APPENDIX A
Regional and Statewide Transportation, Housing, and Land Use Performance Metrics Under SB 150

TABLE OF CONTENTS

ABBREVIATIONS

AMBAG	Association of Monterey Bay Area Governments
AB	Assembly Bill
BCAG	Butte County Association of Governments
Caltrans	California Department of Transportation
CARB	California Air Resources Board
CDTFA	California Department of Tax and Fee Administration
CEC	California Energy Commission
CO_2	Carbon Dioxide
CPAD	California Protected Areas Database
FCOG	Fresno Council of Governments
FMMP	Farmland Mapping & Monitoring Program
GHG	Greenhouse Gas
HCD	California Department of Housing and Community Development
HPMS	Highway Performance Monitoring System
ITS	Intelligent Transportation Systems
KCAG	Kings County Association of Governments
KCOG	Kern Council of Governments
MCAG	Merced County Association of Governments
MCTC	Madera County Transportation Commission
MPO	Metropolitan Planning Organization
MTC/ABAG	Metropolitan Transportation Commission/Association of Bay Area Governments
RTP	Regional Transportation Plan
RHNA	Regional Housing Need Allocation
SACOG	Sacramento Area Council of Governments

SANDAG	San Diego Association of Governments
SB	Senate Bill
SBCAG	Santa Barbara County Association of Governments
SCAG	Southern California Association of Governments
SCS	Sustainable Communities Strategy
SJCOG	San Joaquin Council of Governments
SLOCOG	San Luis Obispo Council of Governments
SRTA	Shasta County Regional Transportation Planning Agency
StanCOG	Stanislaus Council of Governments
TCAG	Tulare County Association of Governments
TIP	Transportation Improvement Program
TMPO	Tahoe Metropolitan Planning Organization
TSM	Transportation System Management
VMT	Vehicle Miles Traveled
ZEV	Zero Emission Vehicle

INTRODUCTION

This appendix summarizes the background, data sources, processing, and analysis of data used to develop the reported SB 150 performance metrics. These performance metrics are organized according to the following six themes:

1. Personal Vehicle VMT and GHG Emissions Per Capita
2. Transportation Choices and Travel Patterns
3. Regional Growth
4. Accessible Communities
5. Housing Choices
6. Investment in Transportation Choices and Development

This 2022 SB 150 Report includes most of the 2018 SB 150 Report metrics with changes and additions to capture equity and accessibility better. Newly added accessibility metrics describe access to multiple destinations based on spatial data across the state. In addition, the 2022 Report also increases the focus on the equity aspects of transportation and housing metrics from the 2018 Report. It does this by separately reporting the results from areas considered to be disadvantaged or low-income communities. The metrics that are disaggregated in this way include commute mode share, commute trip travel time, vehicle ownership, housing activity by income level, and housing units permitted by income level compared to RHNA allocation. Regional GHG emission reductions and accessible communities are new themes included in this report. Hence this appendix provides a detailed methodology, results, and caveats for these two additions. Charts and data presented by region are typically grouped and labeled as representing:

- The four largest (Big 4) MPOs: Bay Area/MTC, Sacramento/SACOG, Southern California/SCAG, and San Diego/SANDAG MPO regions
- The San Joaquin Valley/SJV MPOs: San Joaquin/SJCOG, Stanislaus/StanCOG, Merced/MCAG, Madera/MCTC, Fresno/FCOG, Kings/KCAG, Tulare/TCAG, and Kern/KCOG regions
- The coastal MPOs: Monterey Bay/AMBAG, San Luis Obispo/SLOCOG, and Santa Barbara/SBCAG regions
- The northern MPOs: Butte/BCAG, Shasta/SRTA, Tahoe/TMPO regions.

PERSONAL VEHICLE VMT AND GHG EMISSIONS PER CAPITA

Background

Greenhouse gas emissions (GHG) from passenger vehicles and the associated vehicle miles traveled (VMT) are critical metrics to measure the progress of the SB 375 program. In this report, CARB staff discusses a newly developed VMT and GHG estimation methodology, data sources, results, and caveats. The estimated VMT and GHG are to track the progress towards SB 375 regional GHG emissions reduction targets.

The SCSs developed under the SB 375 program link transportation, housing, and land use at the regional level to reduce per capita GHG emissions from passenger vehicles. Because VMT from passenger vehicles are a significant source of GHG emissions, historical trends of per capita VMT and GHG are key performance metrics to understand progress that individual MPOs are making to meet the targets.

In the 2018 SB 150 report, CARB staff estimated statewide VMT and GHG trends based on gasoline consumption data from the California Department of Tax and Fee Administration (CDTFA) and fuel economy and vehicle fleet mix data from CARB's EMFAC model. At the time, the VMT and GHG trends indicated that California was not on track to meet the goals of the SB 375 program. However, CARB staff could not track regional VMT in that report since CDTFA fuel sales estimates are only available at the state level. Recently, CARB staff received a recommendation from the Bureau of State Audits (BSA)[1] that the SB 150 report must collect and track historical VMT and GHG trends at the regional level to better measure progress of the SB 375 program.

To address BSA's recommendation and better reflect regional trends, CARB staff developed a new approach to estimate VMT for MPOs in California. This new approach utilizes three publicly available data sources for regional VMT, including Highway Performance Monitoring System (HPMS) data, vehicle registration data from the Department of Motor Vehicles (DMV) along with Smog Check Program data from the Bureau of Automotive Repair (BAR), and California Energy Commission (CEC) Retail Fuel Outlet Annual Reporting data. The following section discusses the data sources and methodology to estimate VMT and GHG for the purposes of this report.

[1] California State Auditor, California Air Resources Board: Improved Program Measurement Would Help California Work More Strategically to Meet Its Climate Change Goals. Report Number: 2020-114.

Data and Methodology

This section describes the characteristics and limitations of HPMS, vehicle registration/Smog Check Program, and CEC fuel sales data. Further, it provides a step-by-step methodology to estimate the regional VMT using these three datasets.

1. Highway Performance Monitoring System (HPMS) Data

The California Department of Transportation (Caltrans) publishes an HPMS report every year. The HPMS report provides county- and MPO-level VMT each year. The primary purpose of the HPMS is to support a data-driven decision process within the Federal Highway Administration (FHWA), state transportation departments, and Congress to analyze highway system conditions, performance, transportation planning, and investment needs. The HPMS VMT data represent the on-road vehicle activity using loop detectors from freeways and pneumatic tubes from local and arterial streets. Detailed background information and methods regarding HPMS are available on Caltrans' HPMS data page.[2]

However, HPMS data also have limitations. During the development of the VMT metric for the 2018 SB 150 report, staff found that the HPMS statewide VMT trend (**Figure 1**) only showed a minimal increase and is lower than what would be expected based on estimates from gasoline fuel taxes. In addition, the VMT trend of HPMS is inconsistent with the temporal trend of several key VMT indicators, such as fuel price (**Figure 2**) and vehicle ownership (**Figure 3**). Multiple pieces of literature have reported negative elasticity between VMT and gas price[3], which means people make more discretionary trips and increase VMT and roads become more congested when fuel price is low. For example, fuel prices dropped significantly in the 2014-2016 periods, which has contributed to a rapid VMT increase. Other indicators such as an increase in household vehicle ownership rates also suggest that the continuous and minimal change in VMT trends of HPMS June have been inaccurate. In addition, the data for arterial and local roads are not as reliable as highway data since detectors are unavailable on those roads. Finally, the HPMS trend may not fully reflect changes in demographic characteristics, land use, and socioeconomic factors that can affect VMT, especially for local roads, due to the lack of detectors.

Given the limitations discussed above, the HPMS VMT is not adequate to serve as the sole data source to estimate regional VMT for the SB 150 report. However, in combination with other data sources, it is still an important data source for tracking

---

[2] Caltrans HPMS webpage: https://dot.ca.gov/programs/research-innovation-system-information/highway-performance-monitoring-system

[3] Impacts of Gas Price on Passenger Vehicle Use and Greenhouse Gas Emissions, Policy Brief (2014). Accessed 01/26/2022 at: https://ww2.arb.ca.gov/sites/default/files/2020-06/Impacts_of_Gas_Price_on_Passenger_Vehicle_Use_and_Greenhouse_Gas_Emissions_Policy_Brief.pdf

and estimating VMT in California, considering its wide applicability, the robustness of the data collection process, and its continuous monitoring feature.

Figure 1. Statewide Daily VMT of all vehicle types from HPMS

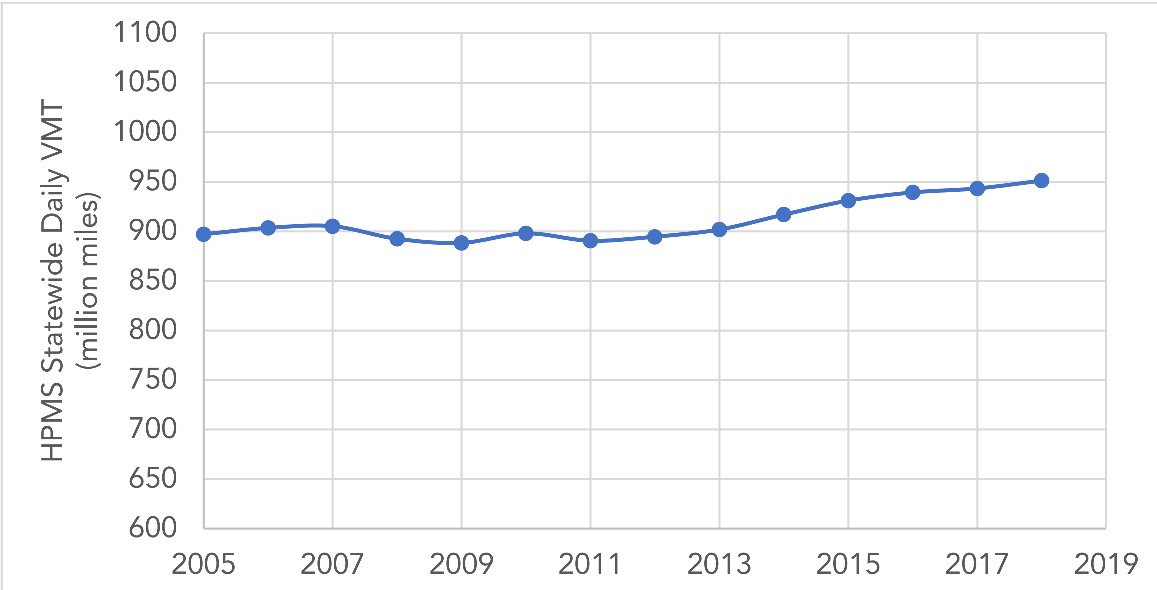


Figure 2. Statewide Average Gasoline Price from US Energy Information Administration (EIA)

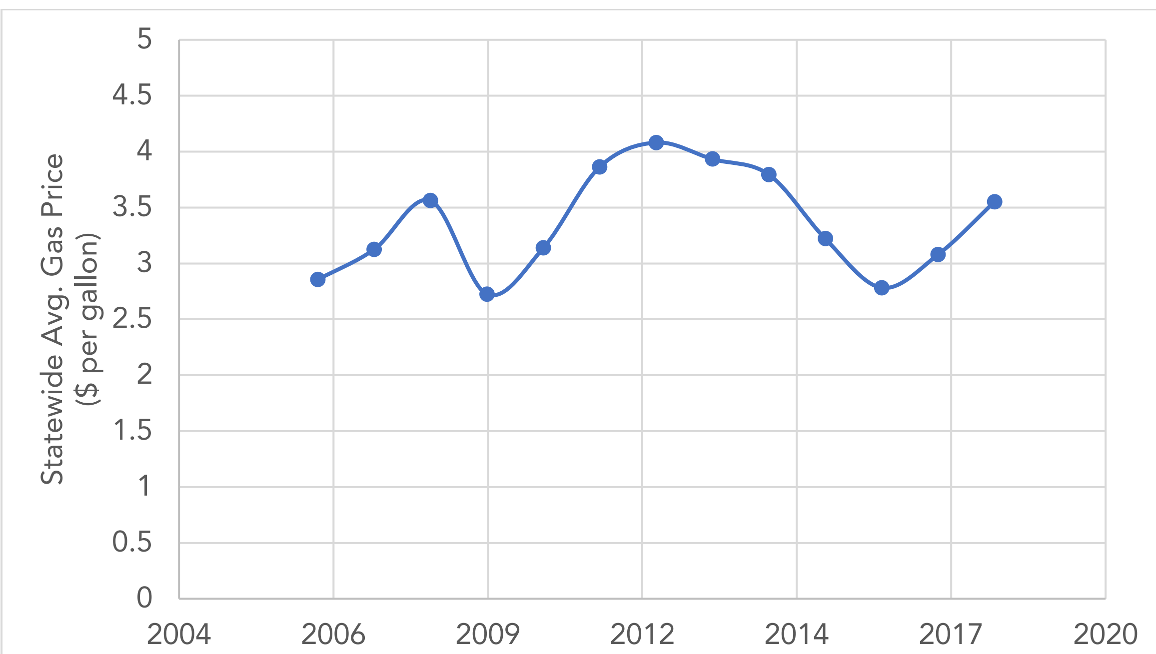
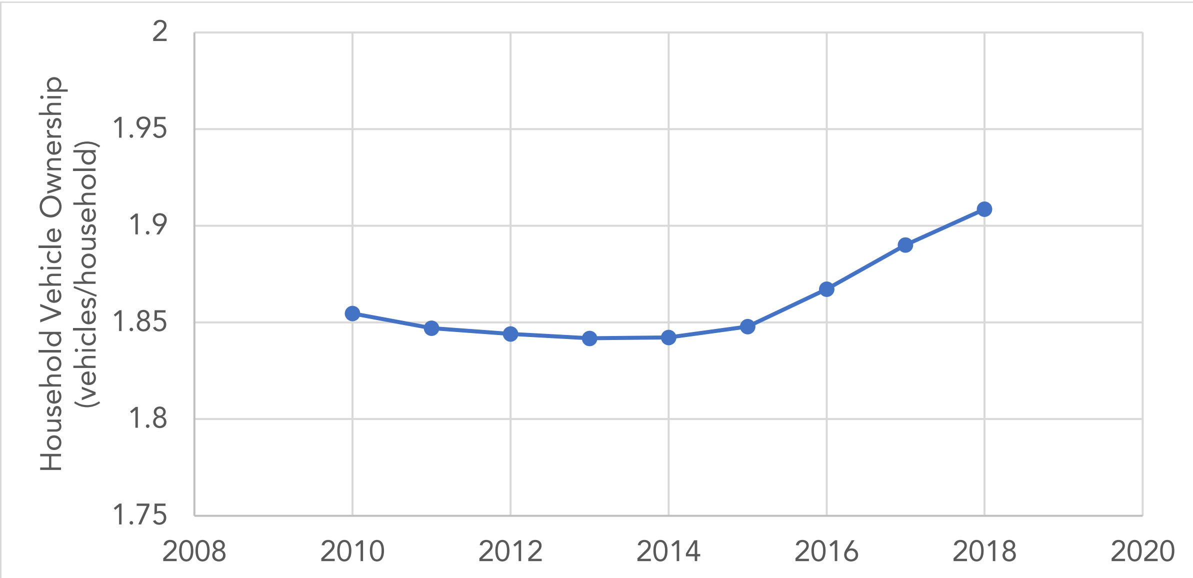


Figure 3. California household vehicle ownership rates from American Community Survey (ACS)



2. Vehicle Registration Data and Smog Check Program Data

The second data source for estimating regional VMT is DMV's vehicle registration database, and the odometer readings from the Bureau of Automotive Repair (BAR) as part of the Smog Check Program. CARB classifies vehicles in California using the DMV vehicle registration database, which provides vehicle make, gross vehicle weight, fuel type, battery size, and model year. Further, it distributes each record to a geographic area based on the registered owner's address and is used in the population numbers for EMFAC. Cars older than 5 years must receive smog checks through BAR's Smog Check Program. At that time, odometer readings are collected via onboard diagnostic data (OBD), allowing the tracking of individual vehicle mileage. These vehicle registration data and mileage records are input into CARB's Emissions Factors Database (EMFAC). The latest EMFAC 2021 dataset estimates historical VMT using DMV vehicle registration data and vehicle odometer readings from BAR's Smog Check Program data up to 2019. This dataset can provide VMT at the MPO and county levels and reasonably represent vehicle ownership and mileage accrual rates in the region. For more information regarding the estimation method, please refer to the EMFAC2021 Technical Document[4].

However, these data may not distinguish the activity by origin and destination because regional VMT estimates are based on vehicle registration data. In addition, this dataset

[4] EMFAC2021 Technical Document: https://ww2.arb.ca.gov/sites/default/files/2021-08/emfac2021_technical_documentation_april2021.pdf

may also underestimate vehicle activity since the Smog Check Program exempts new vehicles for the first five years and does not include electric vehicles.

Given the advantages and limitations discussed, the vehicle registration/Smog Check Program data are also not the best data sources to track regional VMT on its own. However, it is an important data source to account for regional vehicle ownership and mileage accrual rate information to include in CARB's new approach for estimating regional light-duty VMT in California.

3. CEC Retail Fuel Outlet Annual Reporting

The third data source is CEC's Retail Fuel Outlet Annual Reporting. The Petroleum Industry Information Reporting Act (PIIRA) requires all retail transportation fueling stations in California to file a Retail Fuel Outlet Annual Report (CEC-A15) [5] with the CEC. CEC aggregates fuel sales data from individual gas stations at the county level and extrapolates the total consumption to be consistent with CDTFA at the state level. The CEC-A15 data represent nearly 90 percent of total gasoline consumed in California. Therefore, this dataset can be used to estimate regional VMT, similar to the statewide VMT estimation approach using the CDTFA data. This data source represents transportation fuel consumption at the regional level.

However, CEC fuel sales data are only available since 2010. Meanwhile, the quality of this dataset is highly dependent on the gas station survey response rate. For instance, CARB staff observed unexpected regional trends in 2014 for a couple of MPOs. According to CEC, the unexpected trend is likely due to the low response rate in that year. Further, the location of fuel sales may not represent the location of the vehicle activity, which could be another limitation of this approach.

Given the limitations, CEC fuel sales data may not be suitable for tracking regional VMT on its own. However, CARB staff recognizes that the regional fuel consumption patterns provided by the CEC-A15 dataset are valuable for estimating regional VMT. Therefore, it is combined into CARB's new approach.

CARB Method for Estimating Statewide and Regional VMT

Having identified the data sources and the related challenges, CARB staff developed a new approach that uses the three data sources. The methodology is divided into three parts: 1. estimating regional VMT and GHG for the 2010-2019 period; 2. estimating regional VMT and GHG for the 2005-2009 period; 3. finally, calculating per capita VMT and GHG relative to 2005. Due to the data availability issue of CEC Retail Fuel Outlet

[5] CEC A-15 retail fuel sales reporting: https://www.energy.ca.gov/data-reports/energy-almanac/transportation-energy/california-retail-fuel-outlet-annual-reporting

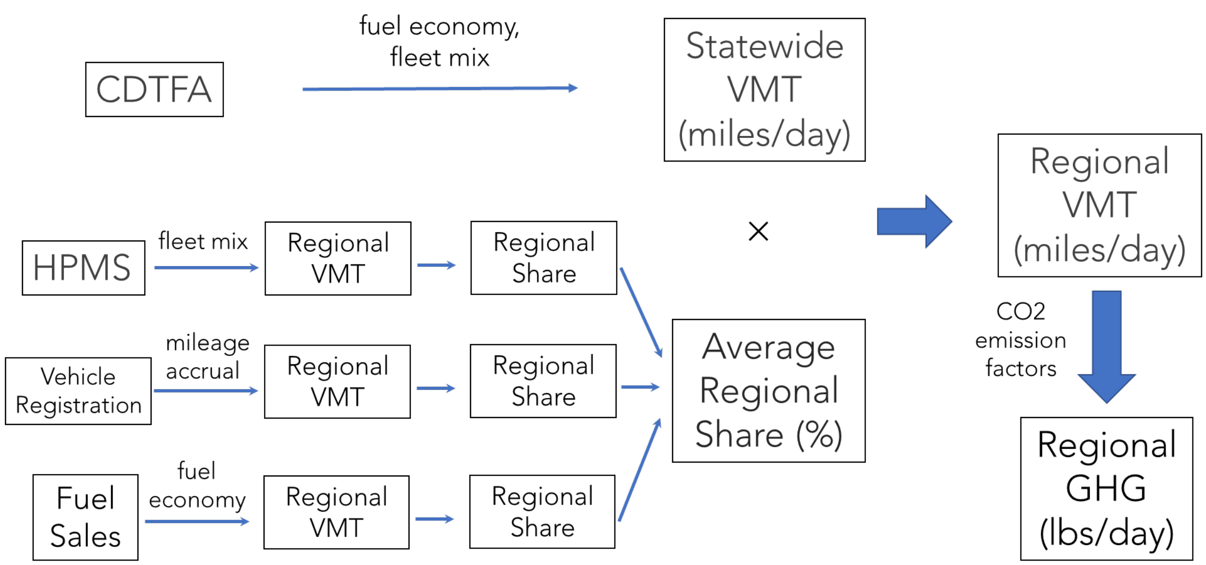
Annual Reporting and HPMS data irregularities discussed above, the methods for the pre-2010 period are different.

1. **2010-2019 VMT and GHG**

Step 1: Calculate statewide light-duty VMT using the CDTFA fuel sales data based on CARB's VMT estimation method for the 2018 SB 150 report.

To estimate the annual statewide VMT from gasoline vehicles, CARB staff multiplied the statewide gasoline fuel consumption data from 2010 to 2019 by fuel economy[6] data. Further, CARB staff adjusted the VMT based on the share of gasoline vehicle VMT and fleet mix data from the latest EMFAC 2021 database. Fleet mix data provide the percentage of gasoline VMT and light-duty vehicle VMT compared to the region's total VMT in a given year. The historical fleet mix data in the EMFAC 2021 database are from the DMV vehicle registration data.

Figure 4. Flow chart of CARB's regional VMT and GHG estimation method for 2010-2019



Step 2: Estimate the regional and statewide VMT based on each of the three identified VMT datasets (i.e., HPMS, vehicle registration/Smog Check Program, and CEC fuel sales data).

[6] Fuel economy data from US EPA (www.fueleconomy.gov) were acquired for each vehicle that operates in California, based onDMV registration database list containing all vehicle VINs associated with passenger vehicles and light duty trucks

- HPMS: Compiled the total VMT for each MPO from HPMS annual reports for 2010 to 2019 and estimated the corresponding light-duty VMT based on regional-specific fleet mix data from the EMFAC 2021 model.
- Vehicle Registration/Smog Check Program: The EMFAC 2021 model calculated statewide and MPO light-duty VMT for the period 2010-2019 using the vehicle registration and Smog Check Program data.
- CEC fuel sales: Downloaded CEC's county-level gasoline sales data for 2010 to 2019[7] and aggregated the county-level gasoline sales data to the MPO level. Next, it multiplied each MPO's fuel sales data by the respective fuel economy data to get gasoline vehicle VMT. The gasoline vehicle VMT was then converted into light-duty VMT based on the regional-specific fleet mix.

Step 3: Estimate the regional VMT share based on the three VMT datasets.

In this step, CARB staff calculated the regional VMT shares of all MPOs based on regional and state VMT in each of the three datasets obtained from Step 2. While individual datasets have limitations in terms of the VMT values, the regional share is still meaningful since each dataset's sampling and estimation approach is largely fixed across MPOs and over time. Next, CARB staff took the average of the three regional percentages to estimate the regional VMT share (Eq. 1) since all three datasets have different strengths and weaknesses that complement each other. For instance, vehicle registration data represent the regional vehicle ownership, CEC fuel sales data reflect the fuel consumption pattern, and HPMS data reflect the on-road travel pattern. The average regional shares for individual MPOs are provided in the Supplemental Info (Tables S1-S3).

$$Regional\ Share_{MPO} = \frac{\frac{MPO\ VMT_{HPMS}}{State\ VMT_{HPMS}} + \frac{MPO\ VMT_{DMV/BAR}}{State\ VMT_{DMV/BAR}} + \frac{MPO\ VMT_{CEC}}{State\ VMT_{CEC}}}{3} \quad \text{Eq.1}$$

Step 4: Calculate regional light-duty VMT and per capita VMT.

The regional light-duty VMT is calculated for all MPOs from 2010 to 2019 based on steps 1 and 3. In other words, multiply the statewide VMT from Step 1 by the regional share from step 3. CARB staff next divided the regional VMT by regional population data from the California Department of Finance (DOF)[8] to get the per capita VMT (Eq. 2).

---

[7] CEC A-15 retail fuel sales reporting: https://www.energy.ca.gov/data-reports/energy-almanac/transportation-energy/california-retail-fuel-outlet-annual-reporting

[8] State of California, Department of Finance, E-2. California County Population Estimates and Components of Change by Year, July 1, 2010-2021. Sacramento, California, December 2021 https://www.dof.ca.gov/forecasting/demographics/estimates/

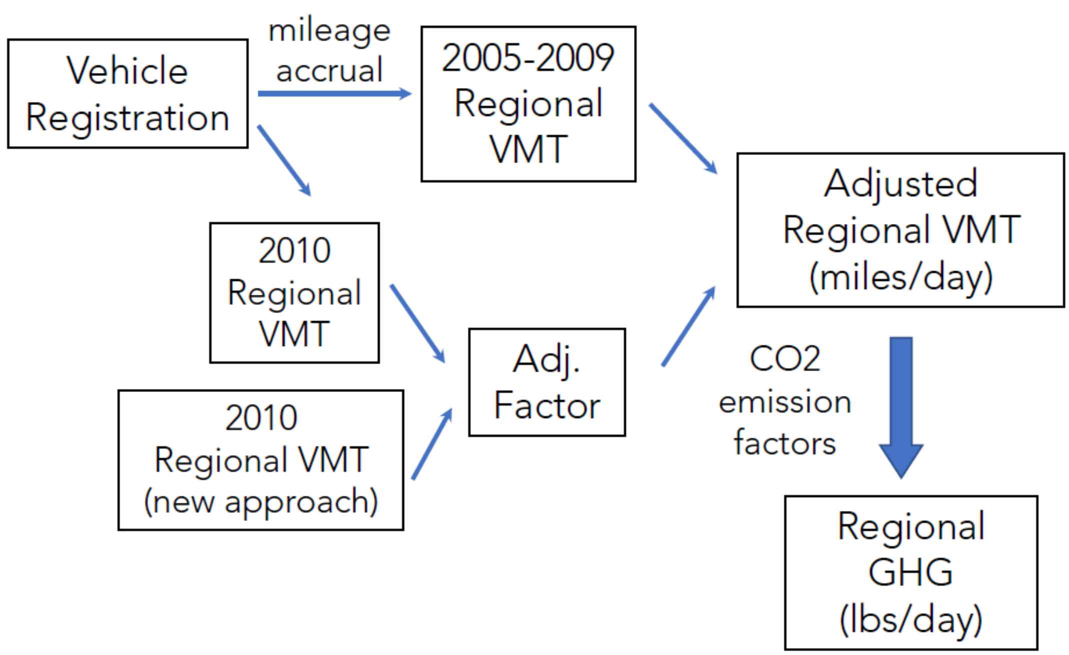
$$VMT_{MPO} = VMT_{\ California} \times Regional\ Share_{MPO} \qquad \text{Eq. 2}$$

Step 5: Estimate regional GHG emissions using EMFAC 2021

This step calculates regional GHG emissions based on regional total Light-duty VMT and regional-specific fleet mix input using the SB 375 mode in EMFAC 2021 web tool. The 2010-2019 VMT input file for individual MPOs obtained from Step 4 is developed for SB 375 mode in EMFAC 2021 to estimate GHG emissions. The GHG emission output from this analysis excludes emission benefits from CARB's light-duty vehicle regulations as required by the SB 375 law, and reductions from these regulations were taken into account when setting the GHG targets. Like with VMT, CARB staff divided the regional GHG by regional population to calculate per capita GHG.

2005-2010 VMT and GHG

Figure 5. Flow chart of CARB's regional VMT and GHG estimation method for 2005-2009



Step 6: Calculate total and per capita light-duty VMT and GHG in the 2005-2009 period

The approach discussed in Steps 1-5 estimates the light-duty VMT and GHG since 2010. Unfortunately, for years before 2010, CEC fuel sales data were unavailable, and HPMS has irregularities (i.e., minor VMT reductions during the 2008 recession, inconsistent with tax-based fuel consumption data at the state level), so the approach described above is not usable. However, it is crucial to track regional VMT and GHG back to 2005 to evaluate the progress of the SB 375 program, as the law requires comparison to a 2005 level. Therefore, CARB staff uses the light-duty VMT using the vehicle registration/Smog Check Program data processed by EMFAC 2021 instead of the three data sources used for the 2010-2019 period, as illustrated in **Figure 5**. The estimated VMT data are further validated using the statewide VMT estimates based on CDTFA, and the estimated VMT are within 0.5% of VMT calculated using CDTFA data. Hence, CARB staff estimated regional light-duty VMT and GHG emissions for each MPO using the vehicle registration/Smog Check Program data in the 2005-2009 period, then calculated the per capita VMT and GHG by dividing by the regional population data from DOF[9].

Step 7: Calculate VMT adjustment factors between the 2005-2009 period and 2010-2019 period

VMT and GHG trends must be continuous to track the progress and performance of the SB 375 program. However, due to different VMT estimation methods, 2005-2009 per capita VMT and GHG estimated in Step 6 are not directly comparable to 2010-2019 values in Steps 1-5. In other words, the VMT changes from 2009 to 2010 could be largely attributable to the differences in the method, given that everything else is constant, including exogenous factors (fuel price, socioeconomic, built environment). Therefore, VMT adjustment factors were developed to combine the VMT per capita results in the 2005-2009 and 2010-2019 periods for all MPOs and track progress. This adjustment factor aims to offset any differences between these two methods and make the trend lines compatible. To calculate the adjustment factors, CARB staff first estimated the 2010 VMT for all MPOs using both approaches (2005-2009 and 2010-2019). However, these 2010 per capita VMT values differed from each other, and hence, CARB staff ratioed the 2010 per capita VMT estimated from the two methods, which becomes the VMT adjustment factors for each MPO (Eq. 3). A similar approach is applied to calculate the GHG adjustment factor for each MPO.

$$VMT\ Adj.Factor = \frac{2010\ per\ capita\ VMT_{2010-2019\ method}}{2010\ per\ capita\ VMT_{2005-2009\ method}} \quad \text{Eq. 3}$$

Step 8: Normalize the per capita VMT and GHG in the 2005-2009 period for all MPOs

The adjustment factors for individual MPOs were then multiplied by the per capita VMT in the 2005-2009 period estimated in Step 6 to get the adjusted per capita VMT (Eq. 4). The adjusted 2005-2009 VMT and the 2010-2019 VMT are now directly

[9] State of California, Department of Finance, *California County Population Estimates and Components of Change by Year, July 1*, 2000-2010. Sacramento, California, December 2011. https://www.dof.ca.gov/forecasting/demographics/estimates/

comparable—similarly, CARB staff calculated the adjusted per capita GHG for all MPO regions.

$$Adjusted\ per\ capita\ VMT = \ per\ capita\ VMT\ _{2005-2009\ method}\ \times VMT\ Adj.Factor \quad \text{Eq. 4}$$

2. **Per capita VMT and GHG change relative to 2005**

Step 9: Analyze the per capita VMT and GHG change with respect to 2005 for each MPO

The per capita VMT values estimated in Steps 1-5 (2010-2019 period) and Steps 6-8 (2005-2009 period) were combined and compared to the 2005 per capita VMT and calculated the percentage change (Eq. 5, CY =2005 to 2019). CARB staff also calculated the per capita GHG change relative to 2005 using the same process.

$$VMT\ change\ w.r.t\ 2005\,_{CY} = \frac{per\ capitaVMT_{CY} - Adjusted\ per\ capita\ VMT_{2005}}{Adjusted\ per\ capita\ VMT_{2005}} \quad \text{Eq. 5}$$

Results

Statewide VMT and GHG

Figure 6 shows the statewide light-duty VMT and GHG trends from 2001 to 2019. The estimated GHG emissions are based on the SB 375 mode in the EMFAC2021 model. The daily light-duty VMT has increased from 2005 to 2019 by 15 percent, from 847 million miles to 977 million miles. In addition, the daily SB 375 GHG emissions from light-duty vehicles had also increased in the same period by 8 percent. However, the rate of VMT and GHG increases has slowed down since 2017.

Figure 6. Statewide daily VMT and GHG trends from the CARB method based on CDTFA data

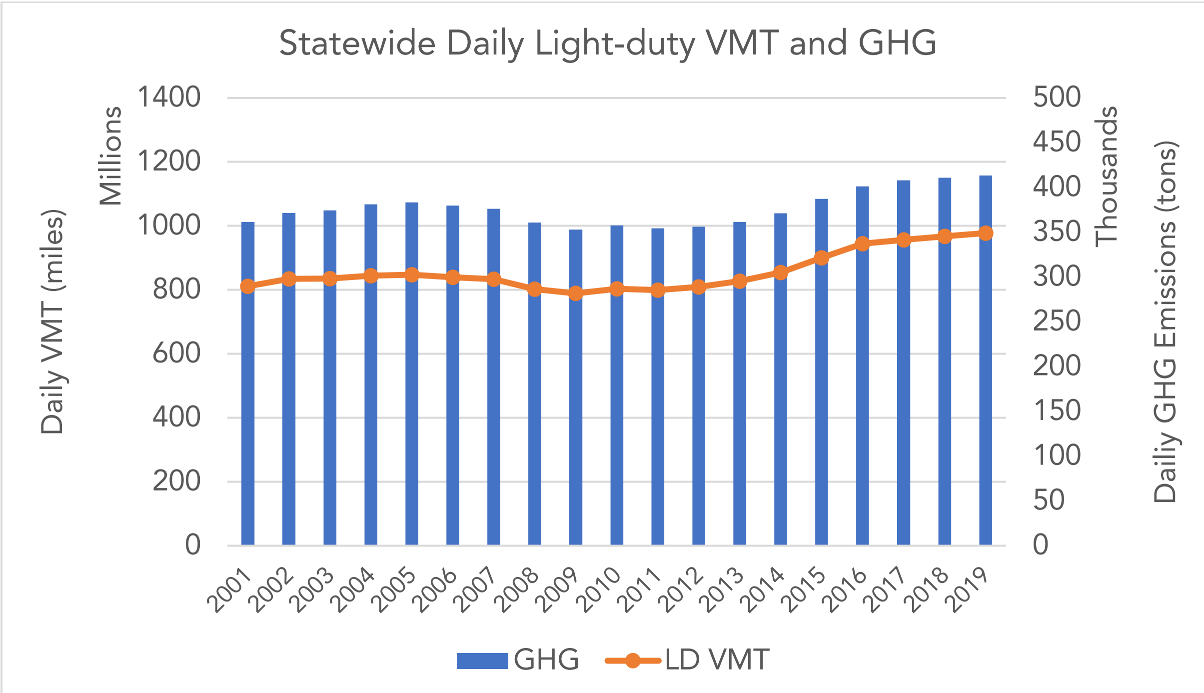
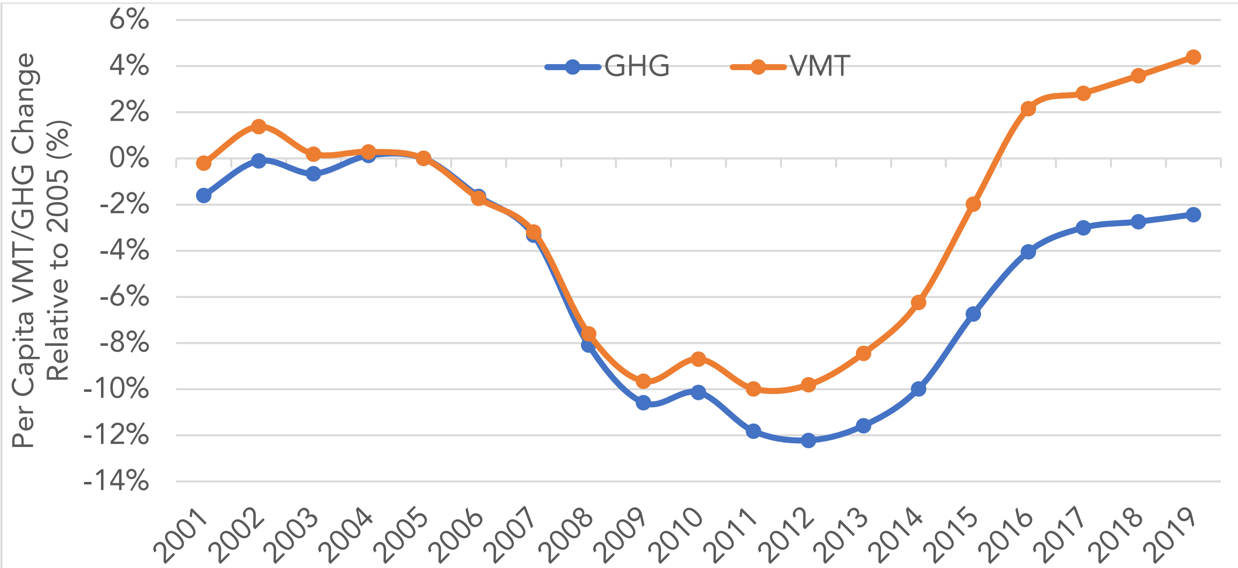


Figure 7 shows the statewide per capita GHG emissions and VMT relative to 2005. GHG emission (blue) and VMT (orange) per capita are 2 percent lower and 4 percent higher than 2005 in 2019, respectively. Like the light-duty VMT and GHG, the per capita measures at the state level have also been slowing down since 2017. Furthermore, the vehicle technology improvements and changes in consumer behavior towards vehicle choices (penetration of hybrid, electric vehicles, and other alternative-fueled vehicles) possibly contribute to decoupling the GHG emission reductions (tailpipe) from VMT in the later years. However, this trend should not be looked at in isolation. Instead, it should be evaluated from the larger transportation sector and lifecycle emissions perspective, which are beyond this report's scope.

Figure 7. Statewide per capita GHG emissions and VMT relative to 2005



Regional per capita VMT and GHG trends

Based on the methods described above, CARB staff then calculated the per capita light-duty VMT and GHG at the MPO level. The estimated GHG emissions are based on the SB 375 mode in the EMFAC2021 model and are consistent with the SB 375 targets. The following charts (**Figure 8**) show the per capita VMT and GHG change with respect to 2005 in each MPO. The result shows that many MPOs' per capita VMT and GHG temporal trends are directionally consistent with the statewide trend, including a reduction in the 2005 to 2012 period and an increase afterward. Similarly, the rate of increase for VMT and GHG slowed down between 2016 and 2019 in most MPO regions.

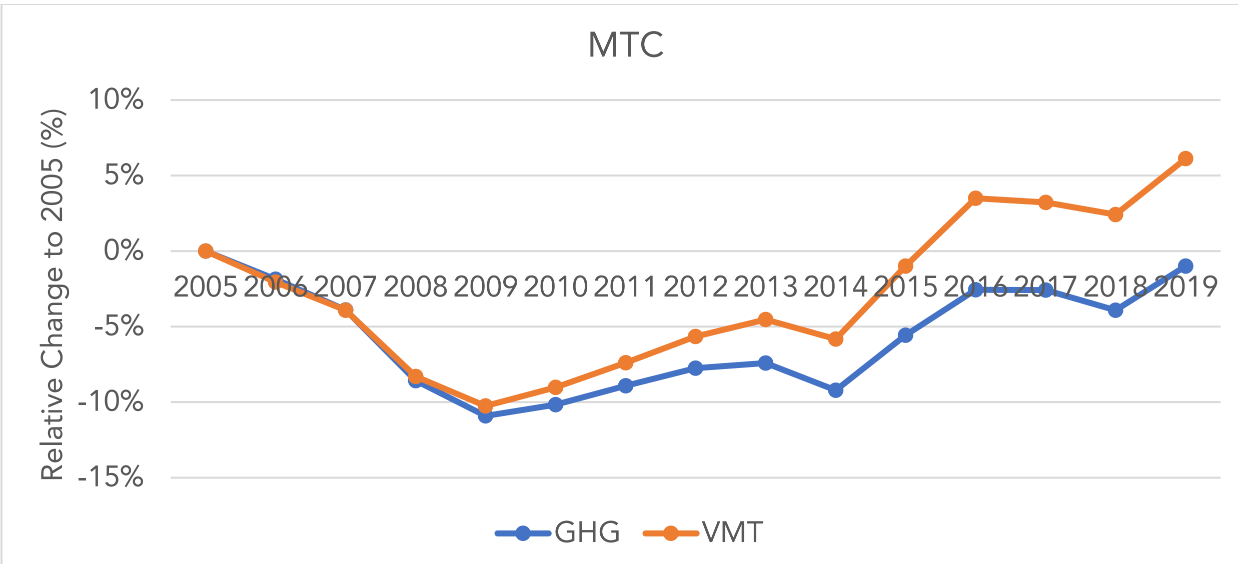
At the MPO level, **Figure 8** shows that the 2005-2019 GHG change ranged from -9.6 percent in TMPO[10] to +26 percent in KCAG. Overall, 11 of the 18 MPOs' 2019 per capita GHG emissions are lower than 2005 levels, although none of the regions were on track to meet the 2020 GHG targets. On the other hand, the VMT per capita in most MPOs was higher than the 2005 level except in the TMPO and SBCAG regions. Though the SB 375 program does not account for benefits from Pavley and Advanced

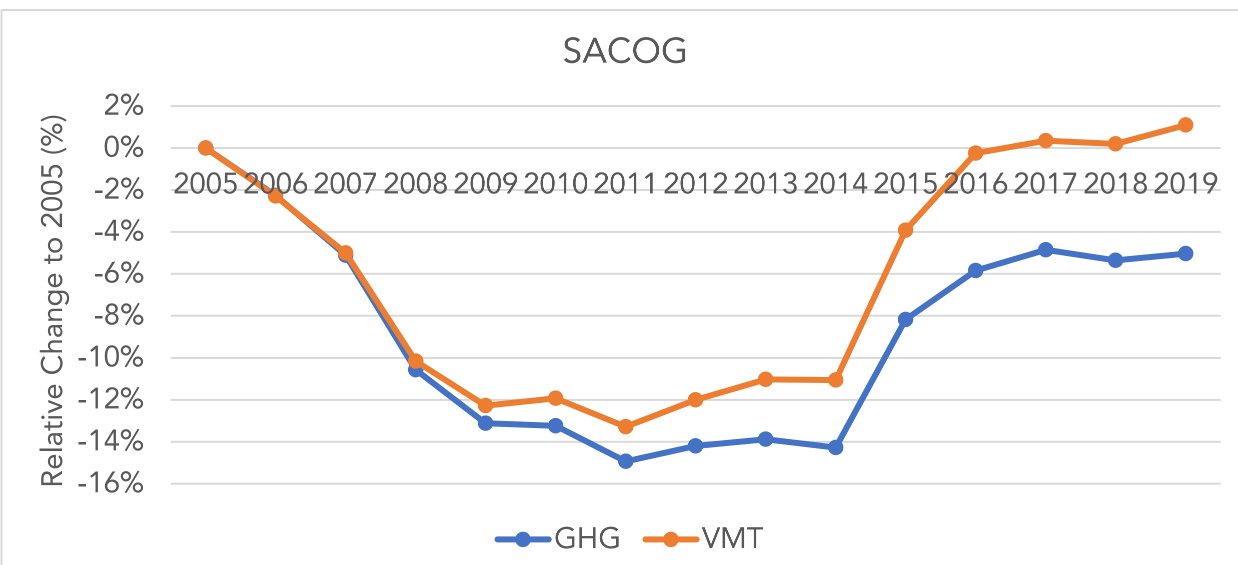
[10] For TMPO, the regional VMT and GHG trends were analyzed based on DMV/BAR data only for the entire period because (a) the TMPO VMT from HPMS is inconsistent across years; and (b) The CEC fuel sales data at the county level cannot be used to estimate TMPO vehicle activity. CARB staff does not believe that TMPO having the greatest reduction is attributable to this data source issue, as it was tested for other MPOs and did not result in significant downward shifts.

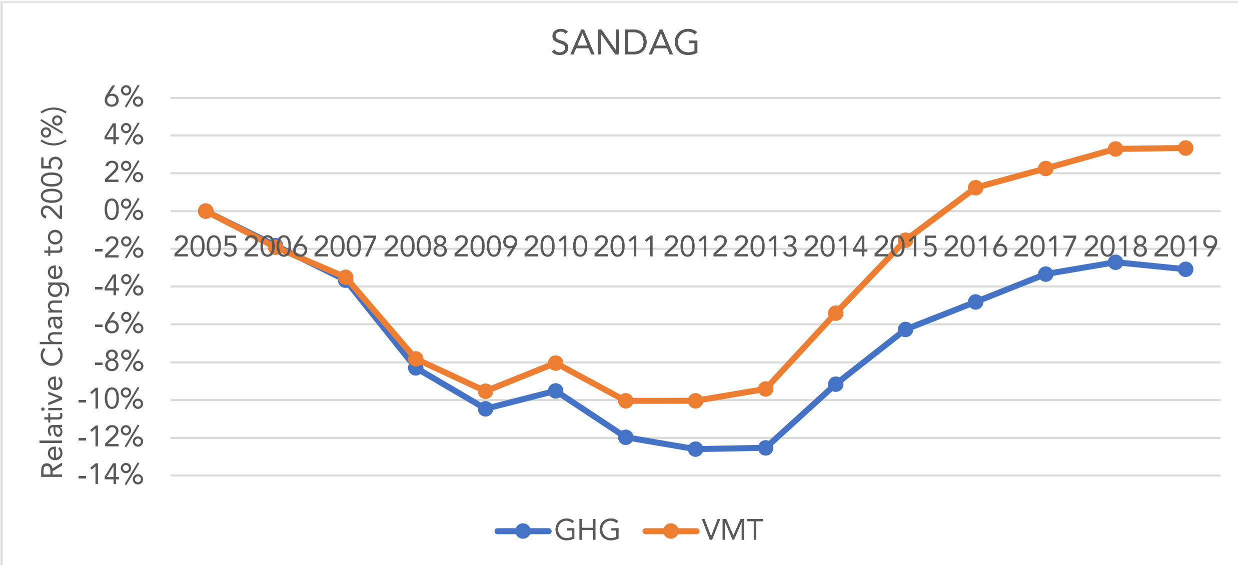
Clean Cars regulations, VMT per capita is higher than GHG due to the natural turnover of older vehicles to cleaner ones with lower GHG emissions and a shift in consumer behavior towards alternative fuels.

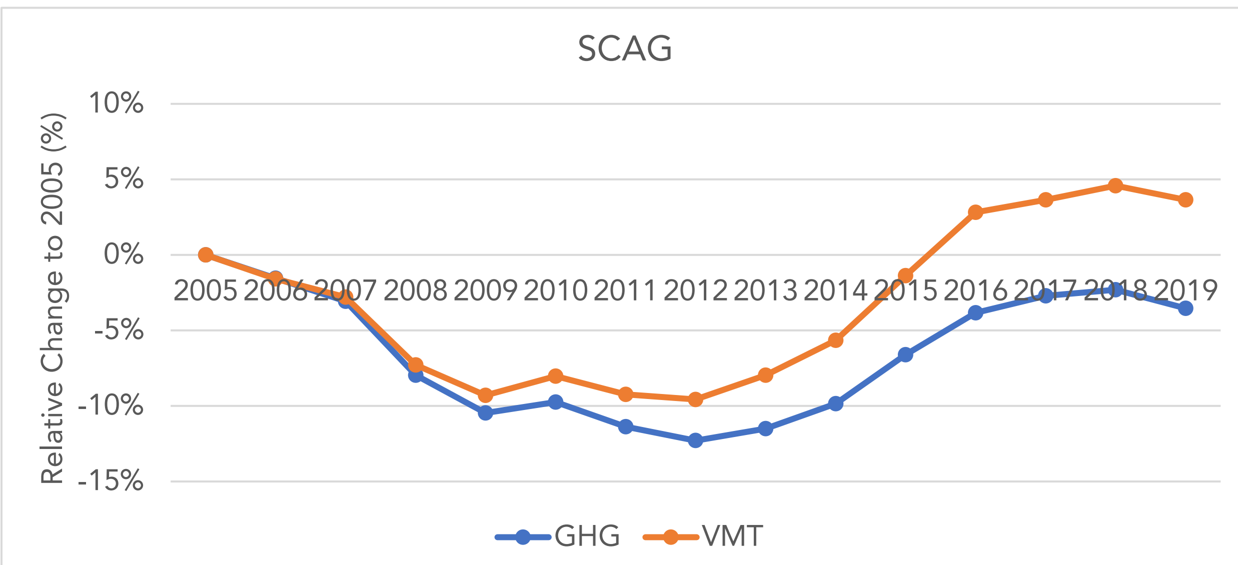
Figure 8. Per capita GHG emissions and VMT relative to 2005 for individual MPOs

Big 4 MPOs

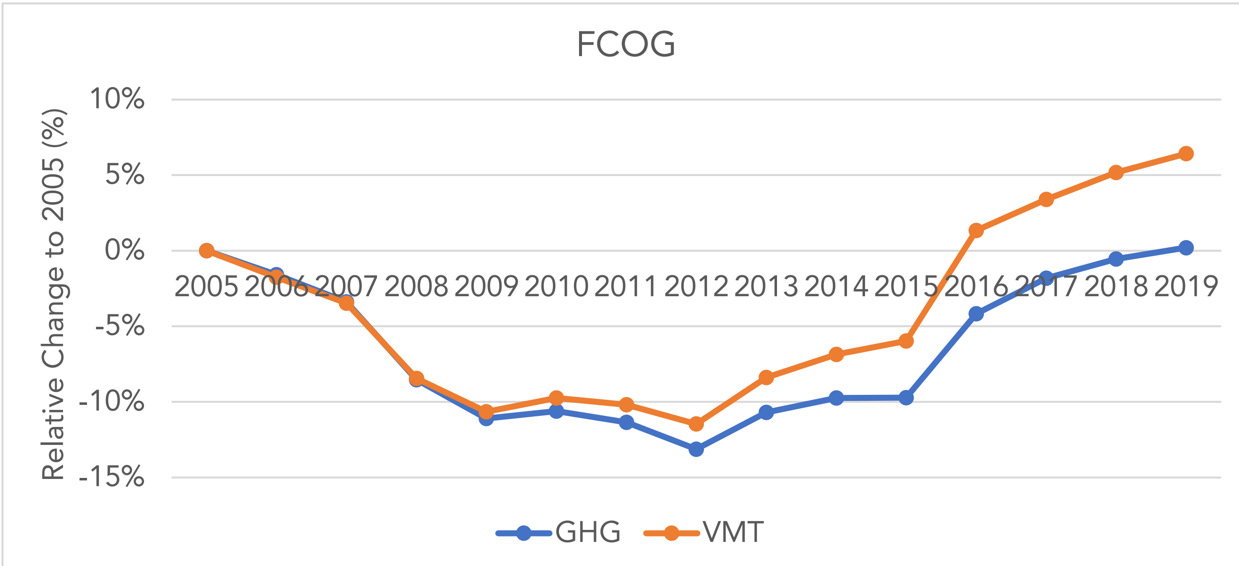


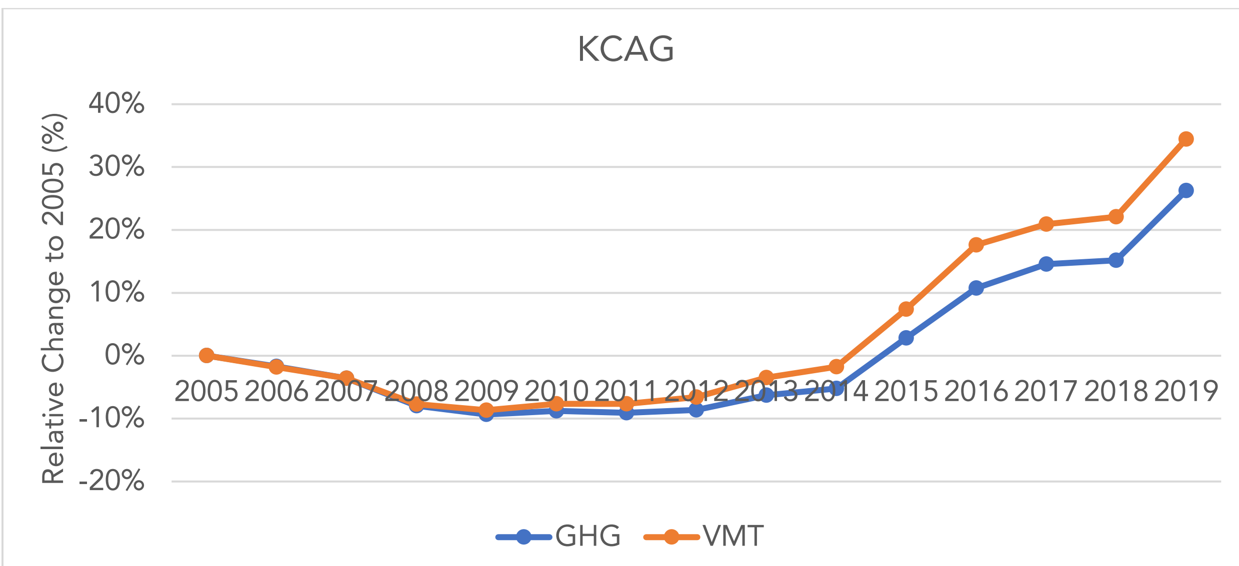


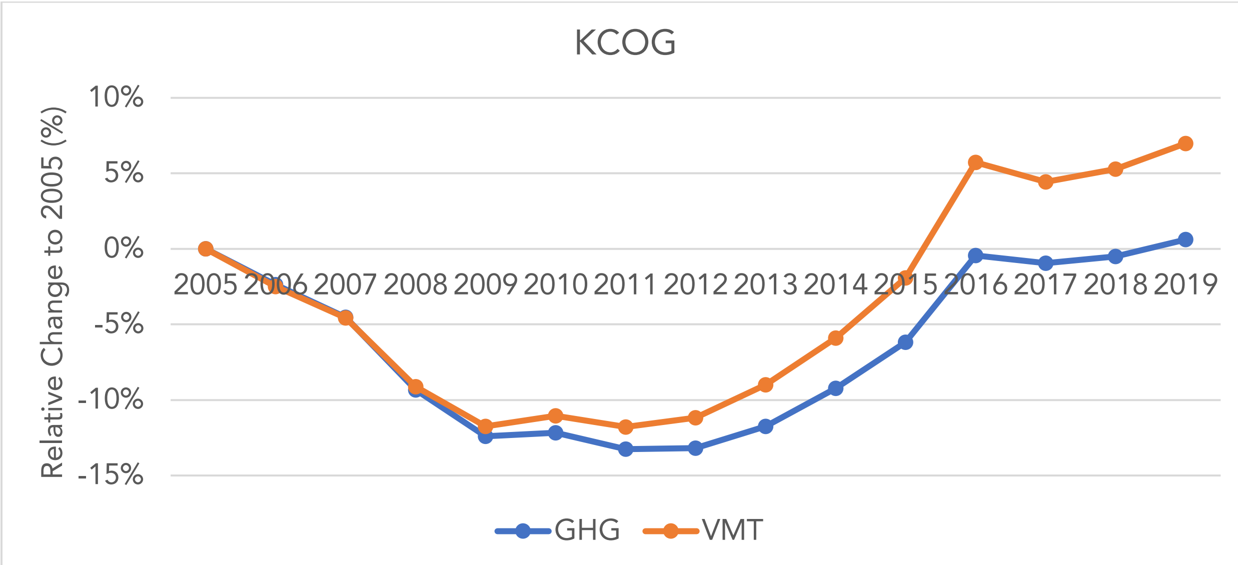

SANDAG
6%
4%
2%
0%
-2%
-4%
-6%
-8%
-10%
-12%
-14%
Relative Change to 2005 (%)
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
GHG
VMT

