABM model incorporated bike and trail facilities in the roadway network, sidewalks are not modeled. Therefore, any GHG benefit originated from improvements to the region's sidewalk network will have to be captured by off-model calculation.

Data sources: Many projects have pedestrian infrastructure improvement, like sidewalk, incorporated in the scope. The complete RTP/SCS project list will provide detailed information regarding these pedestrian improvements. Future transportation funding sources are also identified for active transportation facilities in the RTP/SCS.

Quantification method:
Fresno COG, upon reviewing the list of reference literature recommended by CARB staff in Impacts of Pedestrian Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions Policy Brief (CARB), decided to estimate the GHG reduction from pedestrian infrastructure improvements using findings identified by Fan, Y. (2007), The Built Environment, Activity Space, and Time Allocation: An Activity-based Framework for Modeling the Land Use and Travel Connection. The paper found that vehicle miles traveled per person decreases 0.02% for every 1% increase in sidewalk length. Fresno COG summarizes the sidewalk project lane miles for 2035 and 2049 and applies the above relationship to factor the GHG reductions for these respective years.

e. Transportation System Management (TSM)/Intelligent Transportation Systems (ITS)

Key assumptions:
In the current SCS there are many TSM/ITS projects or components incorporated in various planned projects, such as ramp metering and signal control management. These improvements are not modeled by Fresno COG's ABM model. To properly account for these improvements, off-model calculation will be utilized.

Data sources:
The complete RTP/SCS project list will provide detailed information regarding the TSM/ITS improvements. Future transportation funding sources are also identified for active transportation facilities in the RTP/SCS. The list of TSM/ ITS improvement projects in the preferred RTP/SCS scenario with location, project description, estimated complete years, and project cost information will be provided. The targeted population of TSM-ITS Strategies is the general residents of Fresno County. The funding source will be a combination of Federal, State, and local funds and programs identified in the RTP document.

Quantification method:
Fresno COG utilized the methodology employed in the San Joaquin Valley SCS Off-model Strategy Analysis spreadsheet developed by Trinity Consultants for TSM-ITS strategies, which involves the following steps:

1. Identify the amount of funding for the TSM-ITS strategy by summarizing the TSM-ITS project cost in the RTP/SCS preferred scenario.
2. Identify the unit cost of installation and/or maintenance of the specific TSM related system by calculating the average project cost.
3. Calculate the approximate number of TSM-ITS projects the given funding would allow.
4. Fresno COG assumed the average hourly travel speed to be 40 miles/hour and will calculate the percentage of VMT on the affected roadway network of the regional total provided by Fresno ABM.
5. Based on the proposed number of and type of TSM-related systems, estimate the impact of the proposed TSM strategy to travel speed from empirical literature. The benefit of implementing Adaptive Signal Control Technologies (ASCT) is quantified in Rural Intelligent Transportation Systems (ITS) Toolkit (https://ruralsafetycenter.org/resources/rural-its-toolkit/) to be improvement of average performance metrics by 10 percent or more. In this case, Fresno COG estimated the average hourly travel speed with TSM to be 45 miles/hour.

6. Estimate the GHG emission factors for travel speeds with and without the effects of the TSM strategy using the latest EMFAC model.
7. Estimate the effects of the TSM strategy to GHG emissions. The off-model reductions were then applied to the total SB375 GHG emission reduction calculations for the respective years.

f. Employer-based trip reduction program (Rule 9410)

San Joaquin Valley Air Pollution Control District (SJVAPC) Rule 9410 requires large employer to implement programs aimed at reducing home-based work trips. Fresno COG used local data and valley wide methodology from the valley consultant to quantify the VMT/GHG reduction from such programs.