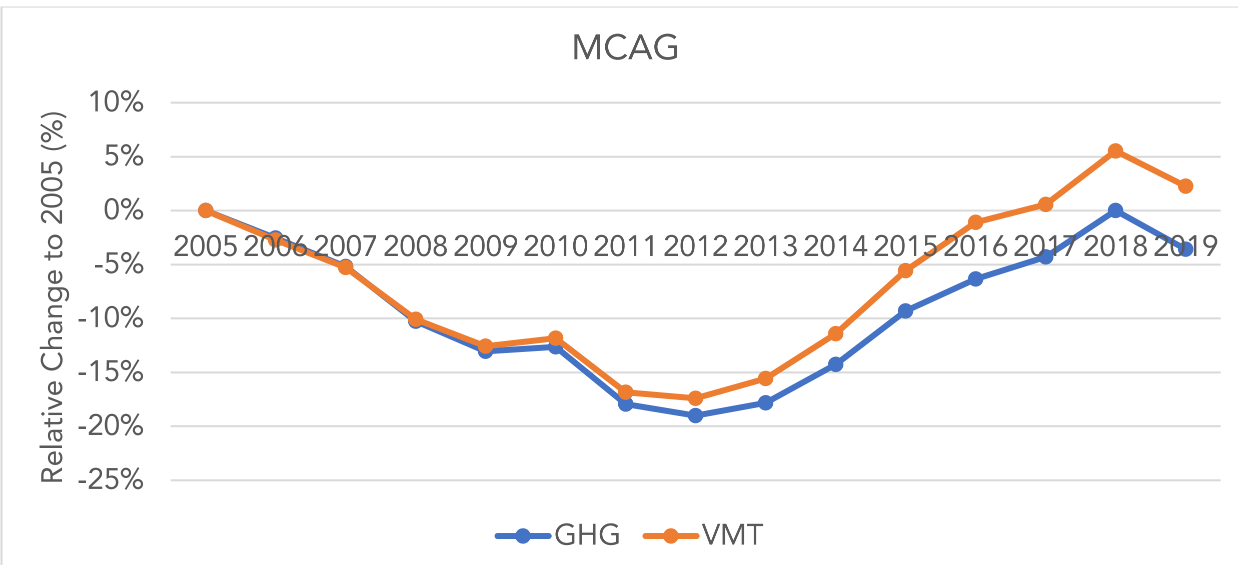

SCAG
10%
5%
0%
-5%
-10%
-15%
Relative Change to 2005 (%)
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
GHG
VMT

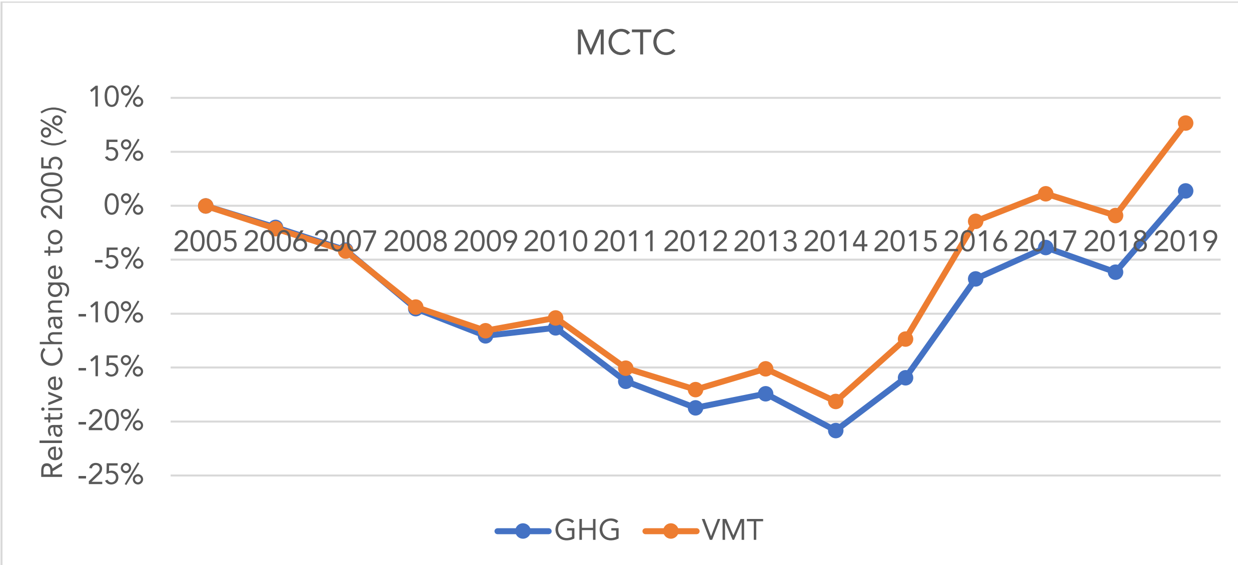
San Joaquin Valley (SJV) MPOs

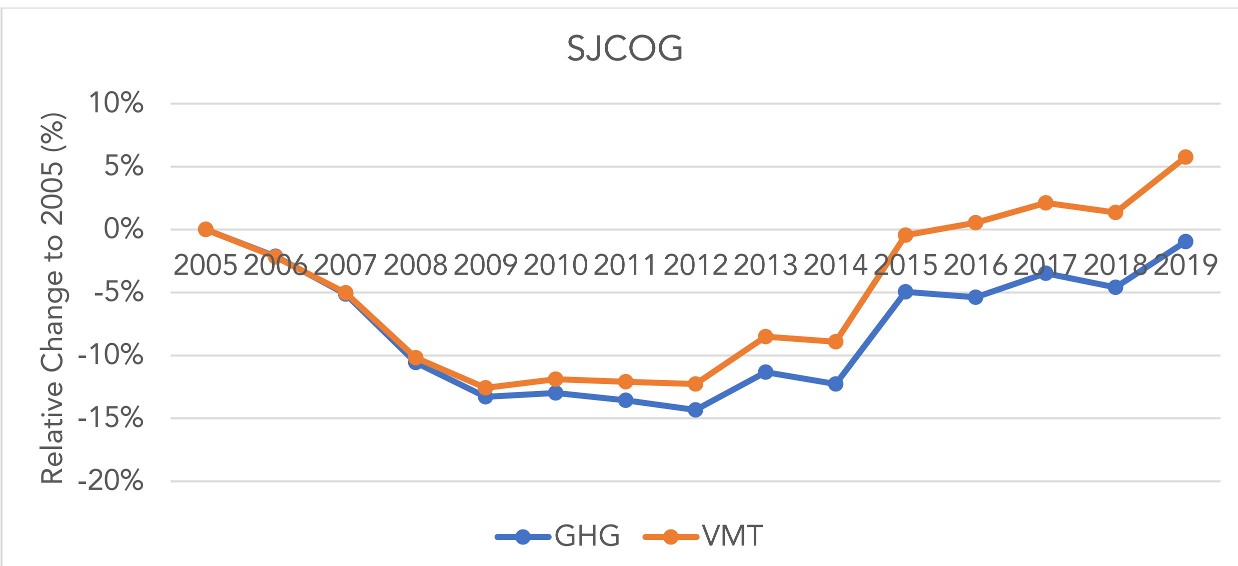


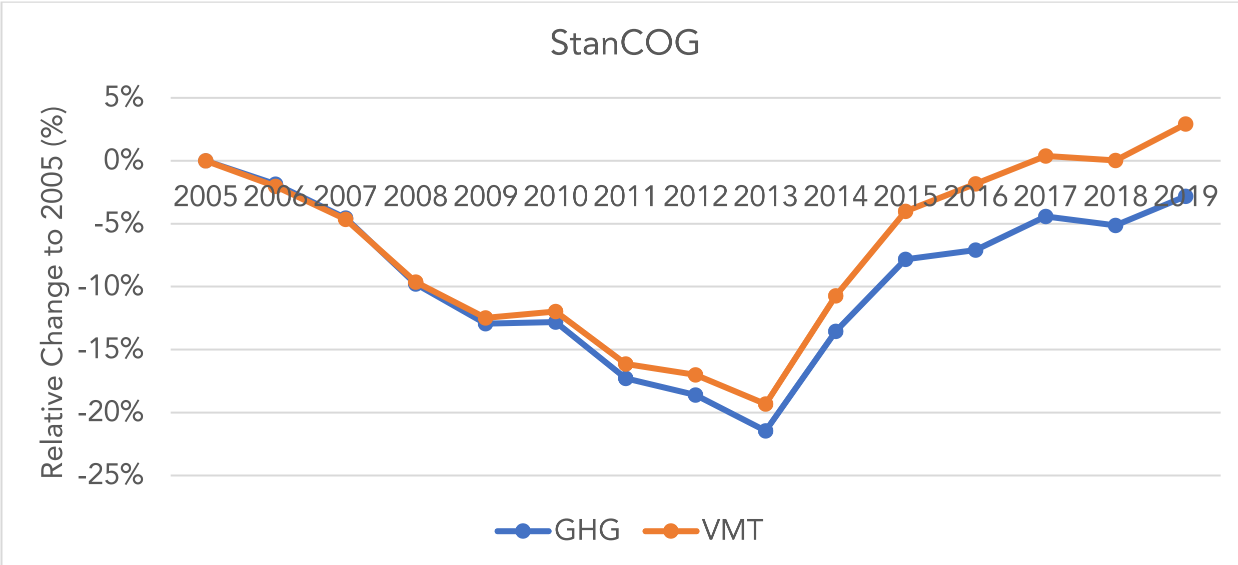


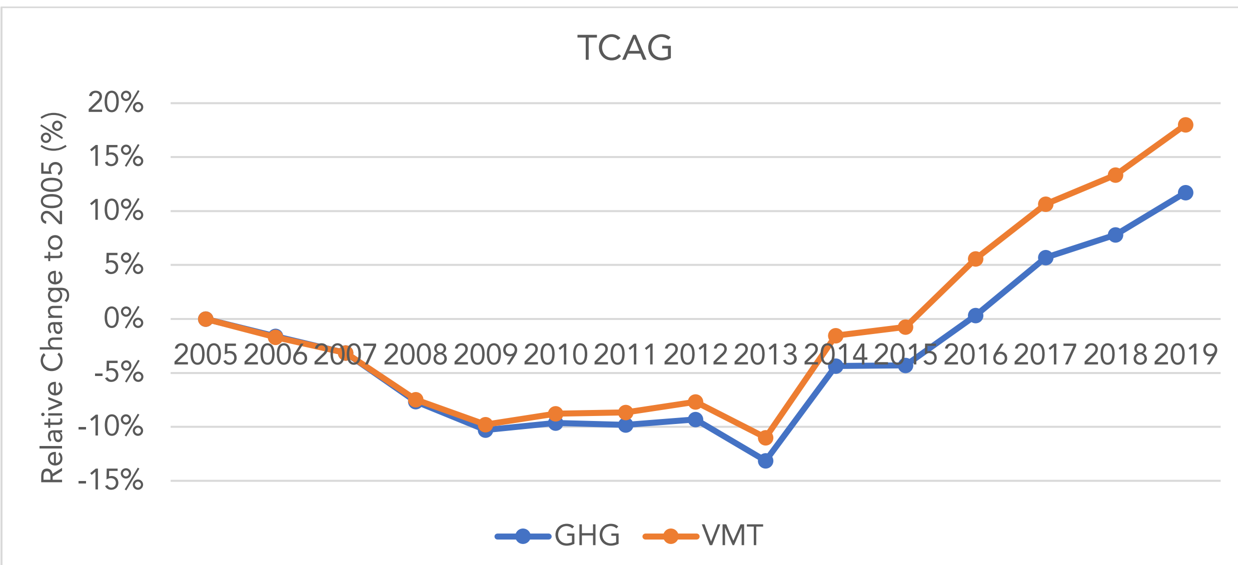

KCOG
Relative Change to 2005 (%)
10%
5%
0%
-5%
-10%
-15%
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
GHG
VMT


MCAG
Relative Change to 2005 (%)
10%
5%
0%
-5%
-10%
-15%
-20%
-25%
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
GHG
VMT

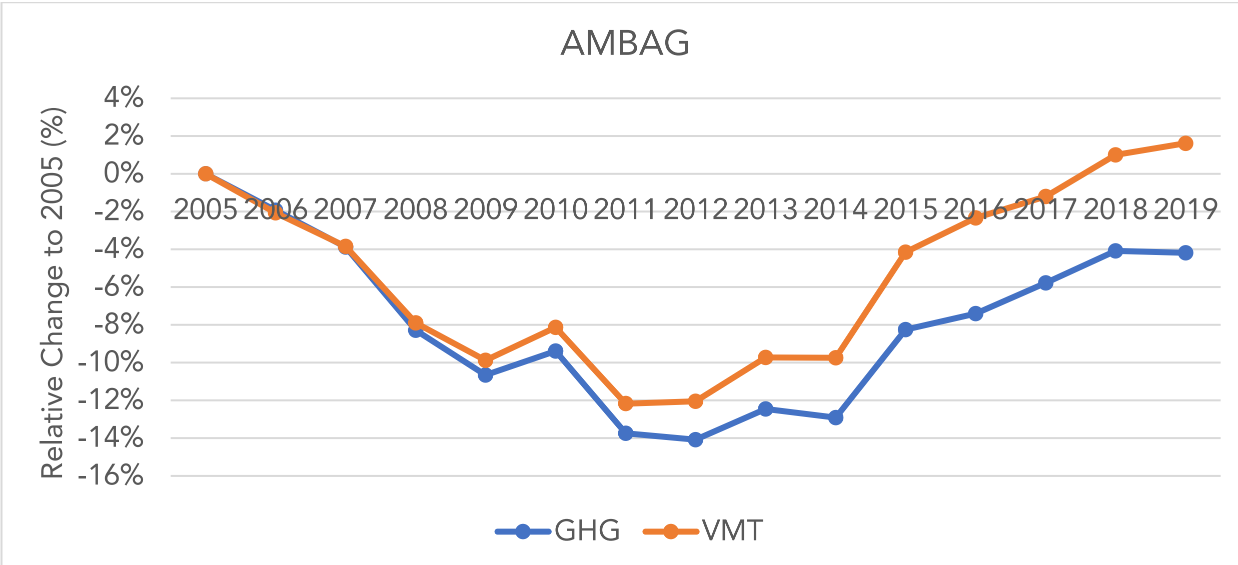

MCTC
10%
5%
0%
-5%
-10%
-15%
-20%
-25%
Relative Change to 2005 (%)
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
GHG
VMT

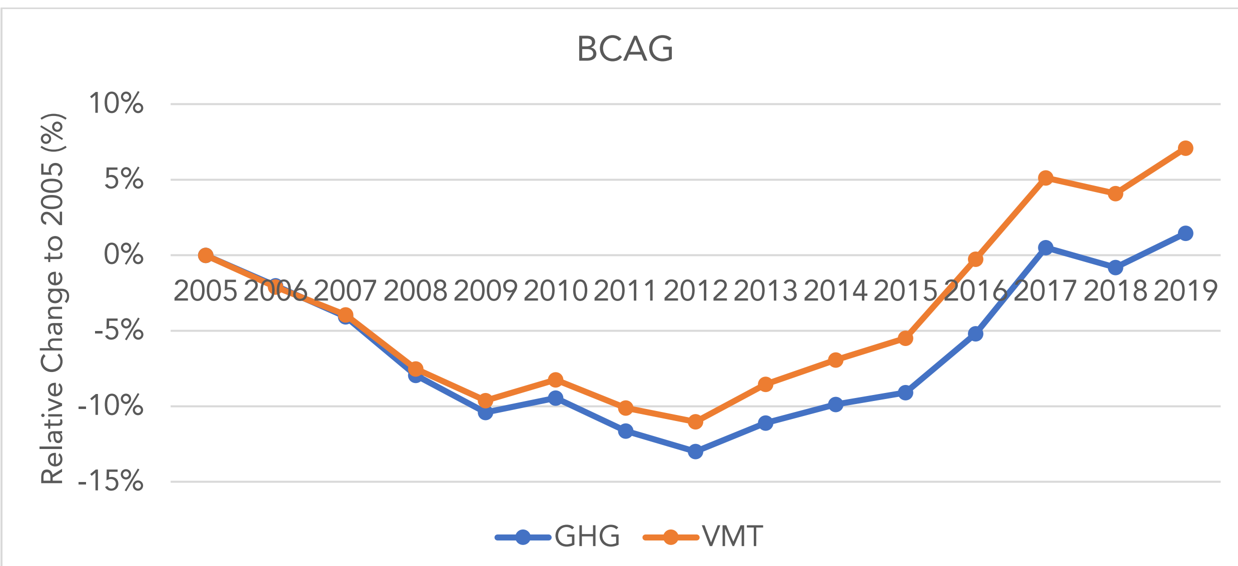

SJCOG
10%
5%
0%
-5%
-10%
-15%
-20%
Relative Change to 2005 (%)
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
GHG
VMT

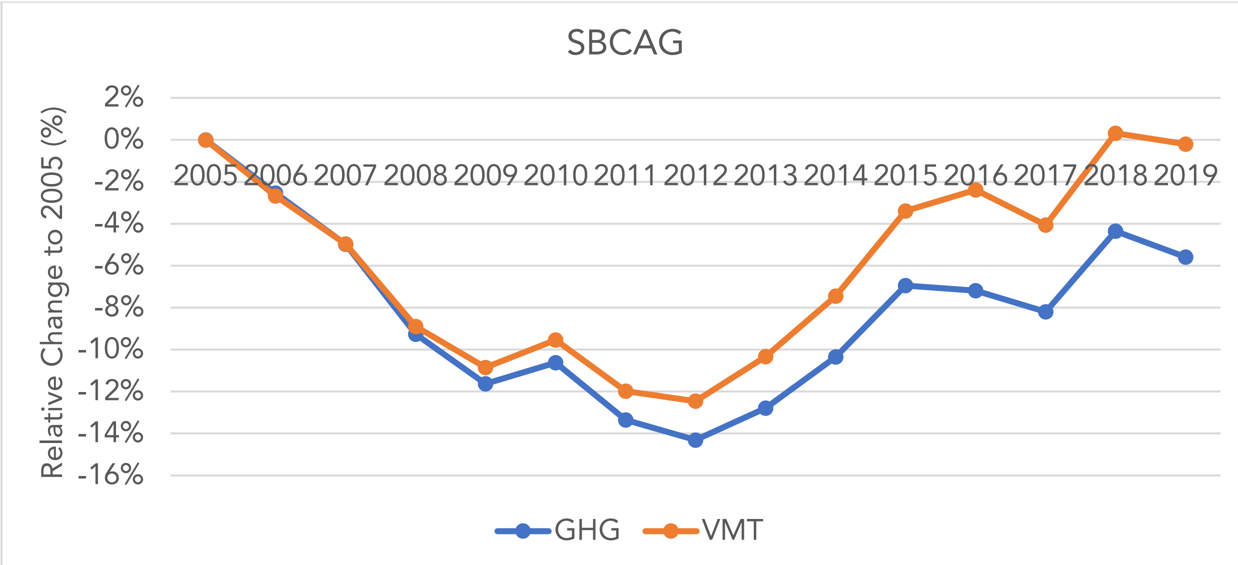

StanCOG
5%
0%
-5%
-10%
-15%
-20%
-25%
Relative Change to 2005 (%)
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
GHG
VMT

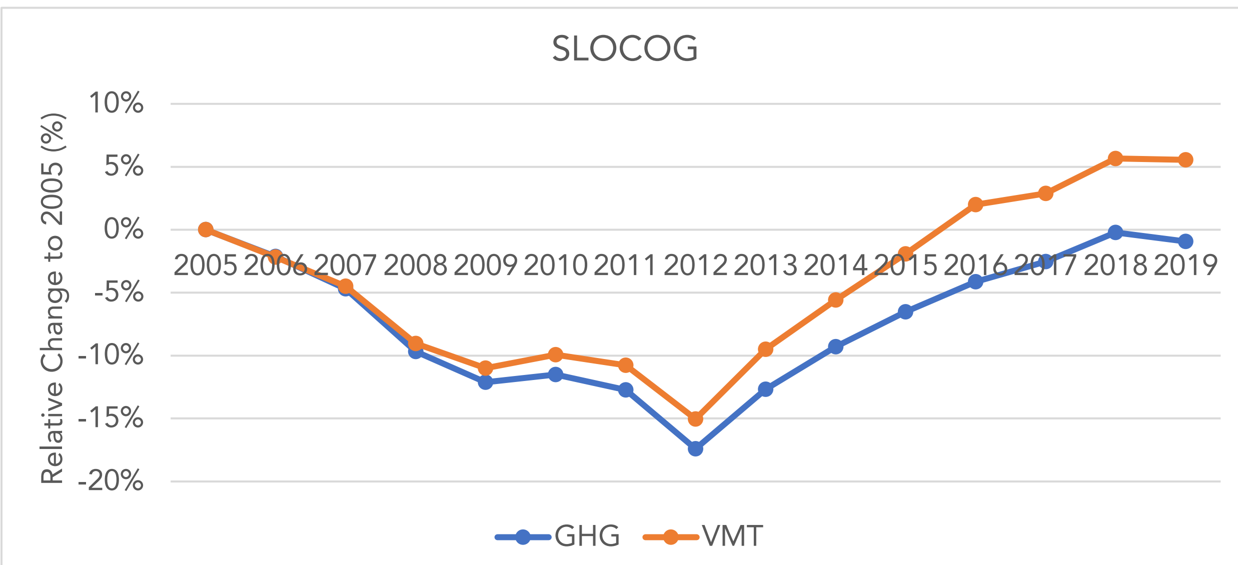

TCAG
20%
15%
10%
5%
0%
-5%
-10%
-15%
Relative Change to 2005 (%)
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
GHG
VMT

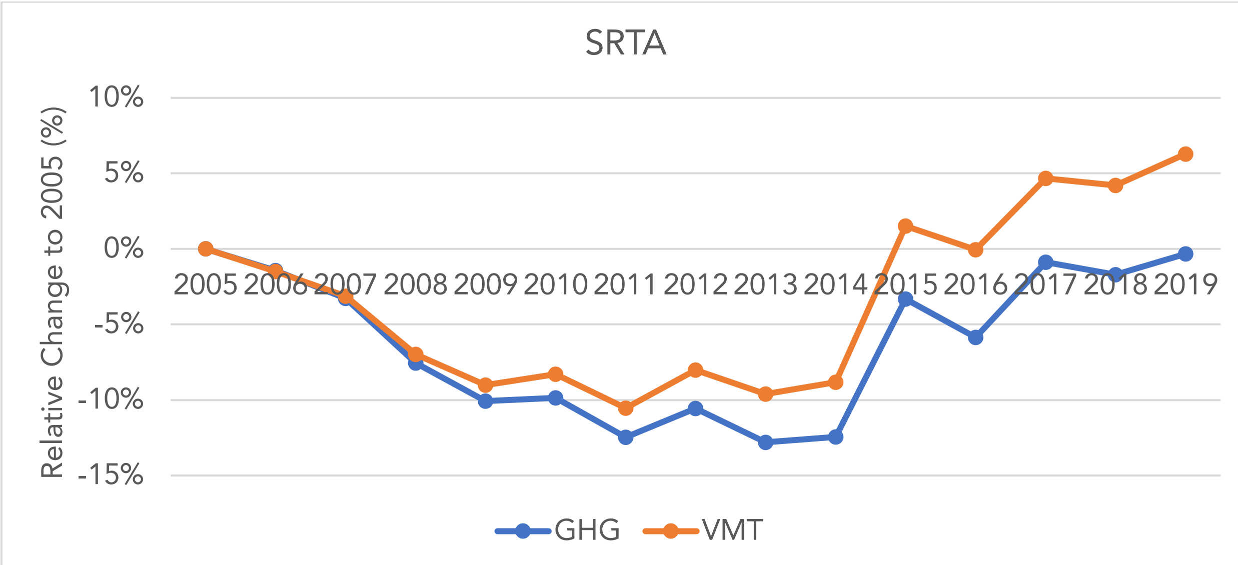
Coastal and Northern California MPO Regions

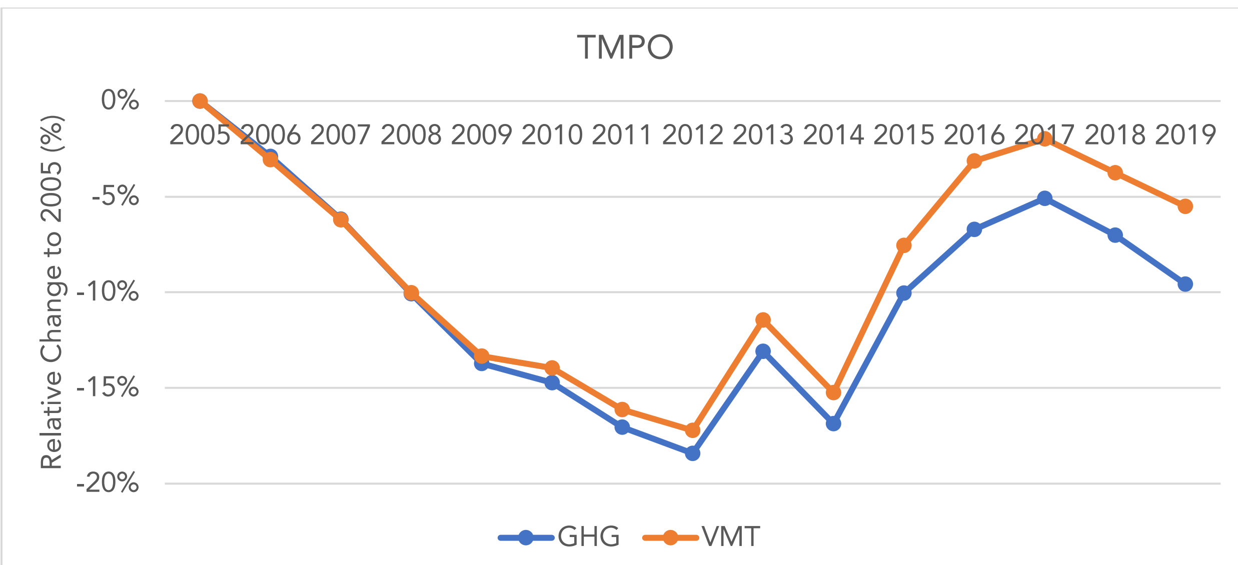





SBCAG
2%
0%
-2%
-4%
-6%
-8%
-10%
-12%
-14%
-16%
Relative Change to 2005 (%)
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
GHG
VMT


SLOCOG
10%
5%
0%
-5%
-10%
-15%
-20%
Relative Change to 2005 (%)
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
GHG
VMT





In the four major MPOs, MTC has the greatest increase in per capita VMT between 2005 and 2019 (6.1 percent), followed by SCAG (3.7 percent), SANDAG (3.3 percent), and SACOG (1.1 percent). In the San Joaquin Valley, the rate of increase in VMT was greater than the statewide level in 6 of the 8 MPO regions, ranging from 6 to 34 percent. Regarding the coastal and northern California MPOs, TMPO and SBCAG have the greatest GHG and VMT reductions in the state and are the only two MPOs whose 2019 per capita VMT are lower than in 2005. In addition, a few MPOs such as SCAG, SANDAG, MCAG, and SLOCOG also showed a decreasing VMT trend or stayed constant in 2019.

Caveats and Next Steps

CARB staff developed an approach to estimate historical regional VMT in California for the 2022 SB 150 report. This approach applied data from CEC fuel sales, HPMS, and vehicle registration/ Smog Check Program datasets to estimate the regional VMT share from 2010 to 2019. Though individual datasets have limitations, the CARB proposed approach is suitable for tracking the regional trends since it incorporates three datasets that represent different facets of transportation-related emissions and therefore complement each other. However, the new approach also has a few caveats. These caveats include not explicitly removing inter-regional travel as necessary to reflect the scope of MPOs' sustainable communities strategies, some of the data sources failing to reflect electric vehicle VMT for purposes of calculating per capita VMT, data volatility, and the lack of weighting factors for each data source. While these caveats are unlikely to change the overall trends of the statewide and regional VMT and GHG estimates, they do affect the precision of the estimates and may require further investigation to improve results in the future. Each of these issues is described in more detail below.

1. Inter-regional Travel

The SB 375 program excludes VMT from through traffic in regional VMT estimates when evaluating whether or not an SCS achieves the GHG targets. However, due to limitations in the sampling methods of HPMS, vehicle registration/Smog Check Program, and CEC fuel sales data sources (the observed VMT), staff are unable to separate the through traffic VMT from total regional VMT. Therefore, the VMT estimation in this report includes inter-regional VMT. To address this inconsistency, CARB staff report the relative changes of VMT over time instead of the absolute VMT values. Thus, each year's inter-regional VMT may balance out by showing the relative change, given that the percentage of through traffic is unlikely to change significantly over time.

This concern is particularly true as it relates to the fuel-based VMT estimates using CEC fuel sales data. CARB staff realized that the location of fuel sales might not fully represent the location of the vehicle activity, especially for smaller regions. Such inconsistency between fueling location and VMT activity is minimized by showing the relative change over time instead of the absolute VMT values, assuming the level of inconsistency does not change significantly over time.

2. Electric Vehicle VMT Impacts

The CEC fuel sales and Smog Check Program data may not account for electric vehicles since they do not need gasoline fuels or participate in the Smog Check Program, which may affect the regional VMT estimates. However, CARB's VMT estimation method neutralizes such limitations by using data sources like HPMS and vehicle registration that include all vehicles. In addition, to address the issue that EV VMT is not captured by the CEC fuel sales data source specifically, CARB staff utilized the latest regional-specific fleet mix data and model year-specific fuel economy to estimate the fleet-wide average fuel economy for each county and MPO. Therefore, the calculated fleet-wide average fuel economy is adjusted to individual regions and accounts for the penetration of EVs.

At the state level, CARB staff calculated statewide VMT by applying the fleet-wide fuel economy from the EMFAC 2021, which accounted for the overall EV penetration in California and the associated effects. Although the best available regional-specific data are applied in this process, it may warrant further investigation and exploration of other data sources to account for EV VMT impacts in the future.

3. Data Volatility

Another caveat within individual data sources is data volatility, which is the discrepancies CARB staff observed from certain regions' VMT and/or fuel consumption patterns that are difficult to explain. For example, data discrepancies have been observed in Caltrans's HPMS and CEC's fuel sales data specifically. CARB staff has consulted with both agencies about the possible causes and the potential impacts. The discrepancies observed in HPMS are likely due to the nature of the existing sampling method, where local and arterial roads have much lower sensor coverage than freeways, and the sampling method changed in 2015. In terms of the CEC fuel sales data, CARB staff observed abnormal regional trends in 2014 for many MPOs. According to CEC, this is because of the low survey response rate in that year. To address this issue, staff from both agencies decided to remove CEC's 2014 data from this analysis for the affected MPOs. In addition, averaging the three data sources minimizes the data volatility.

4. Weighting Factors

The new approach took the average of the regional shares from the three individual data sources to get the regional share for each MPO. As discussed before, CARB staff took a simple average since all three datasets are considered equally important. For instance, vehicle registration data well represent the vehicle owners’ home locations and the regional vehicle type composition, CEC fuel sales data capture the fuel consumption pattern, and HPMS data reflect the on-road travel pattern. However, given the lack of literature or any previous analysis on weighting factors for these datasets, no weighting factors were used in this analysis. CARB staff does believe that trend analyses minimize any related uncertainties due to the lack of weighting factors in estimating the regional share.

Summary

To summarize, CARB staff developed a new approach to estimate California's regional VMT and GHG emissions for the 2022 SB 150 report, utilizing CEC fuel sales data, HPMS, and DMV's vehicle registration/BAR's Smog Check Program data. Recognizing the limitations of the data sources and the VMT estimation methodology, CARB staff determined that the developed approach is reasonable for evaluating the SB 375 program. However, in the long-term, CARB staff is actively exploring other data sources such as big data (e.g., Replica and StreetLight) for comprehensive regional VMT estimates in partnership with Caltrans and MPOs.

TRANSPORTATION CHOICES AND TRAVEL PATTERNS

The transportation system and travel choices available affect VMT and GHG emissions. For the 2022 SB 150 Report, CARB staff analyzed multiple transportation metrics to track the progress of the transportation choices and travel patterns in each MPO region. Further, this report also analyzes the changes in the transportation system and travel choices in priority population areas[11] to understand the equity impacts of transportation choices and travel patterns. CARB staff analyzed six metrics in this theme:

- Commute mode share
- Commute travel time by mode
- Vehicle ownership
- Lane miles built
- Transit ridership per capita
- Transit revenue hours per capita

Commute Mode Share

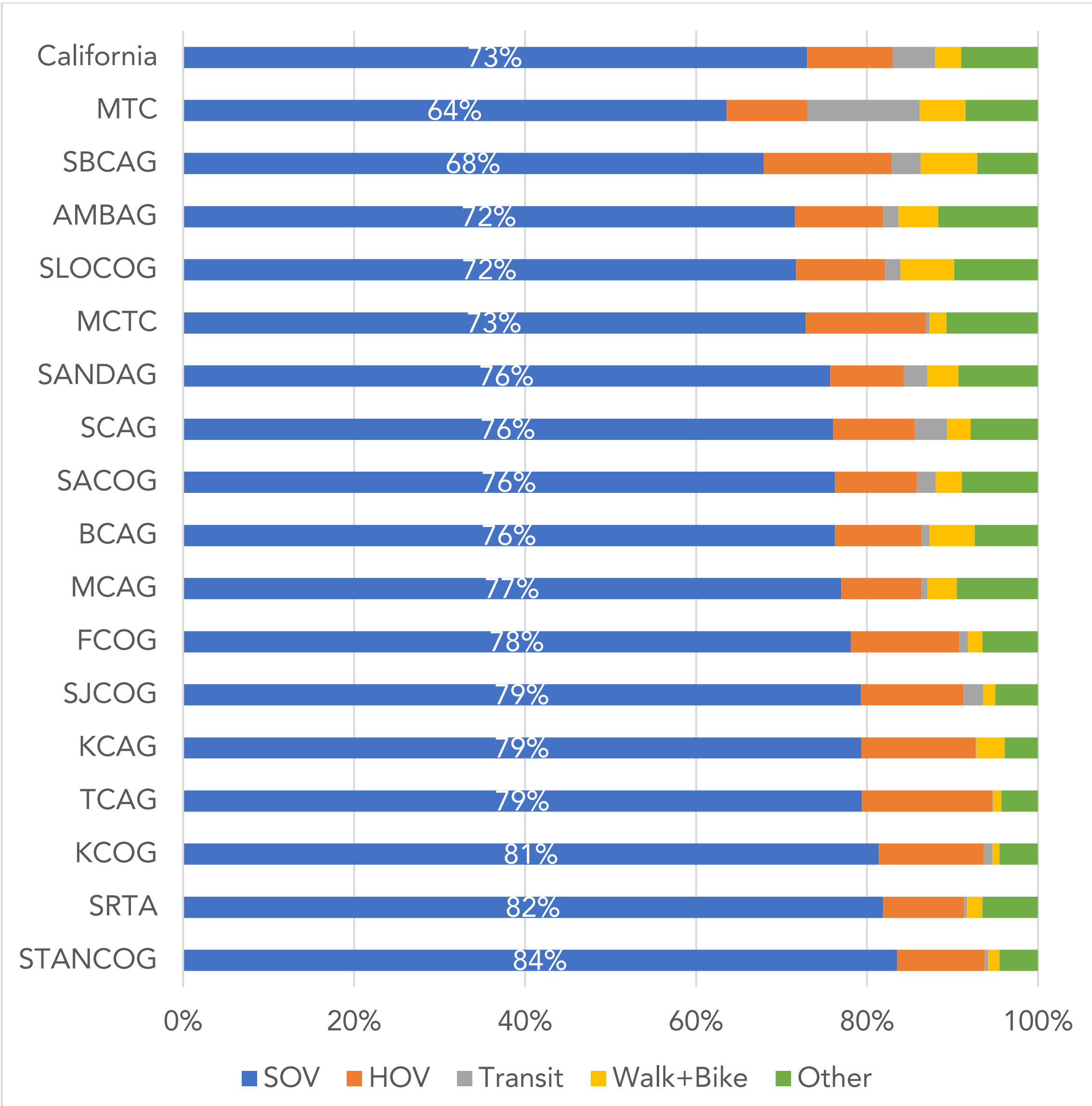
Commute mode share indicates what percentage of people who commute by driving alone, carpooling, public transit[12], and active transportation, and reflects how transportation infrastructure, investments, and policies support different modes of travel. CARB reports the percentages of mode-specific commuters to total commuters from 2010 to 2019 based on the American Community Survey (ACS) 1-year reports (i.e., county-level commute mode share and commute population). However, due to the nature of the data reporting method, this dataset does not reflect commuters who take multiple modes and therefore underestimates the share of specific modes. For example, commuters who ride a bike to the bus station and take the bus to work may report as public transit commuters and neglect the trip's biking portion.

The analysis shows that Californians primarily continue to drive alone to work. **Figure 9** presents statewide and regional 2019 commute mode share. The statewide commute mode shares include single-occupancy vehicles (SOV) or drive alone (73%), carpool or high-occupancy vehicles (HOV) (10%), public transit (5%), bike and walk (4%), and other modes (taxis, TNC, school bus) that are not specified (8%). This chart also lists MPO regions in order of their SOV mode share from lowest to highest. For example, the MTC region (64%) has the lowest SOV mode share, and the StanCOG region (84%) has the highest.

---

[11] Priority populations include disadvantaged communities designated per Senate Bill 535 (De León, Chapter 830, Statutes of 2012) and low-income communities designated per Assembly Bill 1550 (Gomez, Chapter 369, Statutes of 2016)
[12] In the American Community Survey, the public transit mode includes bus, subway, train/commute rail, light rail, streetcar, trolley, and ferryboat.

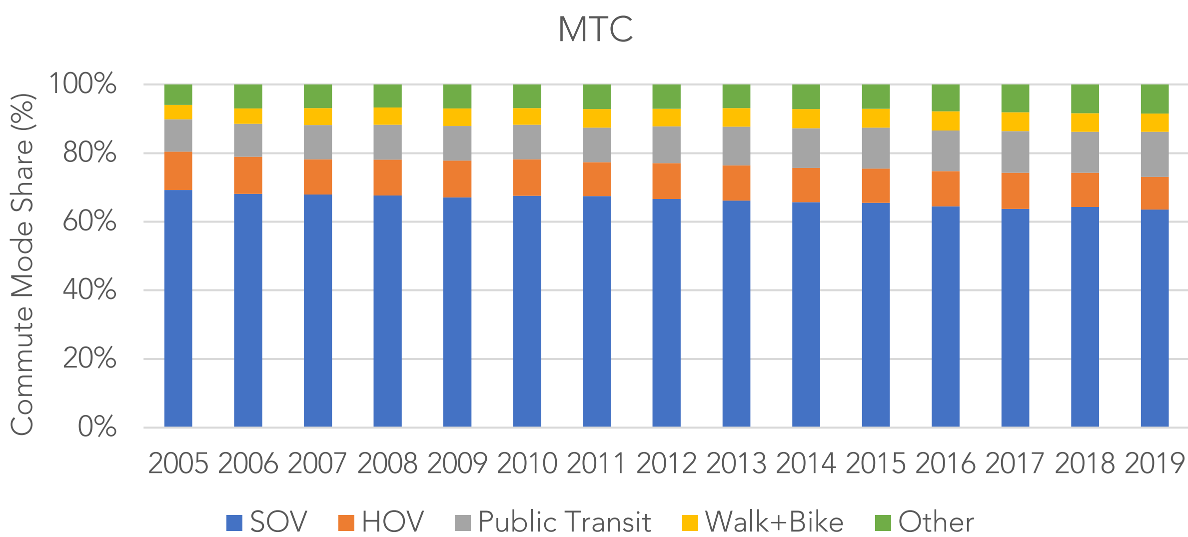
Figure 9. Statewide and Regional Commute Mode Share in 2019

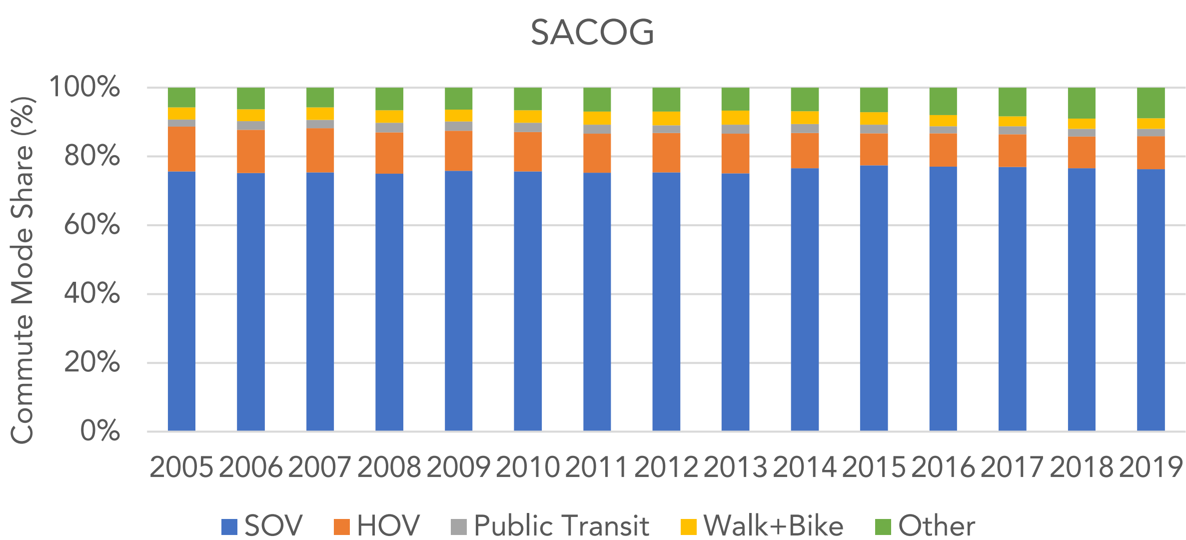


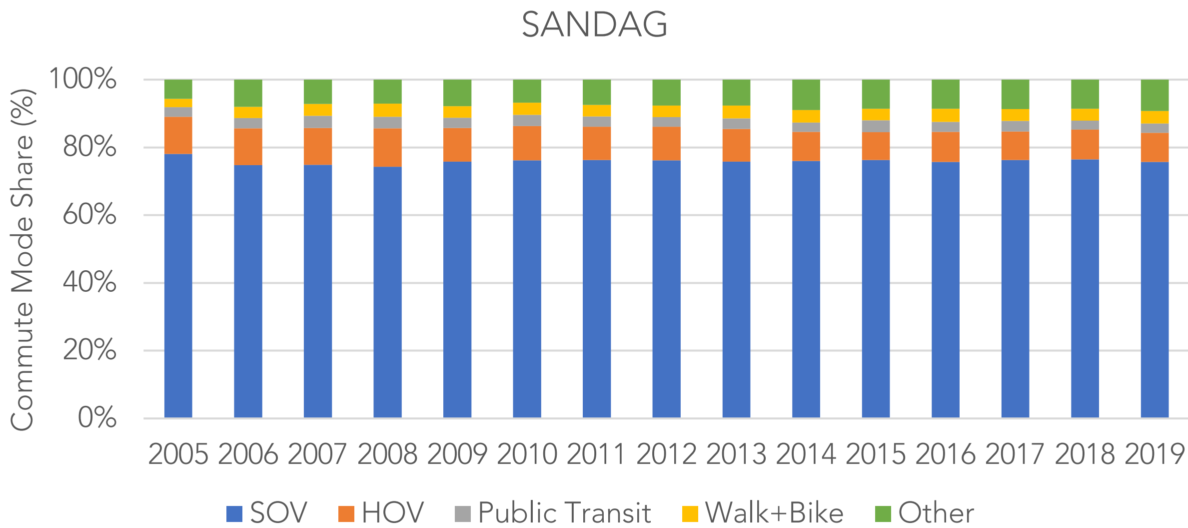
Big Four MPO Regions

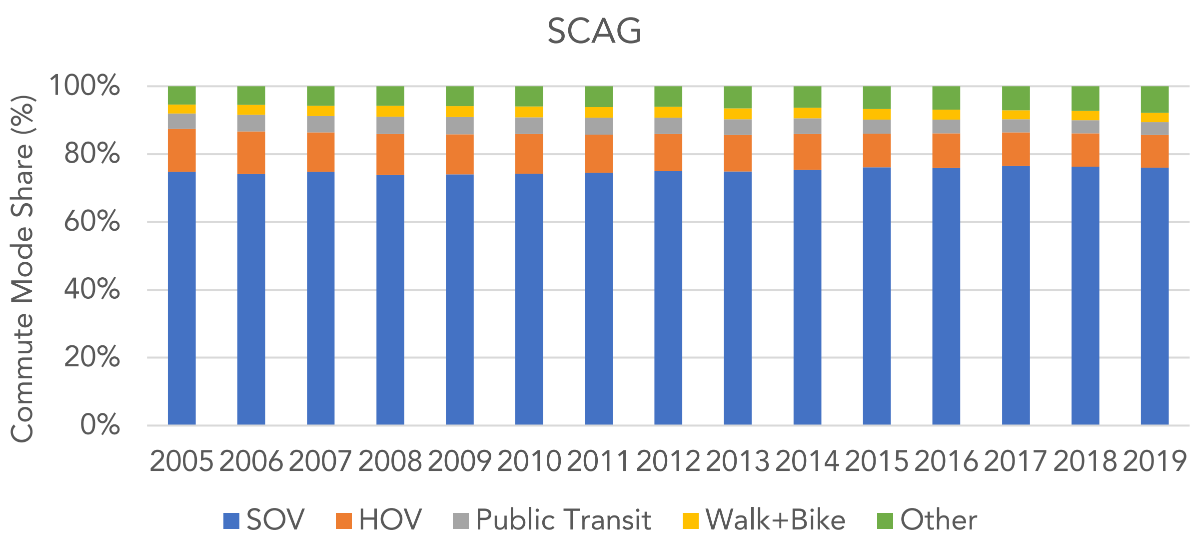
Having shown a snapshot of 2019 across California, **Figure 10** shows the temporal trends of the big 4 MPO regions over the last decade. These charts show changes in commute mode share from 2005 to 2019 in all MPO regions except TMPO due to lack of data. Among the big 4 MPO regions, MTC and SANDAG regions showed a decreasing share of driving modes, but SCAG and SACOG regions showed no substantial changes. MTC is the only MPO region that shows a noticeable increase in public transit mode share (about 4 percent since 2005). For commute trip purposes, the share of walk and bike modes are relatively small in the Big 4 MPO regions, as in all regions.

Figure 10. Temporal trends of commute mode share in the big 4 MPO regions





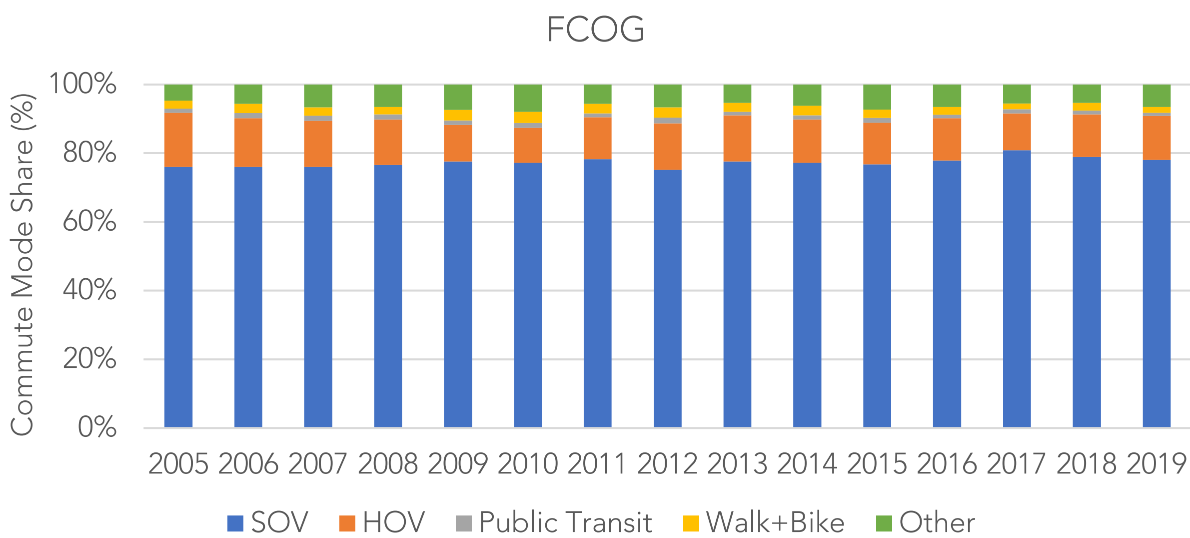


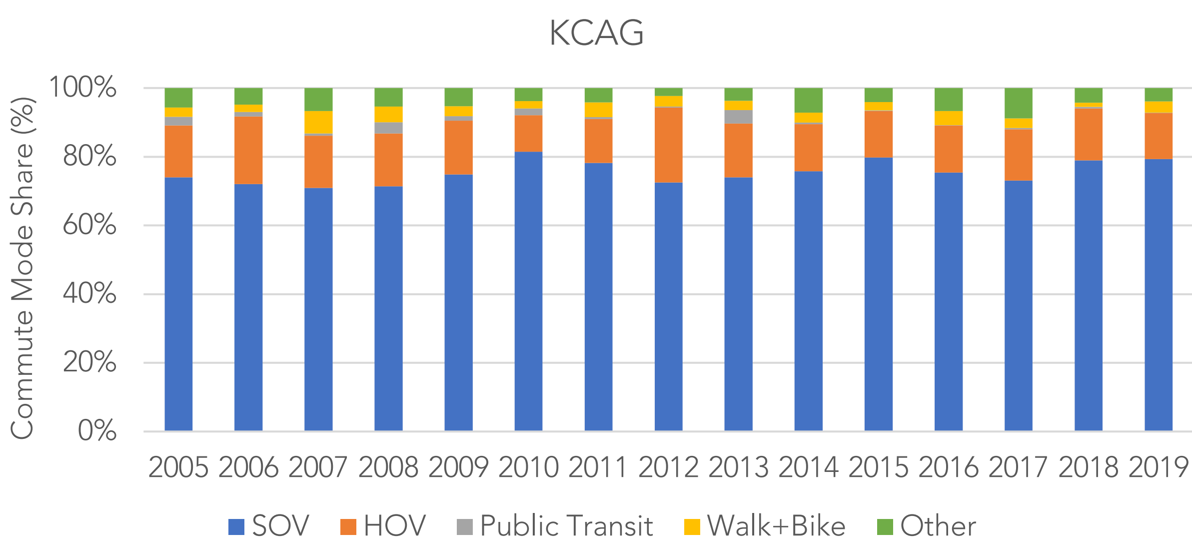


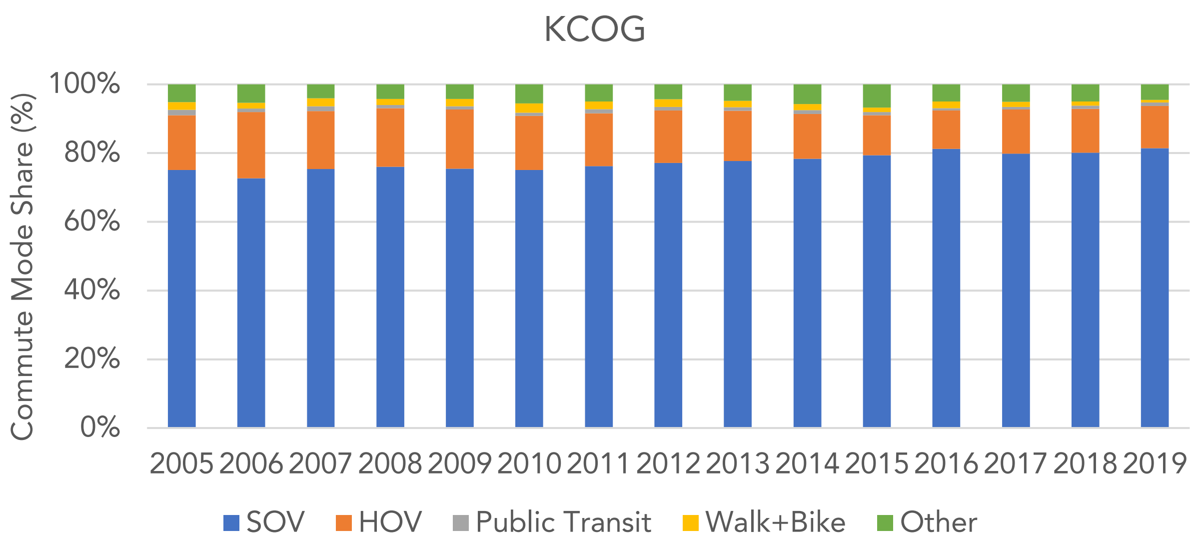
SJV MPO Regions

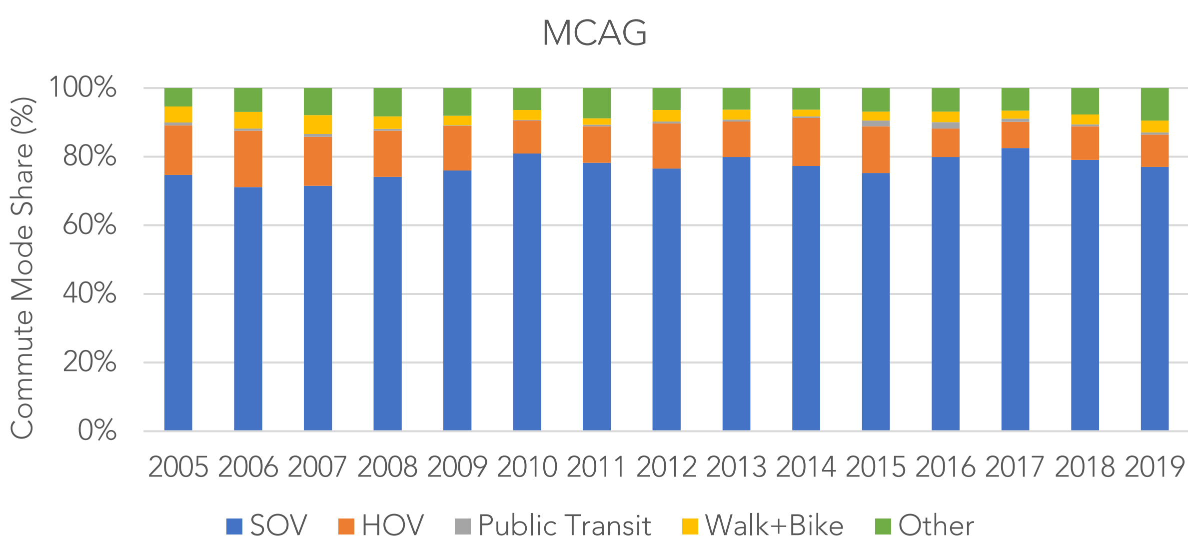
In the SJV region (**Figure 11**), SOV and HOV together accounted for about 90 percent of commute trips and did not show reductions in the analysis period. Further, the SOV mode share rose in all SJV MPO regions from 2005 to 2019. Such a stagnant trend in driving modes (SOV+HOV) with increasing trends of SOV are inconsistent with SCS plans and forecasts. Most MPOs include strategies to reduce personal vehicles and promote alternative modes (transit, active transportation) as a VMT/GHG reduction strategy and project a general decreasing trend of driving modes. Therefore, the observed mode share (high driving) could be a challenge for MPO regions to achieve their SB 375 targets.