Key assumptions:
San Joaquin Valley Air Pollution Control District Rule 9410 implements Employer Based Trip Reduction through eTRIP program. The eTRIP Rule (Rule 9410, Employer Based Trip Reduction), was adopted by the Air District in 2009. The rule will require larger employers to establish an Employer Trip Reduction Implementation Plan (eTRIP) to encourage employees to reduce single-occupancy vehicle trips, thus reducing pollutant emissions associated with work commutes.

Per the final (2009) Air District staff report on Rule 9410, Rule 9410 would apply to an estimated 1,883 worksites throughout the Valley, representing a wide range of sectors and accounting for approximately 500,000 commuting employees. This rule distinguishes those facilities into two tiers. Tier One Worksites are those with 100-249 eligible employees and Tier Two Worksites have 250 or more eligible employees. However, based on eligible worksites data received from Air district in 2026, there are an estimated 81 worksites in Fresno County, of which 46 falls into Tier 1 and 35 into Tier 2. In addition to this, the telecommute survey data was also received from Air district, conducted between 2020 and 2024. Since the telecommute within the Fresno County region is already accounted within the ABM this time, the telecommute shares within Rule 9410 will be deducted using the survey data received from Air district, thereby avoiding the double counting.

Data sources:
Eligible Worksites along with the employee telecommute survey datasets received from the Air District are used to compute the Rule 9410 related off-model GHG reductions.

Quantification method:

Fresno COG utilized the methodology from Valley consultant SCS off-model spreadsheet for the quantification of Rule 9410 strategy, which involves the following steps:
Step 1: Find out the number of eligible worksites and categorize them by Tiers. Since the future data is not available, the current data is used for future year calculations.

Step 2: Average number of employees in each Tier is an assumption, taken from the standard valley wide methodology.

Step 3: Average percentage of employees telecommuting on the worksite is calculated from the employee telecommute survey. The survey data was segregated by tier and the highest number of telecommute employees between Monday-Thursday is taken as the telecommute number for that worksite

Step 4: Telecommute share is calculated by dividing the number of telecommuting employees by total number of survey respondents

Step 5: The telecommute share is averaged across all the worksites within the respective Tier for a given year

Step 6: The latest available data for 2024 is used for 2035 and other future years

Step 7: The trip reduction is used from the valley wide standard methodology. The number of eligible 1-way trips is calculated by subtracting the telecommute share, calculated in step 5, for a given Tier and year.

Step 8: The base year employment and 1-way Home Based Work (HBW) trip length is calculated from the model

Step 9: Since the telecommute share has been deducted, the rebound effect is no longer applicable in our methodology

Step 10: The total CO2 emission reduction is calculated by multiplying the displaced VMT and CO2 emission rate.

The GHG saving provided by Rule 9410 will be calculated by multiplying the VMT reduction by EMFAC factor calculated at the regional level.

g. Car Sharing Strategy

Car share program is a membership-based service that provides access to shared vehicles for shorter-term use, often by the hour where fees are typically prices on per-mile or hourly basis. It is an affordable and convenient alternative to owning a car. Car share program can benefit users by saving money on transportation costs as well as benefit communities and the environment by reducing greenhouse gas emissions and traffic congestion.

Car share program has potential to reduce greenhouse gas emissions by reducing vehicle ownership rates as households often shed one or all their vehicles by becoming car sharing members, reducing single occupancy vehicle trips, and VMT, as mode choices shift to biking, walking and transit use due to lower auto ownership rates. In addition, the car share fleets are often newer and fuel efficient than older privately-owned vehicles which are replaced by car sharing.

Fresno region is fairly newer to car sharing. A Car sharing program with 42 electric vehicles has been in Southwest region of Fresno city, which is highly air polluted area of the city[1] ([1] Ride Share E-Bikes and EVs Are Coming to Southwest Fresno https://gvwire.com/2022/03/08/ride-share-e-bikes-and-evs-are-coming-to-southwest-fresno/). Future efforts and new technology funding appropriations are expected to follow for such program in the region.