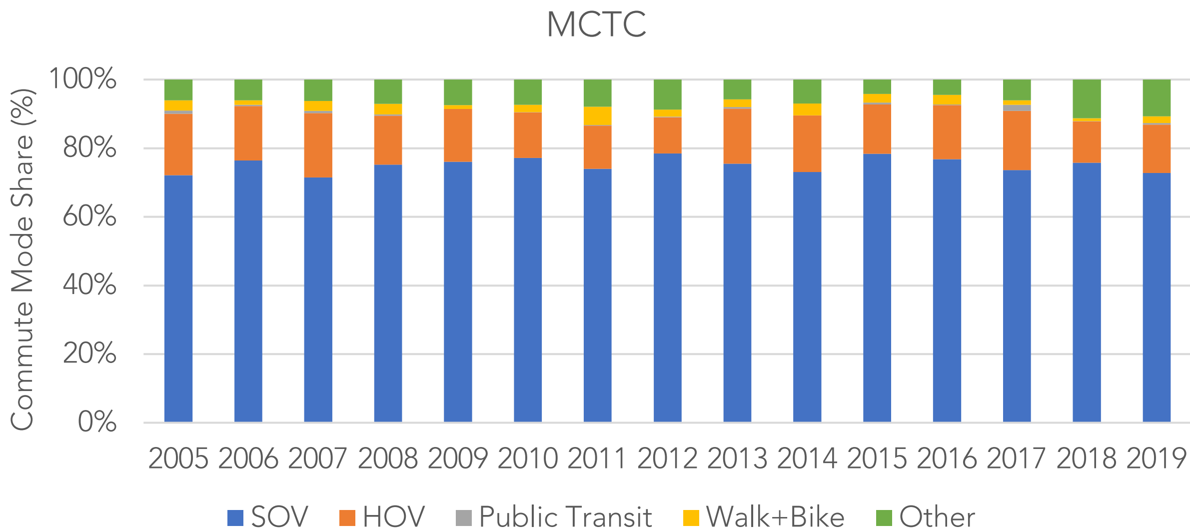
Figure 11. Temporal trends of commute mode share in the SJV MPO regions

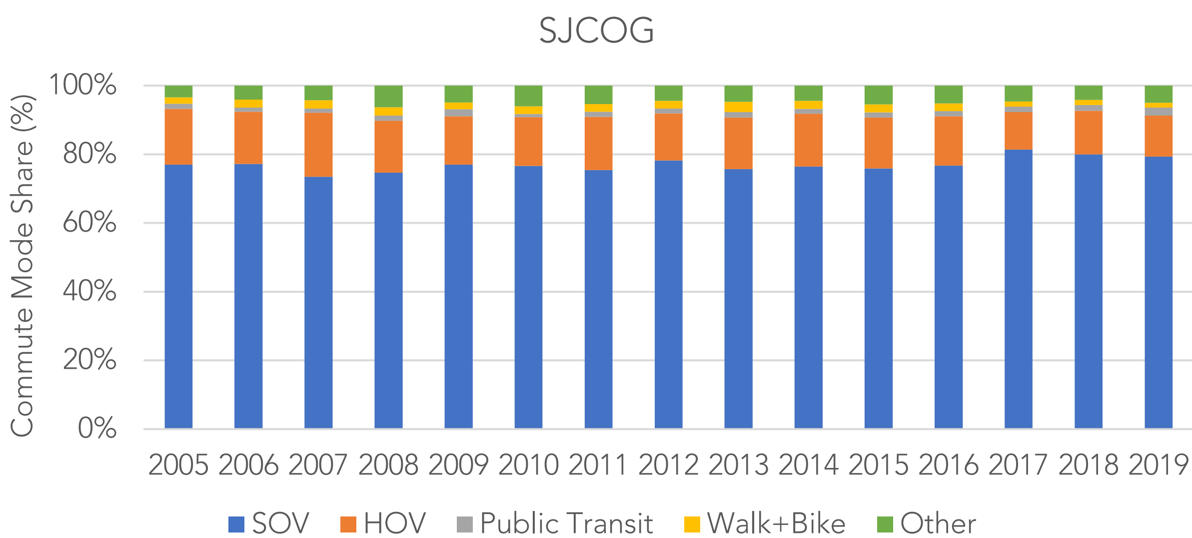


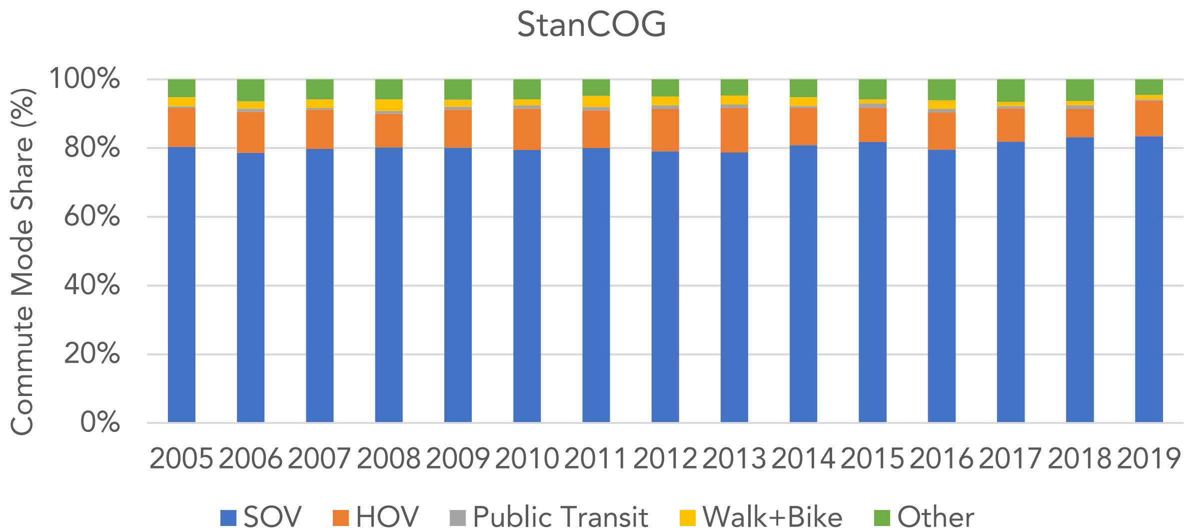


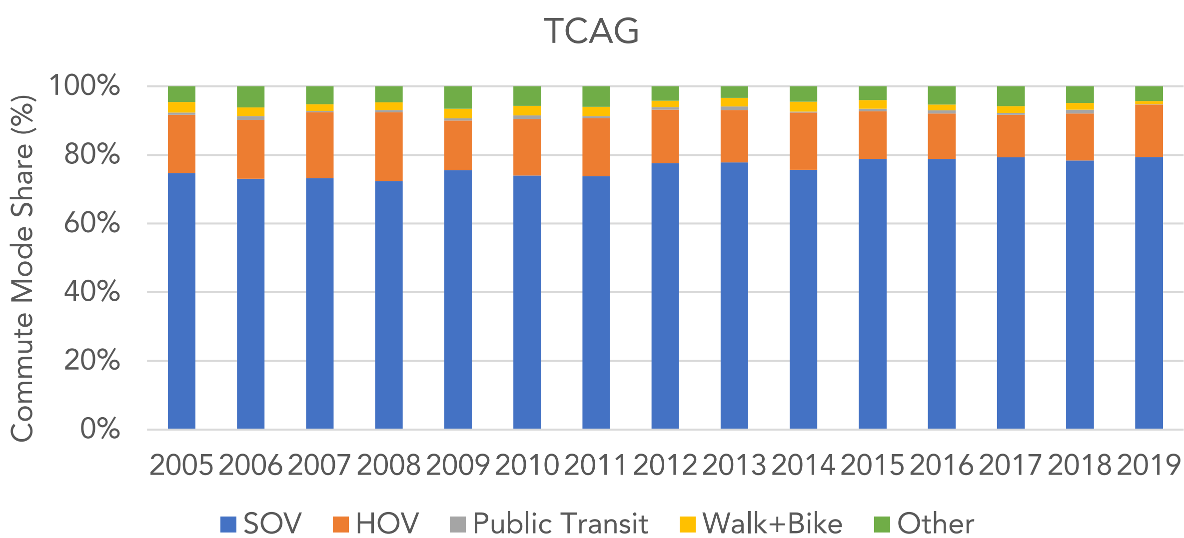

KCOG
Commute Mode Share (%)
100%
80%
60%
40%
20%
0%
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
SOV
HOV
Public Transit
Walk+Bike
Other


MCAG
Commute Mode Share (%)
100%
80%
60%
40%
20%
0%
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
SOV
HOV
Public Transit
Walk+Bike
Other


MCTC
Commute Mode Share (%)
100%
80%
60%
40%
20%
0%
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
SOV
HOV
Public Transit
Walk+Bike
Other


SJCOG
Commute Mode Share (%)
100%
80%
60%
40%
20%
0%
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
SOV
HOV
Public Transit
Walk+Bike
Other

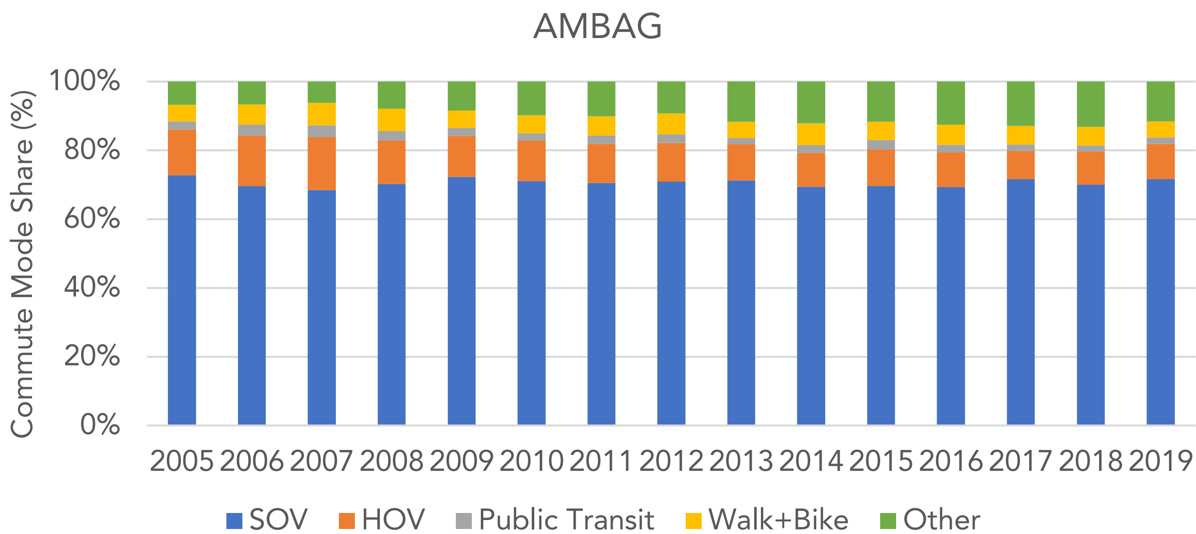


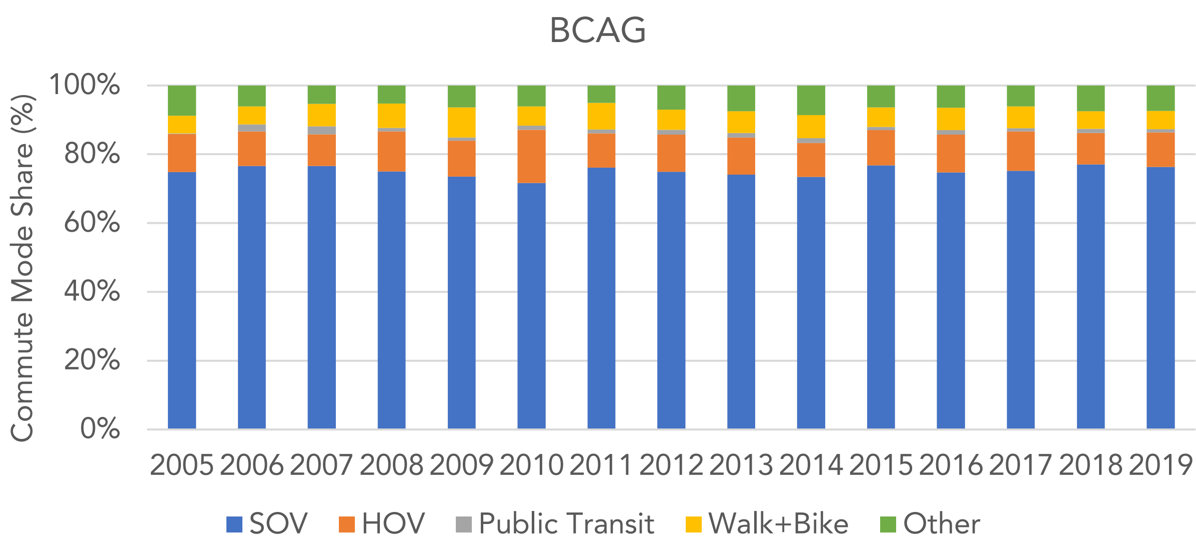


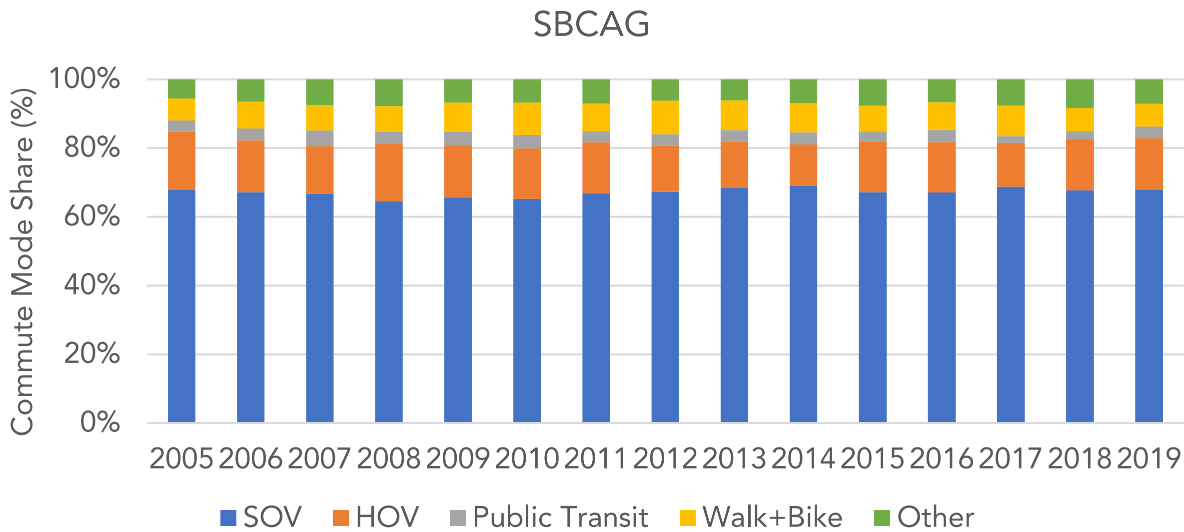
Coastal and Northern California MPO Regions

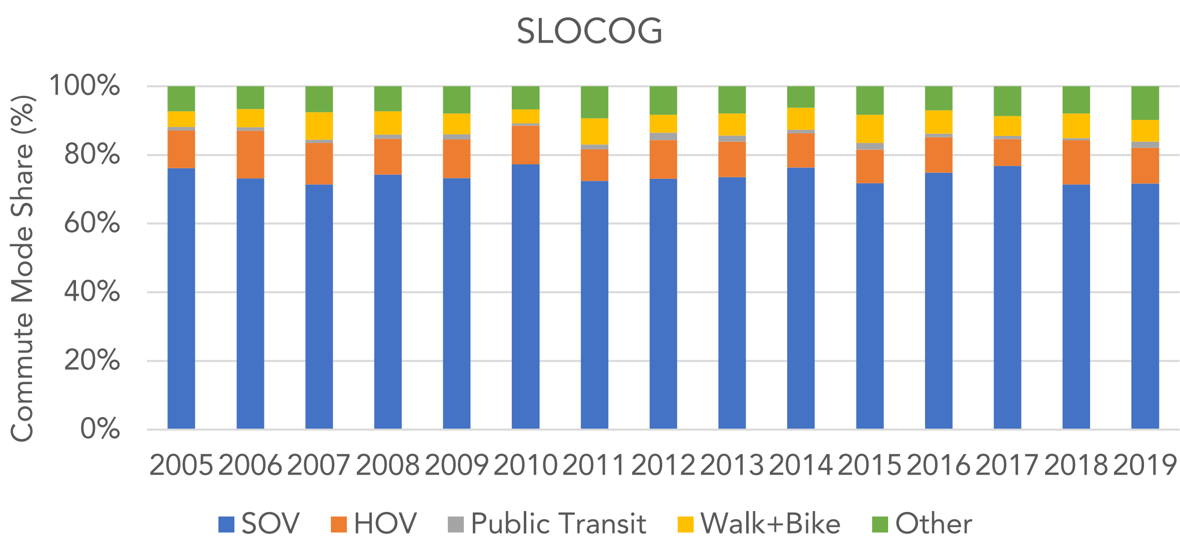
For the remaining MPO regions in the coastal and northern California (**Figure 12**), AMBAG, SBCAG, and SLCOG show a decreasing trend of SOV mode share from 2005 to 2019, while BCAG and SRTA do not. Meanwhile, SBCAG has the highest non-driving mode share (i.e., transit, walk, and bike combined, more than 17 percent in 2019) in this group.

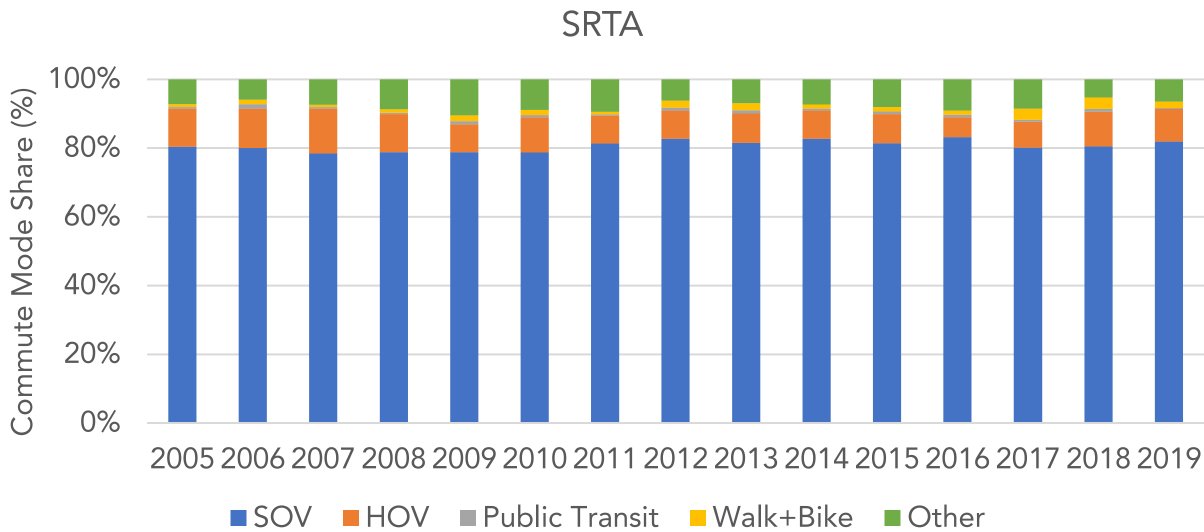
Figure 12. Temporal trends of commute mode share in the coastal and northern California MPO regions






SBCAG
Commute Mode Share (%)
100%
80%
60%
40%
20%
0%
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
SOV
HOV
Public Transit
Walk+Bike
Other


SLOCOG
Commute Mode Share (%)
100%
80%
60%
40%
20%
0%
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
SOV
HOV
Public Transit
Walk+Bike
Other



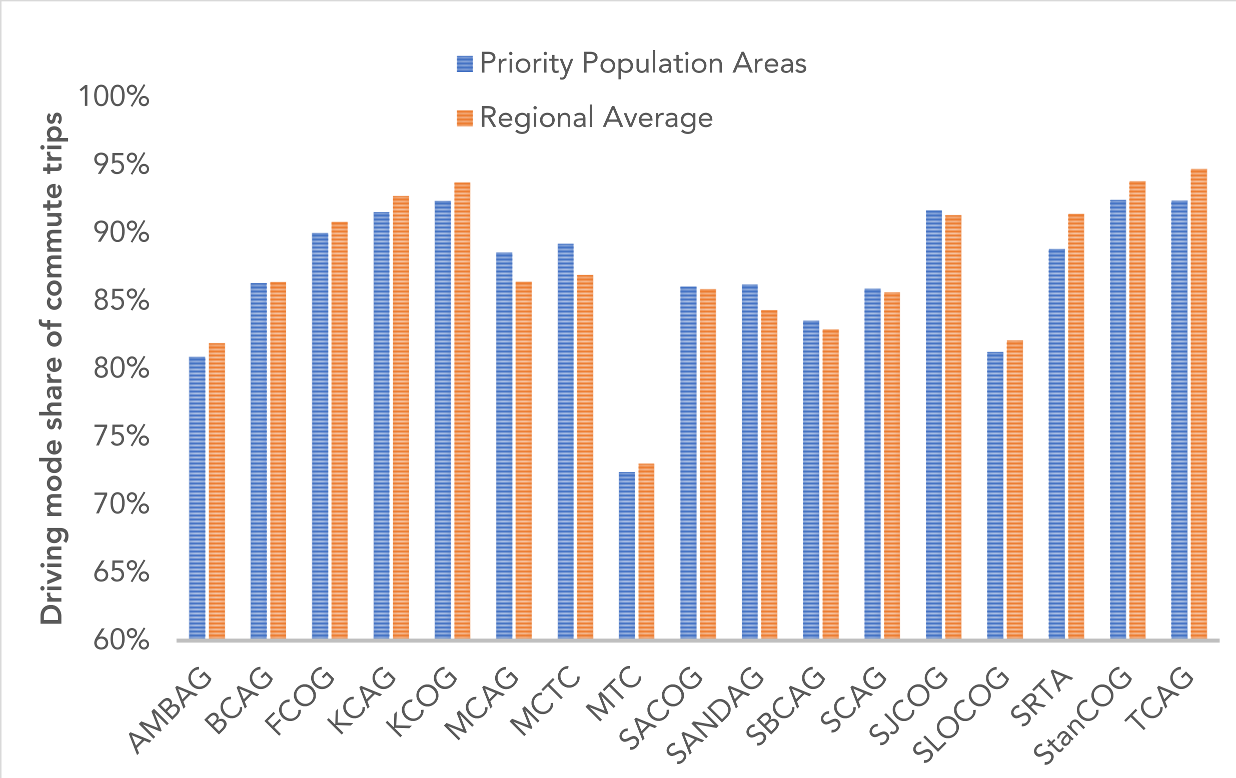
Commute Mode Share in Priority Population Areas

This report also analyzed the commute mode share in priority population census tracts. **Figure 13** compares the driving mode share in the priority population census tracts within each MPO region and the respective regional average in 2019.[13] The trends varied across regions, and the driving mode share in priority population areas is higher than the regional average in three of the Big 4 MPOs (i.e., SCAG, SACOG, and SANDAG). Long distances from job locations and the unavailability of reliable alternative modes in the urban areas are likely to contribute to such a pattern.

On the other hand, in many SJV MPO regions and in the remaining northern and coastal MPO regions, the driving mode share of the priority population areas is lower than the regional average. According to previous studies, the low SOV mode share in these regions could be due to economic challenges and lower vehicle ownership[14].

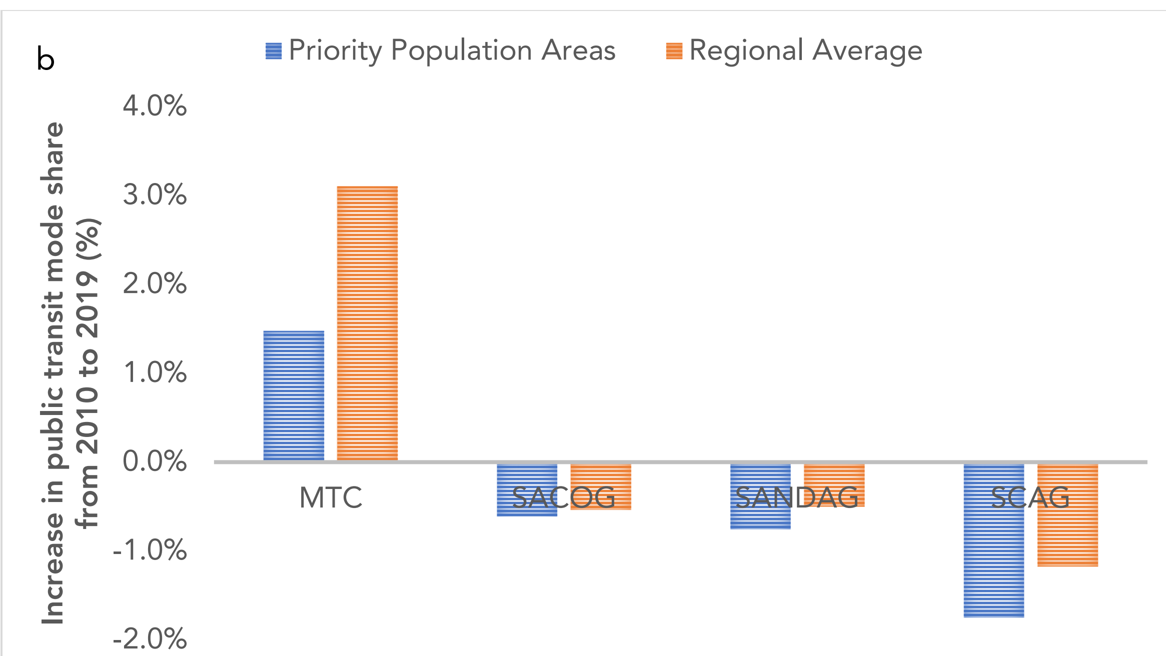
[13] TMPO is not analyzed due to lack of data availability.
[14] Karner, A., & London, J. (2014). Rural communities and transportation equity in California's San Joaquin Valley. Transportation Research Record, 2452(1), 90-97.

Figure 13. Driving mode share (i.e., drive alone and carpool) of commute trips for the priority populations and regional average in 2019



To further understand and compare the rate of change in the priority population mode share relative to the regional average, **Figure 14** (a) shows the change in SOV mode share between 2010 and 2019 for the Big 4 MPO regions. The regional SOV mode share reduced in MTC (-4%) and SANDAG (-0.5%) and slightly increased in SACOG (+0.6%) and SCAG (+1.8%). In contrast, for priority populations, there was a minor decrease in MTC (-1%) and increases in SACOG (+4%), SANDAG (+2.7%), and SCAG (+4%). Not surprisingly, the transit mode shares in priority population areas decreased more than regional average levels, although their 2010 baseline levels were higher. As shown in **Figure 14** (b), the regional average transit mode share increased in MTC (+3.1%) and decreased in SACOG (-0.5%), SANDAG (-0.5%), and SCAG (-1.2%). For priority population tracts, the transit mode share increased somewhat in MTC (+1.5%) for priority populations and dropped in the other three MPO regions more rapidly than the regional average. Overall, these trends suggest that the driving mode share for commute has gone up, and the public transit share has gone down in the four largest MPO regions within priority population areas in the last decade. Though SCSs invest in and promote public transit, observed data indicate that people in priority population areas are shifting their commute modes to driving.

Figure 14. (a) Temporal Change in SOV mode share in the Big 4 MPO regions; (b) temporal change in public transit mode share in the Big 4 MPO regions

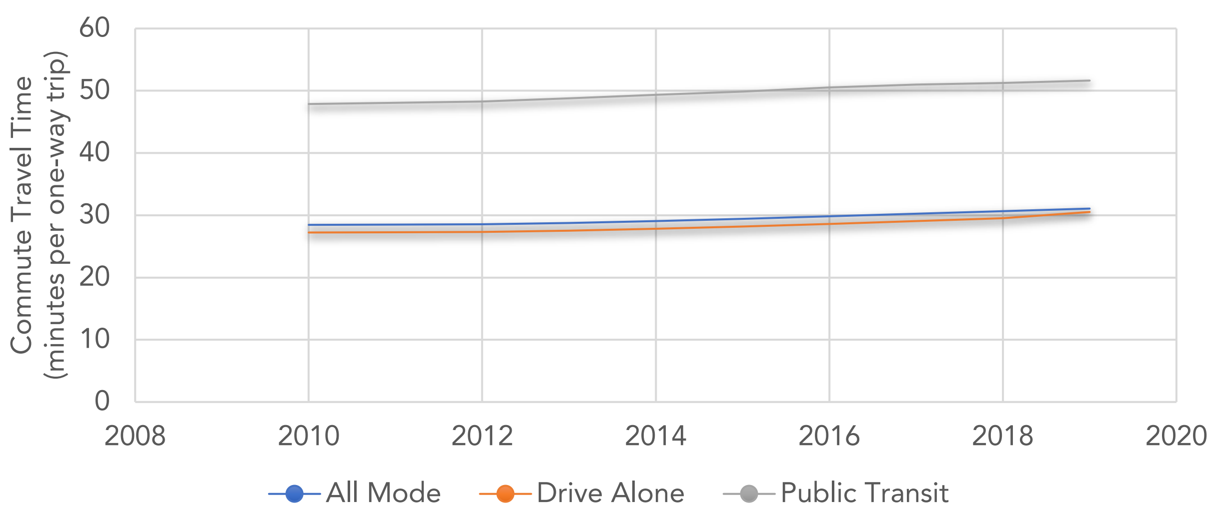


Commute Travel Time by Mode

California workers need to find a way to get to their work sites on a typical workday, except for telework individuals. The location of their residence, transportation modes available, duration of travel, and road congestion level all play vital roles in determining the commute travel time. Therefore, commute travel time by mode is an essential transportation metric to reflect the overall condition of the transportation network and ease of travel.

The ACS collects commute travel time data every year and reports at the census block level, which tracks the change in commute travel time over the period. Based on ACS data, CARB staff analyzed commute travel times in each MPO region and in California. **Figure 15** shows the commute travel time in California for all modes combined, drive alone, and public transit over the past decade. Transit travel time is much higher than drive alone and all modes combined. Furthermore, the combined mode and drive alone travel time have increased by over 2 minutes (8% and 12%, respectively), and the transit travel time has increased by 4 minutes (8%) per trip on average. One caveat in estimating travel time using ACS is that the data source only provides travel in 5- to 15-minute intervals (i.e., 0-5 minutes, 45-59 minutes, etc.), and the longest travel time group is 60 minutes and more. Therefore, CARB staff used the midpoint for all groups and 75 minutes for the 60+ travel time groups to estimate the average travel time.

Figure 15. Commute travel time for all modes combined, drive-alone, and public transit modes in California

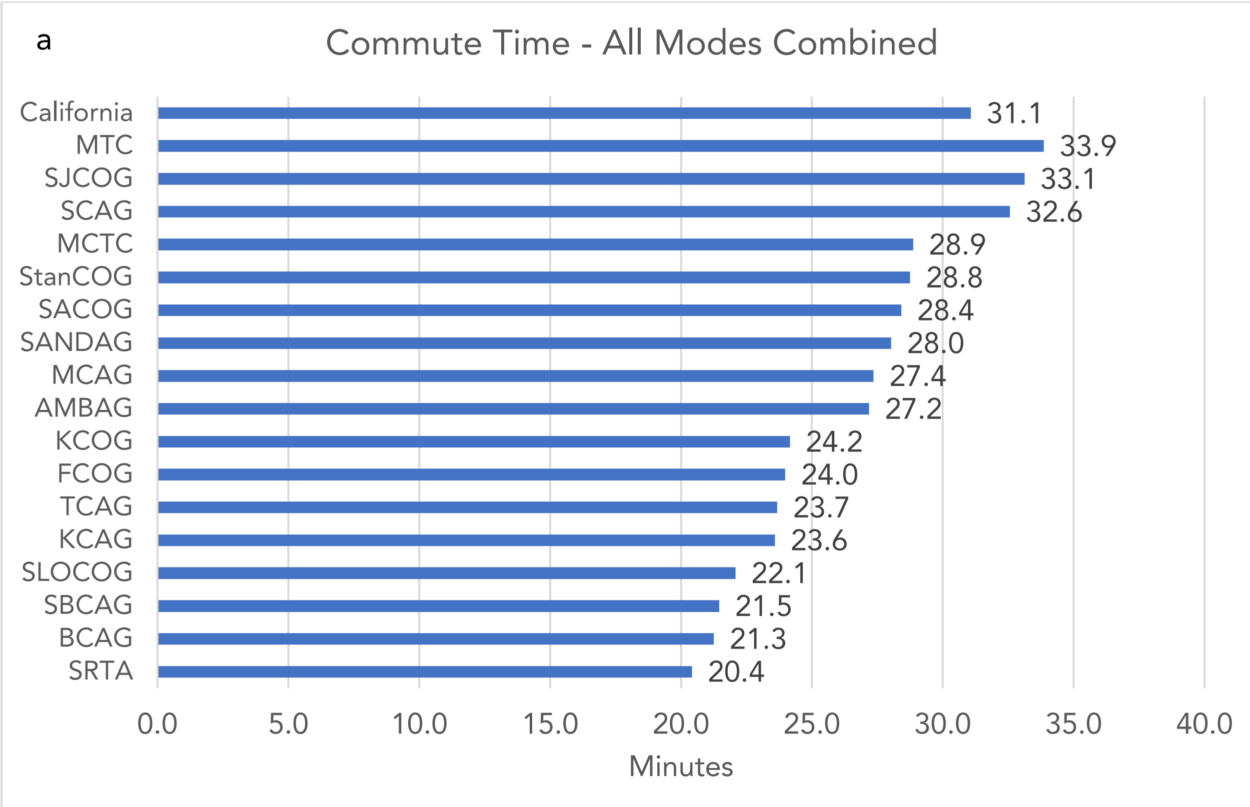


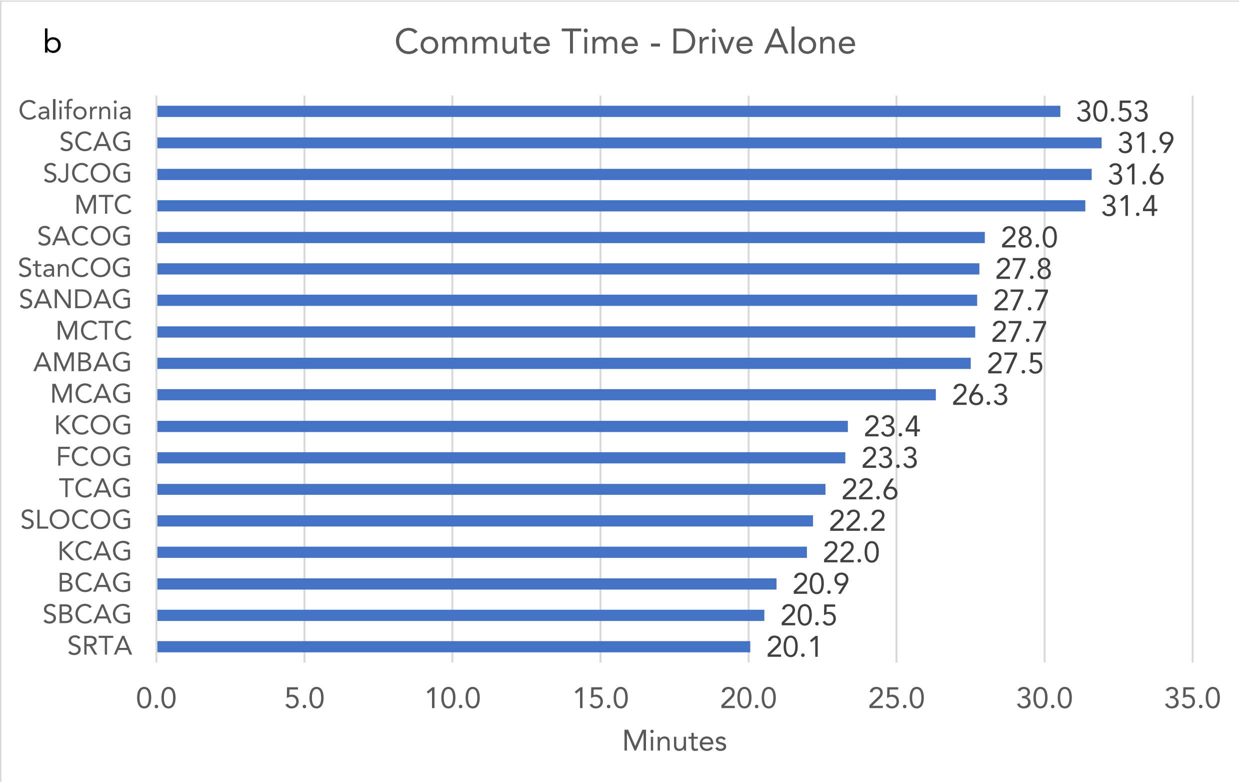
Having examined the statewide trends, CARB staff also calculated the commute travel time for each MPO region to facilitate a spatial comparison. To analyze the regional commute travel time in 2019, CARB staff aggregated the block-level commuter person-time (i.e., number of commuters multiplied by commute time) into the MPO level. Then, the MPO-level commuter person-time was divided by the commuter population by mode in each MPO region to estimate the average regional commute time.

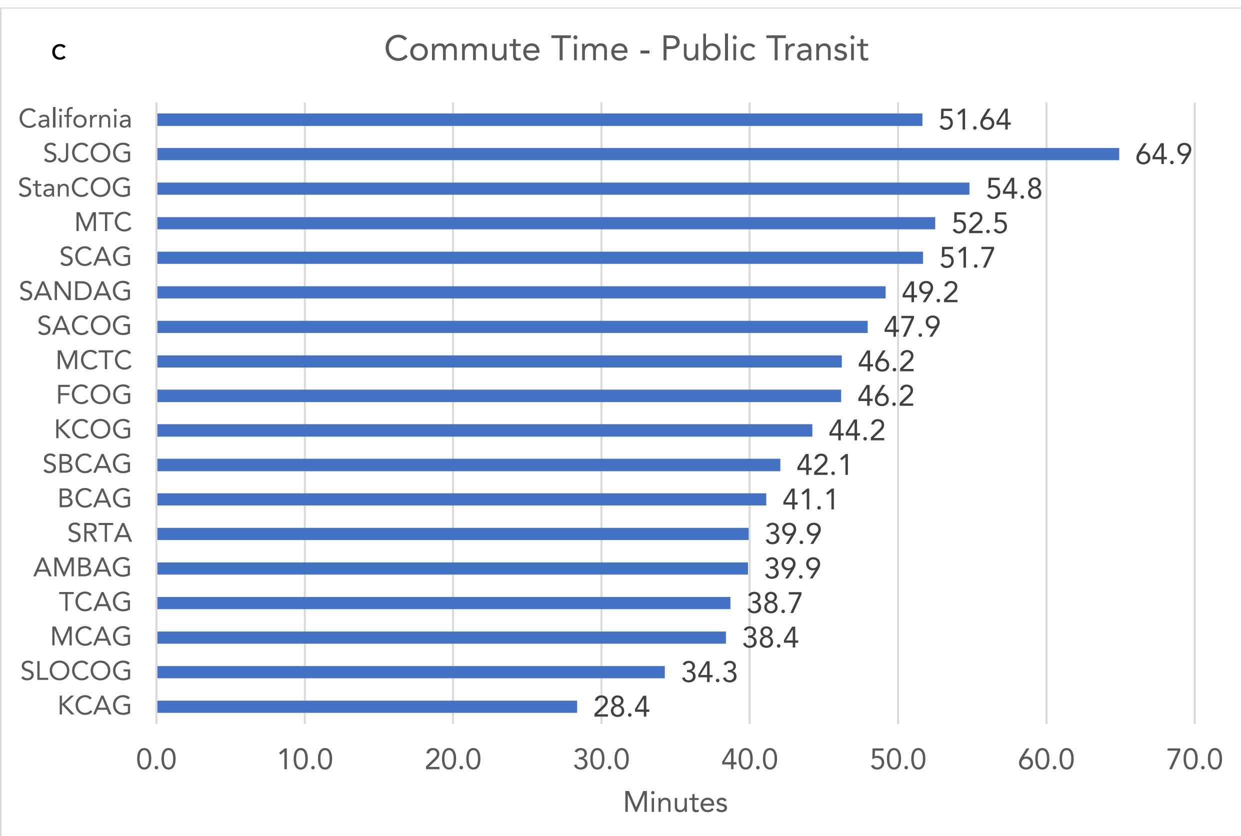
Figure 16 shows average commute travel time statewide and in each MPO region for all modes combined, drive alone, and public transit, ranking high to low in 2019. It is not surprising that MTC (33.9 minutes) and SCAG (32.6 minutes) have some of California's longest commute travel times. This is because commuters living in these MPO regions may travel far to their workplace, which leads to long travel times. For example, people who live in Santa Clara and Orange County may travel to San Francisco and downtown Los Angeles for work, respectively. Further, long commutes may also be due to congestion and inadequate alternative mode choices in some regions.

In addition, some northern SJV MPO regions (SJCOG and StanCOG) also have relatively long commute travel times by drive alone and public transit. This may be due to people living in SJCOG and StanCOG traveling to the Bay Area for work.

Figure 16. Average commute travel time by MPO in 2019 for (a) all modes combined, (b) drive alone, and (c) public transit



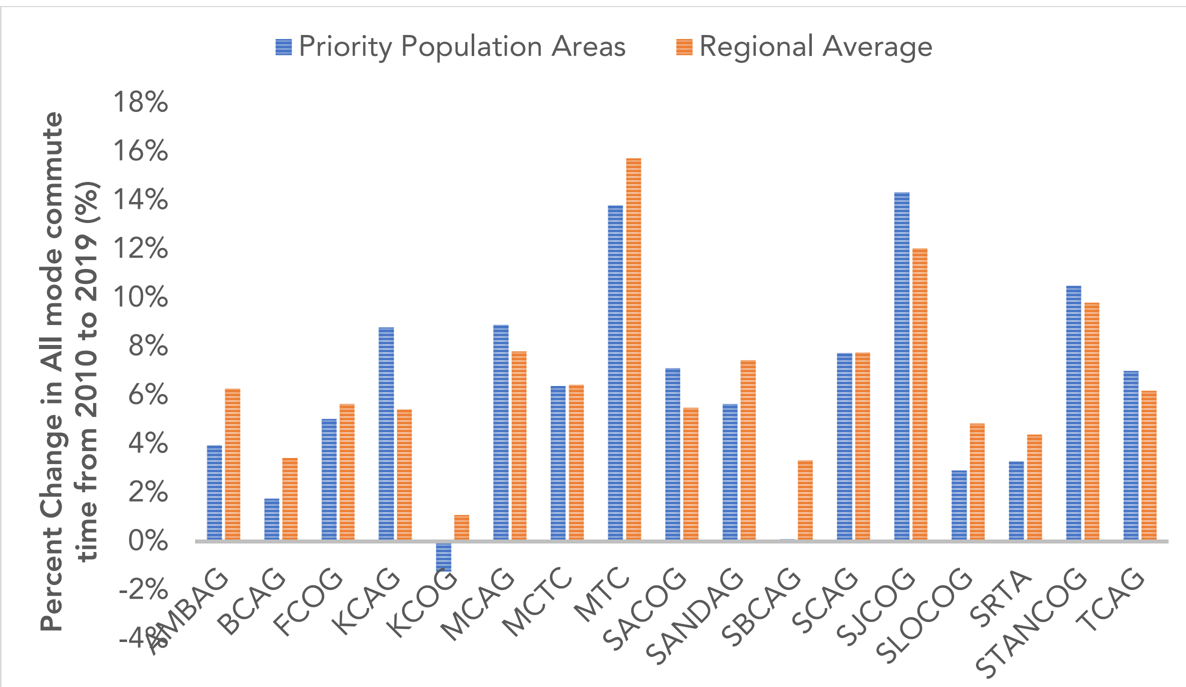

b
Commute Time - Drive Alone
California 30.53
SCAG 31.9
SJCOG 31.6
MTC 31.4
SACOG 28.0
StanCOG 27.8
SANDAG 27.7
MCTC 27.7
AMBAG 27.5
MCAG 26.3
KCOG 23.4
FCOG 23.3
TCAG 22.6
SLOCOG 22.2
KCAG 22.0
BCAG 20.9
SBCAG 20.5
SRTA 20.1
0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0
Minutes


c
Commute Time - Public Transit
California 51.64
SJCOG 64.9
StanCOG 54.8
MTC 52.5
SCAG 51.7
SANDAG 49.2
SACOG 47.9
MCTC 46.2
FCOG 46.2
KCOG 44.2
SBCAG 42.1
BCAG 41.1
SRTA 39.9
AMBAG 39.9
TCAG 38.7
MCAG 38.4
SLOCOG 34.3
KCAG 28.4
0.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0
Minutes

Commute Travel Time in Priority Population Areas

Figure 17 shows the relative change of commute travel time by all modes combined between 2010 and 2019 for priority population areas within each MPO region and their respective regionwide travel time. In some MPO regions, the travel time increased more for people living in priority population areas than the regional average and reversed in other MPO regions. The travel time increased in priority population areas could mean that some residents of priority population areas changed jobs such that their commute increased or that new residents who have a longer commute moved into priority population areas. The regions in which travel time increased for priority populations more than the regional average are mostly in SJV MPO regions such as Kings, Merced, San Joaquin, Stanislaus, and Tulare. Given the mixed results, more research may be needed to understand and interpret these findings.

Figure 17. Comparison of a percent change in all mode commute travel time from 2010 to 2019 between priority populations and the regional average

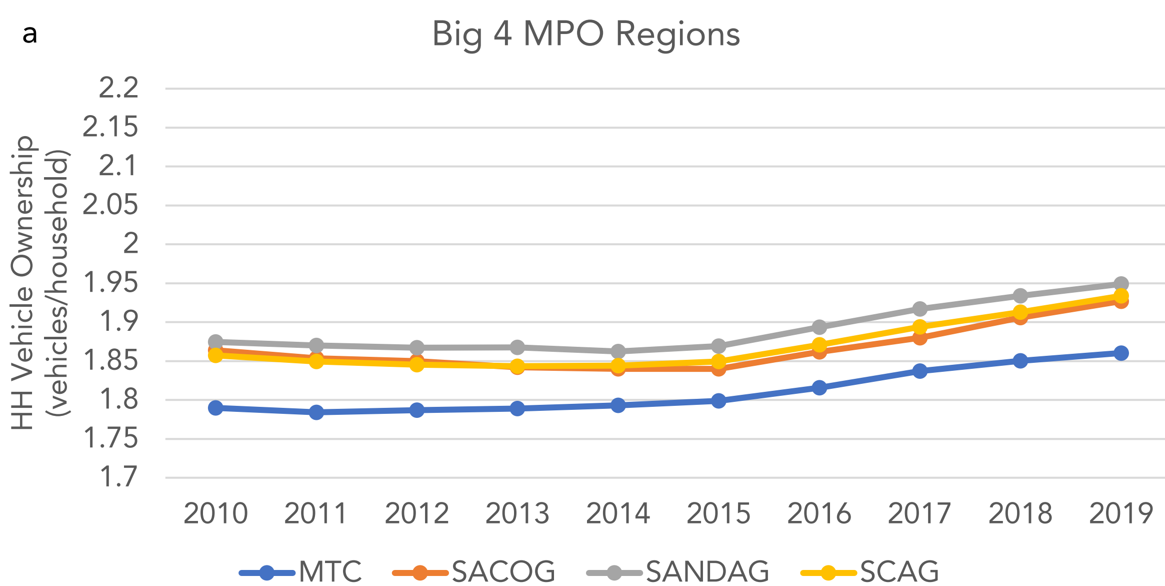


Vehicle Ownership

Vehicle ownership is a key metric that helps to explain travel choices and changes in commute patterns. Many MPOs identify ridesharing programs as part of SCSs to enhance mobility, reduce the need to drive, and mitigate GHG emissions. Therefore, CARB staff analyzed the trend in household vehicle ownership by MPO region from 2010 to 2019. This metric reports the average number of privately owned vehicles by each household in the respective MPO region and is estimated by dividing the total number of privately owned vehicles by the number of households. This analysis uses the tract-level privately owned vehicle data and household data from the ACS 1-year reports from 2010 to 2019.

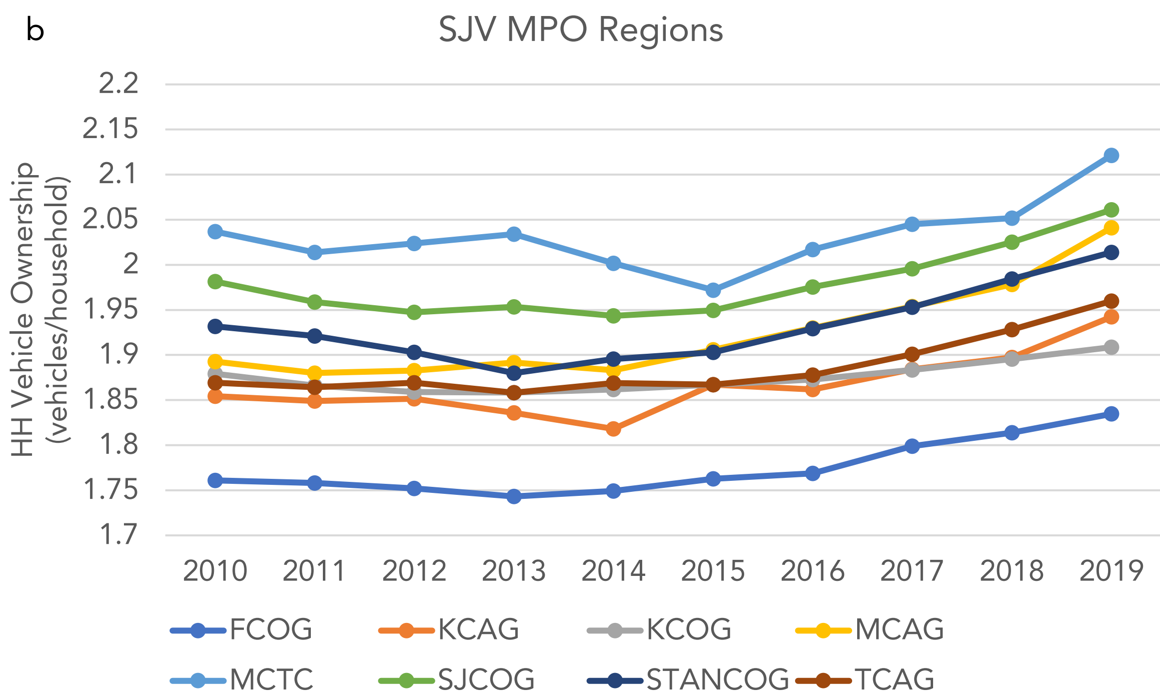
CARB staff presented the household vehicle ownership trends in the Big 4, SJV, coastal and northern California MPO regions[15] in **Figure 18**. The trends are largely consistent across most MPO regions that household vehicle ownership has been steadily increasing over the past decade.

Figure 18. Temporal trends of the household vehicle ownership in the (a) Big 4 MPO regions, (b) SJV MPO regions, and (c) remaining MPO regions in the coastal and northern California

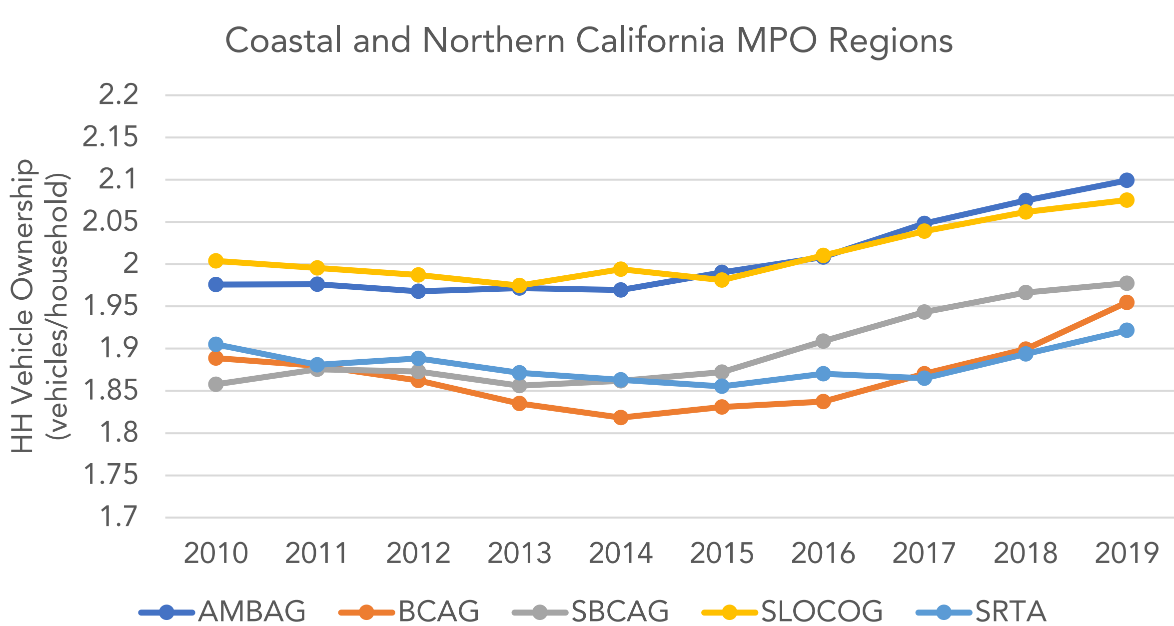


[15] TMPO is not available due to lack of data.

b


SJV MPO Regions
HH Vehicle Ownership (vehicles/household)
2.2
2.15
2.1
2.05
2
1.95
1.9
1.85
1.8
1.75
1.7
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
FCOG
KCAG
KCOG
MCAG
MCTC
SJCOG
STANCOG
TCAG

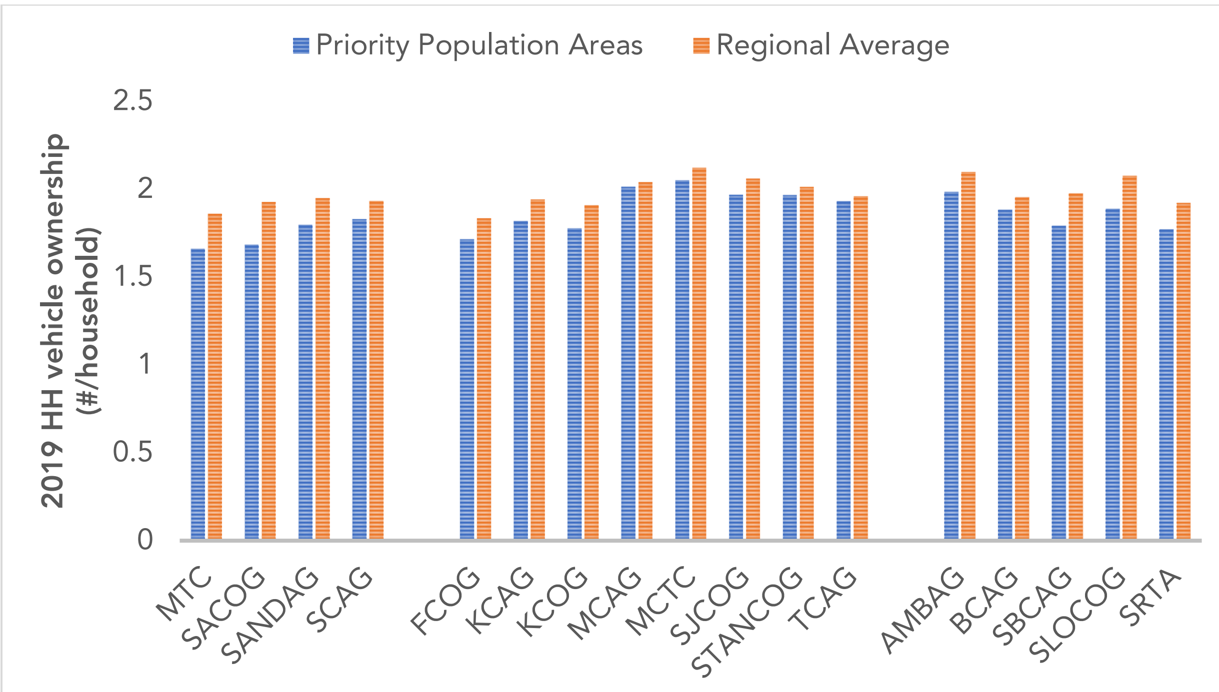
c


Coastal and Northern California MPO Regions
HH Vehicle Ownership (vehicles/household)
2.2
2.15
2.1
2.05
2
1.95
1.9
1.85
1.8
1.75
1.7
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
AMBAG
BCAG
SBCAG
SLOCOG
SRTA

Vehicle Ownership in Priority Population Areas

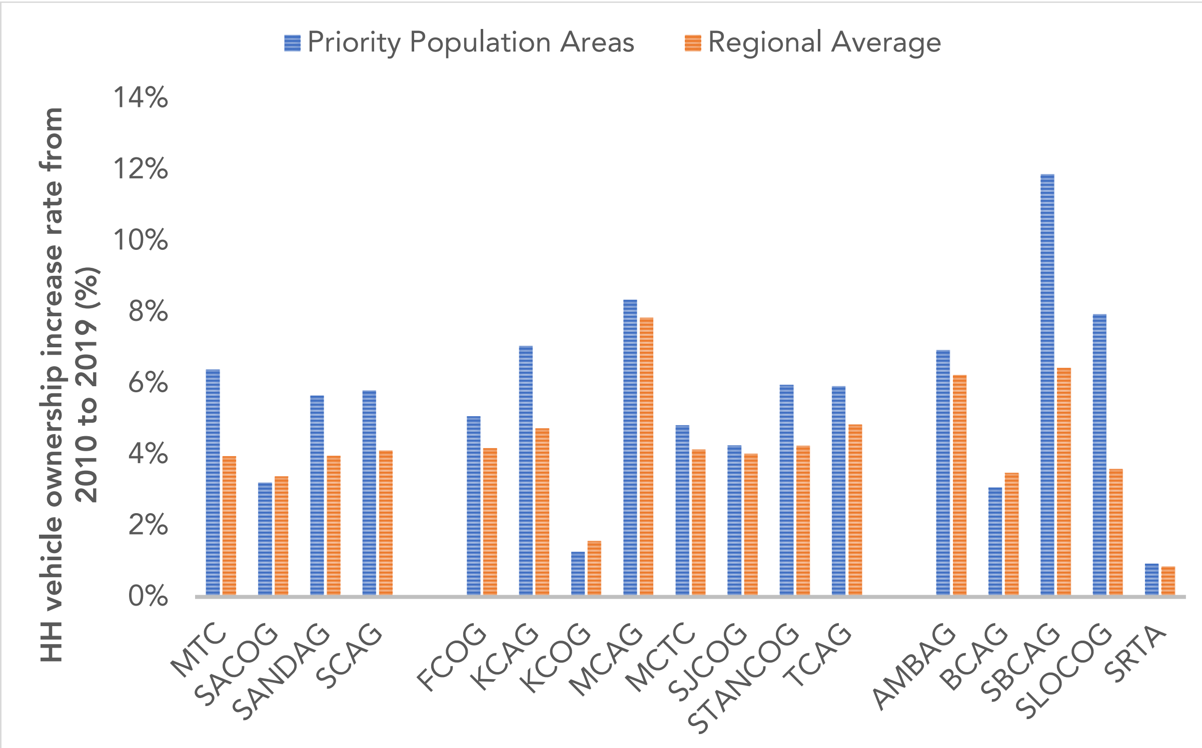
CARB staff also analyzed vehicle ownership in priority population areas in California. **Figure 19** shows that the average household vehicle ownership in priority population areas is lower than the respective regional average for all MPO regions.

Figure 19. Comparison between regional average vehicle ownership and priority population vehicle ownership in each MPO region in 2019.



In the meantime, the temporal analysis presented in **Figure 20** shows that the vehicle ownership rate increased faster in priority population areas in most MPO regions over the past decade, including MTC, SCAG, SACOG, seven SJV MPOs, and four northern and coastal regions. For example, in SBCAG and SLOCOG regions, the increase in vehicle ownership rate in the priority population areas is double that of the regional average. This trend suggests that residents of priority population areas may be needing to drive more and that it will be important to add targeted strategies that support a variety of transportation modes in these areas. This trend also suggests that strategies like EV incentives and EV infrastructures in priority population areas will be especially important to boost their EV adoption rates as they purchase vehicles. Alternatively, new residents who own vehicles at a higher rate may be moving into priority population areas. Further analysis may be needed to understand this trend better.

Figure 20. Increase in vehicle ownership in priority population areas relative to regional average by MPO regions from 2010 to 2019



Lane Miles Built

Increasing roadway capacity is commonly considered an approach to address traffic congestion. However, studies have found that adding roadway capacity increases network-wide VMT by inducing more travel[16]. Therefore, increases in lane miles could negatively affect a region's achievement of the SB 375 targets.

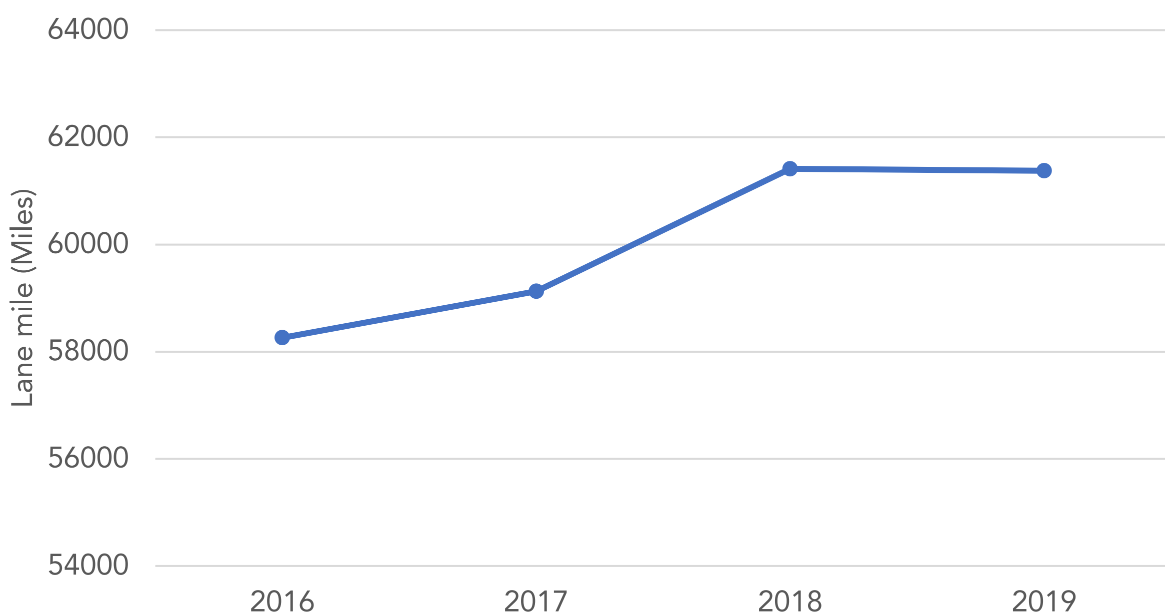
CARB staff analyzed the changes in statewide and regional interstate and principal arterial road lane miles using the HPMS annual reports from 2016 to 2019. HPMS also provided lane miles data in the 2012-2014 period. However, due to a method change in 2015, the 2012-2014 period lane mile data were not directly comparable to later years and were excluded from this analysis.

Figure 21 shows the trend of total interstate and principal arterial lane miles in California, which has increased 5.4 percent, from 58,258 miles in 2016 to 61,376 miles

[16] Handy, S., & Boarnet, M. G. *Impact of Highway Capacity and Induced Travel on Passenger Vehicle Use and Greenhouse Gas Emissions: Policy Brief*. Prepared for the California Air Resources Board. Retrieved from: https://ww2.arb.ca.gov/sites/default/files/2020-06/Impact_of_Highway_Capacity_and_Induced_Travel_on_Passenger_Vehicle_Use_and_Greenhouse_Gas_Emissions_Policy_Brief.pdf

in 2019. The significant increase in lane miles happened during 2017 and 2018. **Figures 22** and **23** show the total and per capita changes of lane miles by MPO region. The data show the SCAG and MTC regions had a significant increase in total lane miles, and KCOG, MCAG, and SACOG regions had the highest increase in per capita lane miles during the 2016-2019 period. Negative values were found in a few MPO regions, including SCAG, SACOG, AMBAG, SRTA, and SJCOG, likely due to road closure and/or construction. Roadway expansion projects may increase VMT and GHG emissions. According to the National Center for Sustainable Transportation, a 10 percent increase in roadway capacity is likely to increase network-wide VMT by 6 to 10 percent in 5 to 10 years[17], which could adversely affect the achievement of SB 375 goals.

Figure 21. Interstate and principal arterial road lane miles in California from 2016 to 2019



[17] Background on Induced Travel, NCST: https://travelcalculator.ncst.ucdavis.edu/about.html

Figure 22. Change in total interstate and principal arterial lane miles from 2016 to 2019 by MPO region

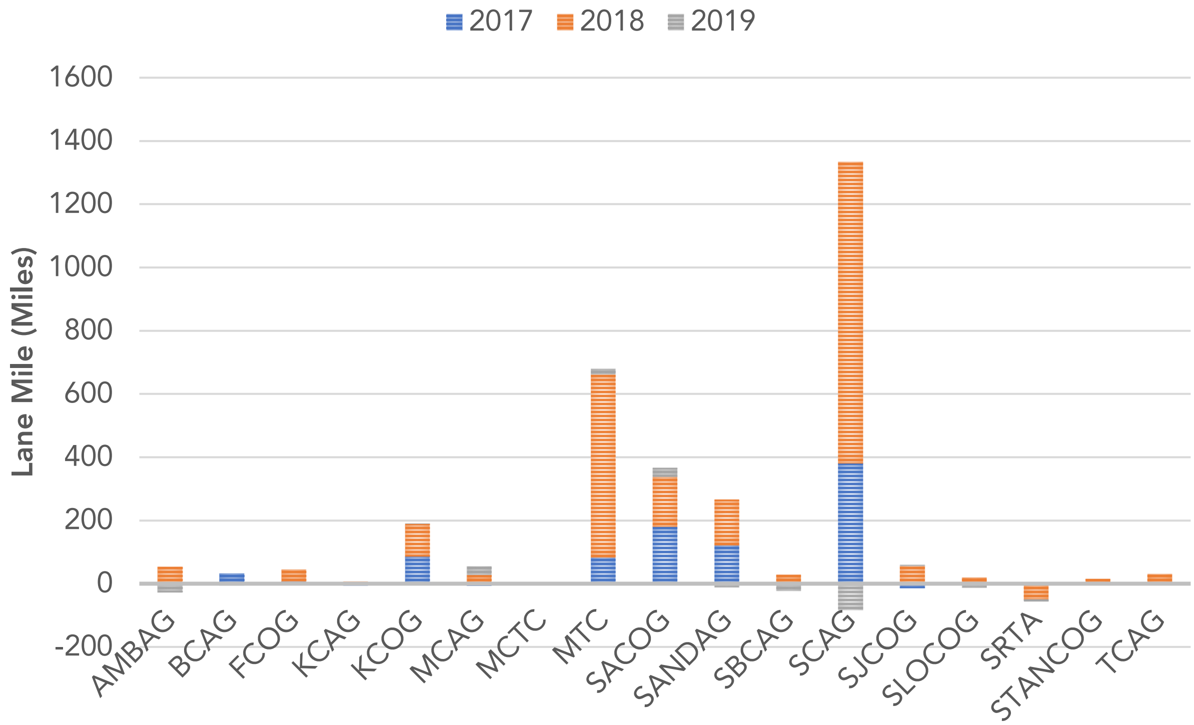
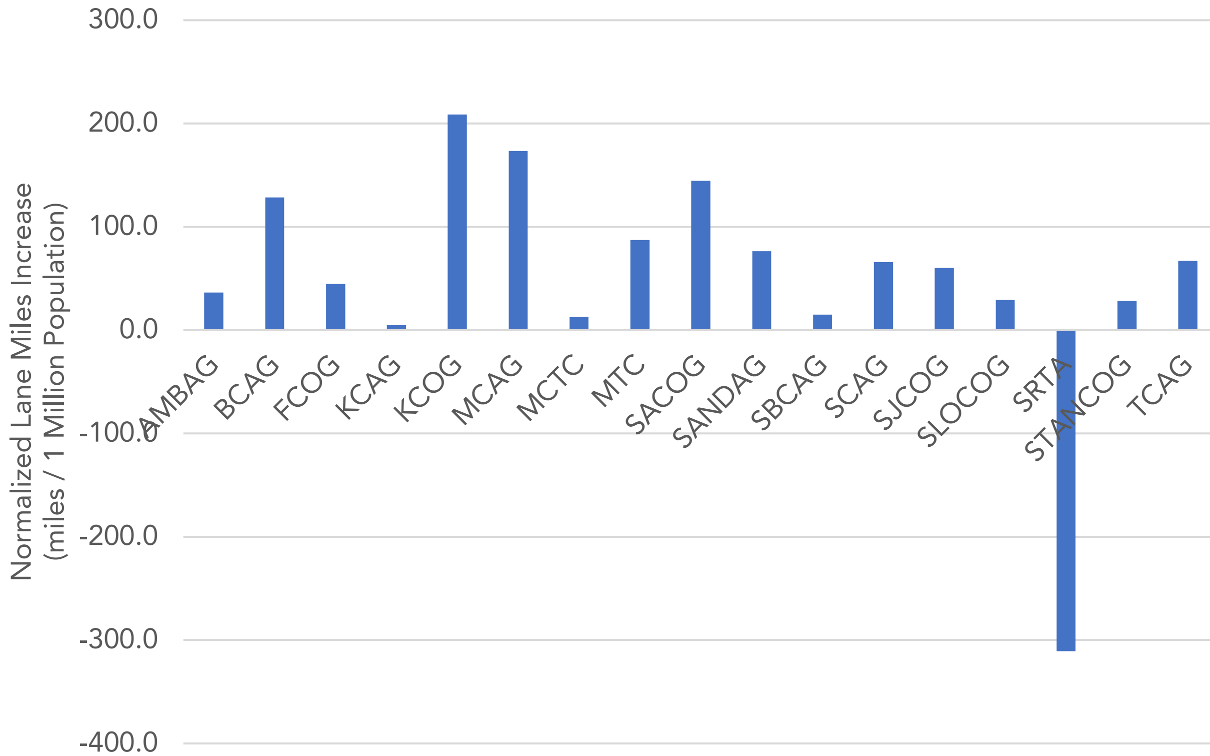


Figure 23. Change in per capita interstate and principal arterial lane miles from 2016 to 2019 by MPO region



Transit Ridership Per Capita

Transit ridership is a critical metric that can reflect people's travel behavior in a region. The National Transit Database (NTD) publishes monthly transit boarding numbers (unlinked trips) reported by local transit agencies. CARB staff analyzed the monthly boarding numbers from this database[18] and calculated the annual boarding numbers in every MPO region from 2005 to 2020. Further, CARB staff converted total boarding to annual per capita transit boarding to account for variation in the regional population.

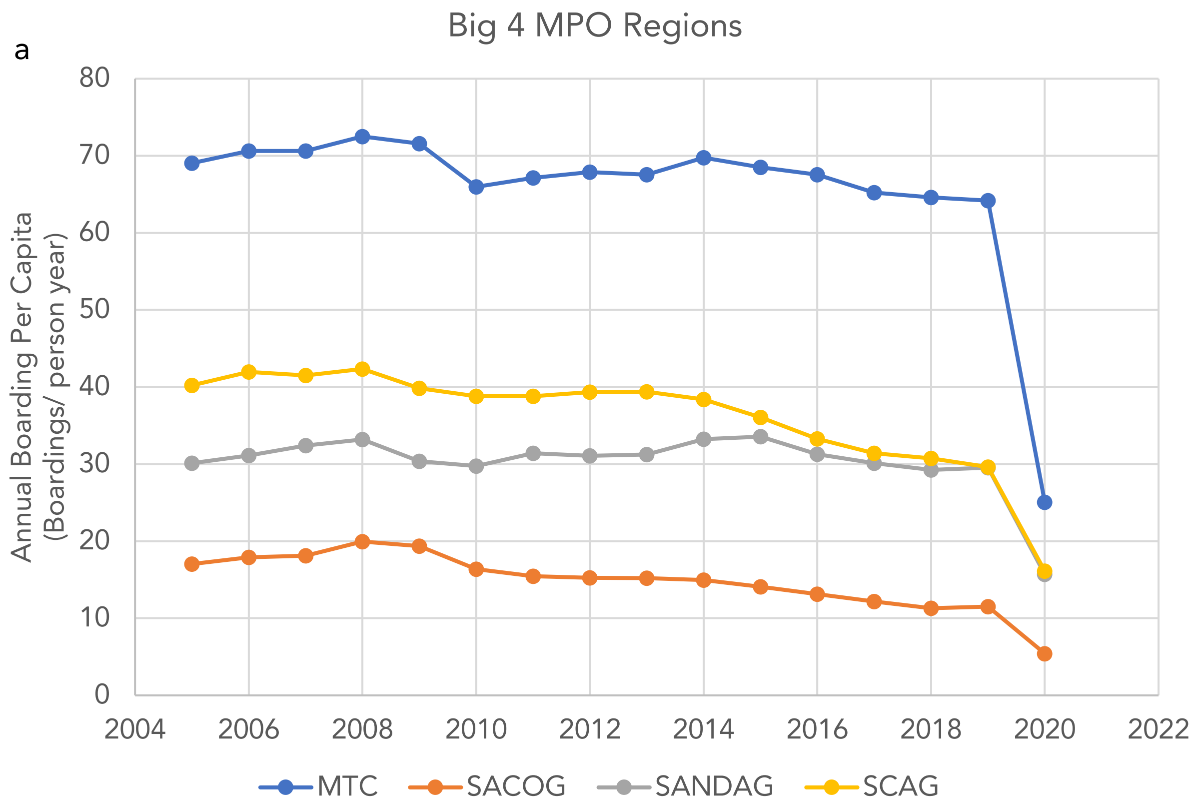
CARB staff shows the per capita annual transit boarding trends in **Figure 24**, grouped by the Big 4, SJV, and the remaining coastal and northern California MPO regions. The charts show that most MPO regions' transit ridership boarding numbers decreased from 2005 to 2019, especially since 2014. The only exceptions are SJCOG and SLOCOG. SJCOG showed increased per capita transit ridership from 2005 to 2014 and a minor decrease afterward. Similarly, SLOCOG showed increased per capita

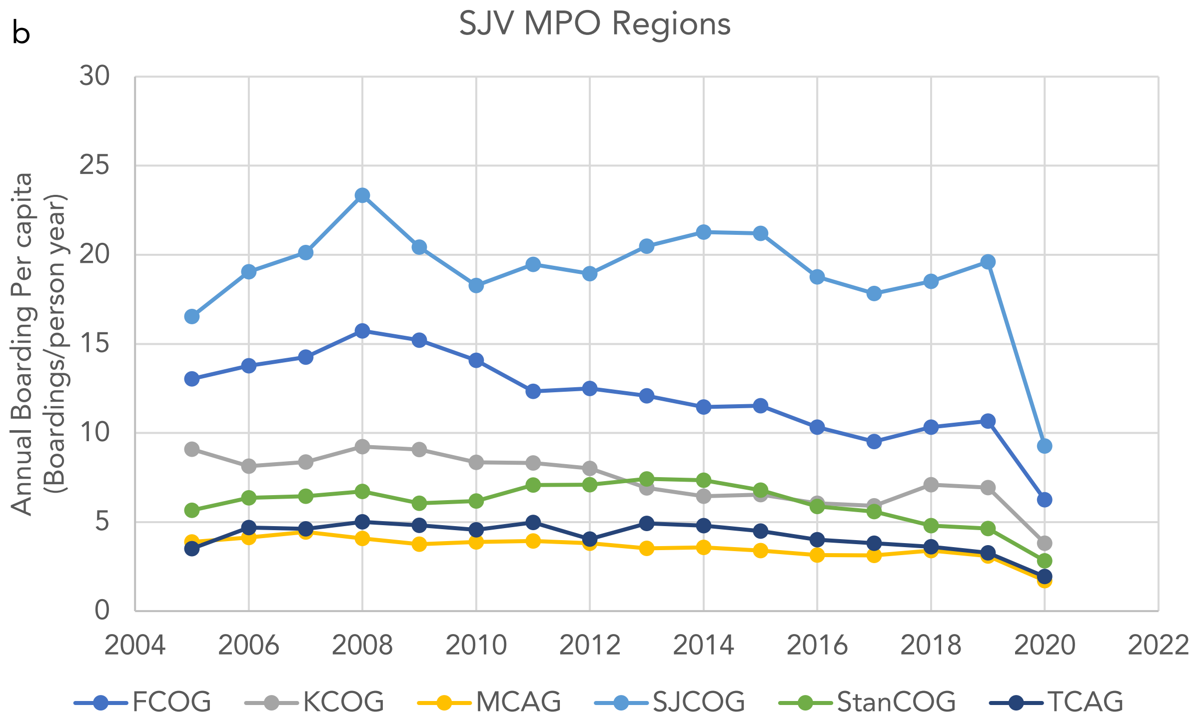
[18] The National Transit Database : https://www.transit.dot.gov/ntd/ntd-data

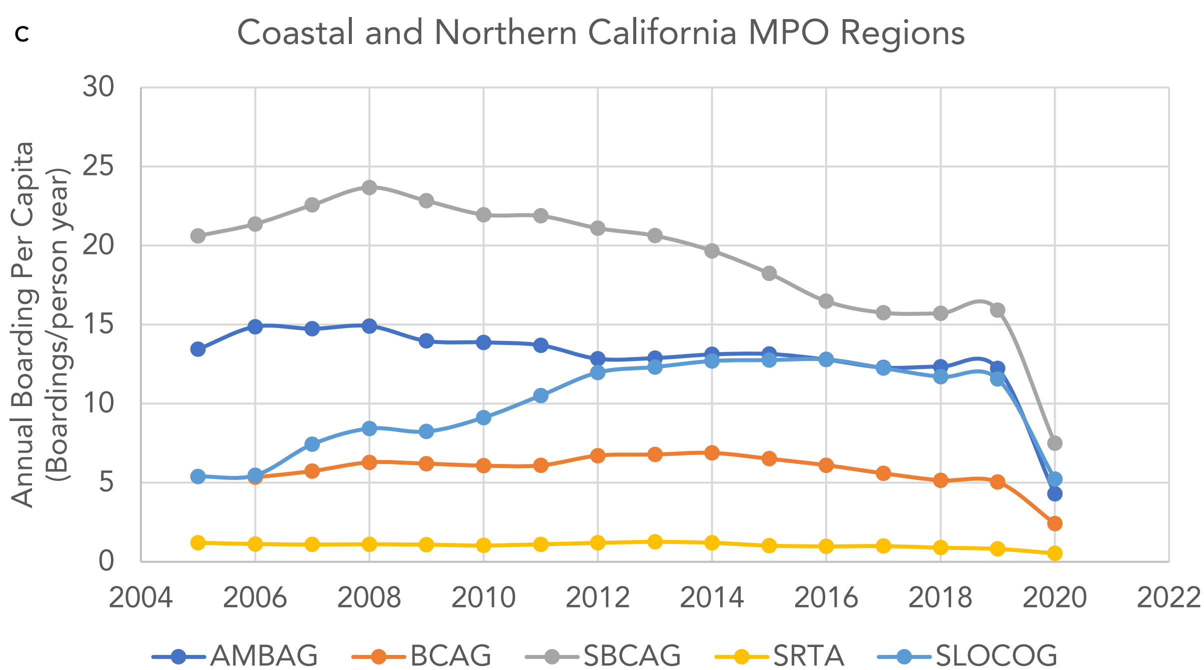
transit ridership from 2005 to 2016 and then maintained at the 2016 level. The sharp decline in 2020 in all MPO regions is due to the pandemic.

Figure 24. Per capita transit ridership in the (a) Big 4 MPO regions, (b) SJV MPO regions, and (c) remaining MPO regions in the Coastal and Northern California from 2005 to 2020

a




b
SJV MPO Regions
Annual Boarding Per capita (Boardings/person year)
30
25
20
15
10
5
0
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
FCOG
KCOG
MCAG
SJCOG
StanCOG
TCAG


c
Coastal and Northern California MPO Regions
Annual Boarding Per Capita (Boardings/person year)
30
25
20
15
10
5
0
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
AMBAG
BCAG
SBCAG
SRTA
SLOCOG

Transit Revenue Hours Per Capita

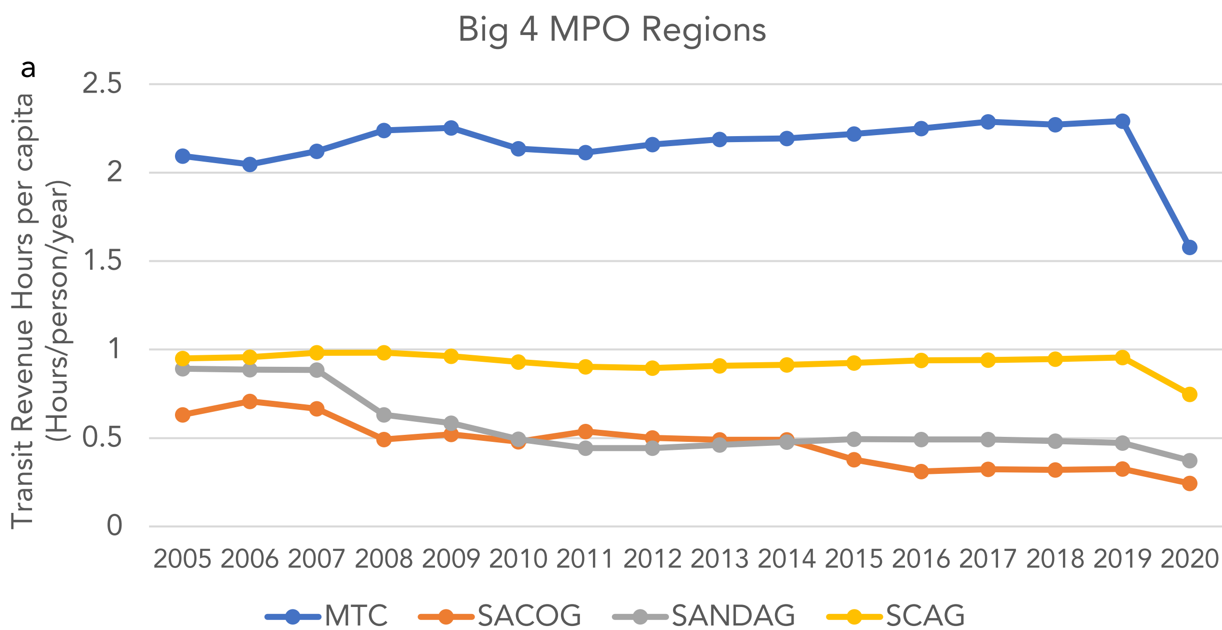
Transit revenue hour means the time from the first passenger pick-up until the last passenger drop-off, excluding driver breaks. This metric describes a region's public transit supply and whether the public transit system is expanding in a given area. The NTD[19] publishes monthly revenue hours reported by local transit agencies. CARB staff analyzed the monthly and annual revenue hours in every MPO region from 2005 to 2020. CARB staff then calculated the per capita transit revenue hours in each MPO region based on total transit revenue hours and regional population from the Department of Finance.

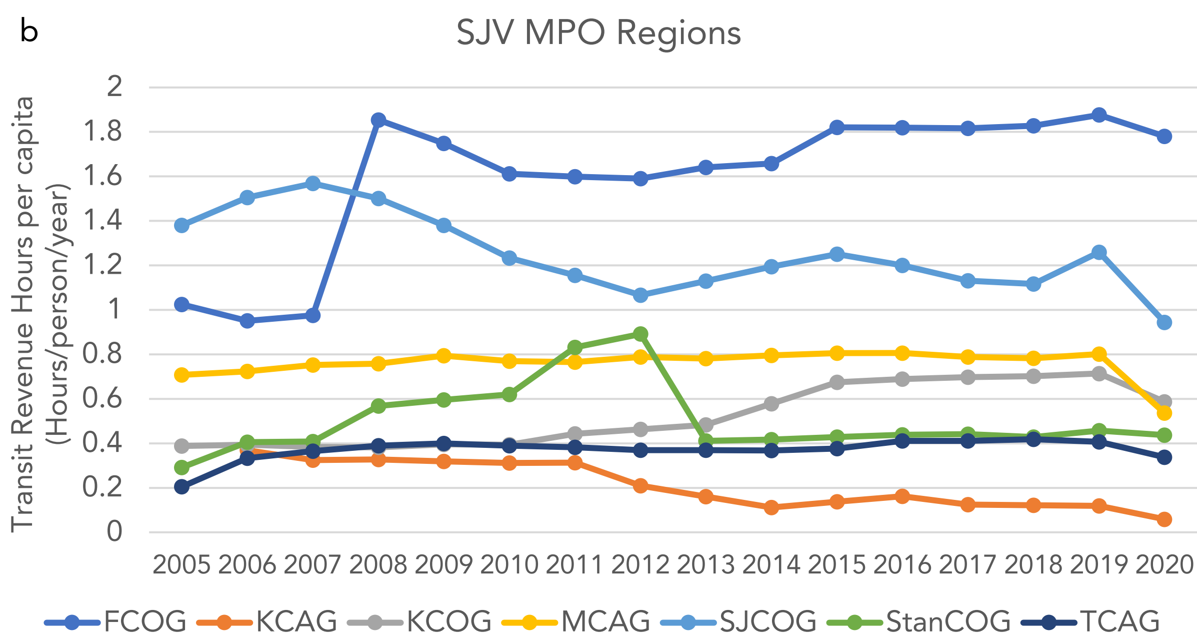
Figures 25 show the per capita transit revenue hours trend by MPO region. Among the Big 4 MPO regions, only the MTC region illustrates increases in per capita revenue hours before the 2020 pandemic, indicating that the region's public transit system is developing. For SCAG, staff observed a generally flat trend with a dip in the middle, probably due to the 2008 recession. The trend line also suggests that the SCAG region's public transit service was slowly recovering from the 2008 recession before the 2020 pandemic, which led to a major drop. For the SACOG and SANDAG regions, public transit service stayed constant or reduced during the same period. However, transit revenue hours sharply decreased during the 2020 pandemic for all 4 MPO regions. For example, MTC showed a 30 percent reduction in 2020.

In the SJV MPOs (except MCTC due to lack of data), the FCOG and KCOG regions increased per capita revenue hours from 2012 until 2019. The remaining valley MPO regions either stayed constant or decreased over the period. The FCOG and SJCOG regions have the highest per capita revenue hours among all eight SJV MPOs, which is largely consistent with the observed transit ridership data. Figure 17c shows the trends for the remaining coastal and the northern California MPO regions, in which the SBCAG region has the highest per capita revenue hours in California.

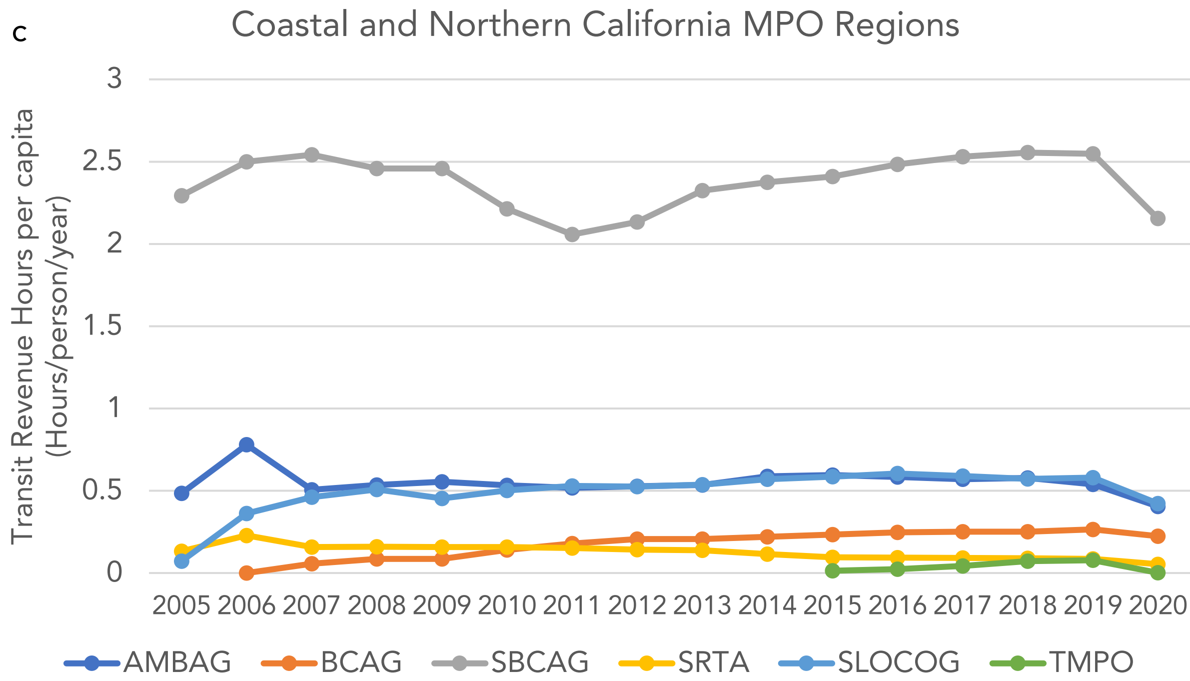
[19] The National Transit Database : https://www.transit.dot.gov/ntd/ntd-data

Figure 25. Per capita transit revenue hours in the (a) Big 4 MPO regions, (b) SJV MPO regions, and (c) remaining MPO regions in the Coastal and Northern California from 2005 to 2020





c



Summary

CARB staff analyzed six transportation-related performance metrics across California regions. CARB staff found that driving is still dominating the commute mode shares in all regions, commute travel time is increasing over time, transit ridership is declining in most MPO regions, and vehicle ownership and lane miles are both increasing. Therefore, these metrics together indicate that Californians' travel behavior still relies on driving, and the penetration of alternative modes is minimal. Although SCSs include strategies to reverse these trends, more work is needed to fully implement these strategies as discussed in the main body of the report.

REGIONAL GROWTH

Regional growth is essential to the success of the SB 375 program as MPO regional practices have been cited as contributing to GHG emissions reduction measures. Land use growth and conservation also directly affect MPOs' growth patterns and influence SCS implementation by achieving more compact land development in each region. CARB staff analyzed three metrics under this theme as follows:

- Acres Developed per 1,000 New Residents
- Growth in Housing Units by Type
- Housing Units Permitted by Structure Type
- Agricultural Land lost
- Land Conservation

Acres Developed per 1,000 New Residents

Land use density has a well-established relationship with VMT[20]. Studies have shown that higher density and efficient land use reduce auto dependence and increase alternative transportation modes, which reduce GHG emissions. CARB staff analyzed the number of newly developed acres in each region relative to population growth over the same period. This metric describes how effectively each MPO uses its developed land to accommodate regional growth and meet its sustainable communities goals.

CARB staff analyzed land acres developed based on Farmland Mapping and Monitoring Program (FMMP) data[21]. This program tracks acreages of various types of lands converted from/to urban land and reports bi-annually the county-level changes. According to FMMP, the "Urban and Built-up Land" term is defined as "land occupied by structures with a building density of at least 1 unit to 1.5 acres, or approximately six structures to a 10-acre parcel."[22] Note that the FMMP data do not reflect factors (such as zoning designations, city limits, economic/market conditions, and others) that may be considered when land use policies are determined. The scale and minimum mapping unit also make it unsuitable for parcel-specific analysis. Using this data, CARB staff calculated the quadrennially developed/urbanized land change in every MPO region from 2000 to 2016. From this, CARB staff also analyzed how compact a region's growth is by normalizing the urbanized land changes in every MPO region with the population change over the same period. CARB staff also calculated a supporting

---

[20] TRB 2014, Special Report 298: Driving and the Built Environment: Effects of Compact Development on Motorized Travel, Energy Use, and CO2 Emissions, Trasnportation Research Board, Washington, D.C. https://onlinepubs.trb.org/Onlinepubs/sr/sr298.pdf

[21] http://www.conservation.ca.gov/dlrp/fmmp/Pages/county_info.aspx

[22] The definitions of all land categories are available at: http://www.conservation.ca.gov/dlrp/fmmp/Pages/mccu/map_categories.aspx

compactness metric based on the acres developed that calculates the urbanized land increase per 1,000 new residents in every MPO region using population information from DOF.[23]

Based on this analysis, CARB staff found that acres of newly developed land in California generally decreased compared to 10-15 years ago. The SCAG region developed the greatest amount of land (37 percent of the state's total newly developed land), which likely coincides with its share of the state population (46 percent). The SJV MPO regions contributed the second-largest development of newly developed land in California (27 percent of the state's total newly developed land), with only 17 percent of the state population. **Table 1** below shows the amount of total developed land for each region, as well as the percentage of that region's land developed from 2002 to 2016.

Table 1. Total Newly Developed Land by Region in Acres

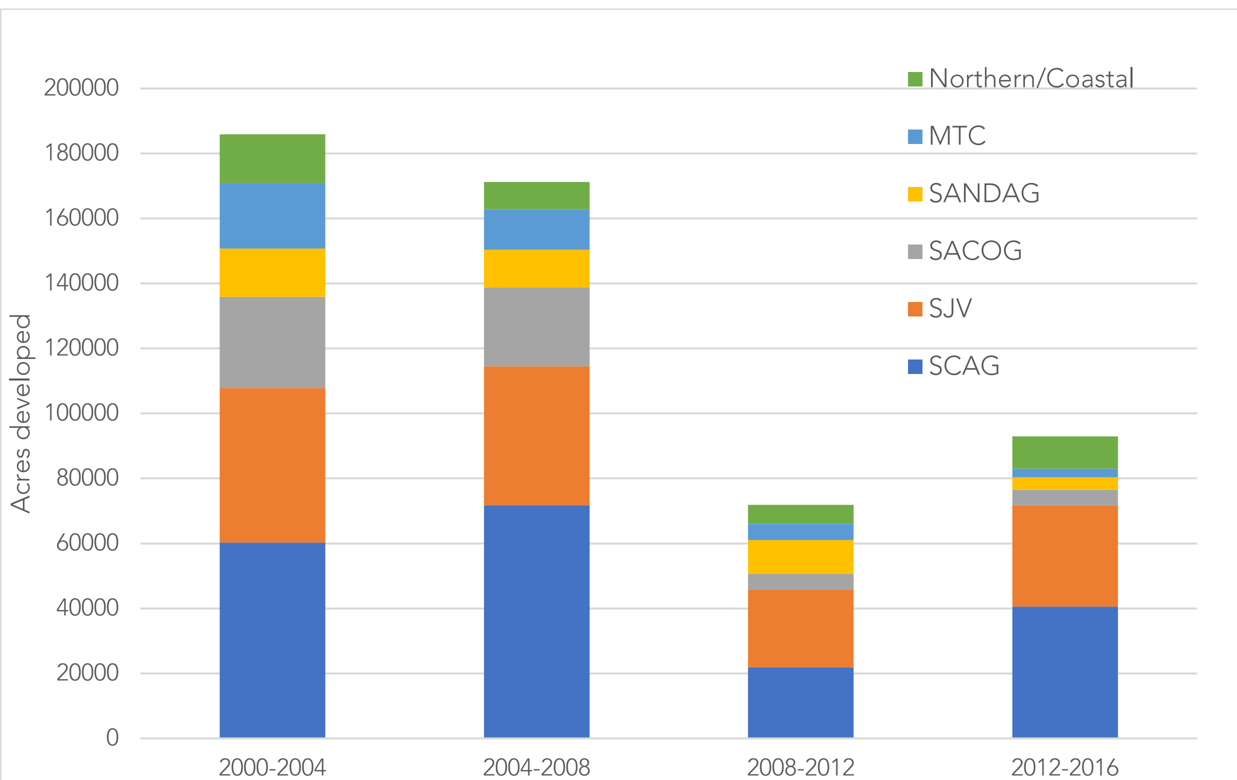
MPO	2002-2004	2004-2008	2008-2012	2012-2016	Total Developed Land
Big 4 MPOs					
SCAG	31.90%	37.90%	11.50%	18.70%	189,214
SACOG	45.30%	39.10%	8.00%	7.60%	61,885
MTC	48.70%	30.30%	12.00%	8.90%	41,386
SANDAG	36.50%	28.50%	25.50%	9.50%	40,917
SJV MPOs					
FCOG	24.80%	28.10%	21.40%	25.70%	24,058
KCAG	16.70%	11.70%	40.30%	31.30%	10,972
KCOG	28.50%	32.30%	9.60%	29.60%	52,225
MCAG	37.10%	28.20%	15.60%	19.00%	8,420
MCTC	33.00%	32.50%	23.00%	11.60%	6,263
SJCOG	43.70%	33.60%	13.00%	9.70%	21,184
STANCOG	56.20%	22.10%	8.20%	13.50%	10,394
TCAG	29.80%	26.40%	18.80%	24.90%	15,240
Northern and Coastal MPOs					

[23] http://www.dof.ca.gov/Forecasting/Demographics/Estimates/).

MPO	2002-2004	2004-2008	2008-2012	2012-2016	Total Developed Land
AMBAG	42.60%	28.80%	23.20%	5.40%	10,738
BCAG	56.20%	23.70%	10.50%	9.50%	6,463
SLOCOG	26.10%	20.80%	10.90%	42.20%	10,859
SBCAG	33.70%	10.20%	38.20%	17.90%	2,963
SRTA	59.80%	23.00%	8.20%	9.00%	4,847

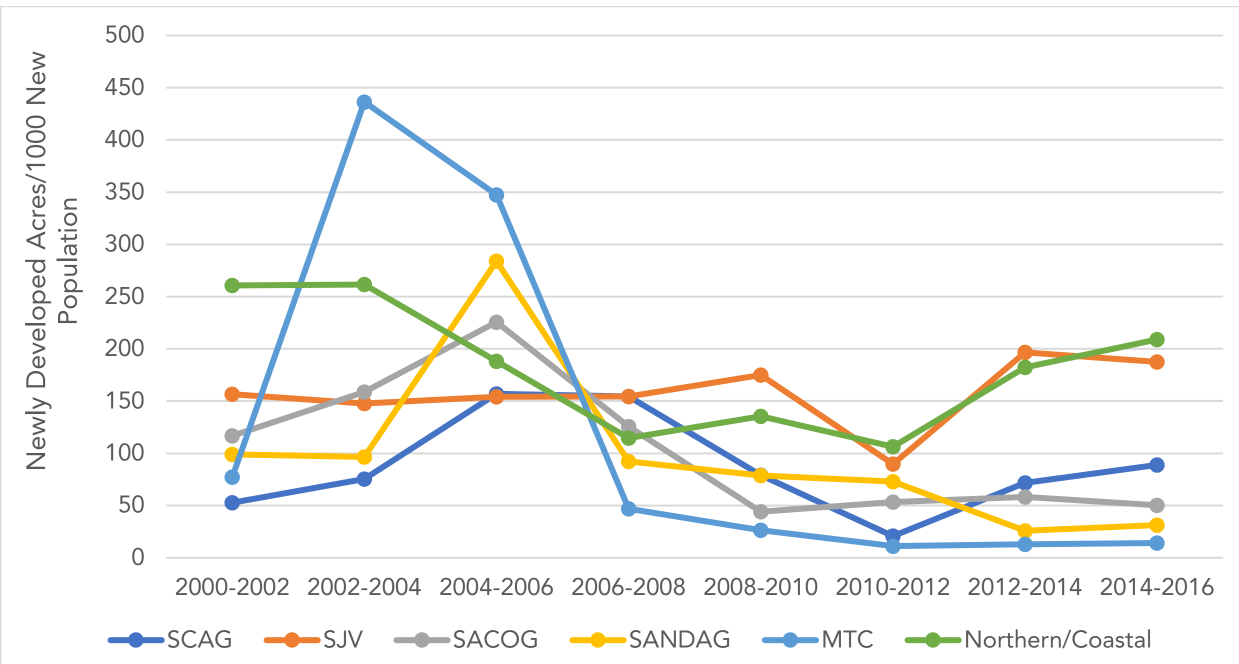
CARB has calculated the total developed land of each of the major regions in Figure 26. As shown below, the greatest amount of land development occurred in 2000-2004, gradually decreasing until the 2008-2012 timespan but increasing again in the 2012-2016 timespan. Most of the land development occurred in the SCAG and SJV regions.

Figure 26. Total developed land



In addition, to understand how a given MPO region is shifting its land development in the context of its population as the population grows tohelp to achieve SCS goals, CARB staff also calculated the supporting compactness metric based on the acres developed, which is defined as newly developed land acreage by the MPO region from 2000 to 2016, divided by a 1,000-persons population change in the same time frame to determine how compact a region is, as shown in Figure 27 below. This calculation also allows MPOs to be compared on a more equal "per capita" basis. Based on this analysis, regions have been trending toward using urban land more efficiently and compactly in most MPO regions since 2005. It is worth noting that MTC's land use development has grown significantly more compact since the 2002-2004 period, indicating high development/urbanization with increasing development to accommodate their population growth.

Figure 27. Newly Developed Land per 1,000 People Growth by Region



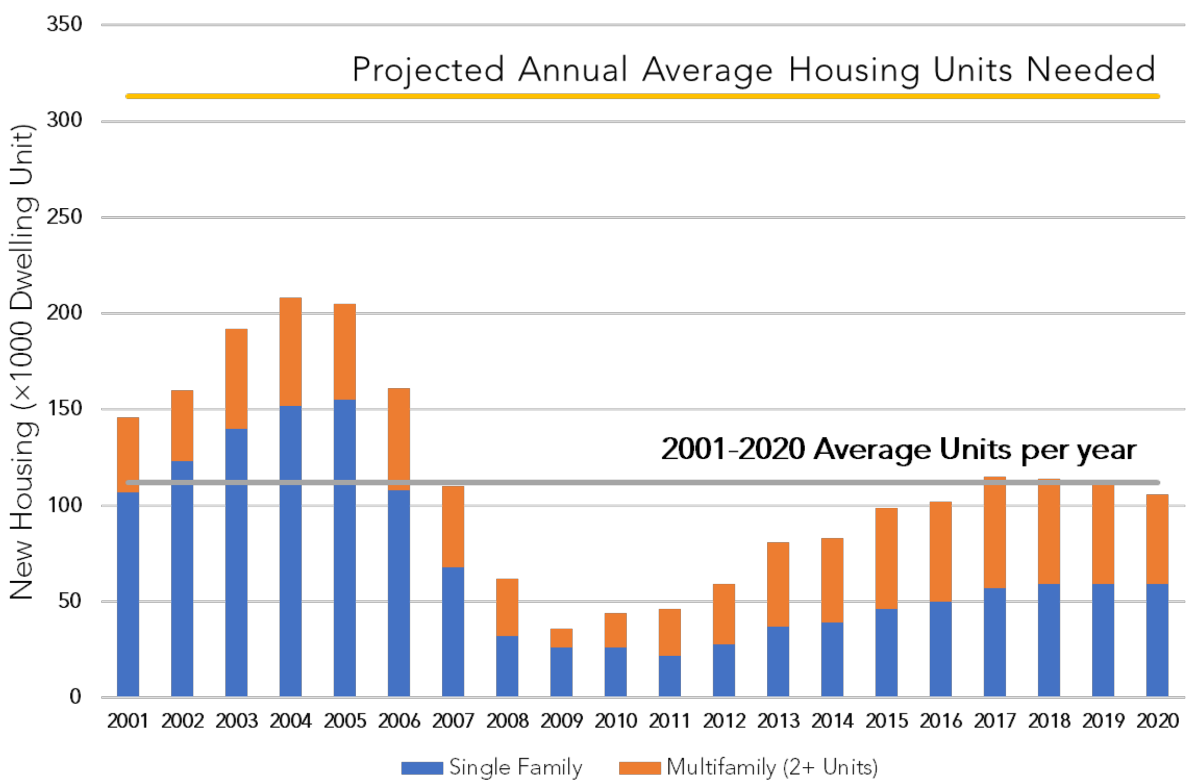
Growth in Housing Units by Type

CARB staff analyzed the growth rate in housing units by type in California from 2001 to 2020 using California Department of Finance (DOF) datasets.[24] This housing unit growth metric reflects the net change in housing units, accounting for the loss of

[24] DOF Population Estimates, E-8 for years 2001 to 2010, and E-5 for years 2011 to 2020: http://www.dof.ca.gov/Forecasting/Demographics/Estimates/

housing units and new homes built. The statewide trend in **Figure 28** shows that the number of housing units in California increased quickly in the first decade of the century and started to slow down beginning in 2008 due to the impact of the economic recession. The year 2012 has the smallest increase in housing units. However, since 2013, the number of housing units increased per year and started to rebound, and the share of multi-family (MF) housing units has outpaced the percentage of single-family (SF) housing units. Such a trend is directionally consistent with the SB 375 goals of increasing density and compact development. On the other hand, according to the California Department of Housing and Community Development (HCD), approximately 2.5 million new housing units are needed over the next eight-year housing need cycle (RHNA) to meet projected population and household growth,[25] **Figure 28** shows that the housing unit production is not keeping pace with projected housing demand.

Figure 28. Net growth in annual housing units in California

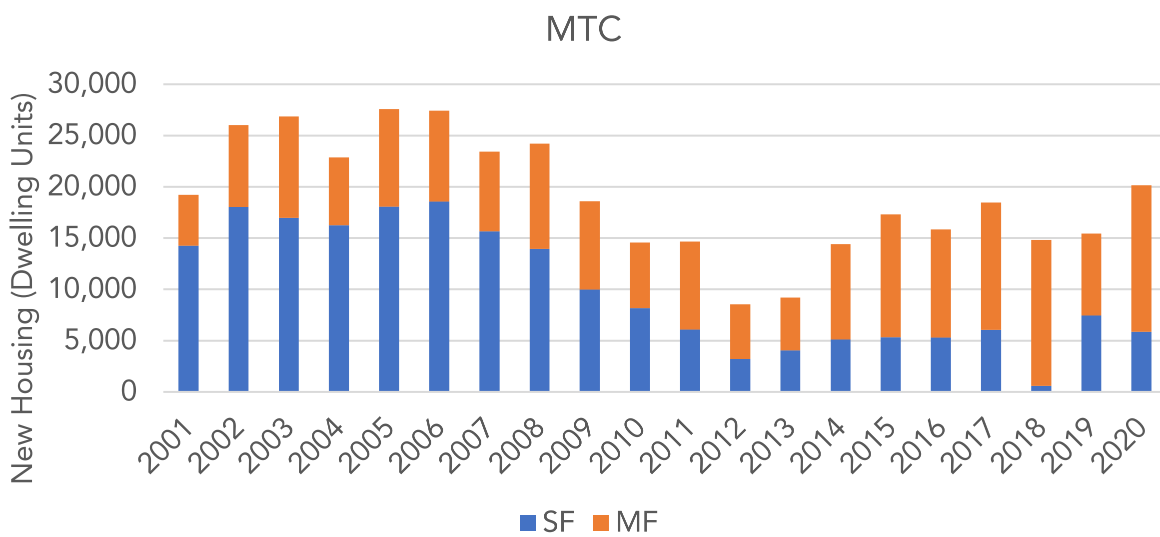


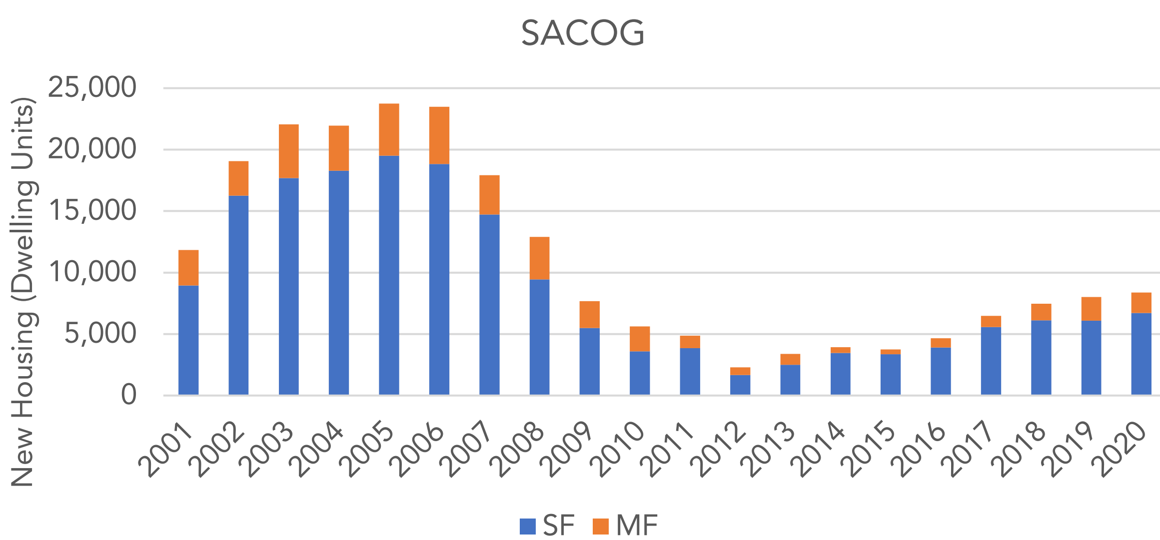
[25] Statewide Housing Plan, CA Dept of Housing and Community Development (2022): https://storymaps.arcgis.com/stories/94729ab1648d43b1811c1698a748c136 (accessed 04/12/2022)

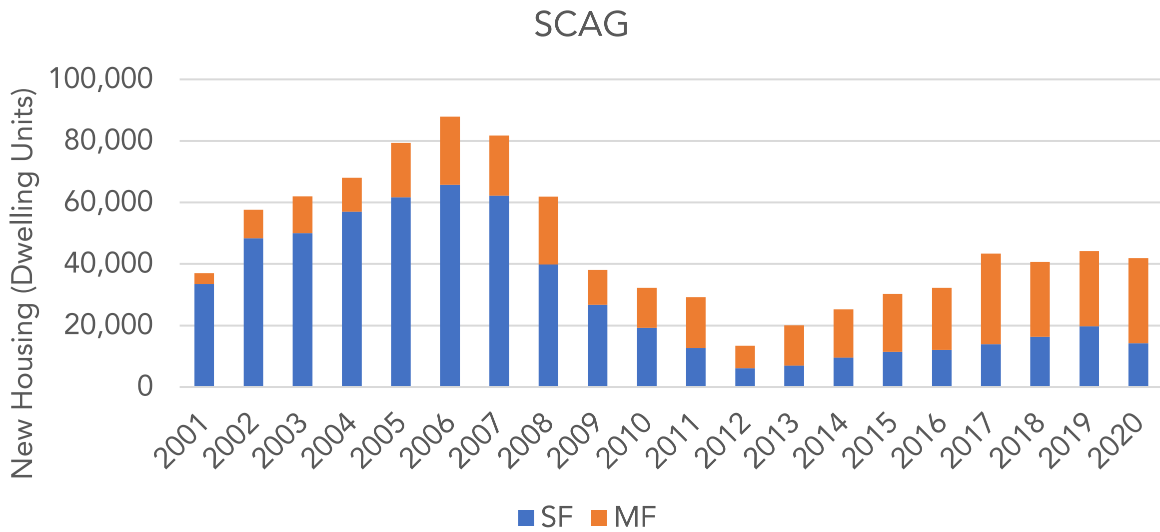
Big 4 MPO regions

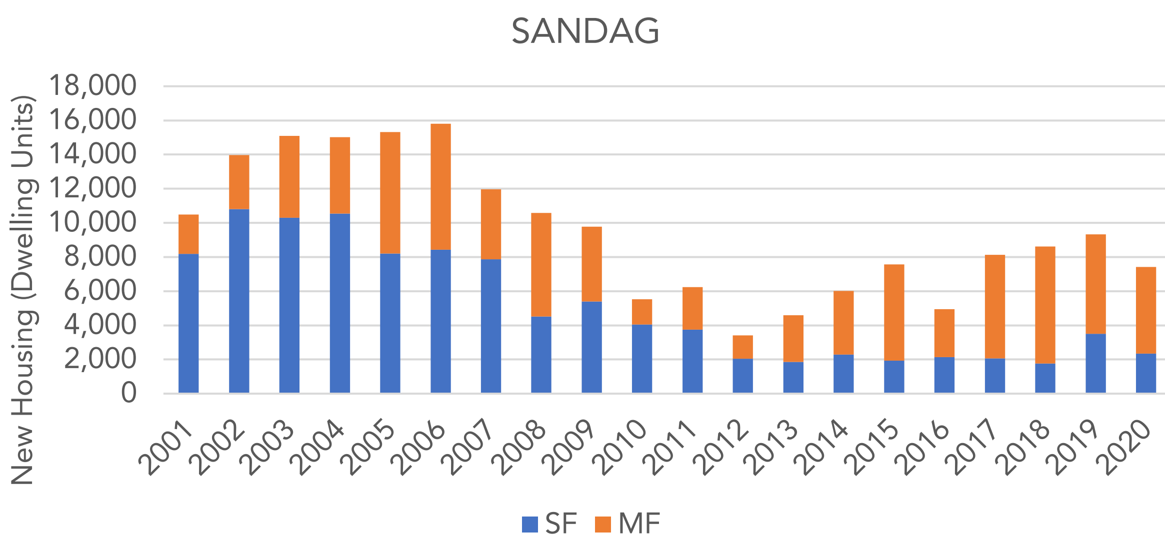
Additional investigation at the regional level shows variation in the growth of housing units by type across different MPO regions in California (**Figure 29**). In the Big 4 MPO regions, data show that annual housing unit growth has been rising and approaching pre-2008 levels. These regions have been building more multi-family housing units than single-family housing units in the past few years, which supports the goals of sustainable communities. SACOG is the only one of the Big 4 MPO regions building more single-family housing units every year. SACOG has also not recovered to pre-2008 levels of construction as the other three MPO regions have. In MTC, the minimal net increase in single-family housing units seen in 2018 is due to the need to replace the 4,000 single-family dwelling units lost in the Sonoma County wildfire.