Quantification method:
Fresno COG utilized the methodology from SCS guidelines car sharing strategy, which involves the following steps:
Step 1: Identify TAZs that have sufficient residential densities to support car sharing. Conservative local residential density support rate eight (8) residential units per acre, which is a higher threshold than suggested in the guidelines. This was selected based on the study cited by the guideline and given that Fresno is relatively less dense city than those referenced in the study.

Step 2: Estimate Total Population of TAZs identified in Step 1 as having sufficient residential densities to support car sharing. Population between age of 21 to 45 residing in those eligible TAZs used.

Step 3: Identify regional car share adoption rate. Use the 10% suggested in SCS guideline as car sharing adoption rate for population of age 21-45 years old.

Step 4: Estimate car share membership population of TAZs identified as having sufficient residential densities to support car sharing (Step 2) using the car sharing adoption rate (Step 3).

$$Membership\ Population_{CS} = (Total\ Population_{CS} * \ Adoption\ Rate_{CS})$$

Membership Population$_{CS}$ =	*Number of car sharing members in region/County/City/TAZs*
Total Population$_{CS}$ =	*Total population of region/County/City/TAZs identified as having sufficient residential densities to support car sharing*
Adoption Rate$_{CS}$ =	*Car sharing adoption rate for region/TAZ*

Step 5: Estimate VMT reductions from vehicles discarded or shed by car sharing members. Use conservative estimate that shed VMT is 8,200 miles per year.

Step 6: Obtain CO_2 emission rates for shed private automobiles from the EMFAC 2021

Step 7: Estimate CO_2 emission reductions from private automobiles shed by car sharing members. $CO2_{shed}$ = Total VMT_{shed} x $EMFAC_{shed}$

Step 8: Estimate VMT from car share members driving car share vehicles. Use conservative estimate that each car share member drives 1,200 miles per year in a car share vehicle

Step 9: Estimate emission rates from car share members driving car share vehicles. Obtain CO_2 emission rates for shed private automobiles from the EMFAC 2021 and reduce by 29%.

Step 10: Estimate CO_2 emissions from car sharing vehicle operation. CO2cs = Total VMTcs x EMFACcs

Step 11: Estimate total CO_2 emissions associated with car sharing in the region/TAZs. Total CO2cs = CO2shed + CO2cs

VII. Data Collection Efforts

Fresno COG has a traffic count program that funds year-round count collection by the local governments. In addition, Fresno COG owns several units of portable bike/ped counters that have been loaned to the local jurisdiction. All bike/ped counts collected by the local agencies are available to Fresno COG. Fresno COG this round subscribed to the big data, Replica to acquire the travel trips information within and outside Fresno County.

Fresno COG hired a consultant to conduct the central California household travel survey (CCTS) on behalf of valley MPOs. The survey was successful in collecting the targeted number of surveys that provide the travel diaries and their daily travel pattern. Also, in 2024, Fresno COG conducted a transit on-board origin and destination survey. The final report and the final dataset were used in the latest round of model/2023 base year update.

Appendix A

YEAR	AOC (2010$)	AOC (2019$)
2024	20.49	25.35
2025	20.93	25.88
2026	20.93	25.89
2027	20.94	25.90
2028	20.95	25.91
2029	20.96	25.92
2030	20.96	25.93
2031	21.18	26.19
2032	21.39	26.46
2033	21.61	26.73
2034	21.82	26.99
2035	22.04	27.26
2036	22.30	27.58
2037	22.56	27.91
2038	22.82	28.23
2039	23.09	28.55
2040	23.35	28.88
2041	23.73	29.35
2042	24.11	29.82
2043	24.49	30.29
2044	24.87	30.75
2045	25.24	31.22
2046	25.62	31.69
2047	26.13	32.32
2048	26.65	32.96
2049	27.16	33.59

[i] *Barrero, Jose Maria, Nicholas Bloom, and Steven J. Davis, 2021. "Why working from home will stick," National Bureau of Economic Research Working Paper 28731.*