Figure 29. Trends of new housing units by type in the Big 4 MPO regions





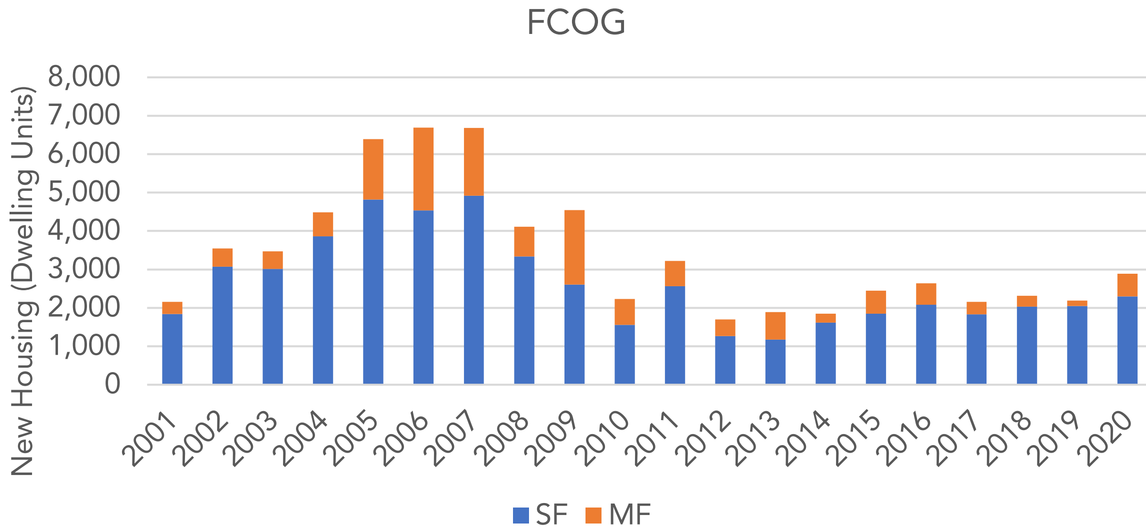


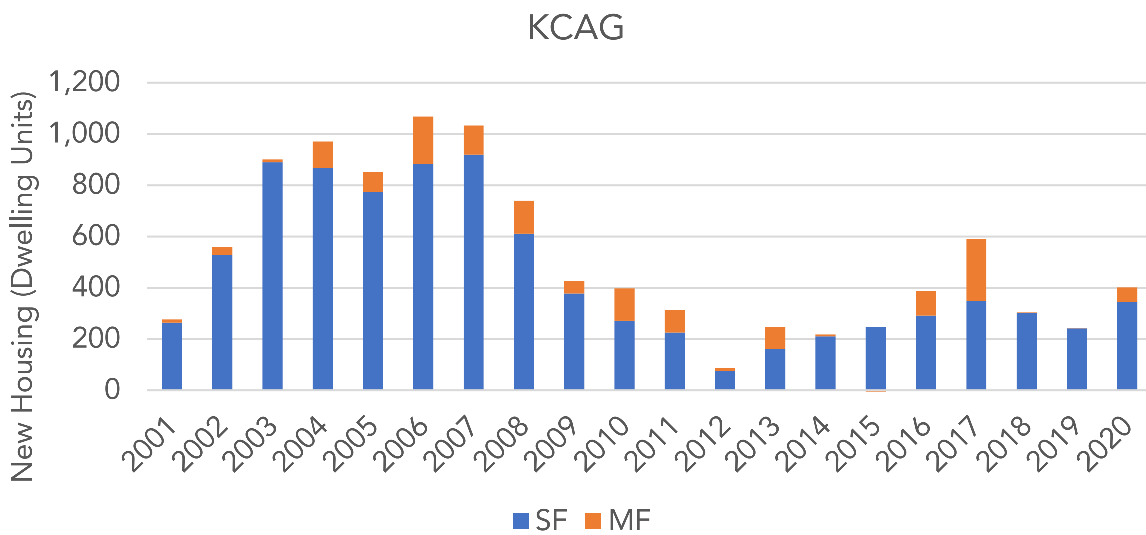


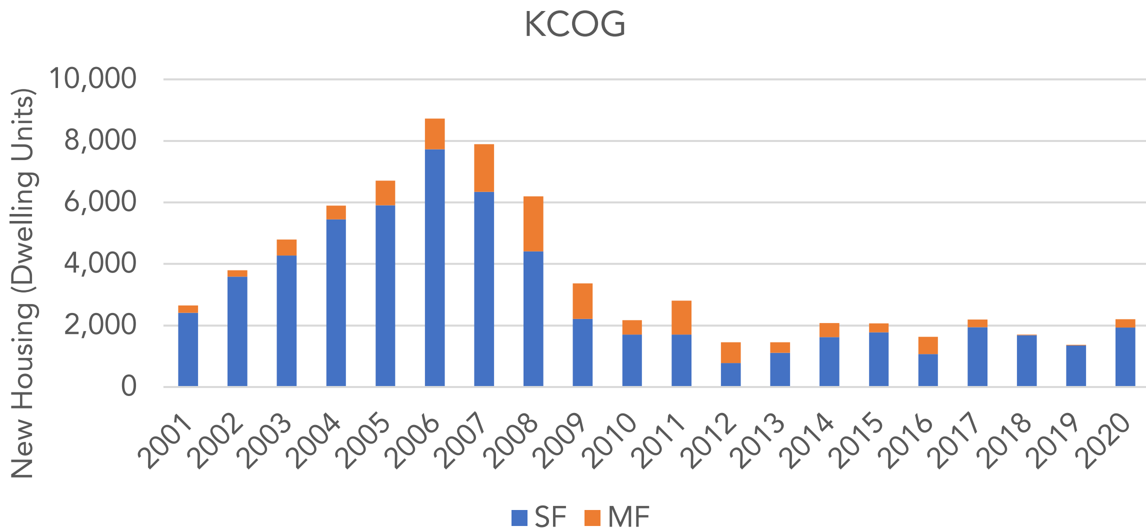
SJV MPO regions

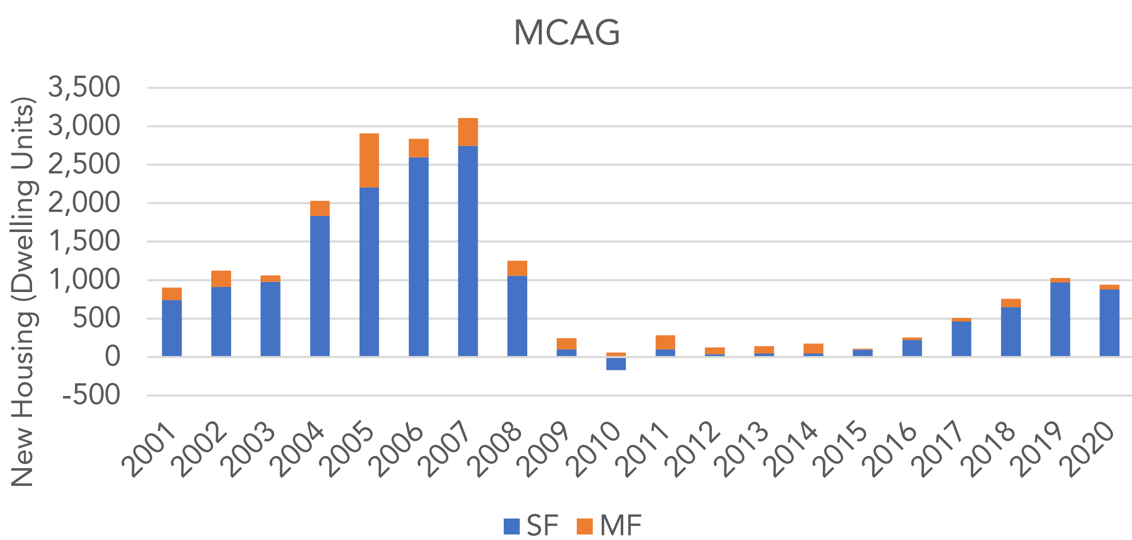
The housing trends in the SJV MPO regions are different from the Big 4 (**Figure 30**). Unlike in the Big 4 MPO regions, the rate of housing unit growth in the SJV region has remained below 2008 levels. Further, most of the housing units built in the SJV region are still single-family houses.

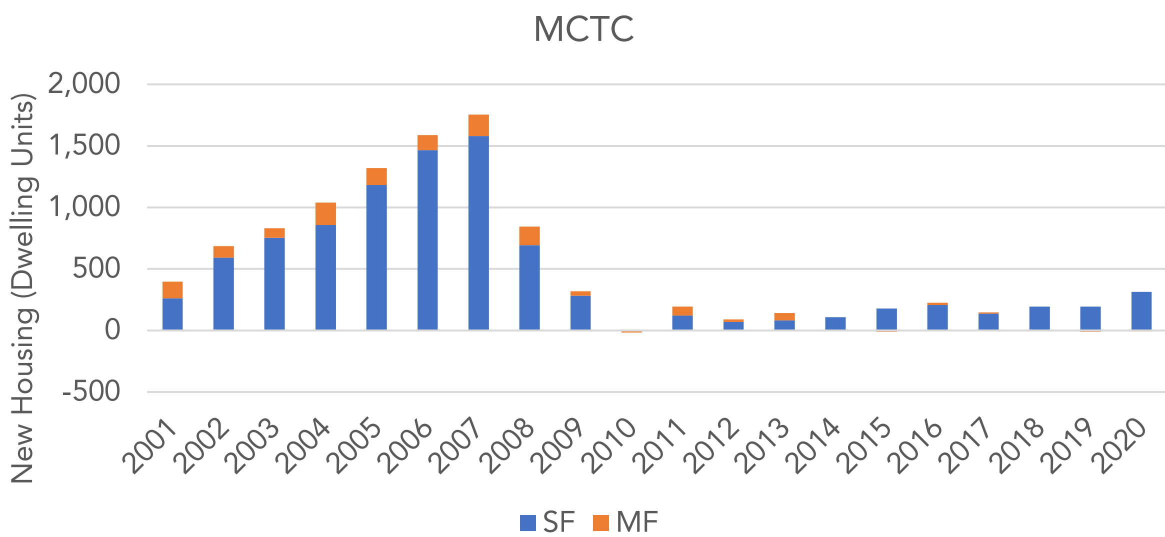
Figure 30. Trends of new housing units by type in the SJV MPO regions

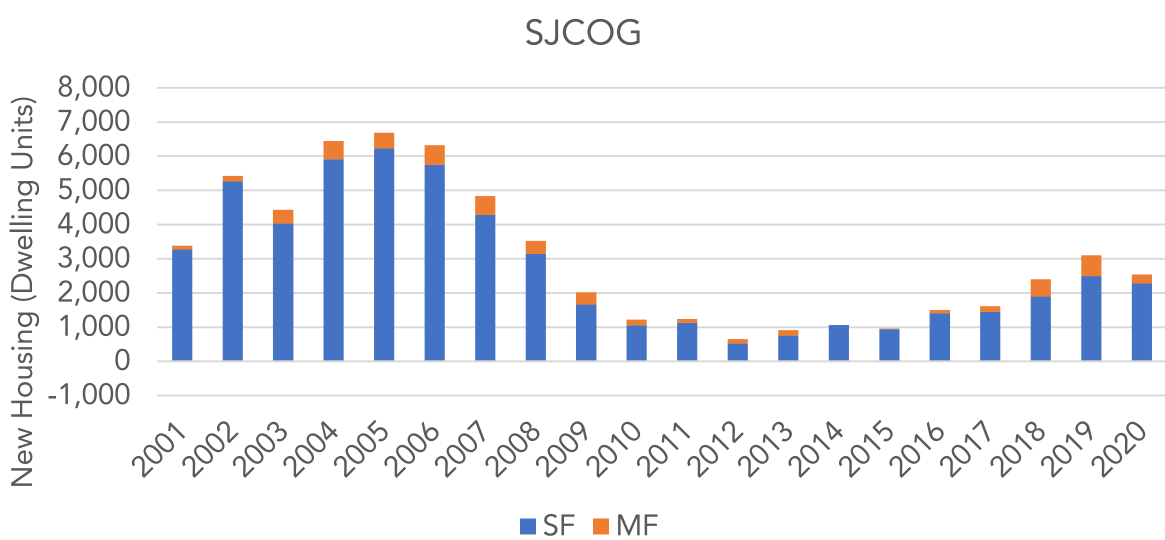


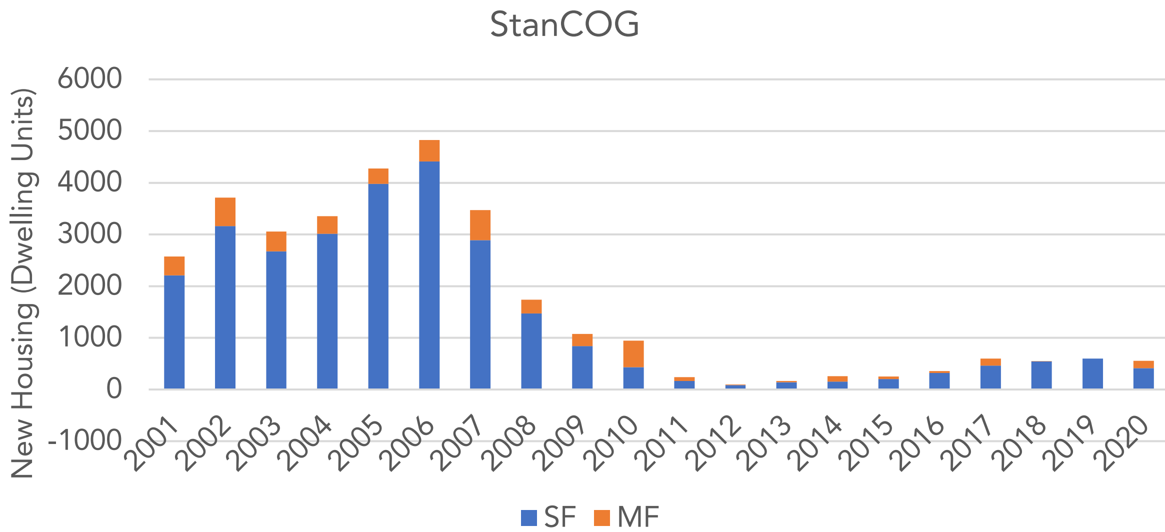


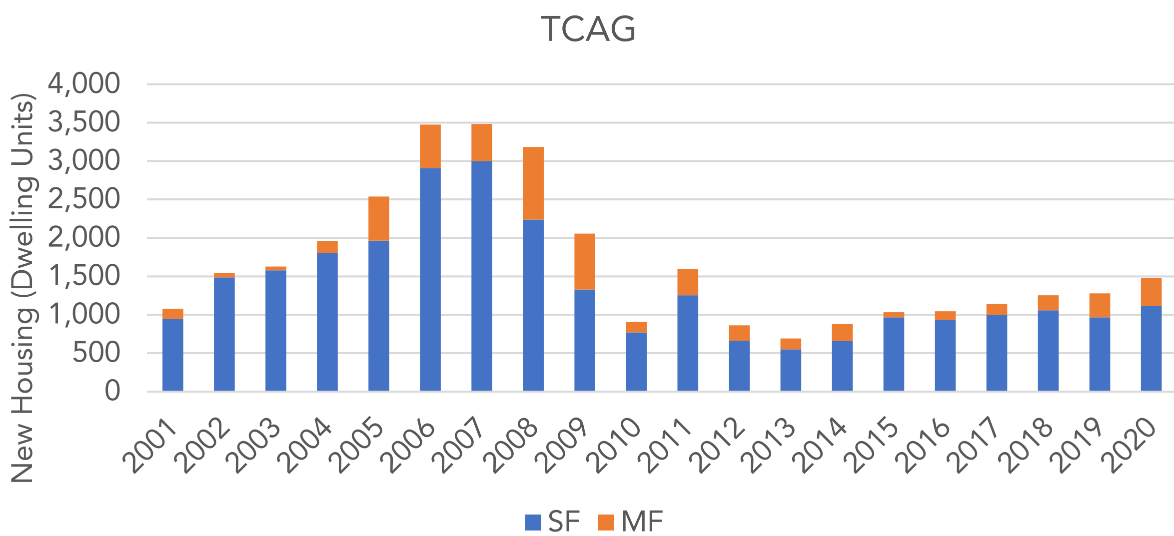

KCOG
New Housing (Dwelling Units)
10,000
8,000
6,000
4,000
2,000
0
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
SF
MF


MCAG
New Housing (Dwelling Units)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
-500
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
SF
MF


MCTC
2,000
1,500
1,000
500
0
-500
New Housing (Dwelling Units)
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
SF
MF


SJCOG
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
New Housing (Dwelling Units)
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
SF
MF

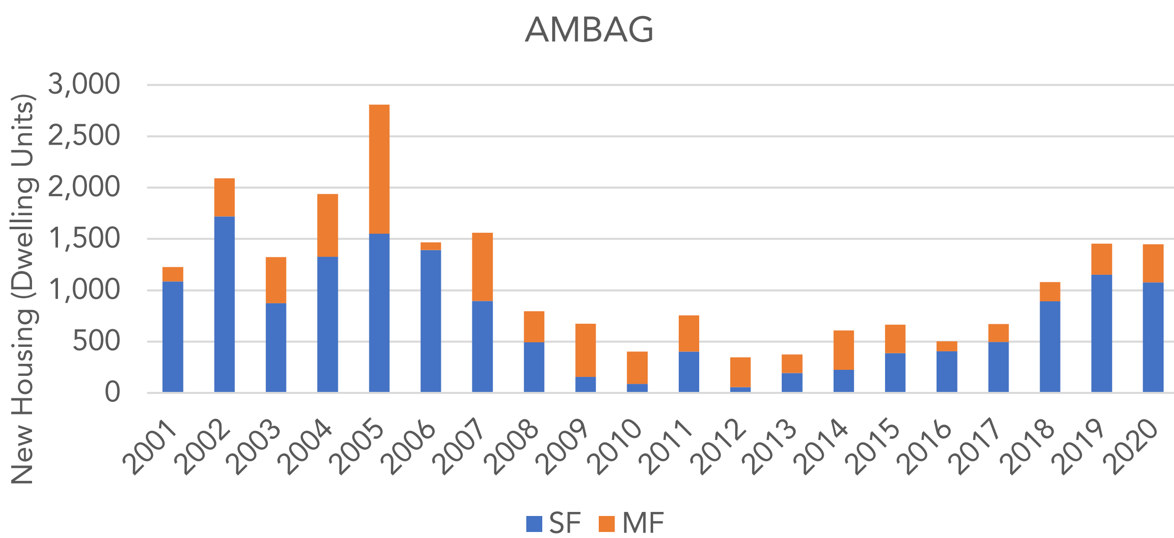

StanCOG
New Housing (Dwelling Units)
6000
5000
4000
3000
2000
1000
0
-1000
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
SF MF

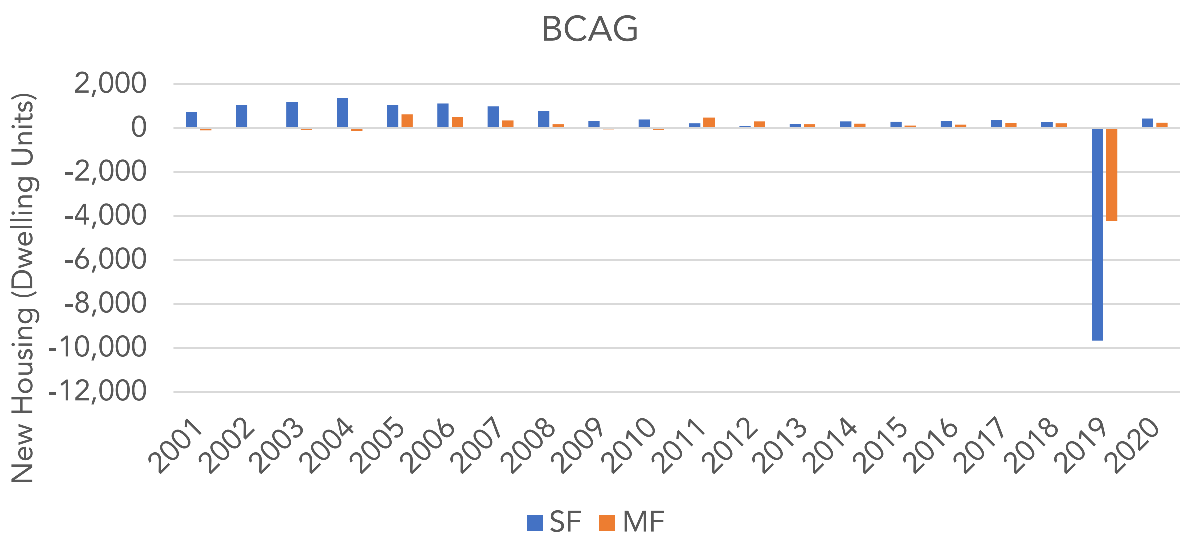

TCAG
New Housing (Dwelling Units)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
SF MF

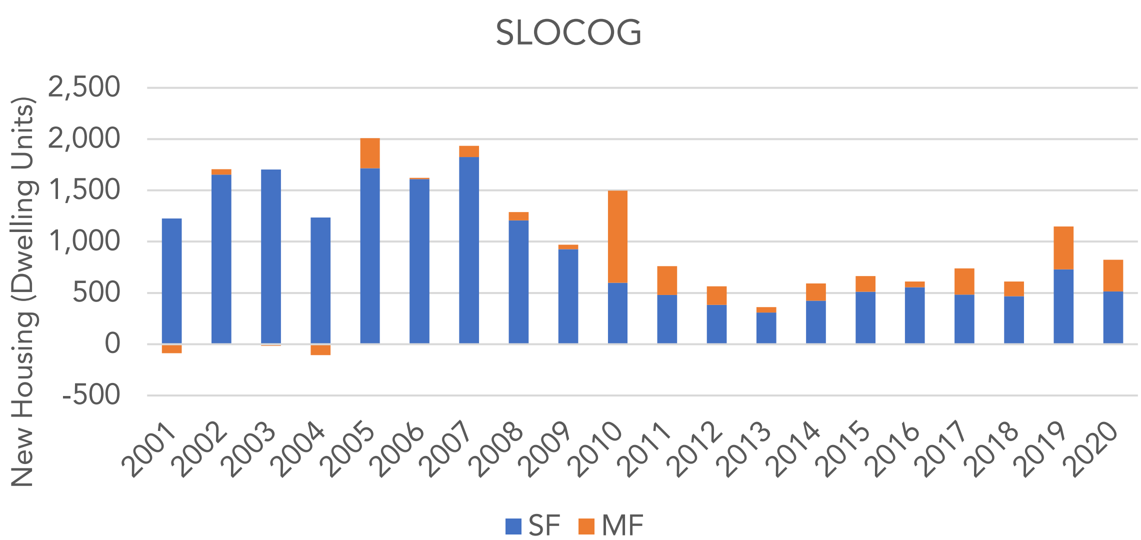
Coastal and Northern California MPO regions

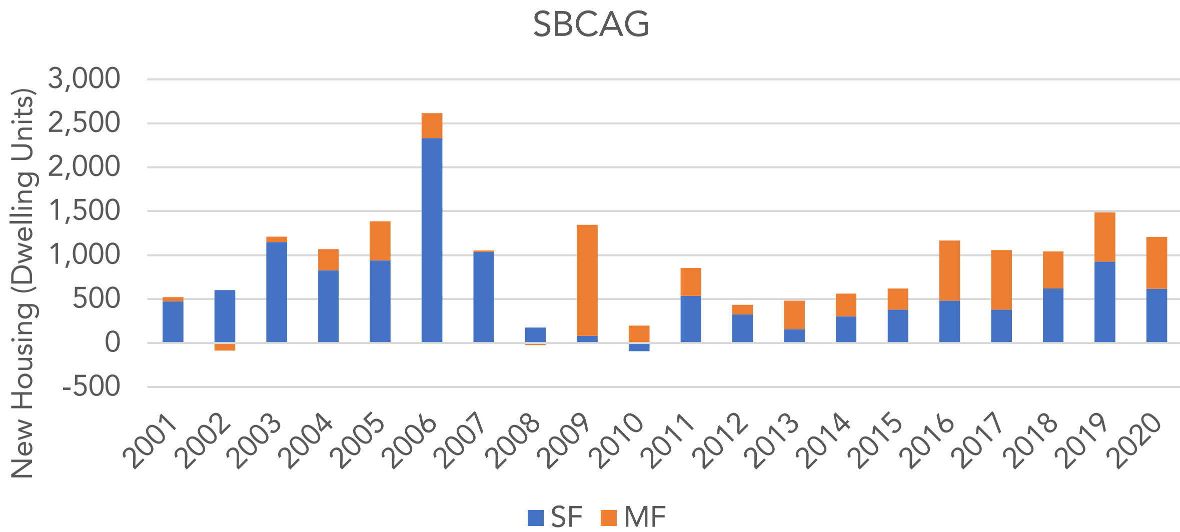
The housing growth patterns in the remaining MPO regions on the coastal and northern California regions vary (**Figure 31**). For instance, AMBAG shows a rapid increase in new single-family housing units. On the other hand, SBCAG has started to build more new multi-family housing units. BCAG and SRTA sadly both experienced the loss of housing units, primarily due to wildfires in 2019. BCAG lost about 14,000 housing units, and SRTA lost about 700 housing units. These losses will result in profound long-term impacts and point to the urgent need for additional climate adaptation and resiliency efforts. The TMPO trend was not analyzed due to a lack of data availability.

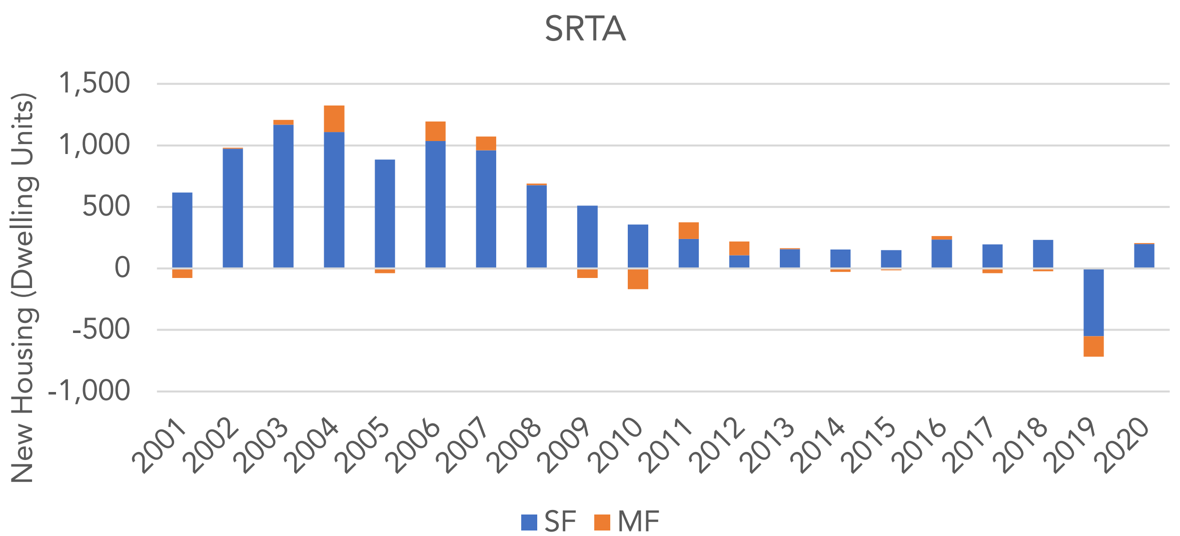
Figure 31. Trends of new housing units by type in the coastal and northern California MPO regions




BCAG
2,000
0
-2,000
-4,000
-6,000
-8,000
-10,000
-12,000
New Housing (Dwelling Units)
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
SF
MF


SLOCOG
2,500
2,000
1,500
1,000
500
0
-500
New Housing (Dwelling Units)
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
SF
MF





Housing Units Permitted by Structure Type

CARB staff analyzed housing units permitted by structure type based on the 5th RHNA cycle data. This metric tracks the newly permitted housing unit type in California and individual regions. Therefore, it can demonstrate whether recent development is consistent with the SCS strategies of encouraging development and MF housing units. Similar to previous metrics, CARB staff used the Housing Element Implementation and Annual Progress Report Data Dashboard[26] for this analysis.

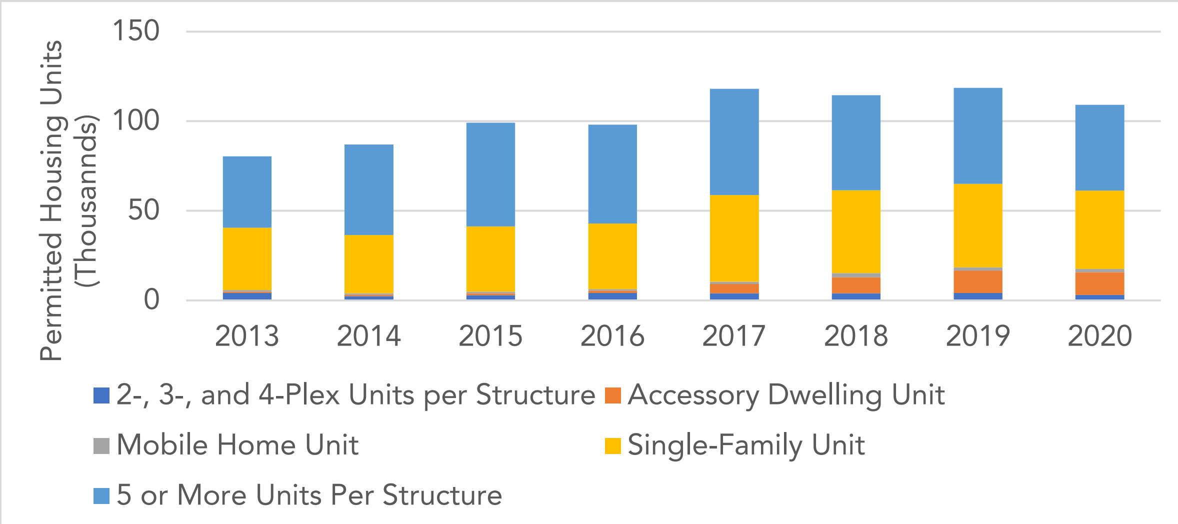
[26] Housing Element Implementation and APR Data Dashboard, Page 11: https://www.hcd.ca.gov/apr-data-dashboard-and-downloads (data accessed on September 8-10, 2021)

Figure 32 below shows California's housing permits by structure type by year under the 5th RHNA cycle. This analysis identified six structure types:

- Single Family Unit (SF): Includes single family-detached units (a one-unit structure with open space on all four sides) and single family-attached units (a one-unit structure attached to another unit by a common wall and commonly referred to as a townhouse, half-plex, or row house).
- 2-,3-, and 4-Plex Units per Structure (2-4): a structure containing two, three, or four units and not classified as a single-unit attached structure.
- 5 or More Units per Structure (5+): a structure containing five or more housing units.
- Accessory Dwelling Unit (ADU): a structure attached, detached, or located within the living area of the existing dwelling or residential dwelling unit that provides complete independent living facilities for one or more persons. It shall include permanent provisions for living, sleeping, eating, cooking, and sanitation on the same parcel on which the single-family dwelling is situated pursuant to Government Code section 65852.2.
- Mobile Home Unit/Manufactured Home (MH) - a one-unit structure originally constructed to be towed on its chassis.

Data show that the 5+ and SFD account for most of the housing unit permits in California. The 5+ and SFD permits peaked in 2017 and decreased in recent years. Conversely, the number of ADU has shown a substantial increase since 2017 due to statewide legislative changes allowing these types of units. This statewide trend suggests there is a movement towards compact development, but additional strategies and incentives may be needed at the state level to increase the amount and pace of multi-family unit development.

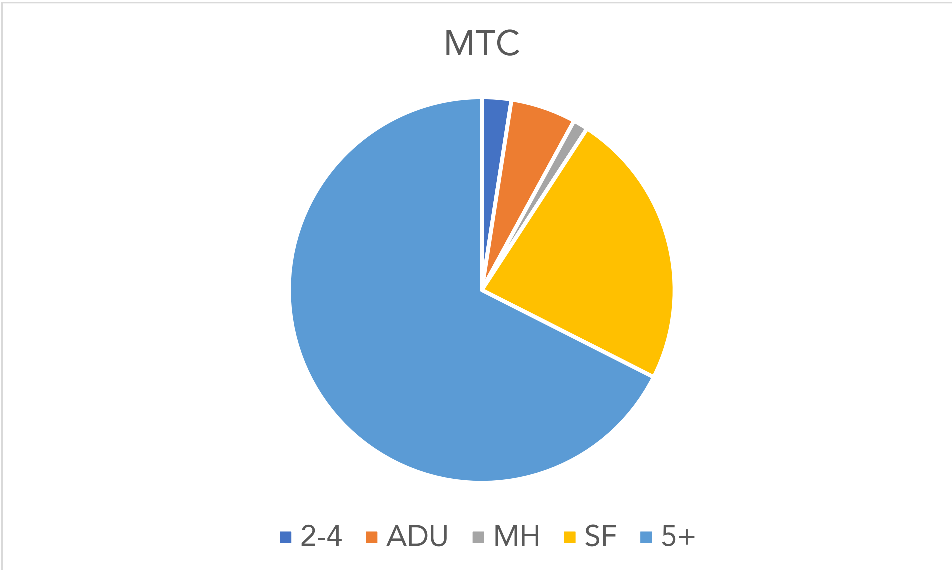
Figure 32. California's housing permits by structure type under the 5th RHNA cycle in 2013-2020

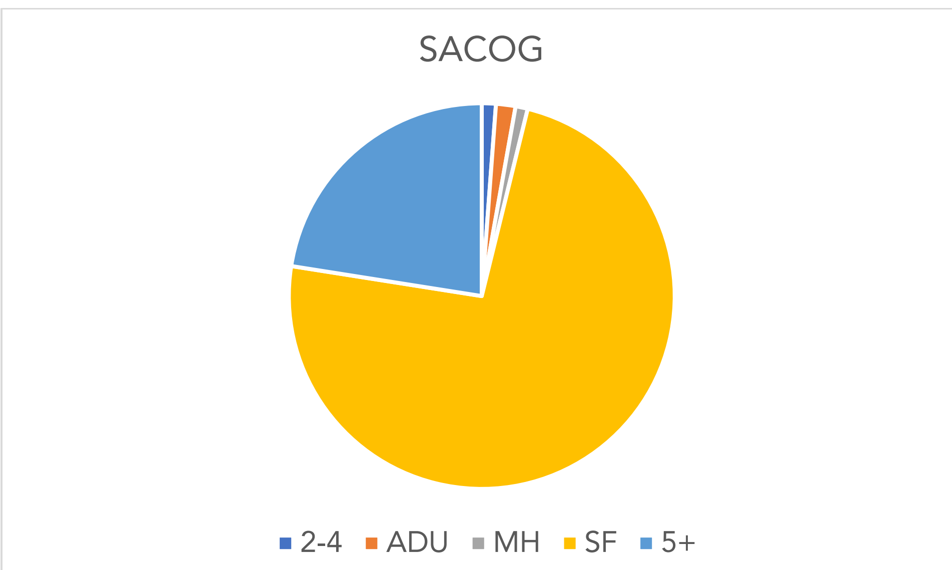


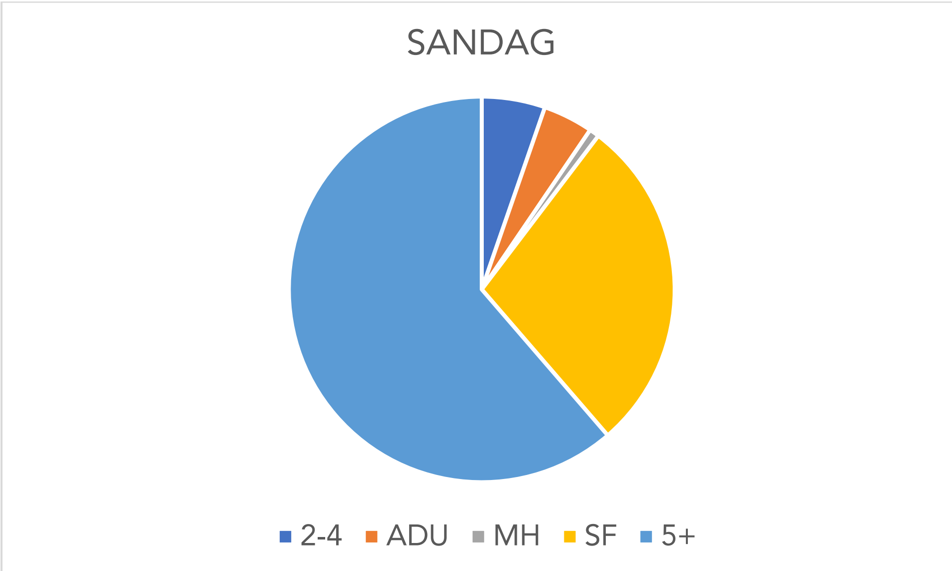
CARB staff also analyzed the distribution of structure types for all MPO regions. **Figure 33** shows the housing units permitted by structure type during the entire 5th cycle for each MPO region. These pie charts show substantial regional variation. They show that the 5+ category has the most significant share of housing unit permits in southern California, including SCAG, SANDAG, and SBCAG. MTC is the only other MPO region with the highest share of 5+ units in other parts of the state. Among the Big 4 MPO regions, SACOG's housing growth is dominated by SF permits (72 percent). In the remaining regions, SF dominates the structure type ranging from 53 percent BCAG) to 96 percent (MCTC). Most MPO regions provide very few to no ADUs except SBCAG (13 percent) of the total units.

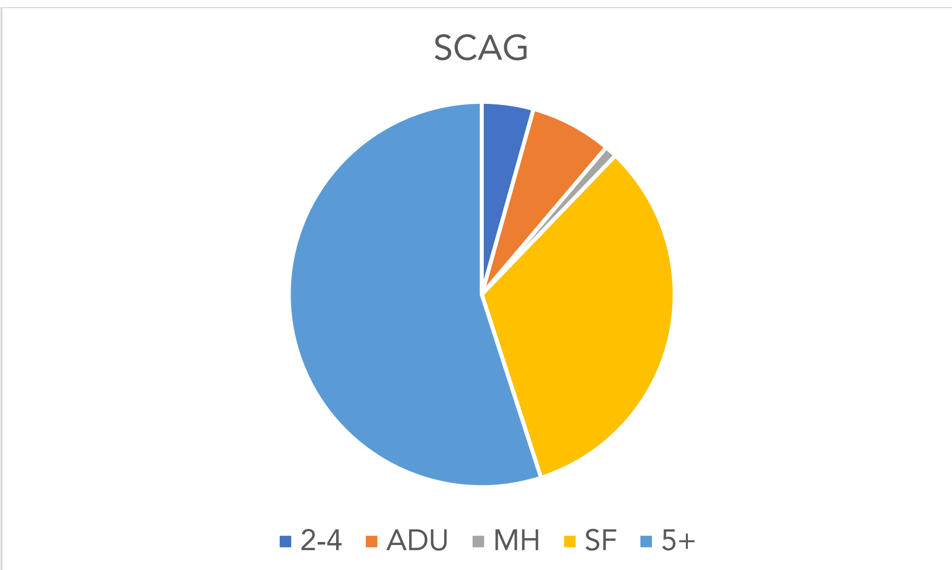
Figure 33. Housing units permitted by structure in the 5th cycle for each MPO region

Big 4 MPO regions

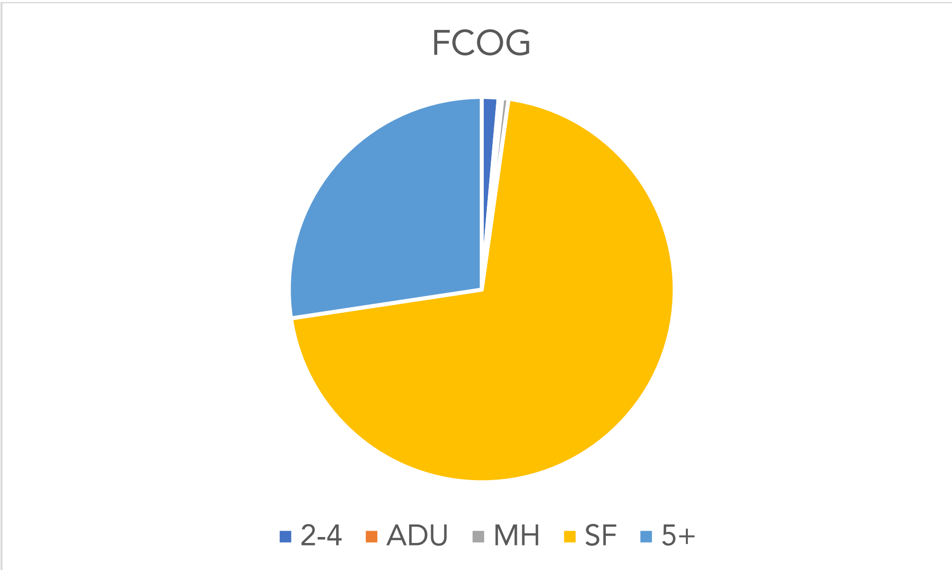


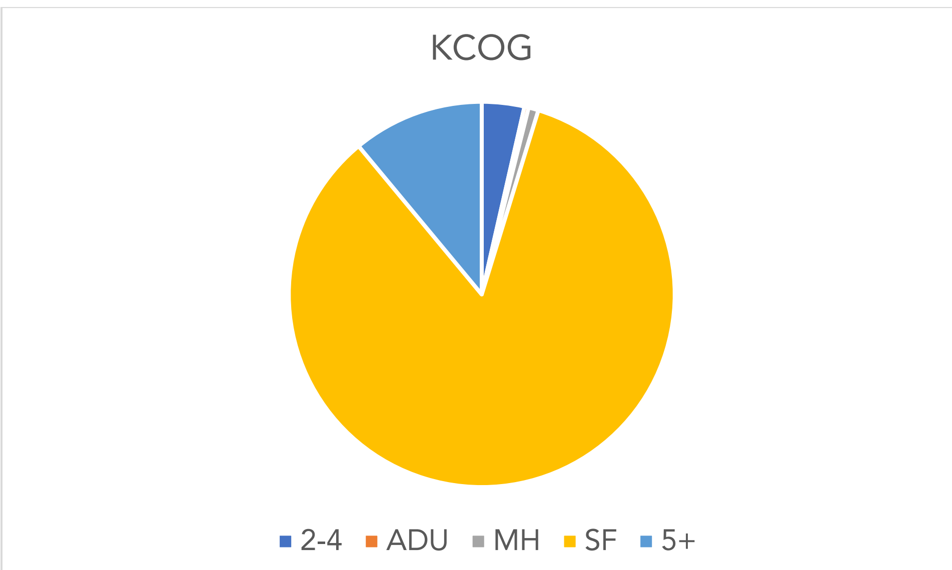


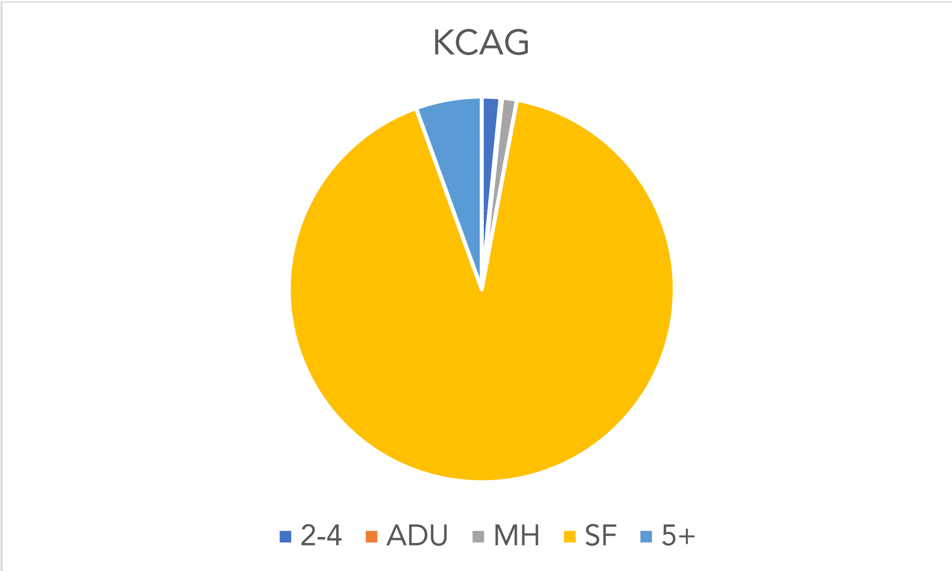

SANDAG
2-4
ADU
MH
SF
5+

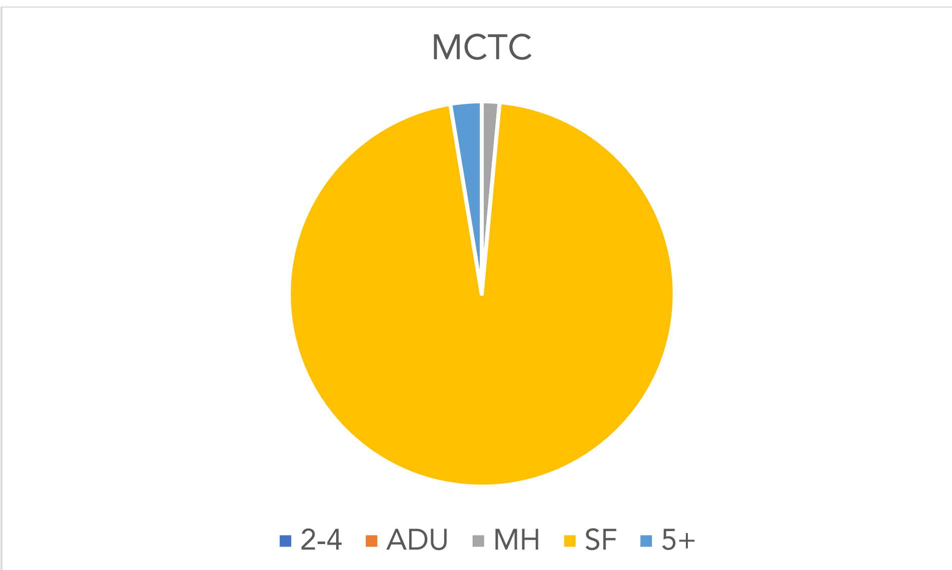

SCAG
2-4
ADU
MH
SF
5+

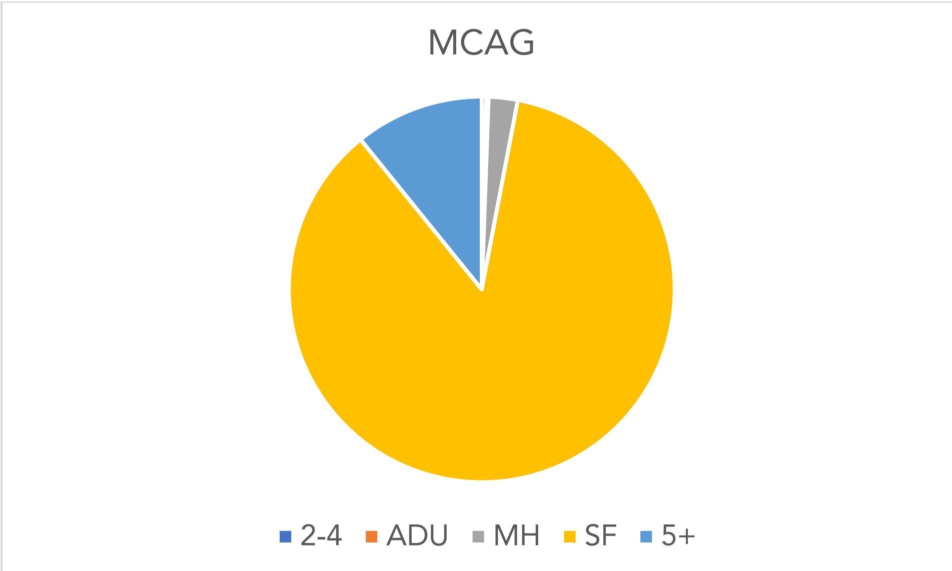
SJV MPO regions

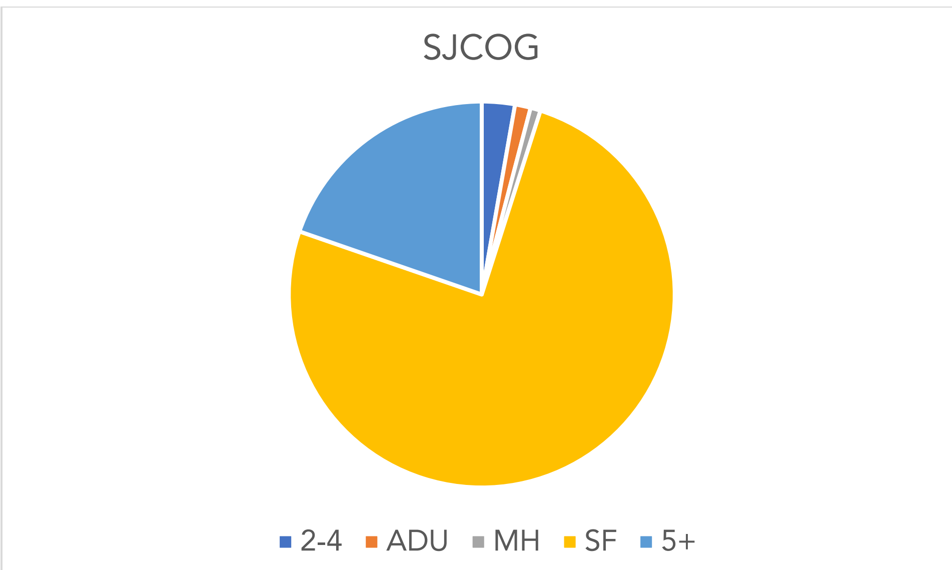


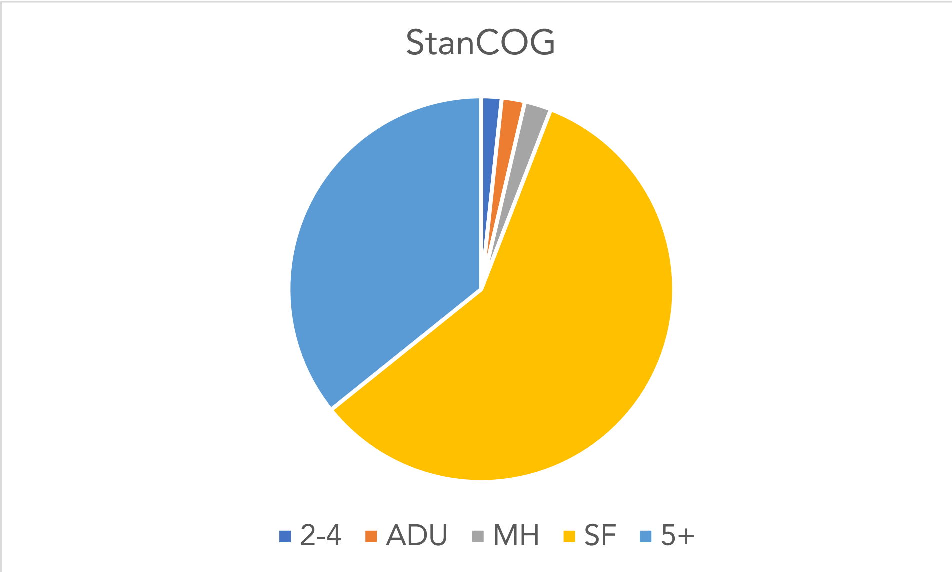


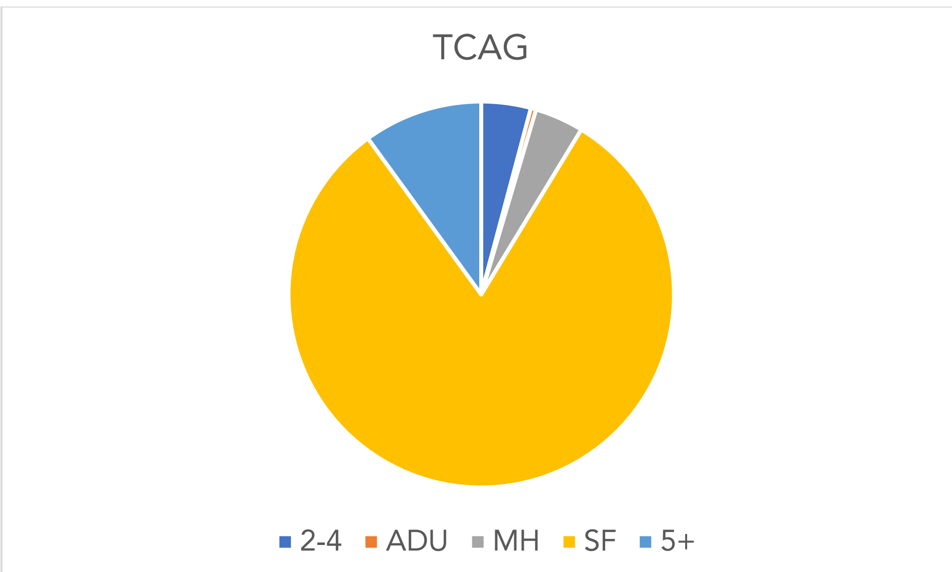

KCAG
2-4
ADU
MH
SF
5+


MCTC
2-4
ADU
MH
SF
5+

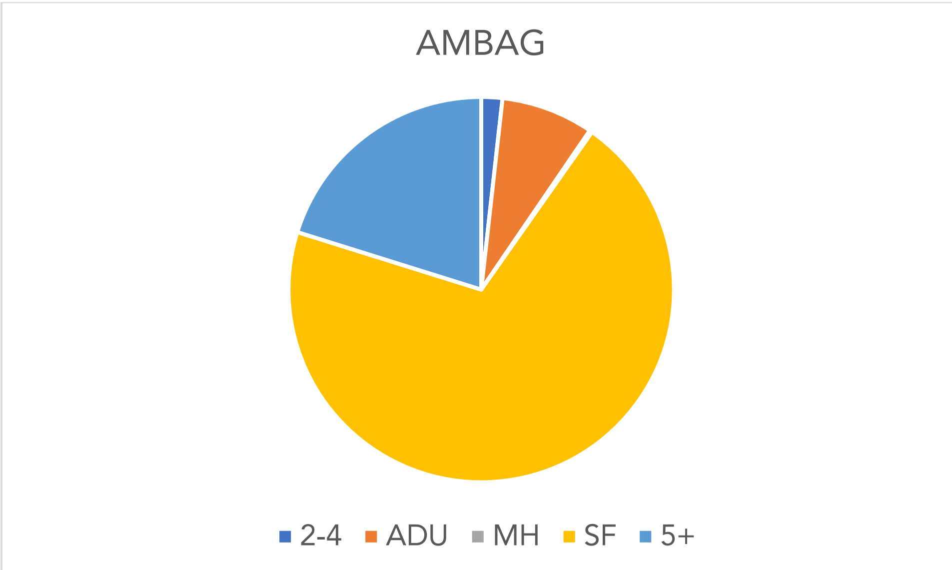

MCAG
2-4
ADU
MH
SF
5+

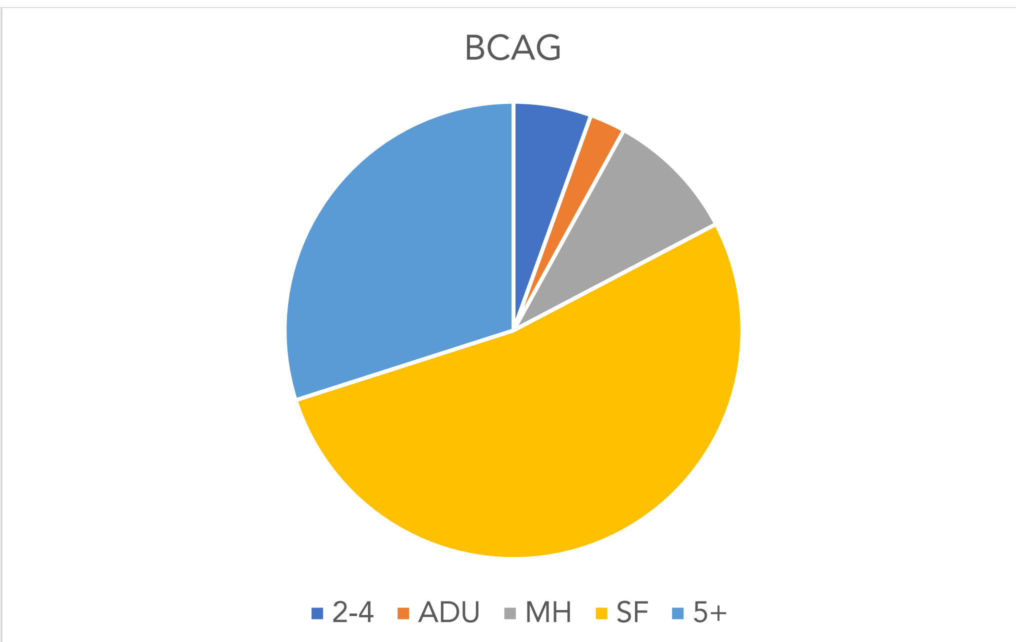

SJCOG
2-4
ADU
MH
SF
5+

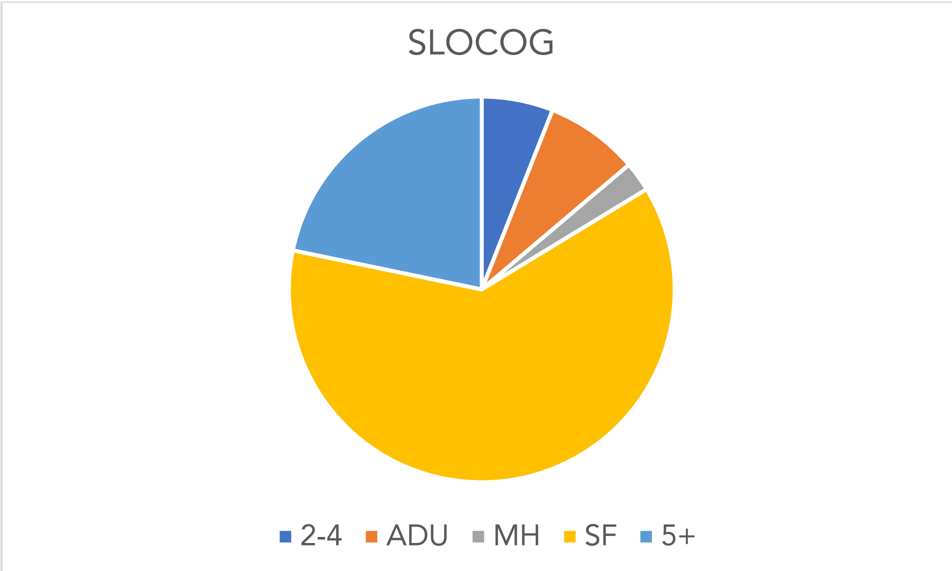

StanCOG
2-4
ADU
MH
SF
5+

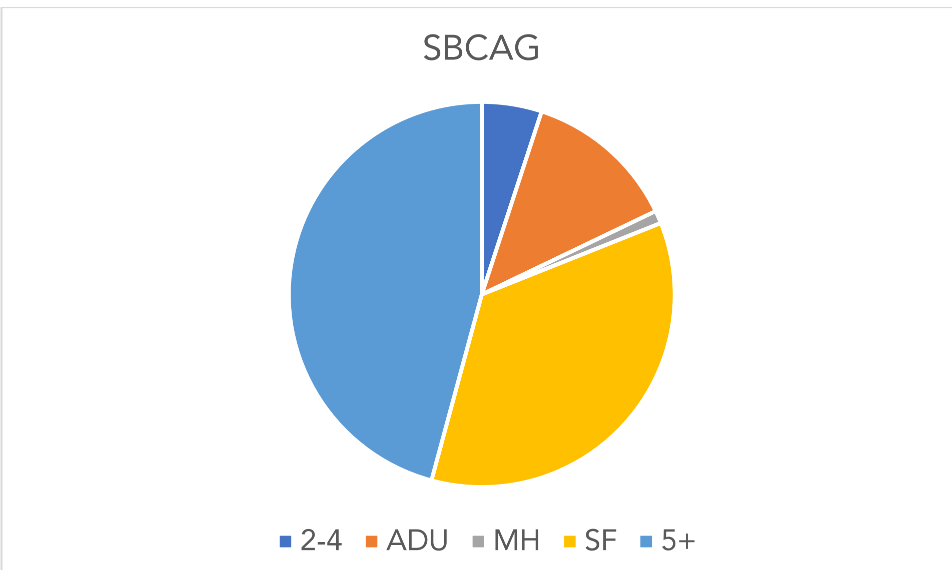

TCAG
2-4
ADU
MH
SF
5+

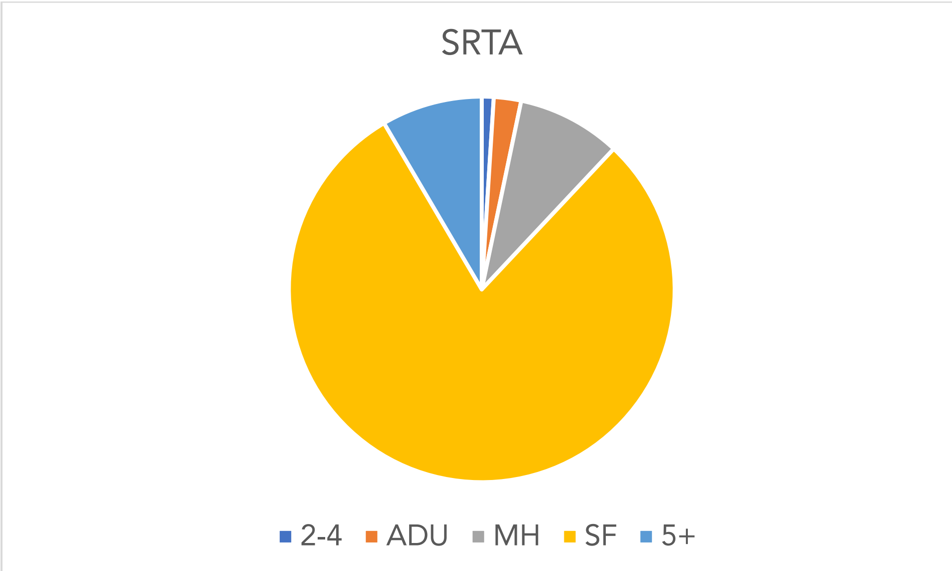
Coastal and Northern California MPO Regions






SLOCOG
2-4
ADU
MH
SF
5+


SBCAG
2-4
ADU
MH
SF
5+



Agricultural Land Lost

Agricultural land lost refers to the amount of agricultural land in each MPO's region converted to non-agricultural land (i.e., utilized for different purposes). Like the aforementioned developed land analysis, analysis of agricultural land lost also indicates how effectively each MPO uses their developed lands but focuses specifically on the loss of cultivated farmland and ranchland rather than the use of other lands for urban development. Also, whereas the acres-developed metric serves to measure how many acres were newly converted to urban land, this metric measures the loss of agricultural land to both urban land and other uses such as low-density development.

Based on the FMMP reports (Table 2), CARB staff calculated the total acres of agricultural land lost in California from 2000 to 2016 statewide and by region compared to the total urbanized land acreage. This analysis includes United States Department of Agriculture designations of prime farmland, farmland of statewide importance, unique farmland, farmland of local importance, and grazing land. In most MPO regions, the rate of agricultural land lost has slowed down over the last decade. According to the analysis, agricultural land development has fluctuated between regions over the years, but for the most part has resulted in a net growth of agricultural land developed since 2004. While it can be easily observed that SCAG has the highest acreage of agricultural land developed and SRTA has the lowest, the relative sizes of each region must also be considered when comparing between regions. **Table 2** below shows the amount of total developed Agricultural Land for each region, as well as the percentage of that region's Agricultural Land developed from 2002 to 2016. The negative percentage values indicate a loss in Agricultural Land in a given period.

Table 2. Total Agricultural Land Developed by Region (in acres)

MPO	2002-2004	2004-2008	2008-2012	2012-2016	Total Agricultural Land Developed since 2004 (acres)
AMBAG	63.7%	39.1%	23.1%	-25.9%	2,314
BCAG	32.1%	13.6%	6.3%	48.0%	5,264
FCOG	18.0%	21.4%	15.3%	45.3%	25,100
KCAG	14.5%	11.5%	25.8%	48.2%	8,463
KCOG	19.4%	27.0%	10.2%	43.4%	33,643
MCAG	24.7%	18.8%	7.2%	49.3%	11,497
MCTC	31.9%	52.2%	16.1%	-0.2%	3,064
MTC	44.3%	23.3%	10.6%	21.8%	33,180
SACOG	48.4%	36.2%	7.1%	8.4%	40,933
SANDAG	44.5%	34.5%	16.9%	4.1%	17,055
SJCOG	41.9%	30.4%	9.0%	18.6%	20,347
SLOCOG	25.2%	21.0%	11.2%	42.5%	6,715
SBCAG	32.1%	7.2%	33.4%	27.3%	1,469
SRTA	54.4%	12.0%	4.7%	28.9%	965
SCAG	29.8%	36.7%	9.0%	24.4%	117,993
StanCOG	50.5%	20.1%	5.7%	23.8%	11,249
TCAG	31.3%	27.9%	22.6%	18.2%	11,314

Land Conservation

Land conservation refers to protecting land from urbanization or other development that damages its ability to provide natural services such as food production, habitat, or groundwater absorption. Like Acres Developed and Agricultural Land lost, land conservation addresses a different facet of an MPO's progress in showing how each is meeting its respective SB 375 goals. Similar to agricultural land, more land conservation means less GHG emissions from human activity resulting from developed land. Therefore, this metric can illustrate how each MPO's land conservation practices support their GHG emission reductions.

CARB staff collected historic protected open space data from the California Protected Areas Database (CPAD)[27] and calculated the acreage of conserved land in each MPO, as shown in Table 3. CPAD contains data about protected lands, including national/state/regional parks, forests, preserves, and wildlife areas. In addition, it includes large and small urban parks, land trust preserves owned outright or in conservation or agricultural easement, and special district open space lands that public agencies or non-profit organizations own. Raw data from CPAD have been published semi-annually since 2014. CARB staff analyzed the annual protected open space percent changes based on CPAD through 2021 and the per capita protected open space area in every MPO. It should be noted that CPAD does not include military lands, tribal lands, private lands, and public lands not intended for open space (e.g., municipal waste facilities and administrative buildings). Meanwhile, it is worth noting that the year land entered into the CPAD database does not necessarily reflect the year of its protection. Furthermore, CPAD data are not usable for regulatory, legal, or other governmental actions without additional analysis of more current official land records in the area of focus.

Data show that the acreage of protected land has been slowly and continuously increasing since 2014 in most regions, except in the StanCOG region. According to CPAD, the loss of protected acres in Stanislaus County from 2015 to 2016 is due to the Nature Conservancy (TNC) selling a property that accounts for most of the acreage. It is still subject to a conservation easement but no longer held in fee ownership by TNC. Figure 2 shows the cumulative CPAD acreage change rate compared to 2014. Please note that the reduction of StanCOG is too significant (i.e., -35 percent) to show in Table 3. Using both **Table 3** and **Figure 34**, CARB staff has concluded that in all regions except StanCOG and MCTC, total conserved land has grown since 2014, with the most growth occurring in the TMPO/TRPA region. Table 3 below shows the amount of Conserved Land growth for each region, as well as the percentage of that region's total Conserved Land growth from 2014 to 2021. The negative percentage values indicate a loss in Conserved Land in a given year.

[27] California Protected Areas Database: http://www.calands.org/

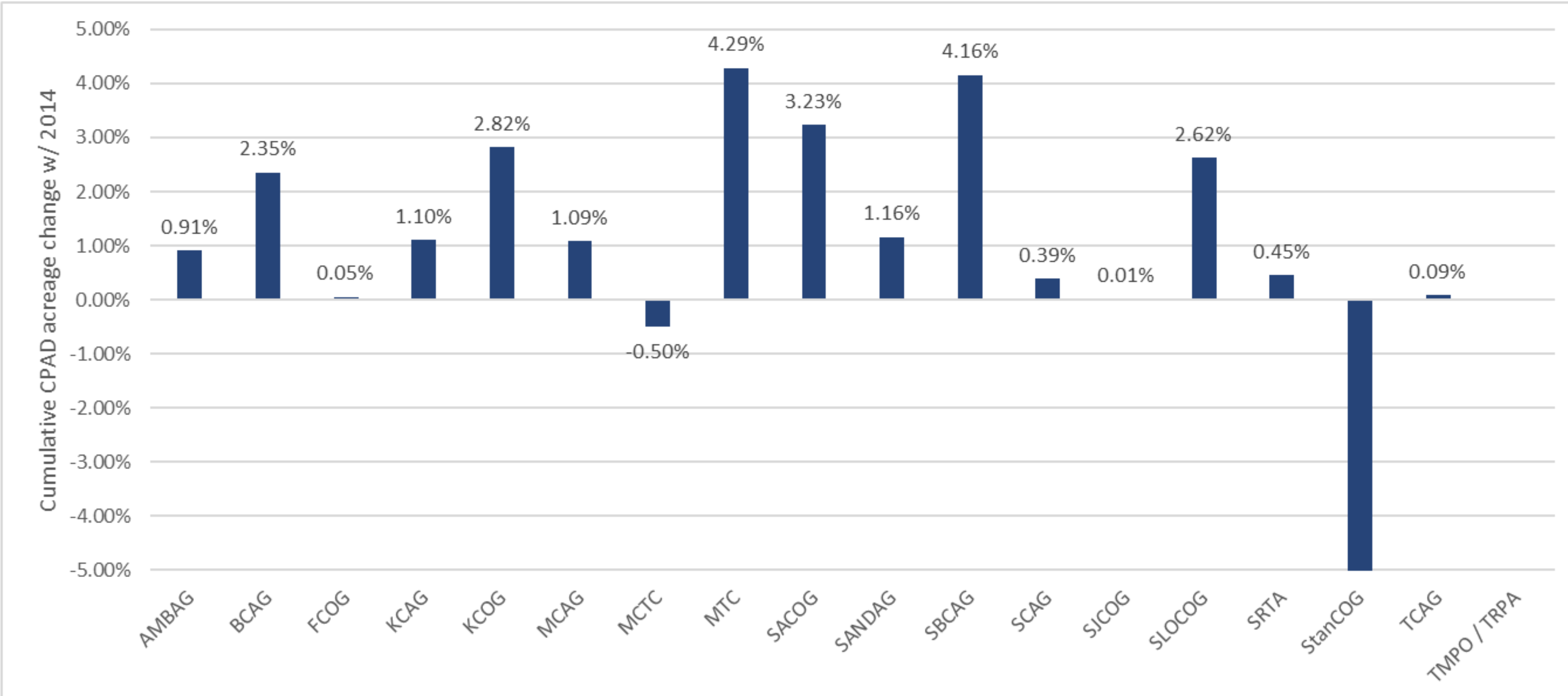
Table 3. Permanent Conserved land from CA Protected Areas Database by Region since 2014 (in acres)

MPO	2015	2016	2017	2018	2019	2020	2021	Total conserved land growth (acres)
AMBAG	7.0%	21.6%	-9.2%	-4.5%	0.2%	3.0%	82.0%	5,998
BCAG	-3.7%	15.2%	0.1%	0.1%	0.0%	0.5%	87.9%	5,255
FCOG	-0.1%	42.2%	21.4%	0.1%	1.3%	13.3%	21.8%	767
KCAG	0.0%	13.9%	0.0%	0.0%	1.7%	7.8%	76.5%	115
KCOG	-0.1%	78.6%	-6.0%	-0.2%	0.3%	1.1%	26.4%	37,443
MCAG	-73.9%	-344.3%	0.0%	0.0%	0.3%	517.8%	0.1%	1,212
MCTC	17.6%	-3.0%	0.0%	0.0%	0.0%	92.3%	-6.9%	-2,558
MTC	14.5%	24.6%	12.1%	2.8%	0.3%	23.4%	22.4%	45,730
SACOG	-7.8%	54.5%	12.0%	2.1%	-0.1%	16.2%	23.1%	38,626
SANDAG	-32.5%	105.3%	16.5%	10.0%	1.5%	7.3%	-8.1%	15,544
SBCAG	2.9%	-0.6%	0.0%	72.7%	0.1%	18.8%	6.1%	33,415
SCAG	-411.3%	246.6%	8.4%	22.2%	0.5%	216.7%	16.9%	56,906
SJCOG	33.3%	-2,400.0%	633.3%	200.0%	-133.3%	600.0%	1,166.7%	3
SLOCOG	1.6%	17.4%	3.0%	2.9%	-3.0%	37.5%	40.6%	13,972
SRTA	0.8%	56.9%	-1.5%	0.0%	3.2%	6.0%	34.6%	4,534
StanCOG	1.9%	98.0%	0.0%	0.0%	-0.1%	0.2%	0.1%	-29,469

MPO	2015	2016	2017	2018	2019	2020	2021	Total conserved land growth (acres)
TCAG	2.3%	6.2%	0.0%	2.5%	3.5%	69.0%	16.6%	1,412
TMPO / TRPA	27.9%	0.7%	29.5%	n/a	n/a	n/a	41.8%	439,473

Figure 34 shows the cumulative CPAD acreage change rate compared to 2014. Please note that the reduction of StanCOG is too significant (i.e., -35 percent) to show in Table 3. Using both Table 3 and Figure 2, CARB staff has concluded that in all regions except StanCOG and MCTC, total conserved land has grown since 2014, with the most growth occurring in the TMPO/TRPA region.

Figure 34. Cumulative Changes in CPAD for 2021 Compared to 2014



* TMPO CPAD change rates were estimated by CARB staff based on shapefiles from CPAD. Unfortunately, data from TMPO/TRPA for 2021 are not reported due to a lack of data availability.

** The ~35 percent reduction in StanCOG since 2016 was due to a significant decrease in NGO-owned in fee and protected for open space purposes in the CPAD record.

In addition, the per capita protected open space area in every region in 2020 is also provided in **Table 4**.[28] This metric compares which regions hold the most protected open space relative to their population, allowing a more appropriate comparison between larger and smaller regions on a "per capita" basis. CARB staff has concluded that SJCOG has the most open space per capita while SANDAG has the least.

Table 4. Per Capita Acreage of Protected Open Space by Region (2020)

MPO	Acres per capita (2020)
AMBAG	0.40
BCAG	0.48
FCOG	0.40
KCAG	3.24
KCOG	3.23
MCAG	1.98
MCTC	1.51
MTC	5.74
SACOG	0.78
SANDAG	0.02
SBCAG	0.14
SCAG	1.85
SJCOG	12.52
SLOCOG	1.50
SRTA	0.86
StanCOG	0.10
TCAG	1.11
TMPO / TRPA	0.07

[28] TMPO/TRPA data during the 2018-2020 period are not available.

Summary

CARB has analyzed the regional growth in the MPO regions within the context of SCS implementation under SB 375 for three different metrics. Generally, newly developed land in California has decreased over the last 15 years. MTC region's compactness has increased the most. Overall, development compactness has improved and supports the SB 375 program but the extent varies significantly between MPO regions. Similarly, in most MPO regions, the rate of agricultural land lost has slowed down over the last decade. However, SCAG has lost the most agricultural land to development since 2004. Furthermore, the acreage of protected land has been slowly and continuously increasing since 2014 in most regions.

ACCESSIBLE COMMUNITIES

Accessibility to key destinations such as jobs, education, housing services, and recreational opportunities is an important SCS metric. This metric reflects the ability to reach a specific destination by walking, biking, or other active transportation modes, thereby reducing the need for driving and GHG emissions. Equitable access to key destinations using non-auto modes of transportation will help reduce GHG emissions and promote residents' health. Access to multiple destinations reflects diverse land uses and efficient and equitable neighborhood designs. Improving access means destinations like schools, shops, and parks will be closer together, and alternate modes of transportation such as walking and biking will be supported and more efficient. Accessibility is not just important from a GHG perspective, it also improves access and supports those who are unable to drive.

In this report, CARB staff defined access as the ability to reach the nearest educational facility, park or open space, transit stop, and/or grocery store within 15 minutes by walking. References to walking are also intended to include other active means of travel, such as wheelchair travel, that occur at a similar pace (assuming a speed of three miles per hour).[29] In this report, access is measured as the percentage of the population in each MPO region that can access the nearest destination type within 15 minutes by walking. Although the metric access means more than just walking or biking to key destinations, CARB staff focused primarily on physical access by walking based on factors such as its relevance to VMT reduction, the availability of data statewide, and the potential to be tracked over time. In addition, it indirectly includes access to jobs and other destinations that are accessible via transit but not estimated.

This section presents the various data sources used, illustrates the method to measure the metric(s), highlights caveats and constraints, and presents the results.

Data Sources

CARB staff used the UrbanFootprint tool to measure walk access for all 18 MPO regions. UrbanFootprint is a web-based platform that allows planners, architects, policymakers, and the public to analyze land use data. The UrbanFootprint tool provides a base canvas – a geospatial dataset reflecting the land use conditions at the parcel or census block resolution.[30] Using Open Street Map (OSM) data and General Transit Feed Specification (GTFS) data, this tool measures walk access and transit access for the base canvas of a given area (in this case, an MPO region). The web-

---

[29] UrbanFootprint (UrbanFootprint | The Urban Intelligence Platform). Note that this platform does not address the quality of pedestrian walkways or accessibility features (such as availability of benches) along the route but merely measures distance via non-highway routes.
[30] Population data at the block level is derived from 2010 Decennial Census

based platform then combines relevant datasets for the selected mode (in this case, walking) of analysis and uses network analysis to generate walk access results.

CARB staff considered access to basic needs (non-work destinations) for this analysis. Selected destinations include educational facilities, parks/open spaces, transit stops, and grocery stores. CARB staff mostly used the broad definitions of each destination as defined in the UrbanFootprint tool to maintain consistency statewide. This report documents a brief description of each destination below.[31] The UrbanFootprint methodology provides more detail.

- Educational Facilities – The locations of schools, colleges, and universities are based on multiple data sources, such as Homeland Infrastructure Foundation-Level Data, National Center for Education Statistics, School Attendance Boundary Information System (SABINS), California School Campus Database, and others.
- Parks/Open Spaces – The locations of parks/open spaces are based on multiple datasets, including Parks and Open Spaces, and California's Protected Area Database 2019.
- Grocery stores – Data for grocery stores are obtained from the OSM platform. Data points for grocery stores include supermarkets and greengrocers, 2016.
- Transit stops - Data for transit stops are obtained from Transitland, last updated in May 2021.

Method

CARB staff analyzed walkability using a speed of 3 miles per hour for four destinations –educational facilities, open spaces, transit stops, and grocery stores–using the UrbanFootprint tool. In addition, CARB staff measured the following: 1) the percentage of the population with access to individual destinations within 15 minutes by walk for each MPO region and 2) the percentage of the population that has access to one of each of the four destinations—educational facilities, parks/open spaces, transit stops, and grocery stores-combined within 15 minutes by walk for each MPO region.

CARB staff analyzed walkability for most regions at the MPO level. However, for large MPO regions (e.g., SCAG and MTC), due to mapping platform constraints, these measures were generated at the county level and CARB staff used population-weighted averages to extrapolate to the full region.

[31] UrbanFootprint refers to education facilities as schools, parks/open spaces as parks. CARB staff used the former terms as the terms used by the tool were narrow in scope.

Results

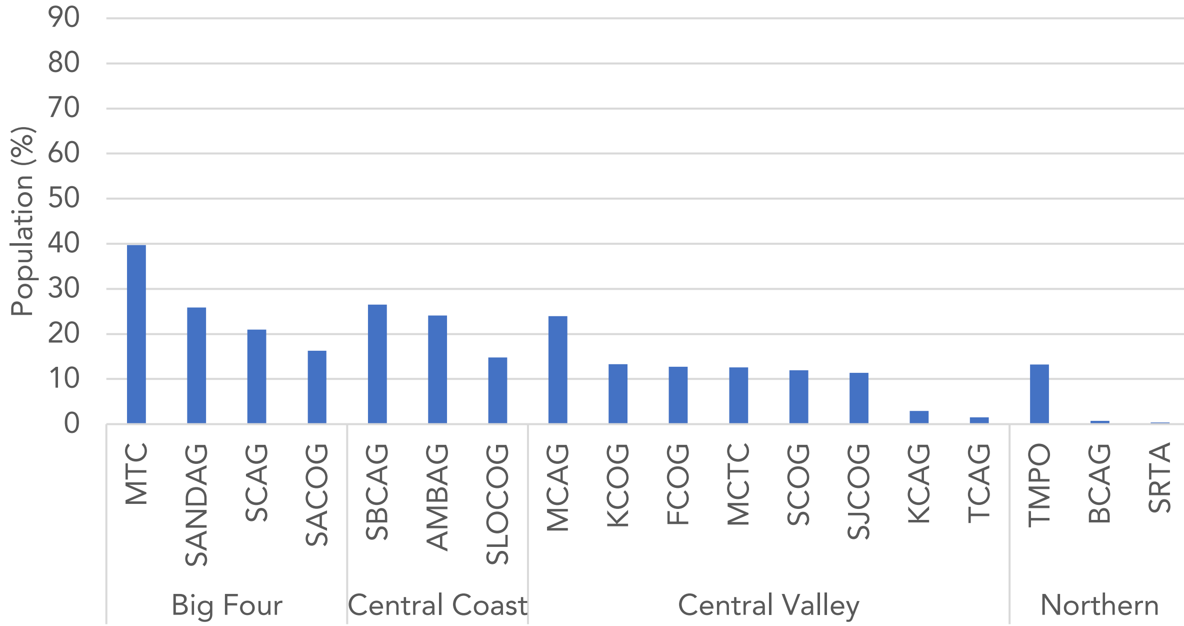
The following figures illustrate 1) combined access to the four destinations across MPO regions and 2) access to individual destinations within each MPO region.

Combined Access to the Four Destinations

Figure 35 illustrates the percentage of people who can access one of each destination type combined within 15 minutes by walking across 18 MPO regions. CARB staff defines combined access to the four destinations as the percentage of people who have access to one of each of the four destinations—nearest park/open space, educational facility, transit stop, and grocery store—combined within 15 minutes by walking.

In each MPO region, less than half of the population has combined access to one of eachthe four destinations type combined within 15 minutes by walking. However, among all MPOs, MTC residents (39.7%) have the highest access to one of each destination type combined relative to the rest of the MPO regions.

Figure 35. Percentage of population with combined access to the four destinations by walking within 15 minutes across MPO regions



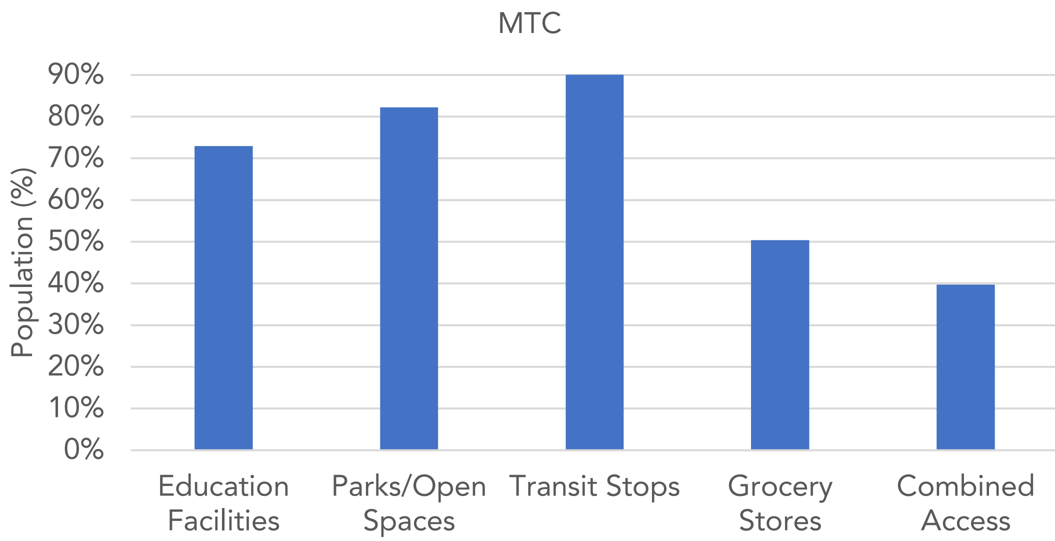
Access to Individual Destinations

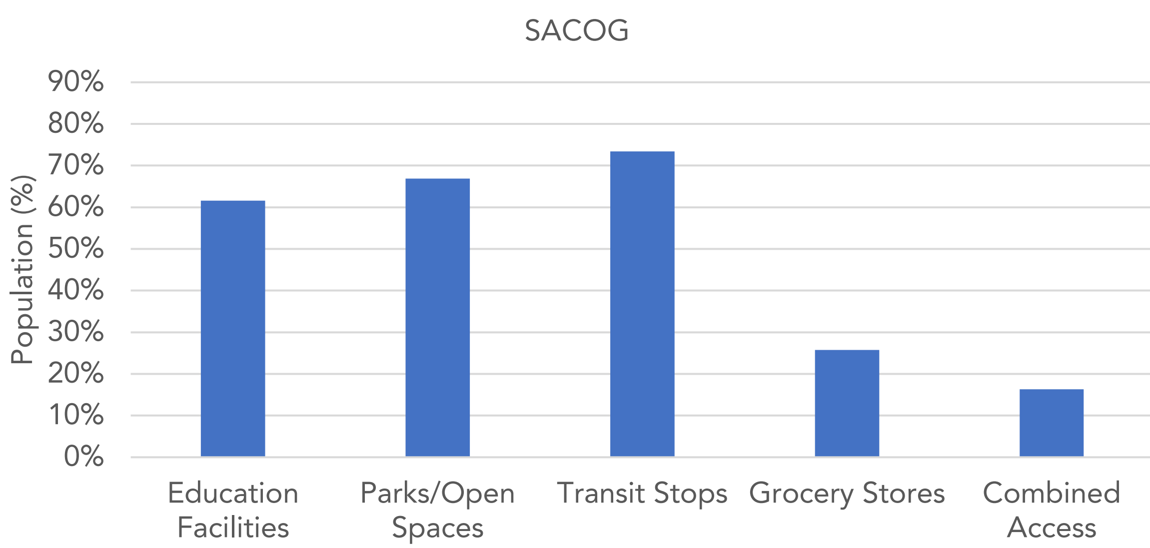
Figure 36 below illustrates the variation in the percentage of people who have access to individual destinations within 15 minutes by walking within each MPO region. The combined access to the four destinations (presented as combined access in figure 29) is also provided for reference.

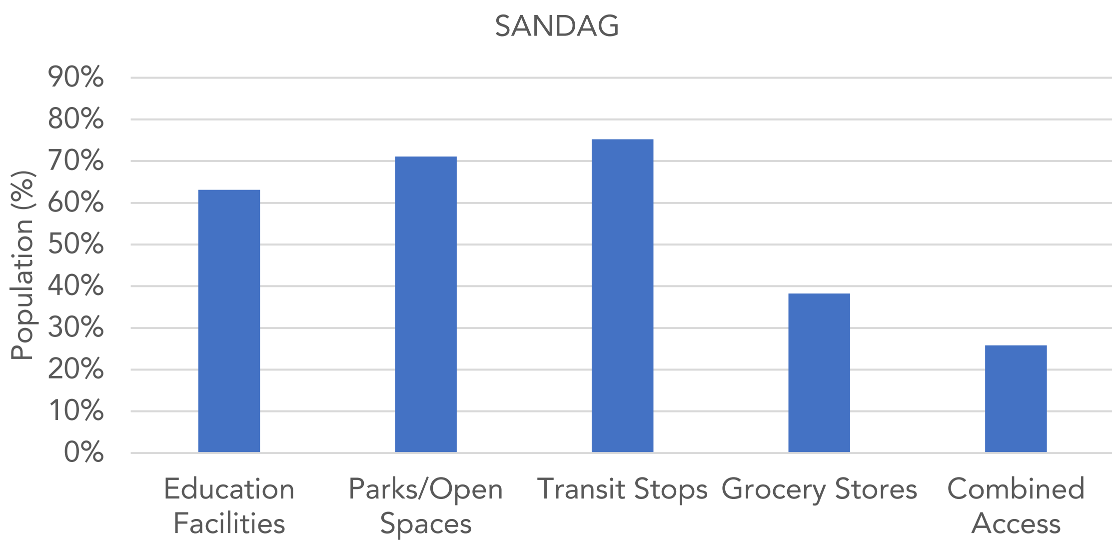
The findings illustrate that for most MPO regions, out of the four destinations, their residents have the highest access to transit stops. On the other hand, grocery stores typically had the least access, with a few exceptions. For example, in SANDAG, 75.2% of residents have access to the nearest transit stop within 15 minutes by walking, while only 38.3% of residents have access to the nearest grocery store within 15 minutes by walking. Data also show that access to individual destinations is always higher than the combined access to the four destinations. For example, in SANDAG, only 25.8% of residents have combined access to the four destinations (nearest park/open space, educational facility, transit stop, and grocery store). This trend indicates that regions are not equally accessible to all destinations and highlights the need for mixed-use development.

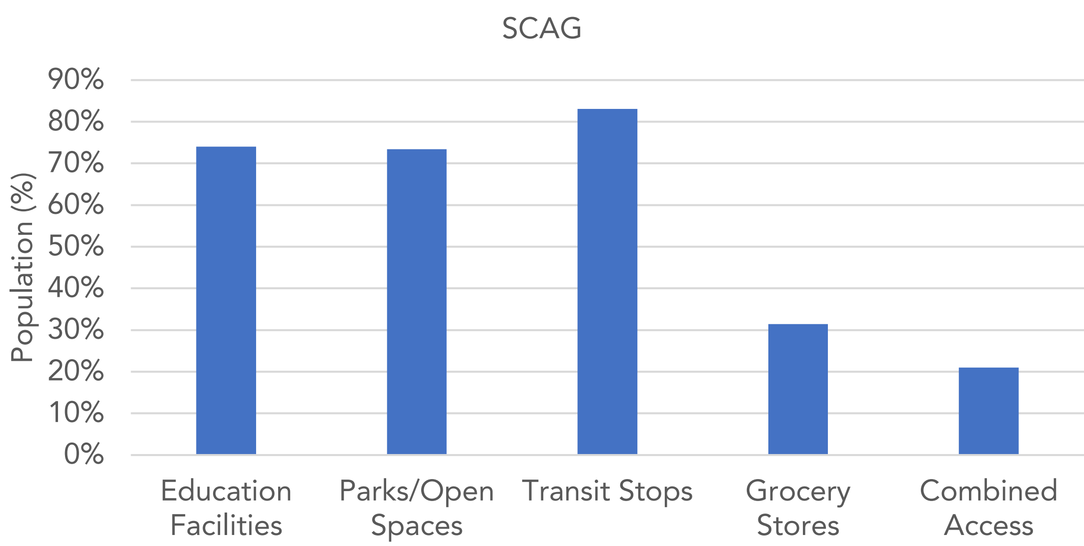
Figure 36. Percentage of population with access to individual destination and combined access to the four destinations by walking within 15 minutes in each MPO region

Big 4 MPO Regions

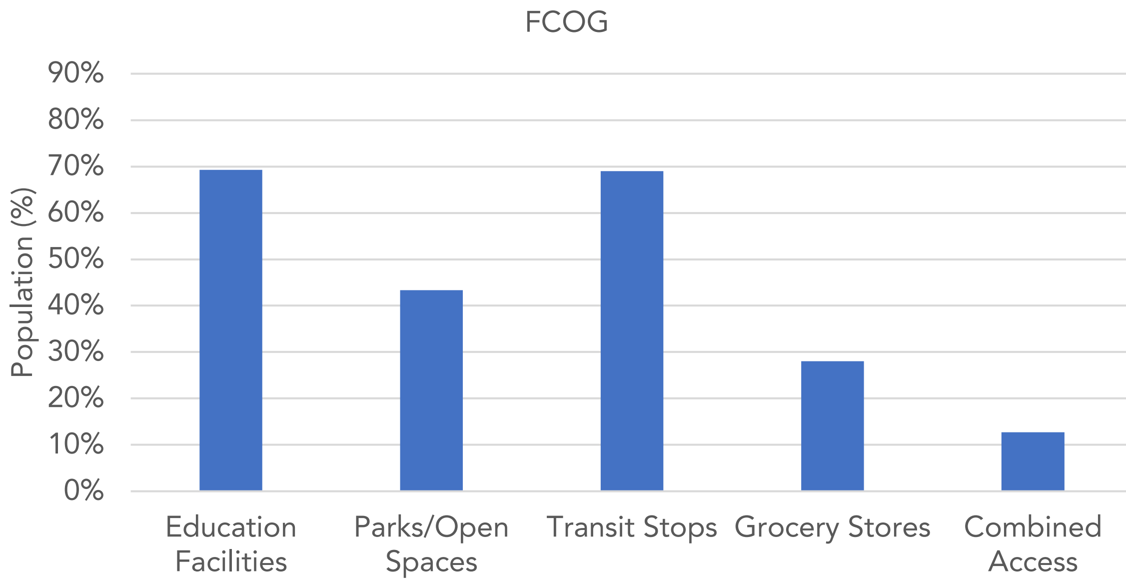


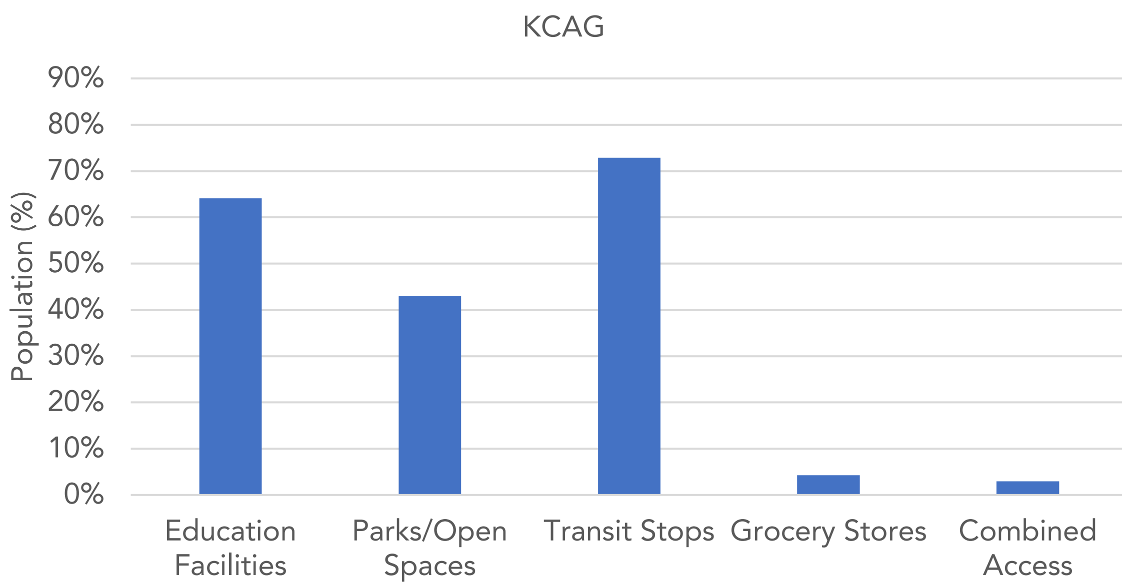


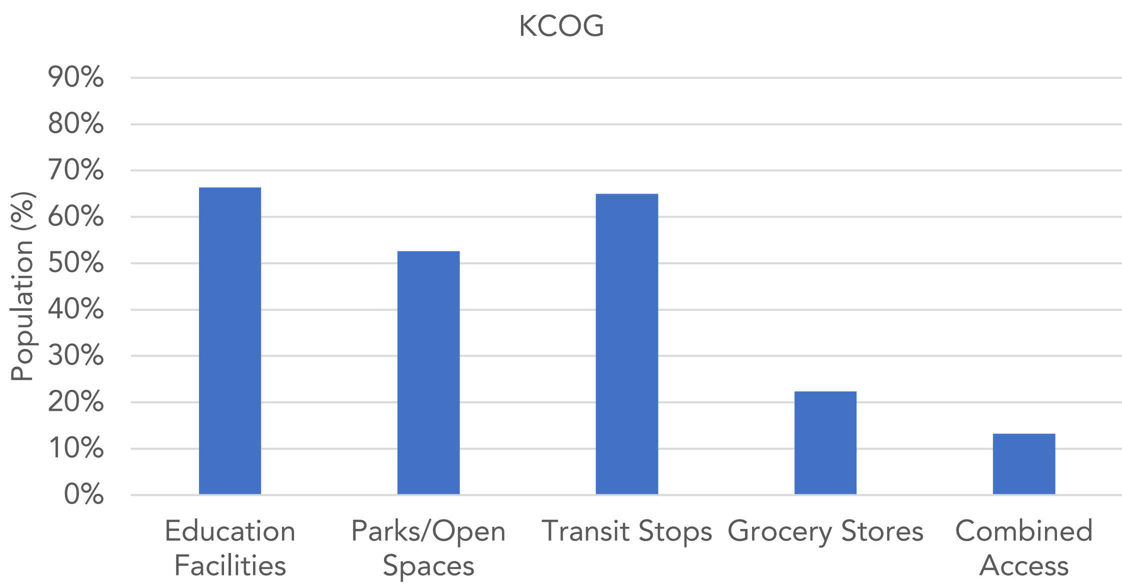

SANDAG
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Population (%)
Education Facilities
Parks/Open Spaces
Transit Stops
Grocery Stores
Combined Access

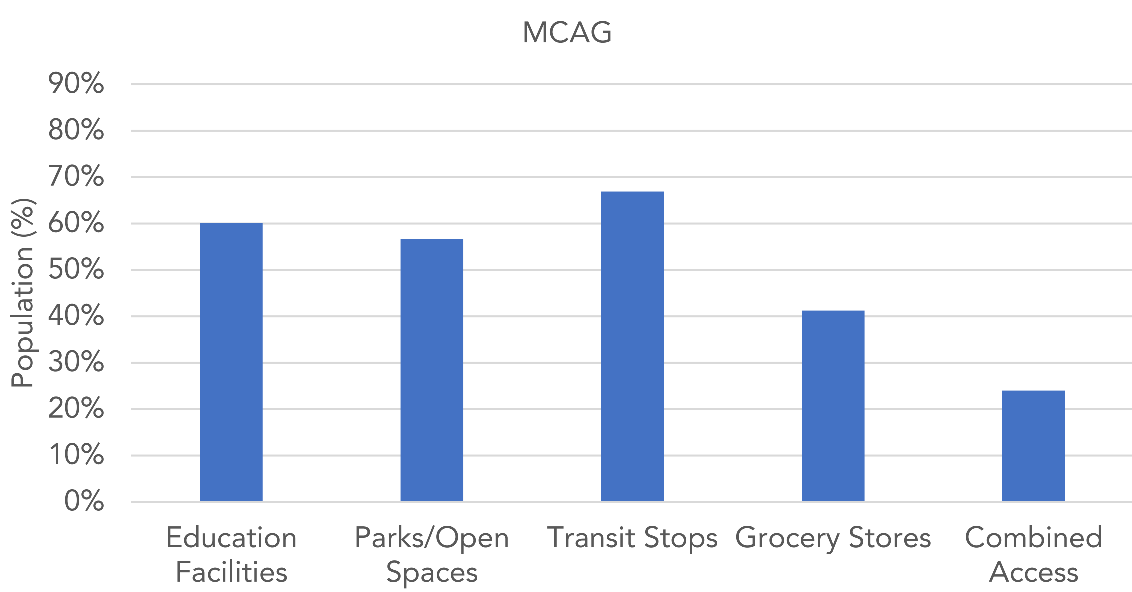

SCAG
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Population (%)
Education Facilities
Parks/Open Spaces
Transit Stops
Grocery Stores
Combined Access

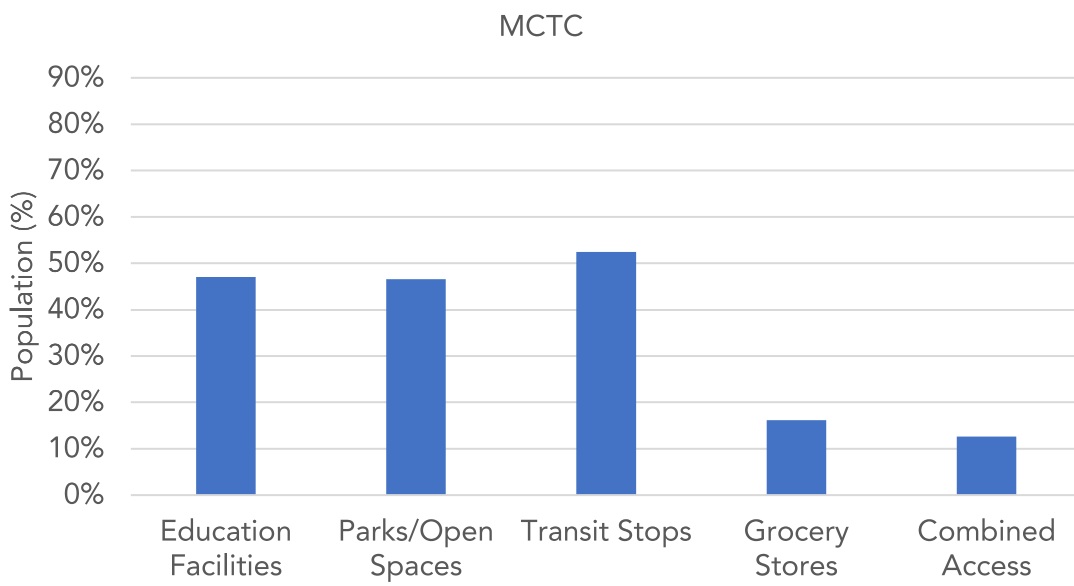
SJV MPO regions



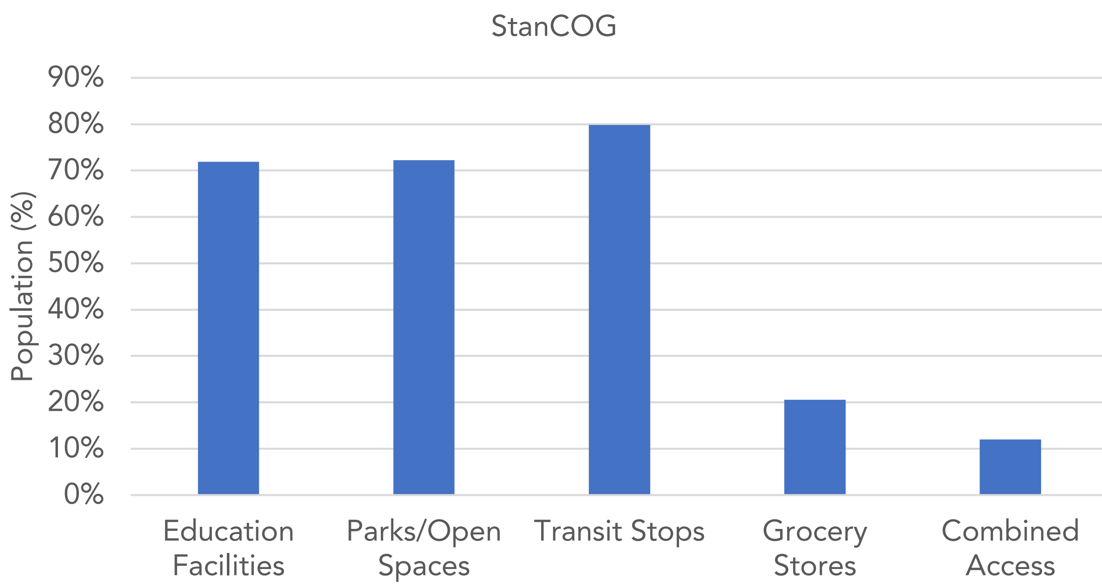


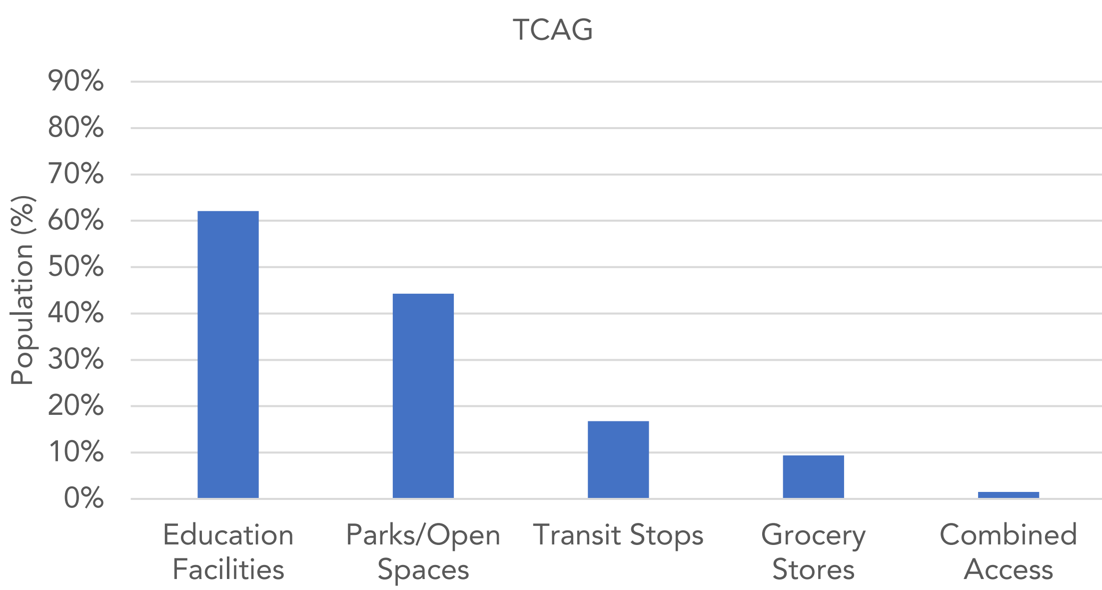

KCOG
Population (%)
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Education Facilities
Parks/Open Spaces
Transit Stops
Grocery Stores
Combined Access


MCAG
Population (%)
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Education Facilities
Parks/Open Spaces
Transit Stops
Grocery Stores
Combined Access

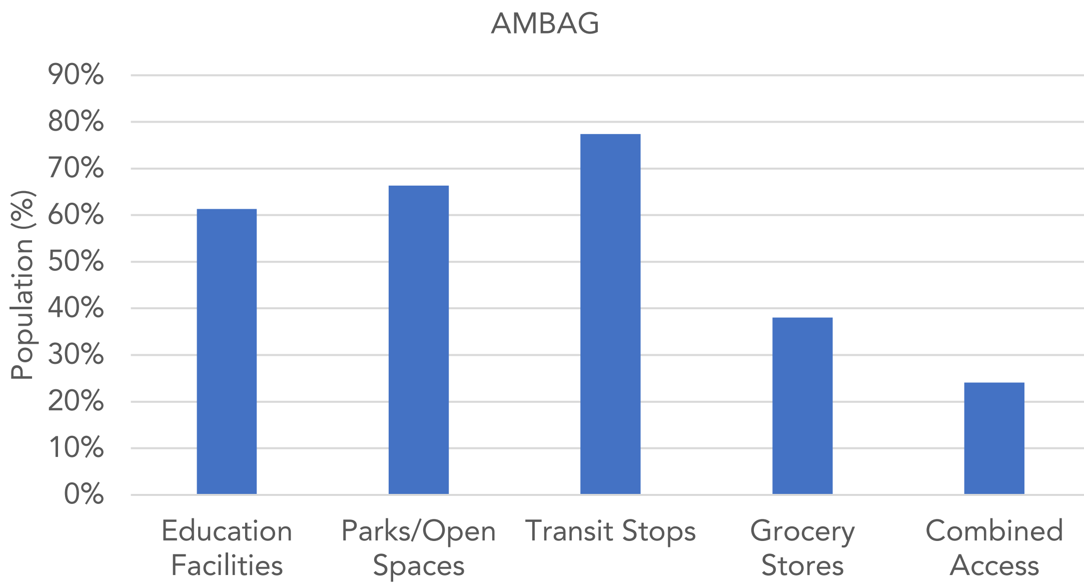

MCTC
Population (%)
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Education Facilities
Parks/Open Spaces
Transit Stops
Grocery Stores
Combined Access

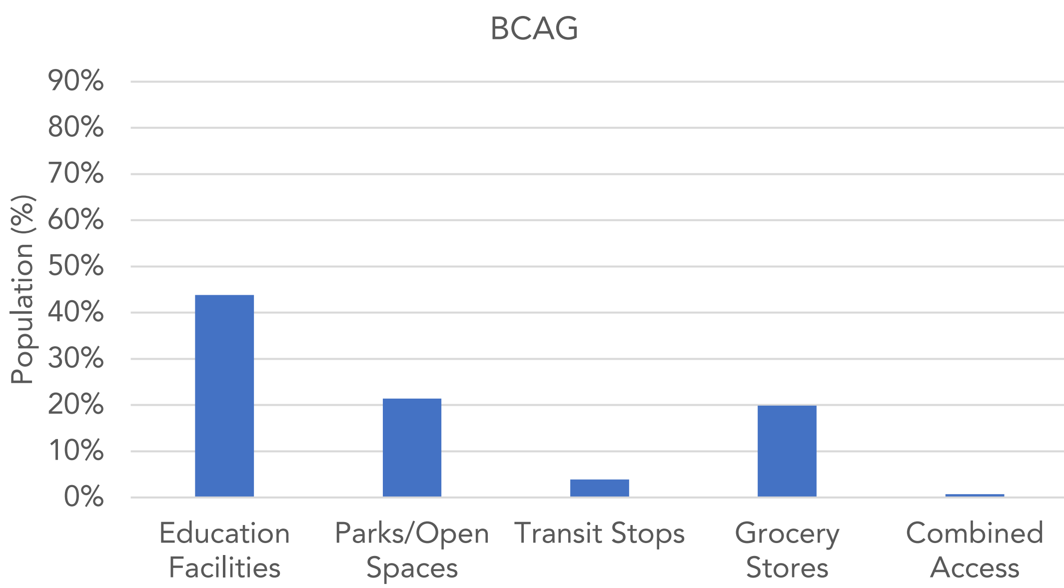

SJCOG
Population (%)
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Education Facilities
Parks/Open Spaces
Transit Stops
Grocery Stores
Combined Access

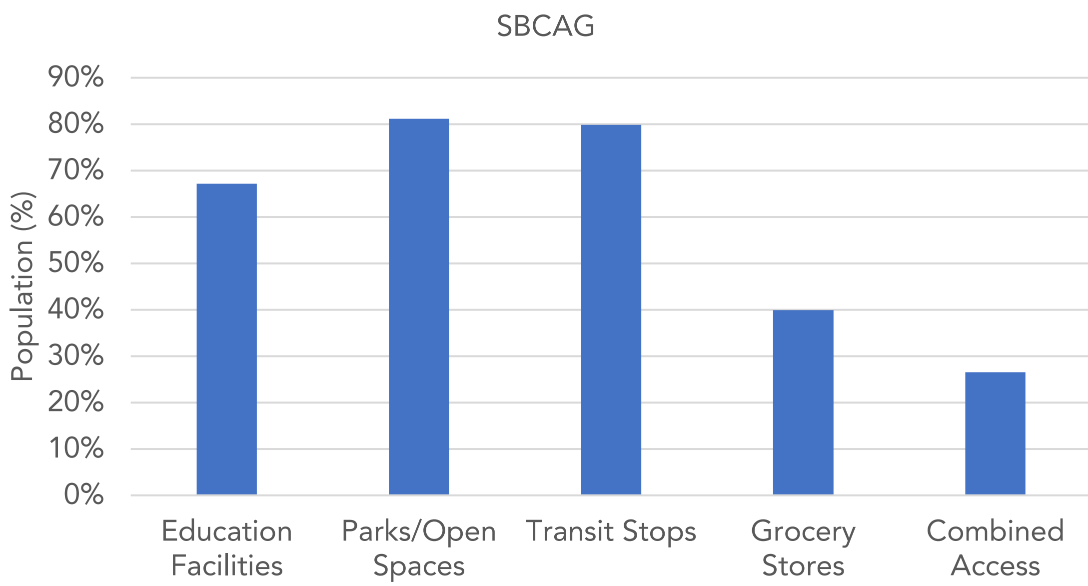

StanCOG
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Population (%)
Education Facilities
Parks/Open Spaces
Transit Stops
Grocery Stores
Combined Access

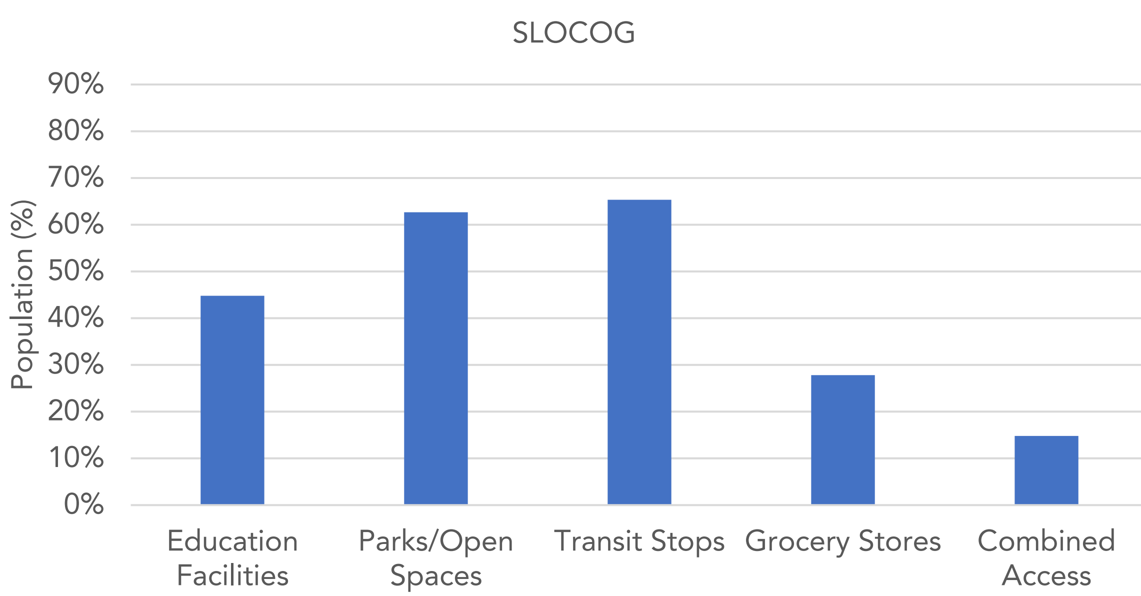

TCAG
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Population (%)
Education Facilities
Parks/Open Spaces
Transit Stops
Grocery Stores
Combined Access

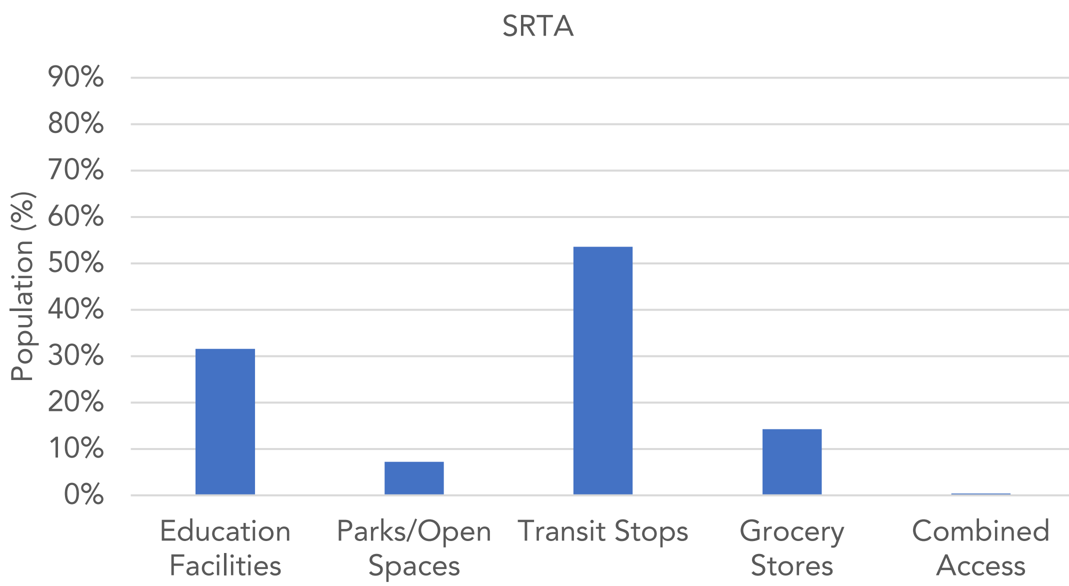
Coastal and Northern California MPO Regions

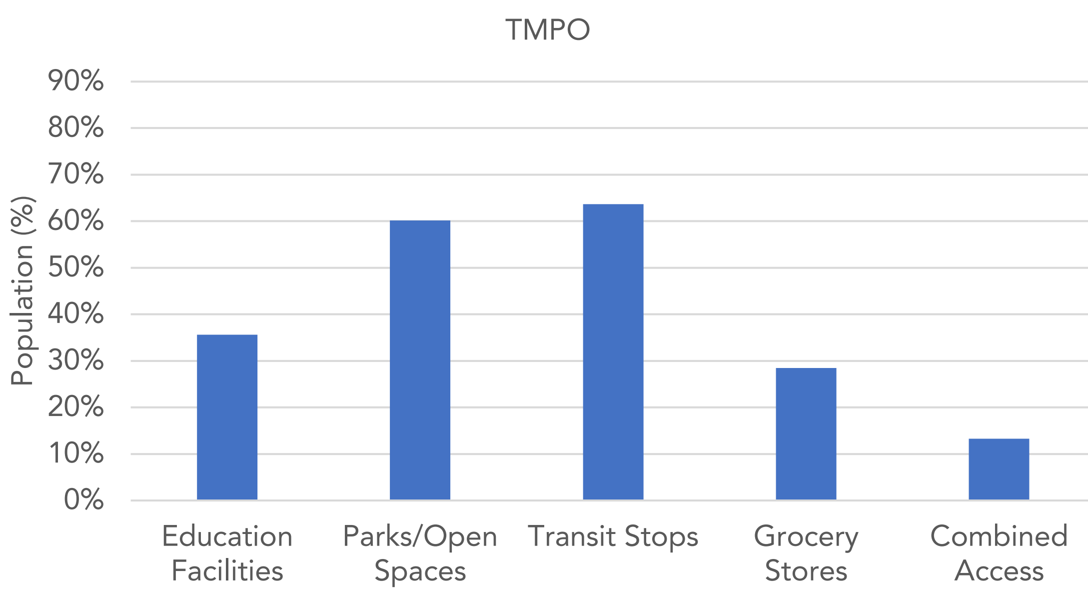





SBCAG
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Population (%)
Education Facilities
Parks/Open Spaces
Transit Stops
Grocery Stores
Combined Access


SLOCOG
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Population (%)
Education Facilities
Parks/Open Spaces
Transit Stops
Grocery Stores
Combined Access





Caveats and Next Steps

Although the datasets used in the tool have their own set of limitations, the UrbanFootprint platform provides a robust dataset available for statewide analysis and comparison at the MPO regional level. However, the interpretation of the results should consider the following caveats:

1. Data granularity

The UrbanFootprint platform generally provides parcel-level data, but due to mapping constraints, parcel-level analysis was unavailable for large counties and MPO regions.[32] Therefore, CARB staff analyzed all MPO regions at the block level in the UrbanFootprint platform. Given this, the percentage of people who can reach a specific destination within a given time frame is likely to be overestimated. Due to data aggregation at the block level, this measure does not account for the time to walk or bike within a block. The US Census defines census blocks as statistical areas bounded by visible features such as roads, streams, railroad tracks, and nonvisible boundaries such as property lines; city, township, school district, county limits; and short line-of-sight extensions of roads. In a city, a census block is similar to a city block bounded by streets on all sides, whereas blocks in rural areas are likely to be large and irregular in shape.[33] Given this, it is essential to note that the average block size in rural areas is relatively higher than in urban areas. Therefore, the percentage of people reaching a specific destination in rural areas within 15 minutes is likely to be overestimated because it does not account for walking or biking within a block.

2. Quality of streets

The access measure does not wholly account for the quality of the road and infrastructure, such as the presence of shade trees, slope, sufficient street lighting, benches for resting, wheelchair-accessible sidewalk ramps, and signage used to reach a specific destination. Given this, a resident may choose another route that might take longer to get to the same destination.

3. Type and characteristics of a destination

The access to a select destination is likely to change if the type and characteristics of the destinations are different. For example, the proportion of the population with 15-minute walking access to facilities of higher education specifically will be lower than that of the population with that same access to any education facility. In other words, the findings in this report may have overestimated the access to various destinations, so the results should be interpreted by considering this caveat.

---

[32] UrbanFootprint tool has a maximum canvas size. For parcel-level analysis, the maximum size is 350 tracts or smaller. Since select counties and MPO were beyond this size, CARB staff conducted block-level analysis in November 2021.
[33] Census.gov

4. Access-proximity versus usage

Prior research on accessibility focuses on physical proximity[34], but physical proximity may not translate into usage. For example, depending on a user's needs regarding park facilities, they may travel further to use a park that meets their needs. To capture usage, Saxon (2021) analyzed cell phone data for 20 major cities to calculate access to parks based on park usage instead of proximity. Considering privacy issues and understanding that this is limited to a sample of the population with cell phones, CARB staff used proximity as a measure of access and will explore big data for future reports to better measure usage.

Summary

Improving access to key destinations facilitates a mix of land uses, enabling more efficient alternate modes of active transportation and will help reduce GHG emissions. The findings illustrate that less than half of the population has access to one of each destination type within 15 minutes by walking within each MPO region. This trend indicates that in collaboration with local agencies, MPO regions should promote a better balance of land uses by encouraging housing and non-work-related establishments to exist in closer proximity, thereby reducing the need for driving and GHG emissions.

[34] Talen and Anselin, 1998; Logan et al., 2017

HOUSING CHOICES

Housing development is an essential component of achieving SB 375 goals. For example, housing policies that support compact development, multi-family units, and equitable development can expand land use mix, improve connectivity between home and job locations, and allow better transit accessibility to reduce VMT [35]. In this report, CARB staff analyzed data for multiple housing metrics and tracked the implementation of housing strategies in each MPO. In addition, to understand the extent to which this growth is equitable and sustainable, this report also tracks the progress of addressing the housing crisis in California, especially for people living in priority population areas and low-income households. CARB staff analyzed seven metrics under this theme, as follows:

- Vacancy rate
- Housing cost burden
- Jobs-housing balance
- Percent of jurisdictions with a certified housing element
- Housing units permitted compared to Regional Housing Needs Allocation (RHNA)
- Housing activity by income level
- Units with density bonus or inclusionary deed restrictions

Vacancy Rate

CARB staff analyzed housing vacancy rates by region based on DOF population and housing estimates data.[36] The trends of regional vacancy rates can affect housing prices, which could profoundly impact home location choices and travel behavior. The housing vacancy rate for each MPO region is calculated based on the county-level housing units and occupancy rates. The housing vacancy rate dataset reported by DOF accounts for units that are sold and rented but not yet occupied. In contrast, data sources like the ACS consider housing units vacant only if they are on the market for sale or rent. For example, in a rental apartment where the tenant has signed the lease but has not yet moved in, this apartment unit is considered vacant in DOF's definition, whereas other data sources like ACS consider it to be occupied. Due to definition differences, the vacancy rates reported by DOF are higher than the renter and homeowner vacancy rates reported by ACS. ACS data were not usable for this analysis

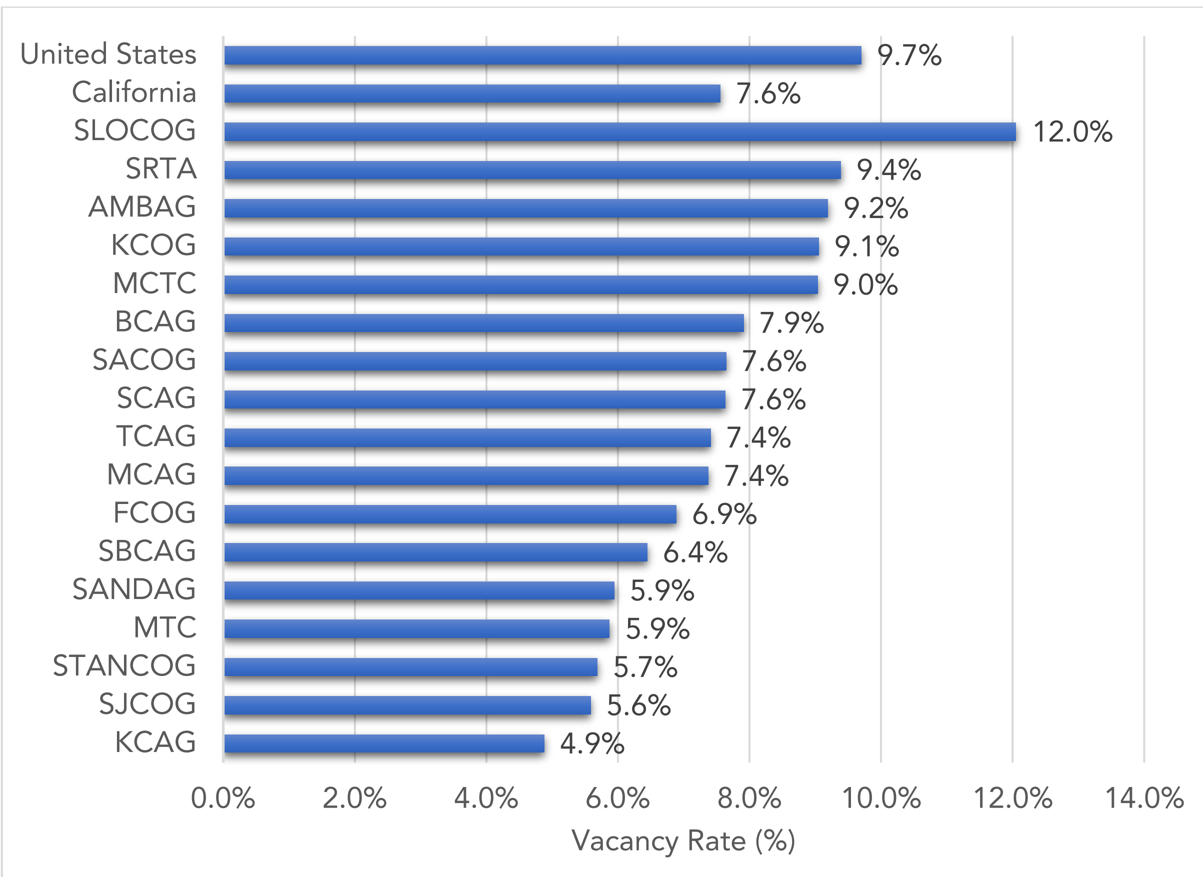
[35] Land Use-Related Policies Effects on VMT and GHG: https://ww2.arb.ca.gov/our-work/programs/sustainable-communities-program/research-effects-transportation-and-land-use

[36] DOF Population and Housing Estimates: https://www.dof.ca.gov/forecasting/demographics/estimates/

because its renter and homeowner vacancy rates are missing in multiple MPO regions.[37]

Figure 37 shows that the statewide vacancy rate was 8 percent as of January 2021. Based on the decennial census, this rate is lower than the national average of 9.7 percent in 2020.[38] Within the Big 4 MPO regions, the SCAG and SACOG regions' vacancy rates are similar to the state level; SANDAG and MTC regions' vacancy rates are on the lower end. It should be noted that the reported vacancy rate for MPO regions in Figure 34 does not tell the complete picture of the market because it is an average across multiple market segments like income level and housing type.

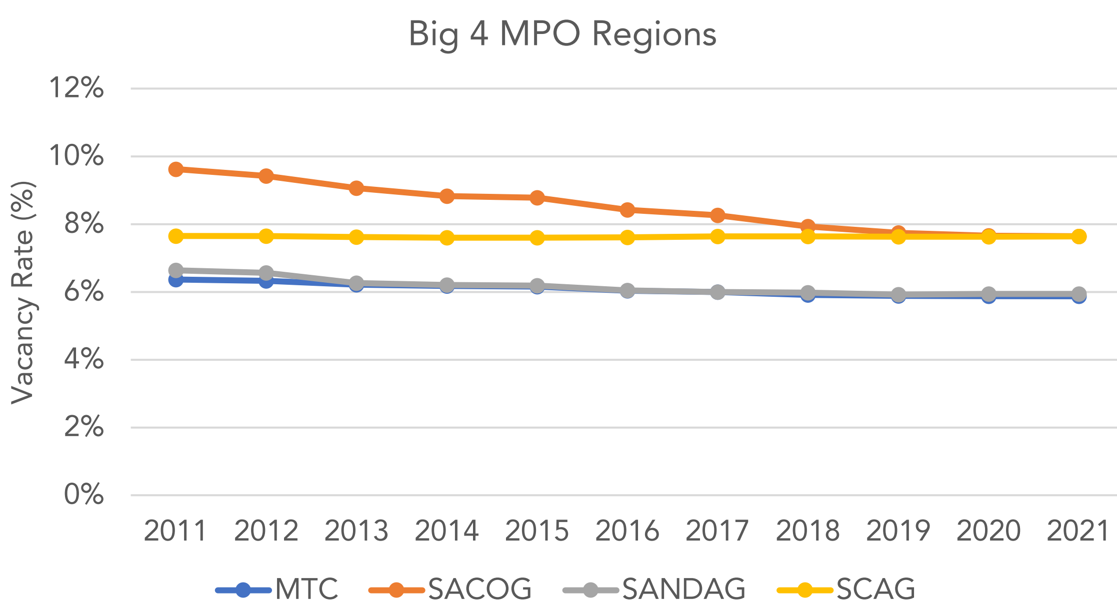
Figure 37. Vacancy rate of United States, California, and MPO regions as of Jan 1, 2021

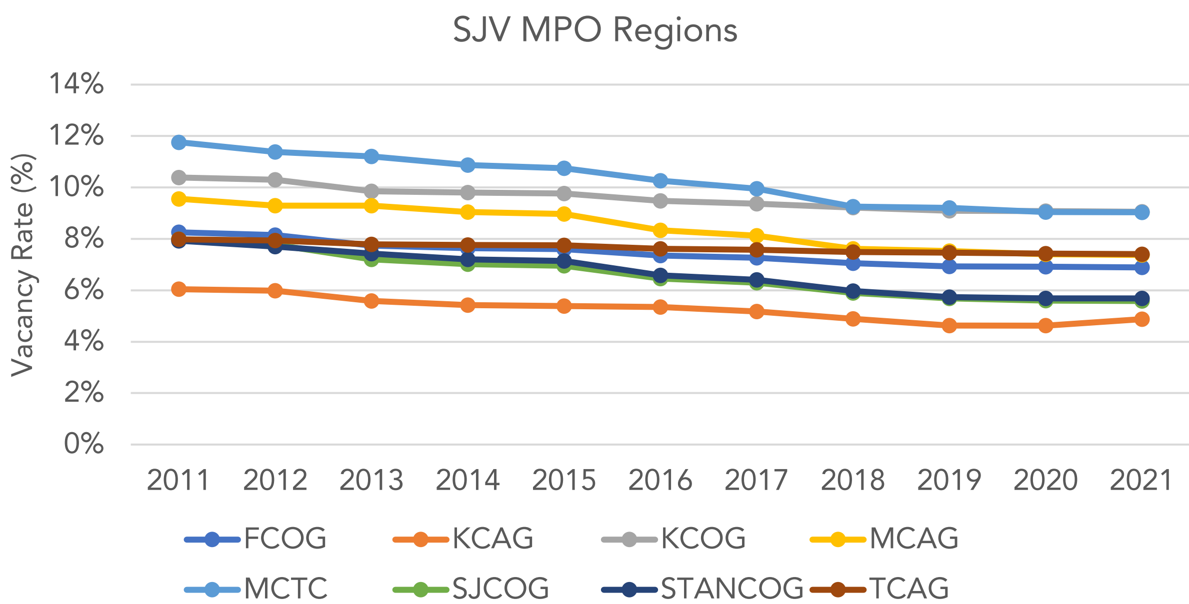


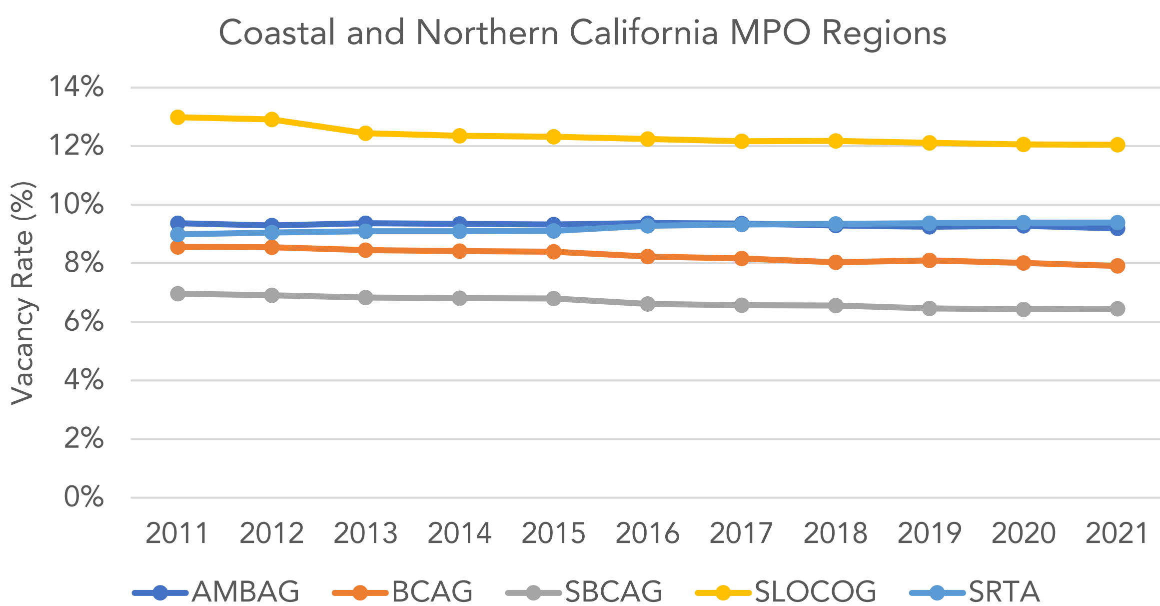
[37] Data for at least one county of the following MPOs' are missing for one year or more: MTC, SCAG, SACOG, AMBAG, BCAG, KCAG, MCTC, and TMPO.
[38] U.S. Housing Vacancy rate declined in the past decade (August 2021): https://www.census.gov/library/stories/2021/08/united-states-housing-vacancy-rate-declined-in-past-decade.html (accessed February 7th, 2022). Note: this vacancy rate definition is consistent with DOF

CARB staff also analyzed the temporal trend of vacancy rates in MPOs. As shown in **Figure 38**, a decreasing trend in the housing vacancy rate is observed in most MPO regions, suggesting that a greater percentage of California's housing stock is occupied. Within the Big 4 MPO regions, the SCAG, MTC, and SANDAG regions have maintained stable vacancy rates in the past decade, while the SACOG region's vacancy rates have decreased. In the SJV MPO regions, while their baseline vacancy rates vary, all MPO regions show a decreasing trend with a comparable slope. The observed trends in SACOG and SJV regions are likely due to the slow recovery rate in the construction of new housing units. For the MPO regions in the coastal and northern California, the vacancy rates are generally stable with a minor decreasing trend across all regions; SLOCOG had an early drop then flattened in recent years. Similar to new homes built, the vacancy trend of TMPO is not analyzed due to a lack of data availability.

Figure 38. Temporal trend of housing vacancy rates in each region







Housing Cost Burden

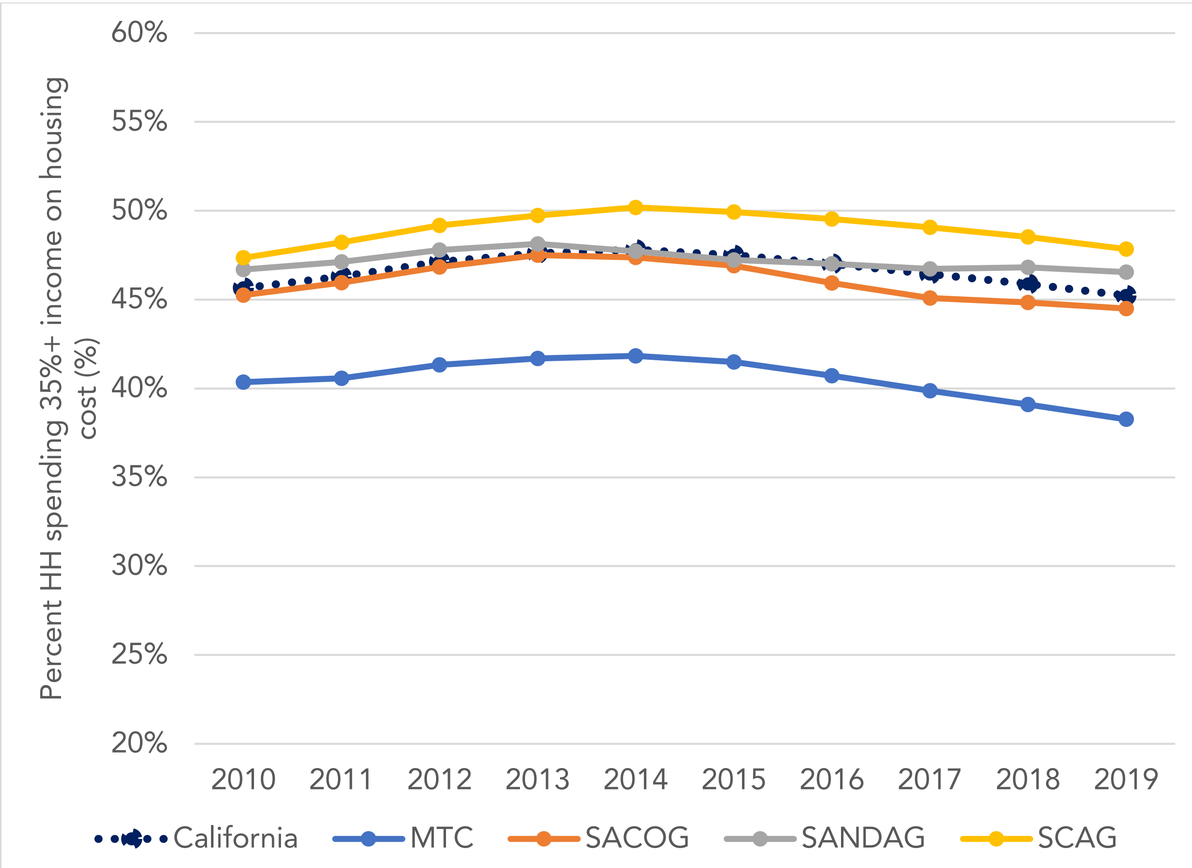
CARB staff analyzed housing cost burden trends in every MPO region from 2010 to 2019. Housing costs can be a substantial financial burden to predominantly low-income households. Traditionally, those families who pay more than 30 percent of their income for housing are overburdened. However, recent articles have argued that the 30 percent threshold is too low.[39, 40] Meanwhile, the Organisation for Economic Co-operation and Development (OECD) defines the housing cost overburden rate as "the proportion of households or population that spend more than 40 percent of their disposable income on housing cost."[41] Considering California's relatively high average housing cost in the US and the housing demand shortage, CARB staff selected 35 percent of income for housing cost as a threshold for defining "overburden" in this analysis. This threshold selection is a carryover from the CARB 2018 SB 150 report based on recommendations from subject experts. In other words, households who spend 35 percent or more of their income on housing costs are considered overburdened in this report. Block-level housing costs as a percentage of household income data and household numbers from ACS are aggregated into MPO regions to show the percentage of households who spend 35 percent or more of their income on housing costs in the Big 4, SJV, central coast, and northern California regions from 2010 to 2019 in **Figures 39-41**, respectively. The blue dot lines in these figures represent the average statewide overburden rate and shows the percentage of households who spend 35% or more of their income on housing costs in California; the dots show the percentage of households who spend 35% or more of their income on housing costs in individual MPO regions.

The statewide and Big 4 MPO regions' trends show that the overburden rate increased between 2010 and 2014 and slowly decreased in recent years. Among the Big 4 MPO regions, SCAG shows the highest overburden rate, while MTC has the lowest. However, the observation that MTC has the lowest overburden rate among the Big 4 MPO regions should not be interpreted as the region having the least housing cost. Instead, MTC is one of the regions with the highest housing cost across the US, based on ACS data. But the MTC region also has a high regional income level (i.e., median household income was $116k in 2019), reducing the overburden percentage. Since ACS data uses the residence place, this estimate does not include the households displaced from the MTC region due to the high housing cost burden.

---

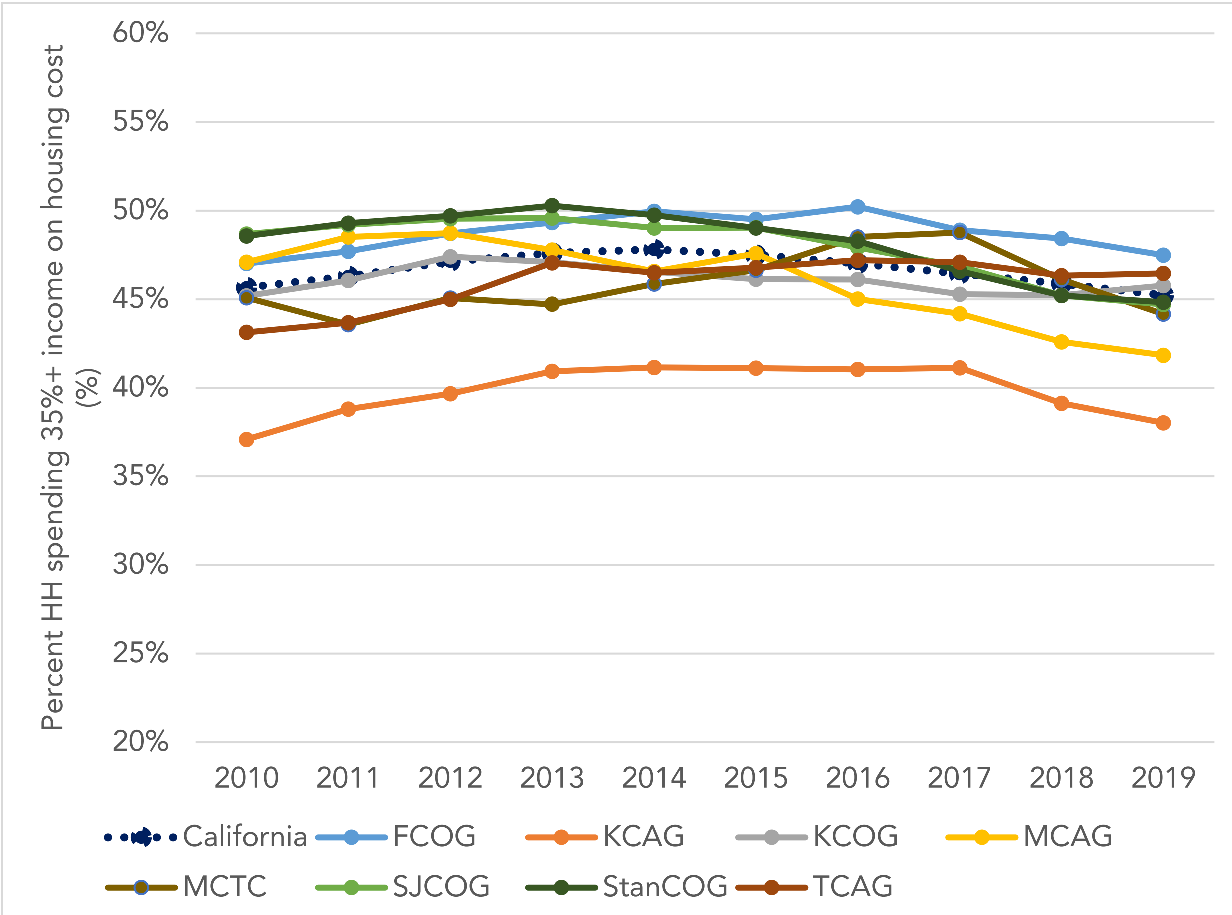
[39] Rental Burdens: Rethinking Affordability Measures: https://www.huduser.gov/portal/pdredge/pdr_edge_featd_article_092214.html#:~:text=HUD%20defines%20cost%2Dburdened%20families,of%20one's%20income%20on%20rent. (Accessed February 7th. 2022)
[40] Housing's 30-Percent-of-Income Rule Is Nearly Useless: https://www.bloomberg.com/news/articles/2014-07-17/housings-30-percent-of-income-rule-is-near-useless (Accessed February 7th. 2022)
[41] Housing costs over income: https://www.oecd.org/els/family/HC1-2-Housing-costs-over-income.pdf(Accessed February 7th. 2022)

Figure 39. Housing cost burden in the Big 4 MPO regions



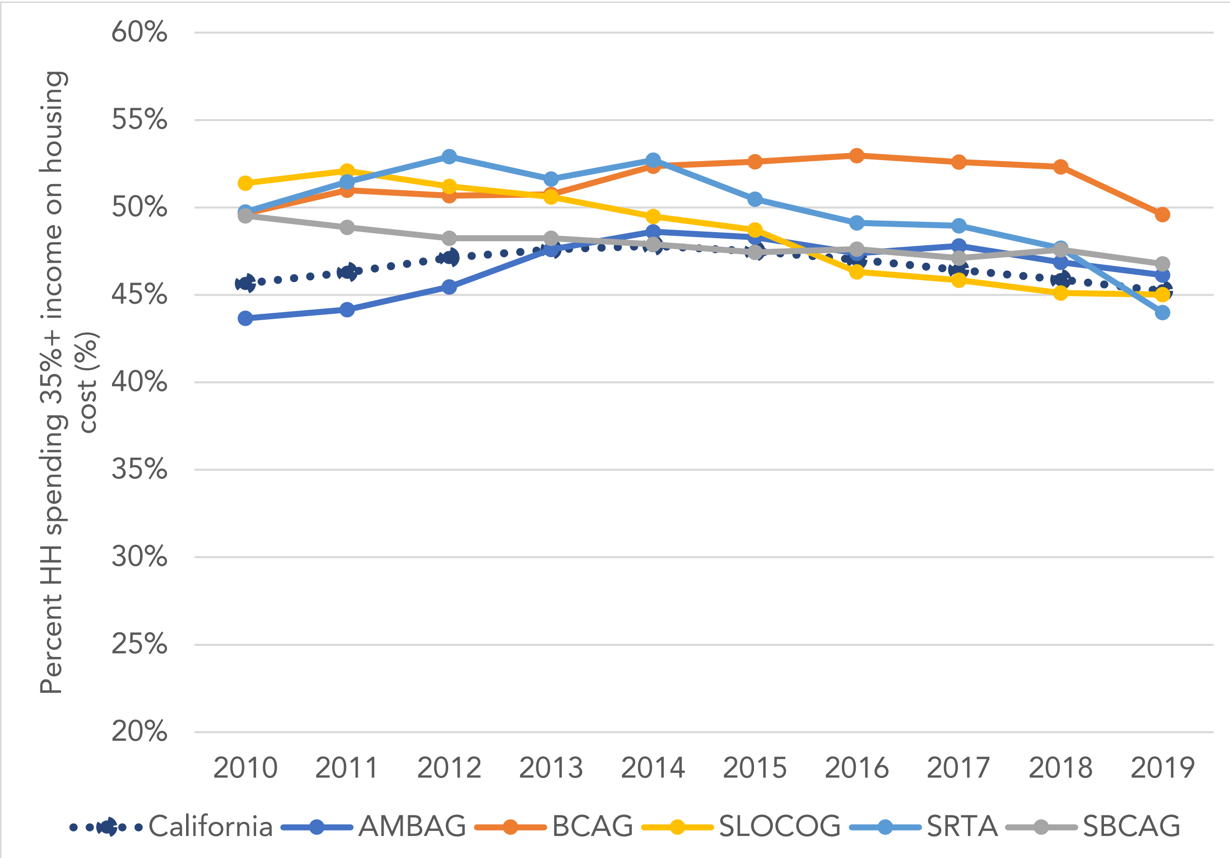
SJV MPO regions' housing cost burdens vary across counties and change over time. For instance, in the 2010-2013 period, SJCOG and StanCOG regions had the highest overburden rate across the 8 MPOs. Then, starting in 2014, the FCOG region had the highest overburden rate in the SJV, which continues today. TCAG is another SJV MPO region that shows a generally increasing trend in the overburden rate, leading to housing and equity concerns.

Figure 40. Housing cost burden in the SJV MPO regions



For the remaining MPO regions in the central coast and northern California, SLOCOG and SBCAG regions are showing decreasing trends in the overburden rate, consistent with the overall sustainability and equity goals. In contrast, the BCAG region has the highest overburden rate.

Figure 41. Housing cost burden in the coastal and northern California MPO regions



Jobs-Housing Balance

Jobs-housing balance is a metric that analyzes the distribution of employment opportunities relative to housing units within an MPO region. In other words, the jobs-housing balance reduces people's travel distances to and from work by placing home and work locations closer, which supports the SB 375 goals. On the other hand, if a given area has a much greater concentration of work locations than homes, workers must be drawn from different regions, leading to longer commute distances and regional VMT.

In this analysis, CARB staff used a jobs-housing imbalance index, which shows the relative jobs-housing imbalance level in each MPO region. Using EDD and DOF data, CARB staff first calculated the county average employment to household rates (jobs-housing ratio) from 2005 to 2020. Next, CARB staff calculated the standard deviation of the county-level jobs-housing ratio within each MPO region as the jobs-housing imbalance index using the following equation:

$$\text{Index}_i = \sqrt{\frac{\sum(R_{i,j} - \bar{R}_i)^2}{n}}$$

In this equation, Index_i stands for the jobs-housing imbalance index in the year i; $R_{i,j}$ stands for the jobs-housing ratio in the year i of county j; n stands for the number of counties in a given MPO; and $\bar{R}$i stands for the regional average jobs-housing ratio in the year i. For the four multi-county MPO regions: MTC, SCAG, SACOG, AMBAG, plus SJV, $\bar{R}$ refers to the regional average (i.e., treating the eight SJV MPO regions together as one large region); for the remaining single-county MPOs, $\bar{R}$ refers to the statewide average.

Figure 42 shows the result of the jobs-housing imbalance analysis for the five multi-county regions. An upward trend in this figure means the imbalance level is worsening over time. The analysis shows that the jobs-housing imbalance level in the SJV region is the lowest among the five regions, suggesting the jobs-housing ratio in all SJV MPO regions are, relatively low. SCAG shows a general decreasing trend, suggesting that the regional jobs-housing balance improves over time. However, the SCAG region's jobs-housing imbalance level is the highest in California, explaining long-distance SOV commute travel time. The jobs-housing imbalance worsens in the MTC, AMBAG, and SACOG regions, where residential areas are increasingly separated from work locations over time.

Figure 42. Temporal trend of jobs-housing imbalance index in multi-county regions: MTC, SCAG, SACOG, AMBAG, and SJV regions

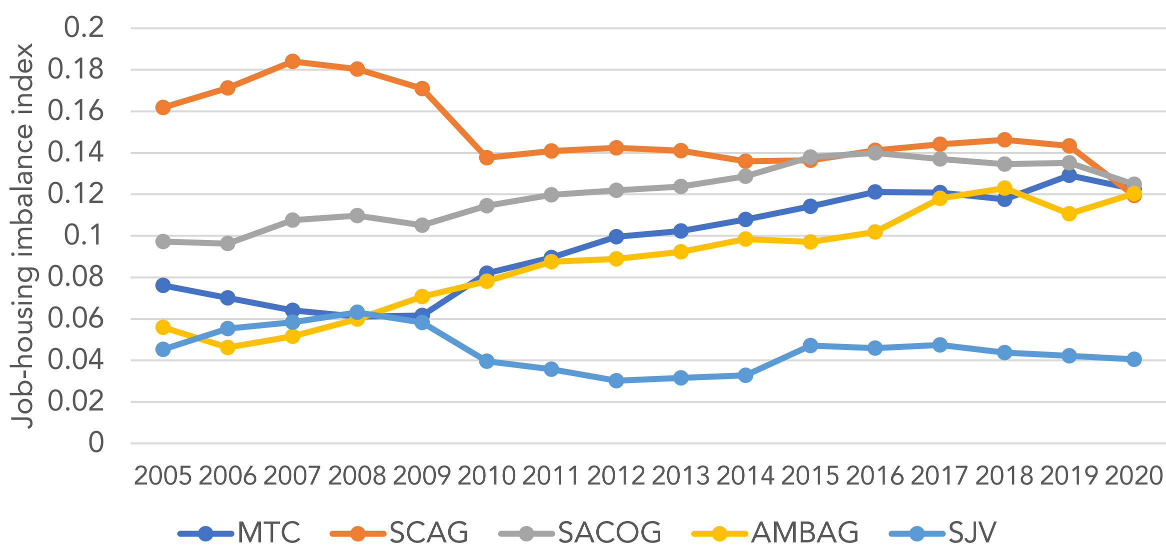
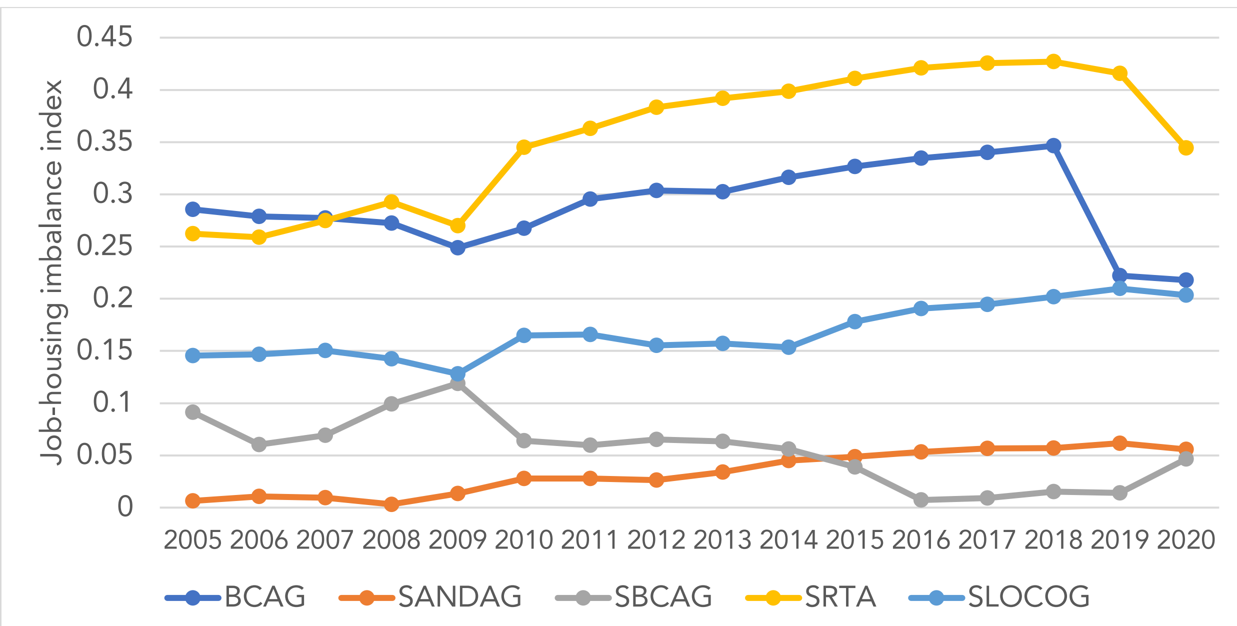


Figure 43 shows the result of the jobs-housing imbalance analysis for the remaining single-county MPO regions.[42] The analysis shows that the jobs-housing imbalance level in the SANDAG region is the lowest among the five single county regions, suggesting its jobs-housing imbalance level relative to the statewide average is very low. SBCAG's jobs-housing imbalance level is relatively low and shows a decreasing trend, suggesting that the regional jobs-housing balance improves over time. SRTA and BCAG observed sharp reductions in the jobs-housing imbalance level in 2020. These two regions' historical jobs-housing imbalances are possibly due to fewer job opportunities. However, Figure 40 indicates that they are closer to the statewide average due to an increase in unemployment across the state in 2020 due to COVID. This brought the state average jobs-housing rate closer to the level of these two regions, leading to a reduction in the jobs-housing imbalance.

Figure 43. Temporal trend of jobs-housing imbalance index in single-county regions: BCAG, SANDAG, SBCAG, SRTA, and SLOCOG regions



It is worth noting that having an equivalent number of jobs and homes in the same county does not necessarily mean people can work and live in the same county. Many other factors determine the job and home location choices like jobs by occupation, home affordability, school district, accessibility to destinations, etc. To "match" housing to jobs and vice versa requires a more detailed analysis of the suitability of the

[42] TMPO not analyzed due to lack of data.

housing stock for those who hold local jobs. Therefore, this jobs-housing balance metric should be better interpreted with other transportation metrics like commute travel time. For example, although this analysis shows that SJV has the lowest imbalance across all regions, CARB staff recognize that StanCOG and SJCOG have some of California's most extended commute times based on the commute travel time metric (**Figure 16**).

Percent of Jurisdictions with a Certified Housing Element

In this section, CARB staff analyzed the percentage of local governments with an adopted housing element that complies with the State's housing element law in each MPO region. The Housing Dashboard Tool[43] from HCD provides the status of 5th cycle housing elements in California. California's housing element law acknowledges that local governments must adopt plans and regulatory systems that provide housing development opportunities. Therefore, housing policies in California rest largely upon the development, adoption, and effective implementation of local housing elements. In this section, CARB staff analyzed the percentage of local governments with an adopted housing element that complies with the State's housing element law in each MPO region.

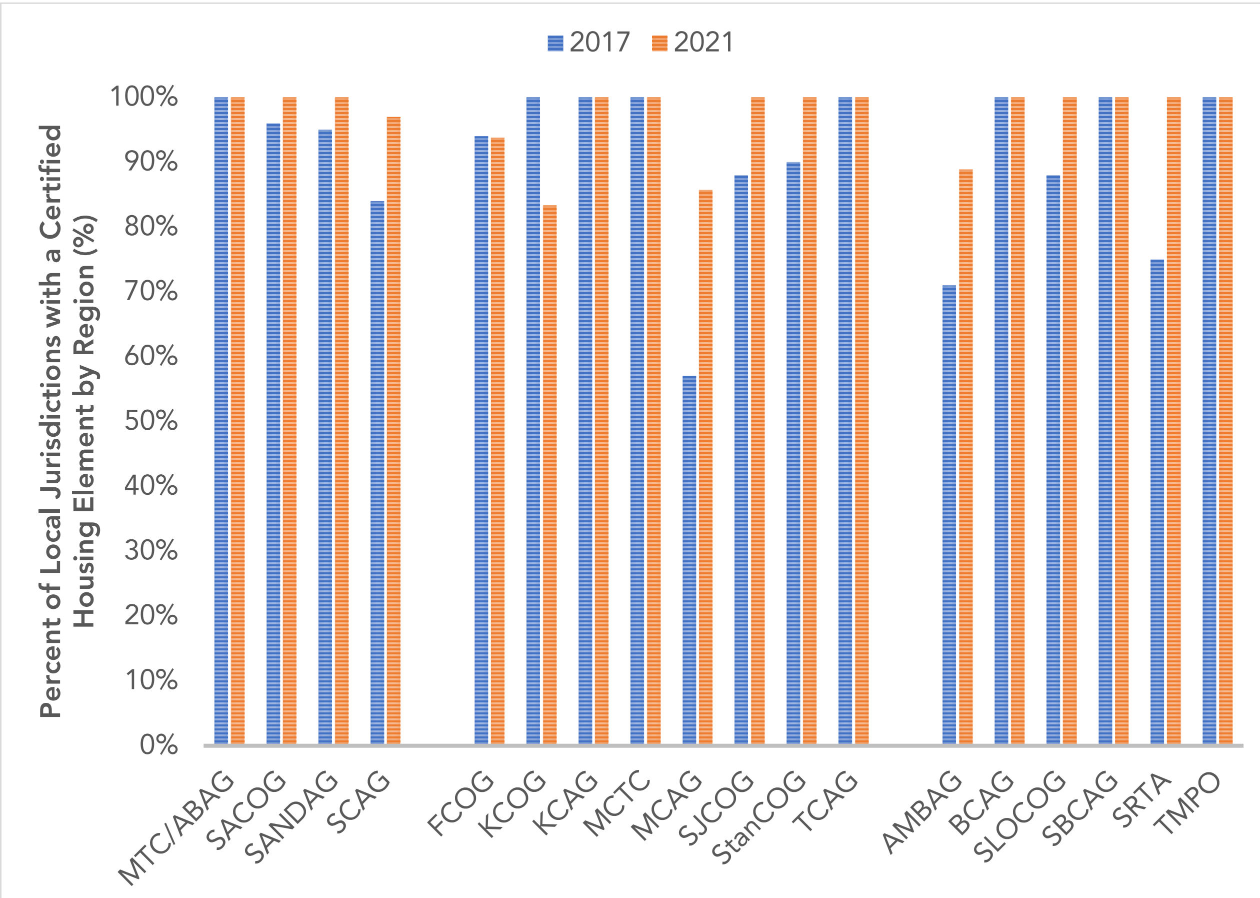
Table 5 shows the percent of jurisdictions with a certified housing element. The percentage varies across MPO regions: 13 of the 18 MPO regions have 100 percent compliance; two have 90+ percent; three have 80+ percent. **Figure 44** further compares the progress of MPO regions since the previous SB 150 report. The percentage of jurisdictions with a certified 5th cycle housing element has improved compared to the 2018 SB 150 report, in which only eight MPOs had 100 percent compliance (**Figure 44**). This is probably mainly attributable to changes in state law that created more consequences for jurisdictions without certified housing elements. Based on the latest data, KCOG has the lowest rate (i.e., 83 percent). One caveat of this analysis is that local jurisdictions (and MPOs) have different housing element cycle schedules,[44] which may affect the rate shown below. In addition, several MPOs are heading into their 6th cycle housing element updates.

[43] Housing Element Implementation and APR Data Dashboard, Page 2: https://www.hcd.ca.gov/apr-data-dashboard-and-downloads (data accessed on September 8-10, 2021)
[44] For a list of jurisdiction planning period schedules, please see: http://www.hcd.ca.gov/community-development/housing-element/docs/housing-element-update-schedule.pdf.

Table 5. Percent of local jurisdictions with a certified housing element by region

MPO	In Compliance Percentage
Association of Monterey Bay Area Governments (AMBAG)	89%
Butte County Association of Governments (BCAG)	100%
Fresno Council of Governments (FCOG)	94%
Kern Council of Governments (KCOG)	83%
Kings County Association of Governments (KCAG)	100%
Madera County Transportation Comission (Madera CTC)	100%
Merced County Association of Governments (MCAG)	86%
Association of Bay Area Governments (ABAG)/Metropolitan Transportation Commission (MTC)	100%
Sacramento Area Council of Governments (SACOG)	100%
San Diego Association of Government (SANDAG)	100%
San Joaquin Council of Government (SJCOG)	100%
San Luis Obispo Council of Governments (SLOCOG)	100%
Santa Barbara County Association of Governments (SBCAG)	100%
Shasta County Regional Transportation Planning Agency (SRTA)	100%
Southern California Association of Governments (SCAG)	97%
Stanislaus Council of Government (StanCOG)	100%
Tahoe Metropolitan Planning Organization (TMPO)	100%
Tulare County Association of Govenments (TCAG)	100%

Figure 44. Comparison of the percent of local jurisdictions with a certified housing element by region in the 5th cycle of Regional Housing Needs Allocation (RHNA) between HCD's 2017 and 2021 reports



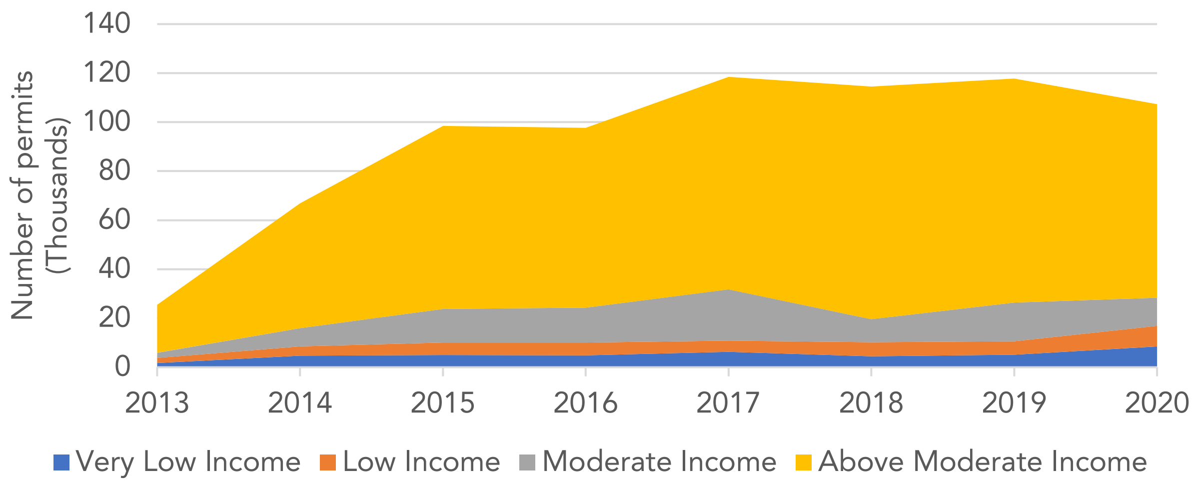
Comparison of Housing Units Permitted Relative to Regional Housing Needs Allocation (RHNA)

CARB staff analyzed housing development progress in California and individual MPO regions and compared it with regions' RHNA targets by income categories. This metric shows each region's progress in building new homes and addressing housing needs. CARB staff used the Housing Element Implementation and Annual Progress Report Data Dashboard[45] for this analysis.

Figure 45 shows California's housing permits by affordability tier by year under the 5th RHNA cycle. In this analysis, housing unit permits are divided into four categories based on income level (i.e., very low income, low income, moderate income, and above moderate income)[46]. Data show that the above-moderate housing units account for most of the total housing unit permits across the State. In contrast, the very low and low-income housing units together account for less than 15 percent of total permits in most years. Without the construction of more very low and low-income housing units, these households will continue to experience high rates of cost burden. In addition, lower-income households may move farther away from high-quality jobs, transportation, and services in search of more affordable housing options, potentially hindering the SCS goals.[47]

[45] Housing Element Implementation and APR Data Dashboard, Page 6: https://www.hcd.ca.gov/apr-data-dashboard-and-downloads (data accessed on September 8-10, 2021)
[46] Definitions of all income levels are from HCD, available at: https://www.hcd.ca.gov/grants-funding/income-limits/ (accessed on February 3rd, 2022). Very low income: Below 50% area median income (AMI); low income: 50-80% AMI; moderate: 80-120% AMI; above Mod: 120%+
[47] 2022 Statewide Housing Plan, California Department of Housing and Community Development - March 2022: https://statewide-housing-plan-cahcd.hub.arcgis.com/ (accessed 5/6/5022)

Figure 45. 5th RHNA cycle housing permits by affordability by year in California

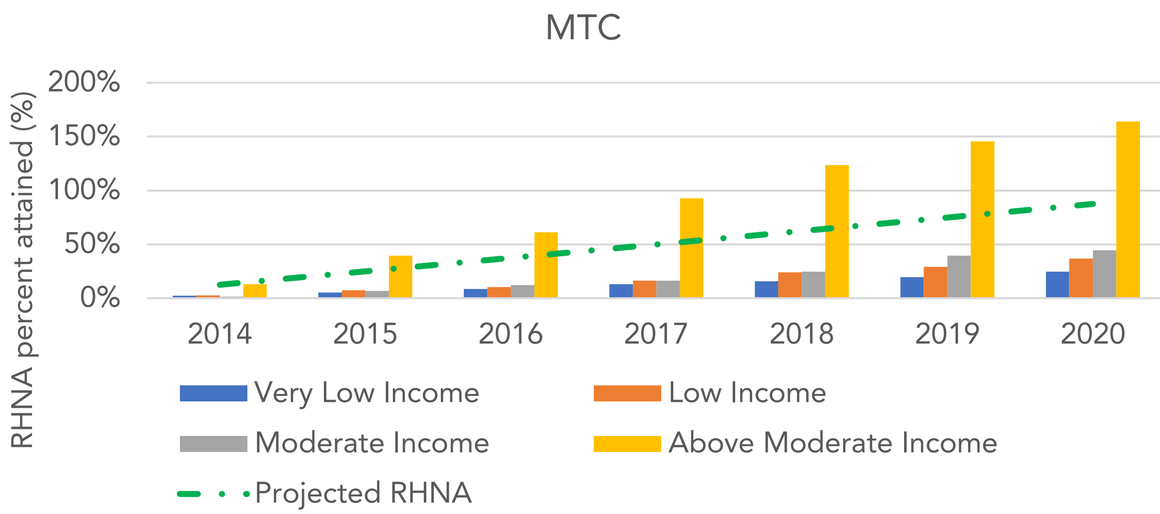


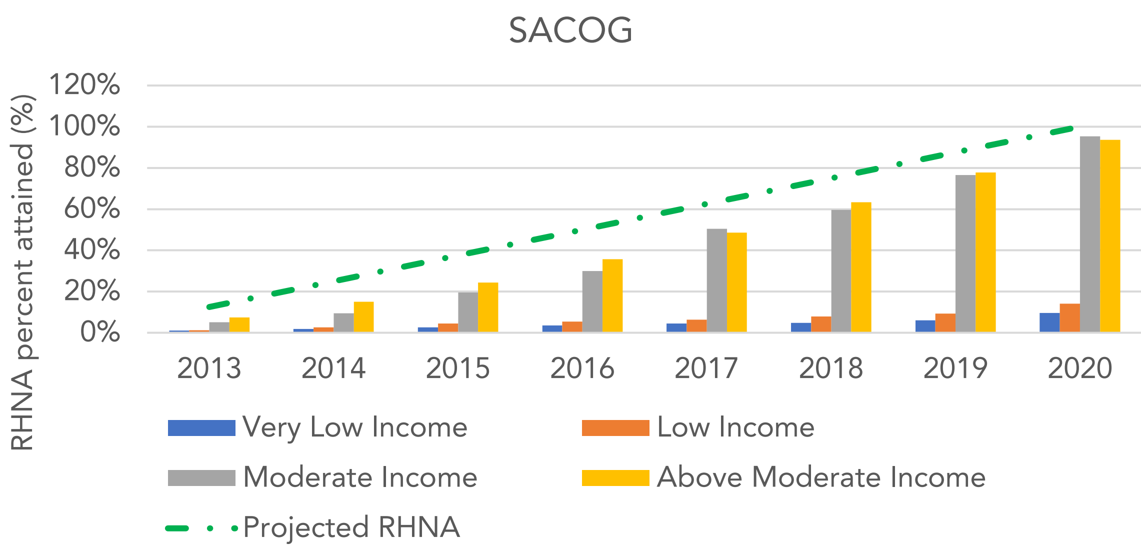
Having analyzed the statewide trend, CARB staff also examined the number of housing permits in all MPO regions and compared this to RHNA goals. **Figure 46** shows the cumulative permits issued within each MPO region based on HCD housing unit permit information as a percentage of RHNA goals. The green dashed reference line represents the percentage of each MPO's 8-year cycle (e.g., 50 percent of the green dash line means the region is in the fourth year of the 8-year cycle, and the regions should have met 50% of the RHNA goals). The chart shows the rate at which MPO regions are meeting their RHNA goals for different income groups.

This series of comparisons indicate that the attainment rates in most MPOs are permitting homes more slowly than the pace needed to meet their RHNA goals, except for SLOCOG. The permit rates for very low income and low income housing units are substantially lower than moderate and above moderate income housing units for all MPO regions. In MPOs such as AMBAG, MTC, SCAG, and SRTA, above moderate income housing units are permitted faster than the reference line indicates that they need to be. In contrast, the low income and very low income housing units are far behind the rate that the reference line indicates, which could worsen the housing inequity problem in California. It should be noted that each MPO may be in different stages of its timeline because MPOs start their current housing element planning period at different times. For example, SANDAG, SCAG, and SACOG started their 5th RHNA cycle in 2013; BCAG, SLOCOG, SRTA, and MCTC in 2014; AMBAG, MTC, FCOG, KCOG, SBCAG, SJCOG, STANCOG, and TCAG in 2015; and MCAG and KCAG in 2016. Please note that the comparison only includes jurisdictions in the RHNA progress report.

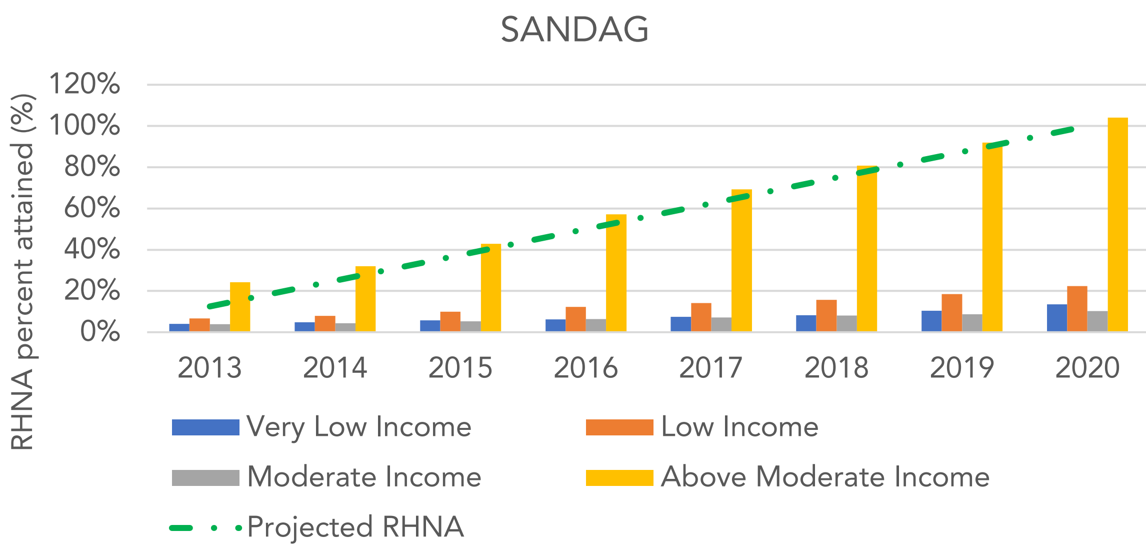
Figure 46. Comparison of RHNA permitting progress in individual MPOs and the portion of the RHNA cycle that has passed[48]

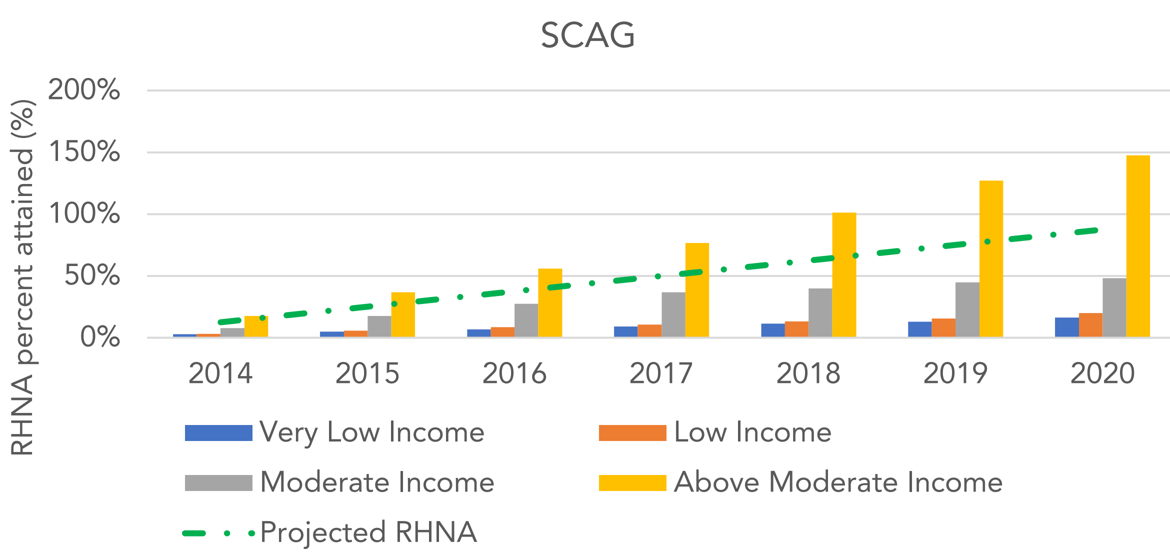
Big 4 MPO regions



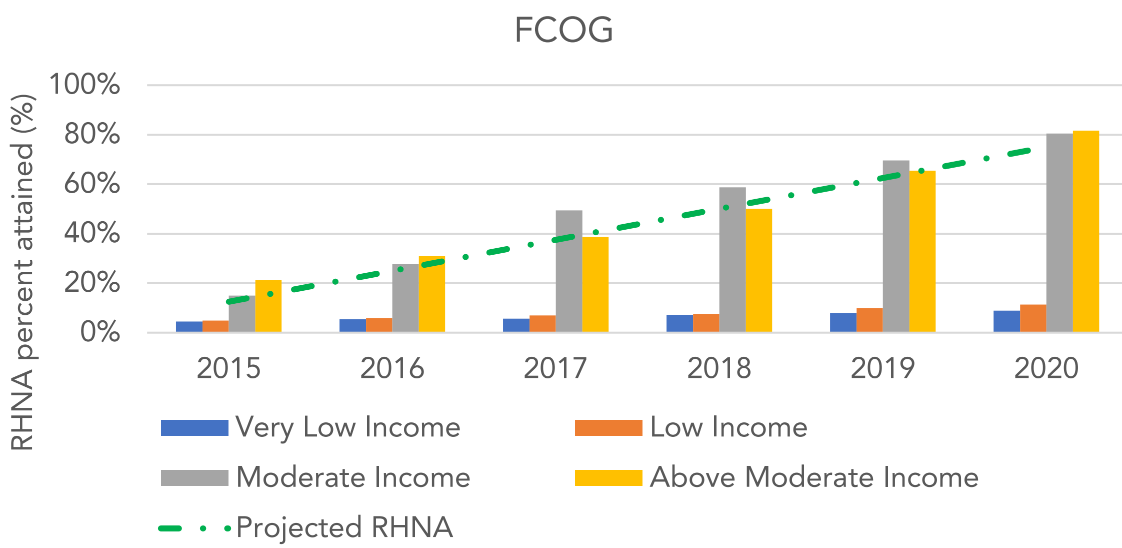


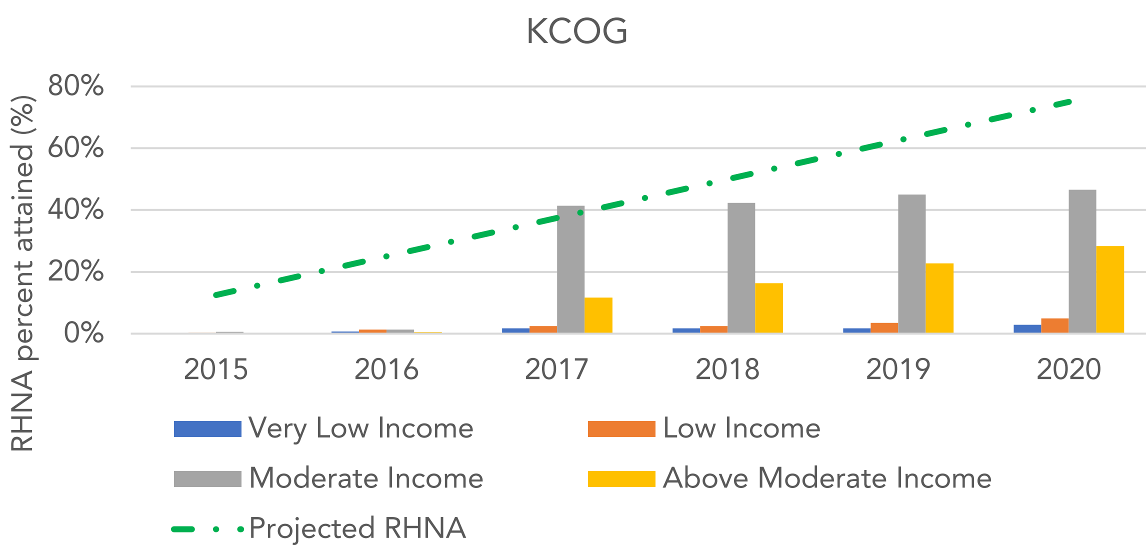
[48] Note: The projected rate of RHNA is the number of years in the planning period divided by the total RHNA cycle (8 years).

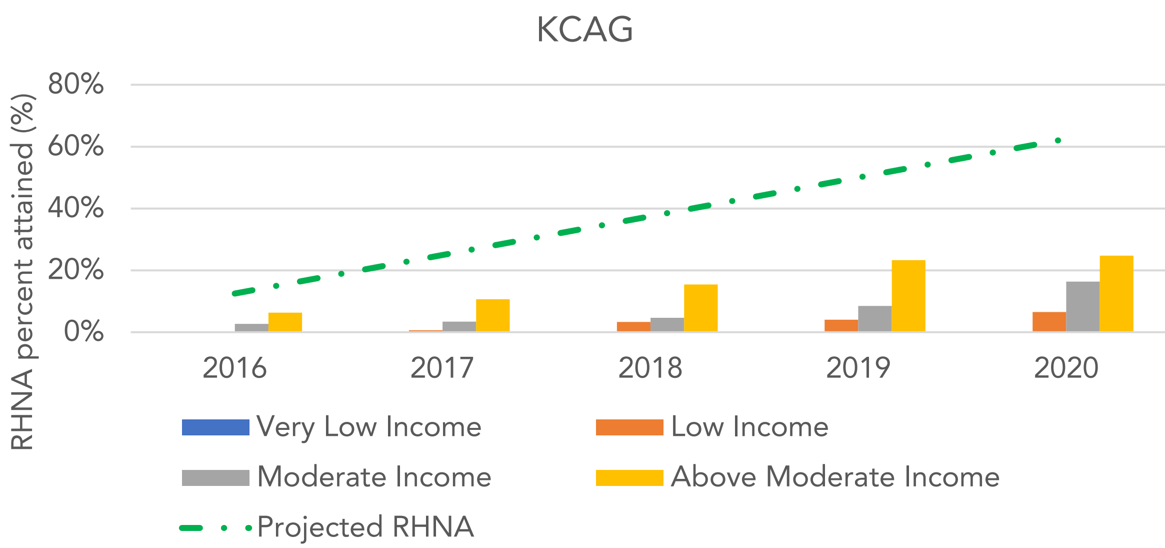

SANDAG
RHNA percent attained (%)
120%
100%
80%
60%
40%
20%
0%
2013
2014
2015
2016
2017
2018
2019
2020
Very Low Income
Low Income
Moderate Income
Above Moderate Income
Projected RHNA

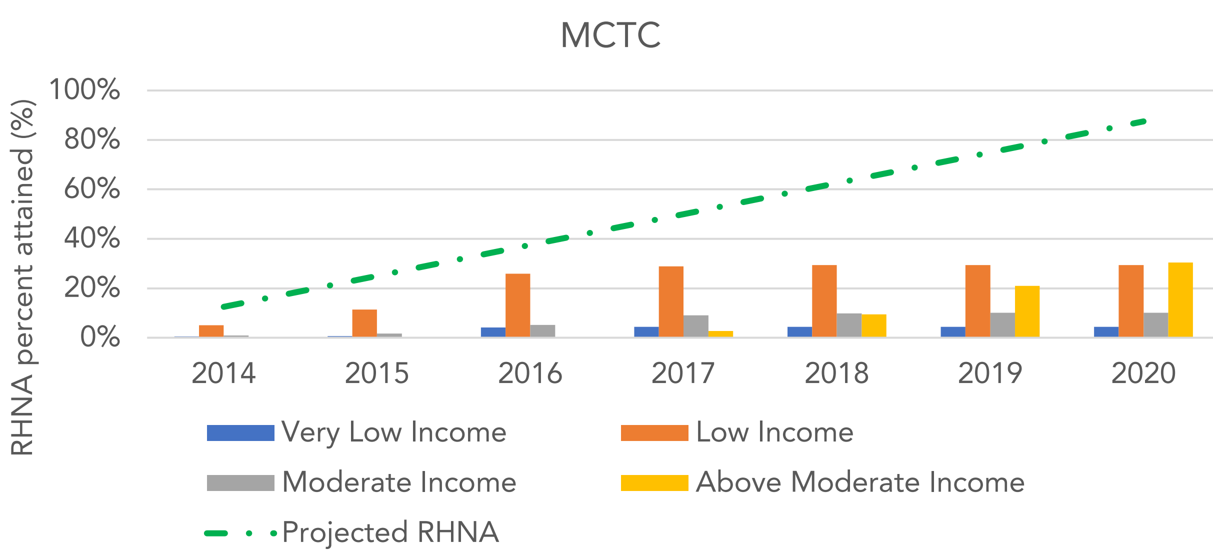

SCAG
RHNA percent attained (%)
200%
150%
100%
50%
0%
2014
2015
2016
2017
2018
2019
2020
Very Low Income
Low Income
Moderate Income
Above Moderate Income
Projected RHNA

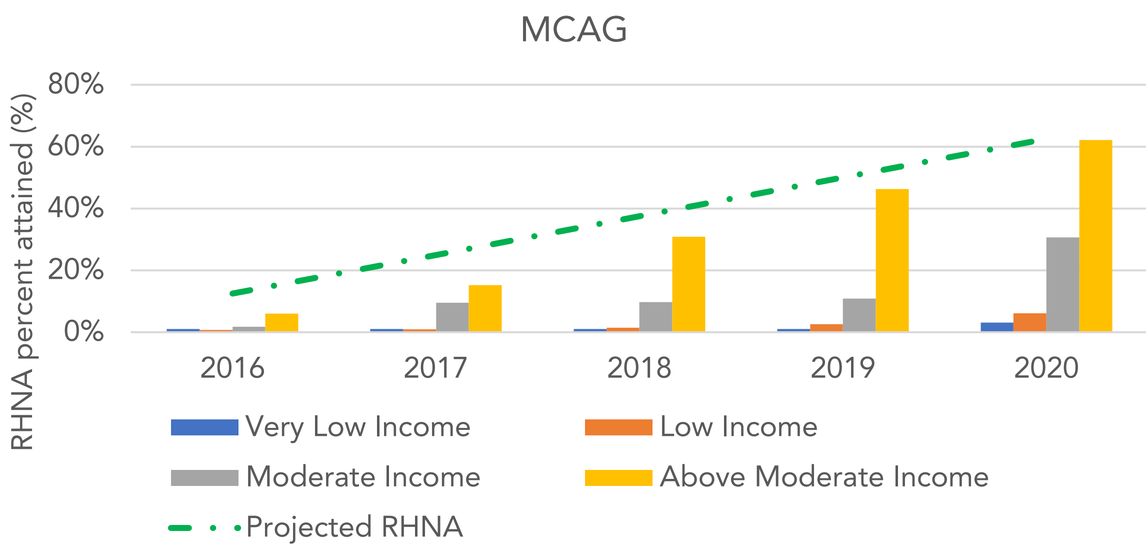
SJV MPO regions

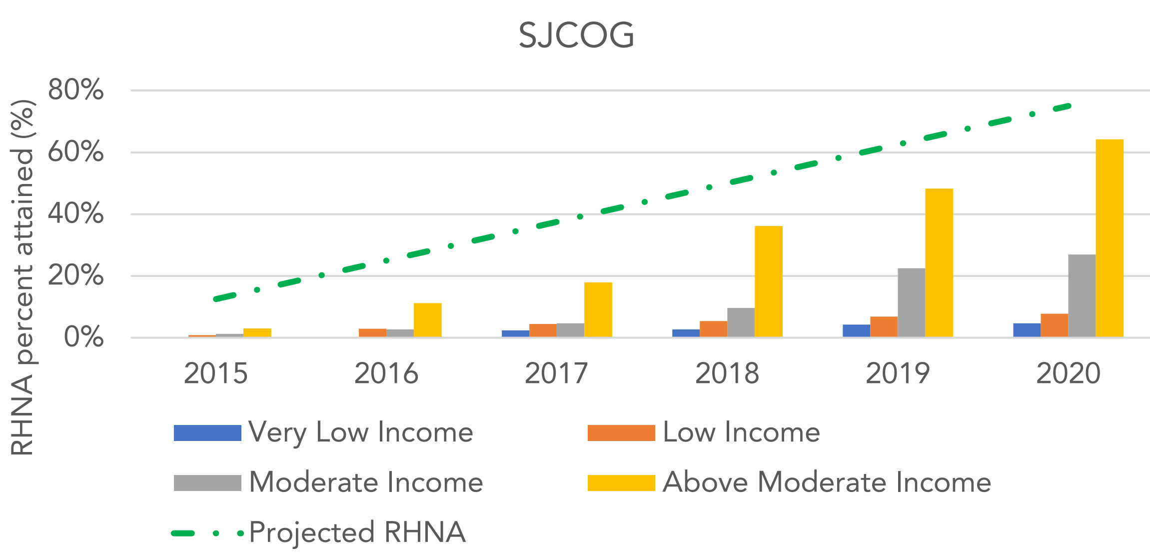


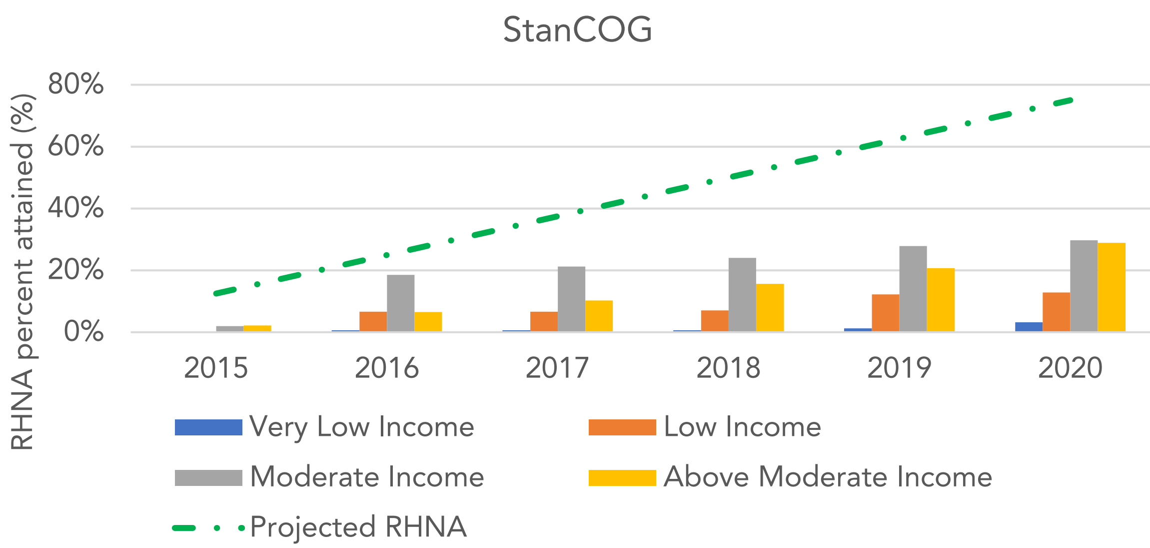


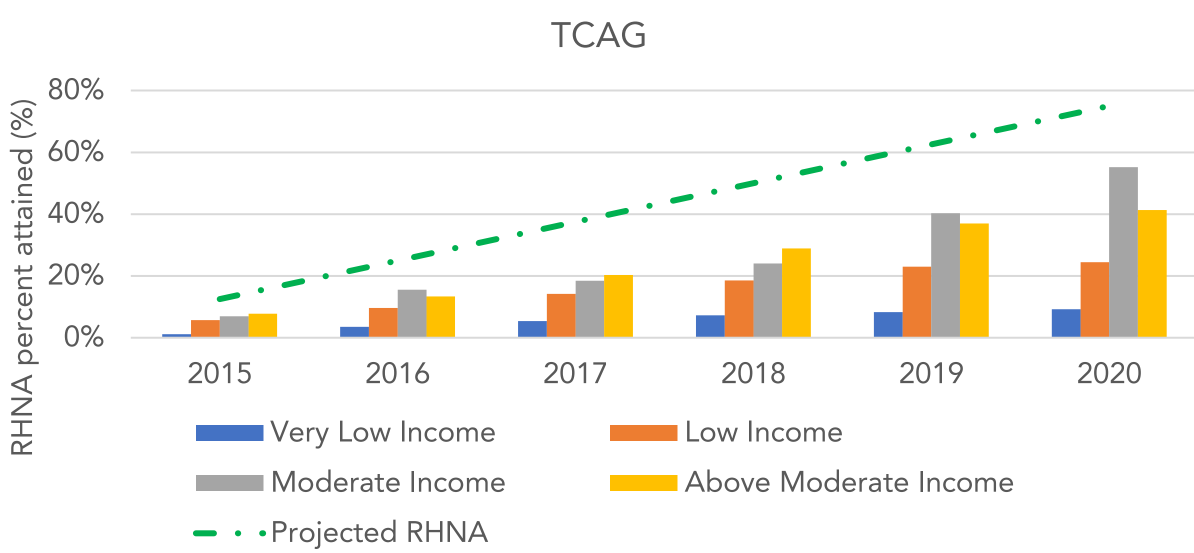

KCAG
RHNA percent attained (%)
80%
60%
40%
20%
0%
2016
2017
2018
2019
2020
Very Low Income
Low Income
Moderate Income
Above Moderate Income
Projected RHNA


MCTC
RHNA percent attained (%)
100%
80%
60%
40%
20%
0%
2014
2015
2016
2017
2018
2019
2020
Very Low Income
Low Income
Moderate Income
Above Moderate Income
Projected RHNA

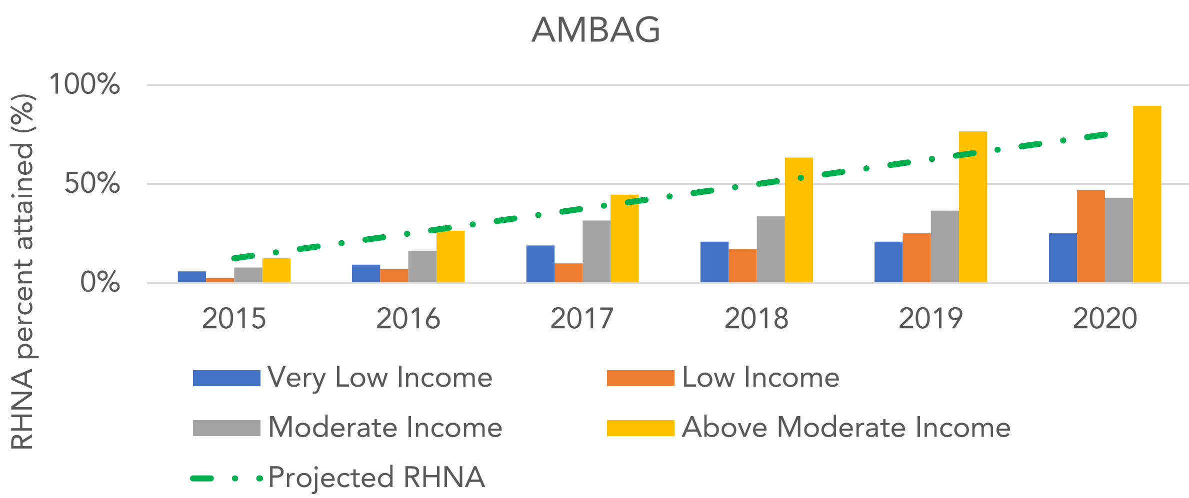

MCAG
80%
60%
40%
20%
0%
RHNA percent attained (%)
2016
2017
2018
2019
2020
Very Low Income
Low Income
Moderate Income
Above Moderate Income
Projected RHNA

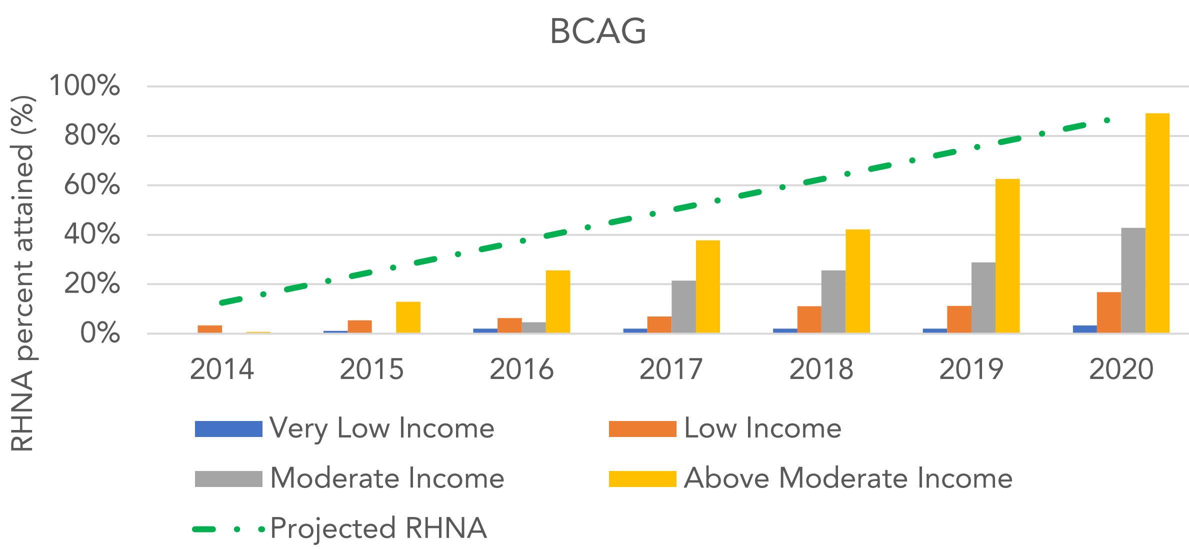

SJCOG
80%
60%
40%
20%
0%
RHNA percent attained (%)
2015
2016
2017
2018
2019
2020
Very Low Income
Low Income
Moderate Income
Above Moderate Income
Projected RHNA

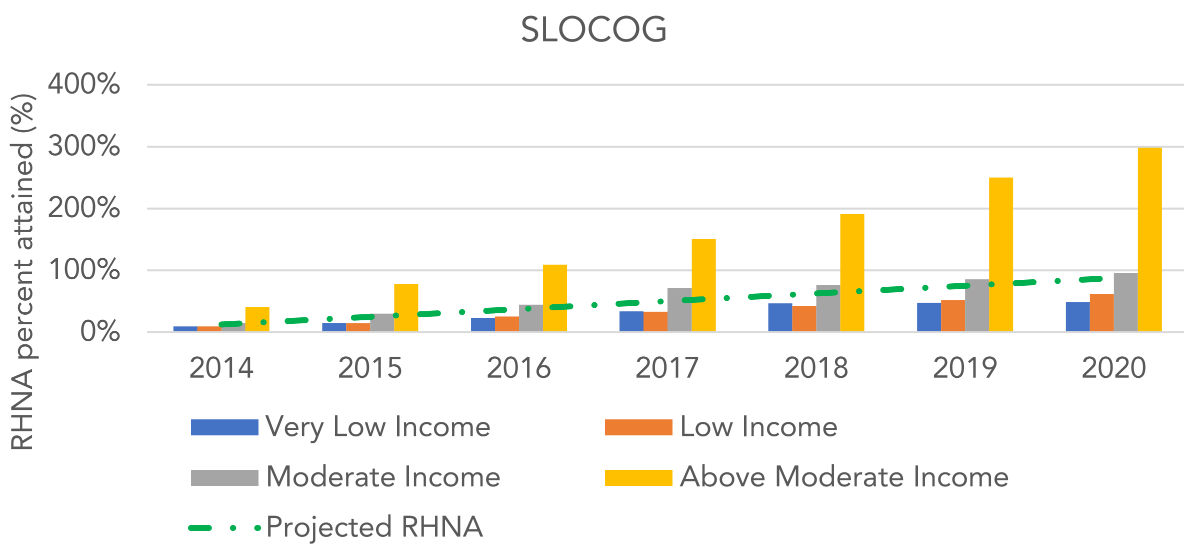

StanCOG
80%
60%
40%
20%
0%
RHNA percent attained (%)
2015
2016
2017
2018
2019
2020
Very Low Income
Low Income
Moderate Income
Above Moderate Income
Projected RHNA

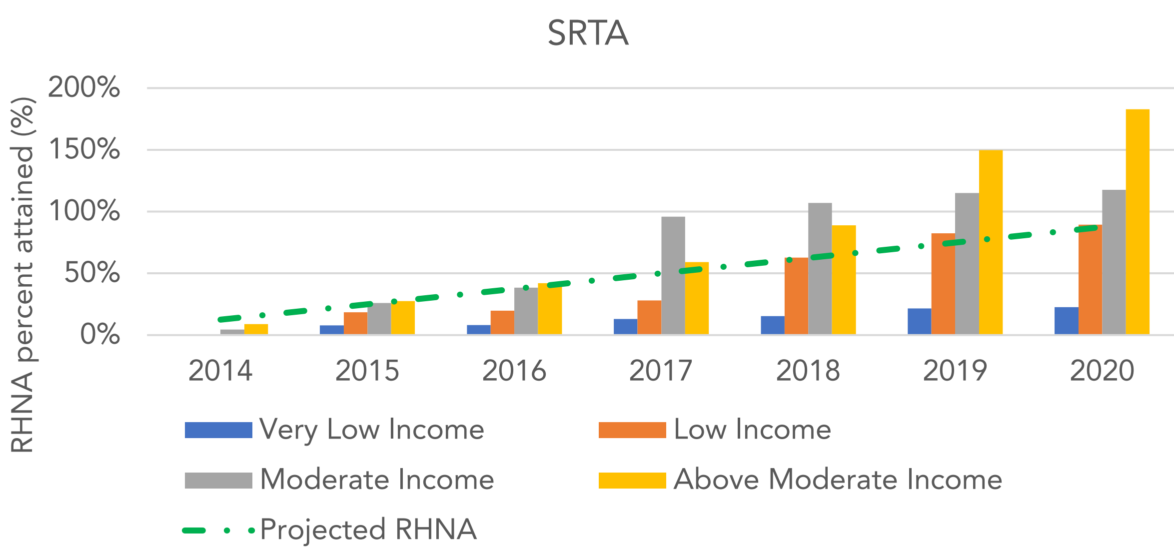

TCAG
80%
60%
40%
20%
0%
RHNA percent attained (%)
2015
2016
2017
2018
2019
2020
Very Low Income
Low Income
Moderate Income
Above Moderate Income
Projected RHNA

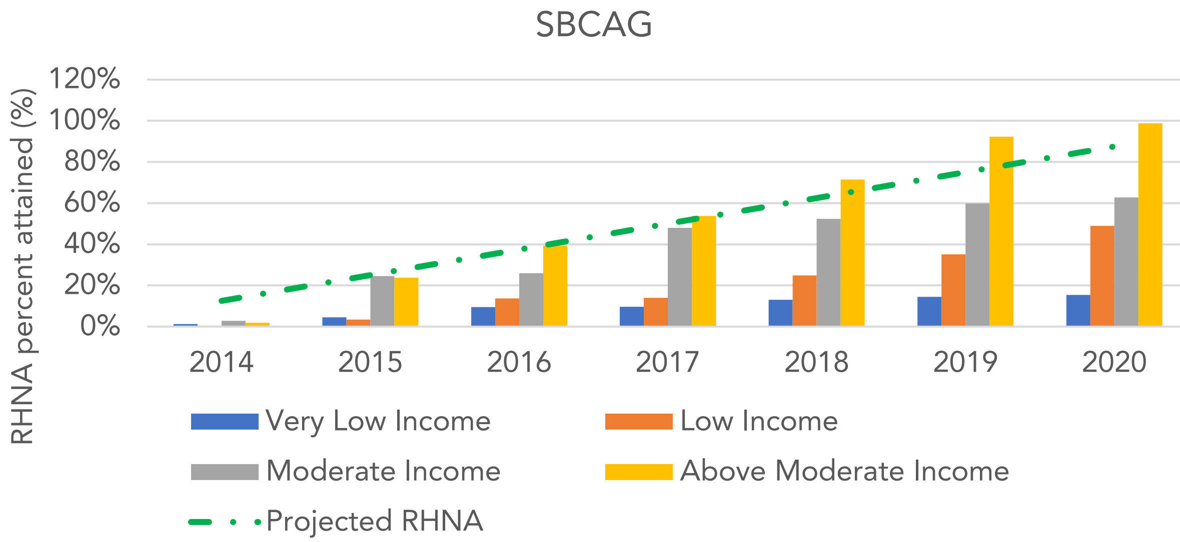
Coastal and Northern MPO regions






SLOCOG
RHNA percent attained (%)
400%
300%
200%
100%
0%
2014
2015
2016
2017
2018
2019
2020
Very Low Income
Low Income
Moderate Income
Above Moderate Income
Projected RHNA


SRTA
RHNA percent attained (%)
200%
150%
100%
50%
0%
2014
2015
2016
2017
2018
2019
2020
Very Low Income
Low Income
Moderate Income
Above Moderate Income
Projected RHNA



Housing Activity by Income Level

Based on HCD's Housing Element Implementation and Annual Progress Report Data Dashboard,[49] CARB staff analyzed housing activity by affordability level, which is a new metric in the 2022 SB 150 report. It tracks the status of housing projects in each MPO region that are affordable at different income levels and shows the progress of affordable housing development in each region.

Figure 47 shows each MPO region's housing activity by affordability level based on the Dashboard data. The Dashboard reported data for the most recent three years (i.e., 2018-2020) and distinguished housing activity status into four categories as follows:

- Submitted - An application for a new housing unit has been submitted to and deemed complete by a local government. This application is either an application for a planning entitlement, or for a building permit where only a building permit is required by the local jurisdiction.
- Entitled[50] - A new housing unit or project which has received all the required local land use approvals or planning entitlements.

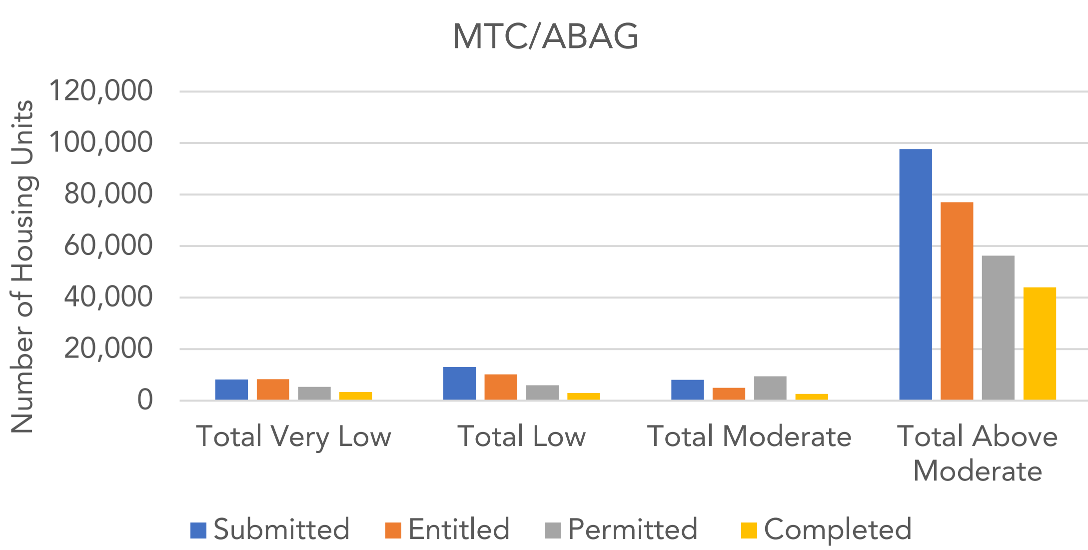
[49] Housing Element Implementation and APR Data Dashboard: https://www.hcd.ca.gov/apr-data-dashboard-and-downloads (data accessed on September 8-10, 2021)
[50] Projects that do not require discretionary approval from the local planning agency may not require "entitlement," as entitlement is a planning-specific function. However, these projects will likely still require a building permit, and as such, may be reported as "submitted" or "permitted" by the local building department.

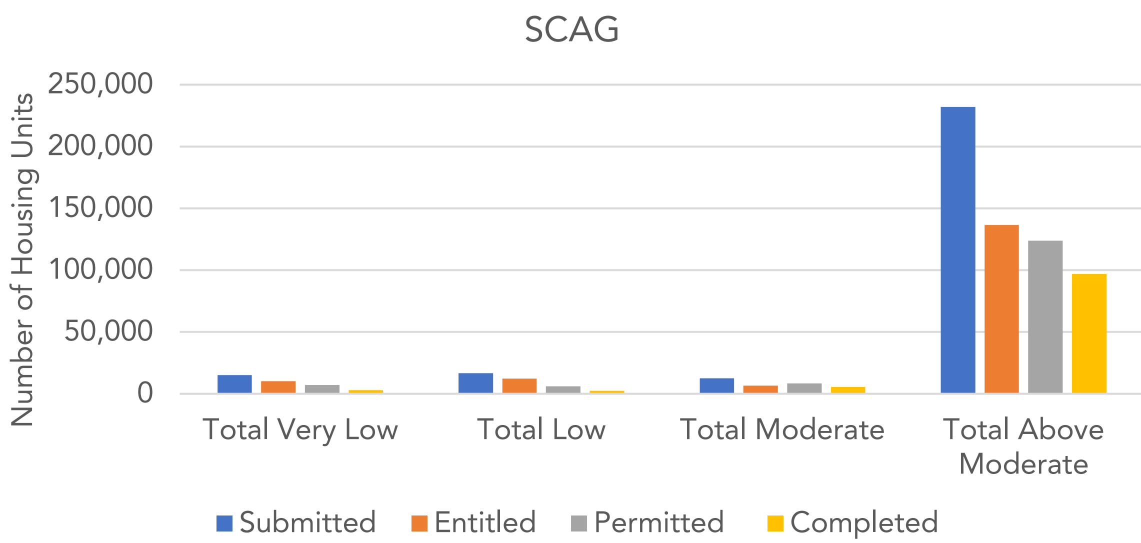
- Permitted – A unit for which building permits for new housing construction have been issued by the local government.
- Completed – A new housing unit that has been constructed and has been issued a certificate of occupancy or other forms of readiness (e.g., final inspection notice or completion)

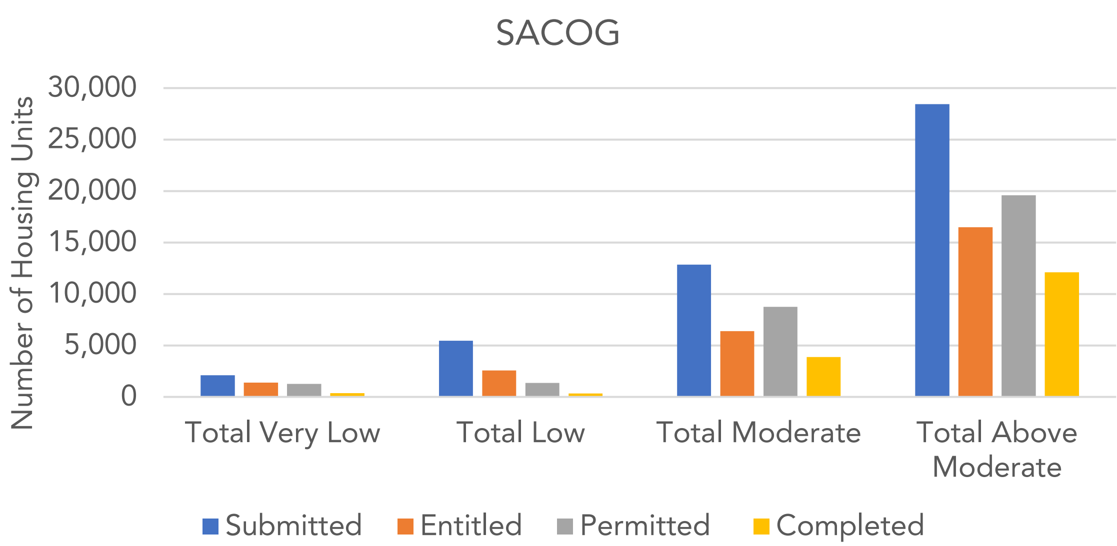
Figure 47 show that in every MPO region, the greatest numbers of housing units are in the above moderate category. The number of very-low and low-income housing projects going through the pipeline is substantially lower than the above-moderate projects in all MPO regions during the analysis period, suggesting that additional efforts are needed to address the affordable housing problem in California. Very low and low income housing units generally require subsidies from federal, state, and local governments to construct, including tax credits, tax-exempt bonds, loans, and grants. These findings are consistent with the metric comparing housing units permitted to the Regional Housing Needs Allocation (RHNA). Figure 46 also shows that there are typically more housing applications submitted than completed housing. This trend may be due to various factors, and more work is needed to understand it.

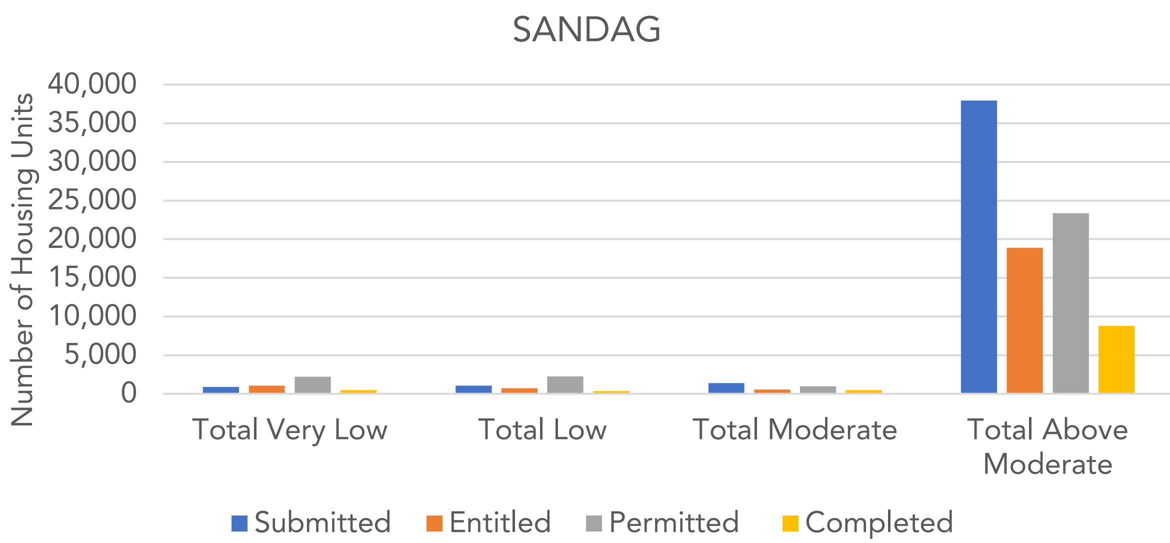
Figure 47. 5th RHNA cycle housing development activity by income level in each MPO region

Big 4 MPO regions

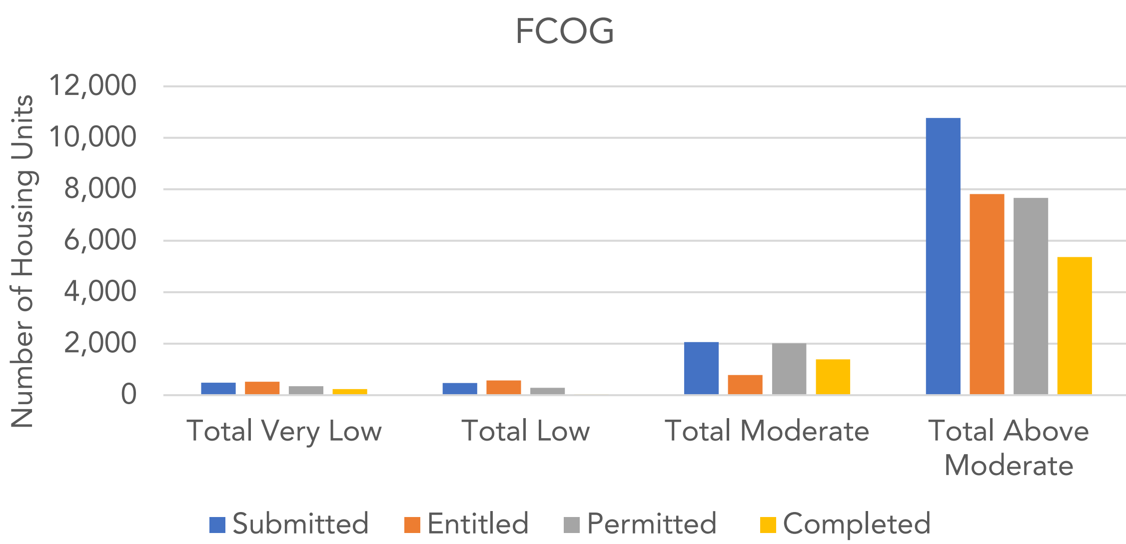


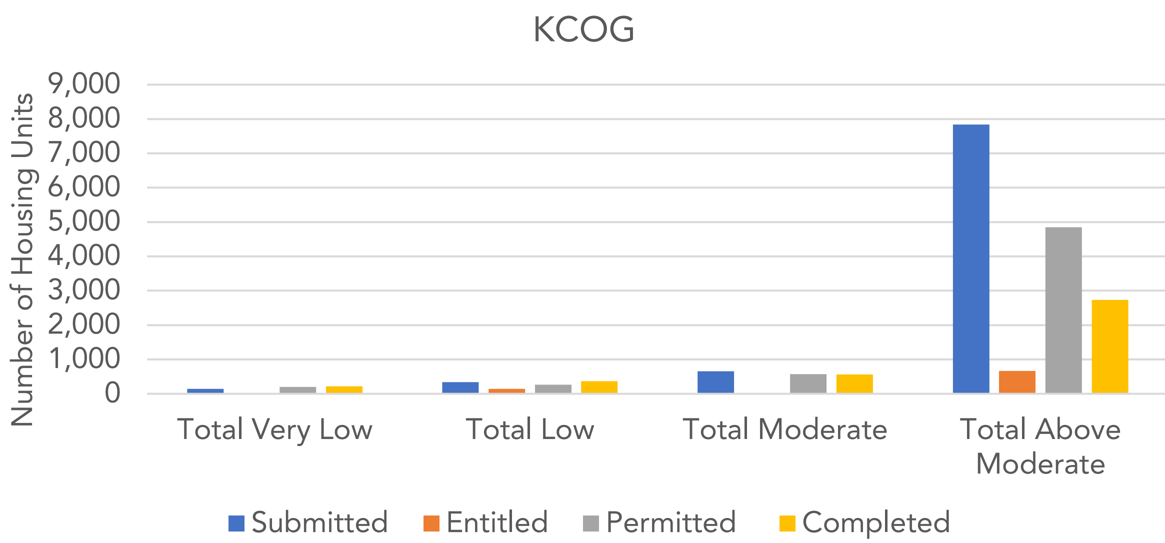

SCAG
Number of Housing Units
250,000
200,000
150,000
100,000
50,000
0
Total Very Low
Total Low
Total Moderate
Total Above Moderate
Submitted
Entitled
Permitted
Completed

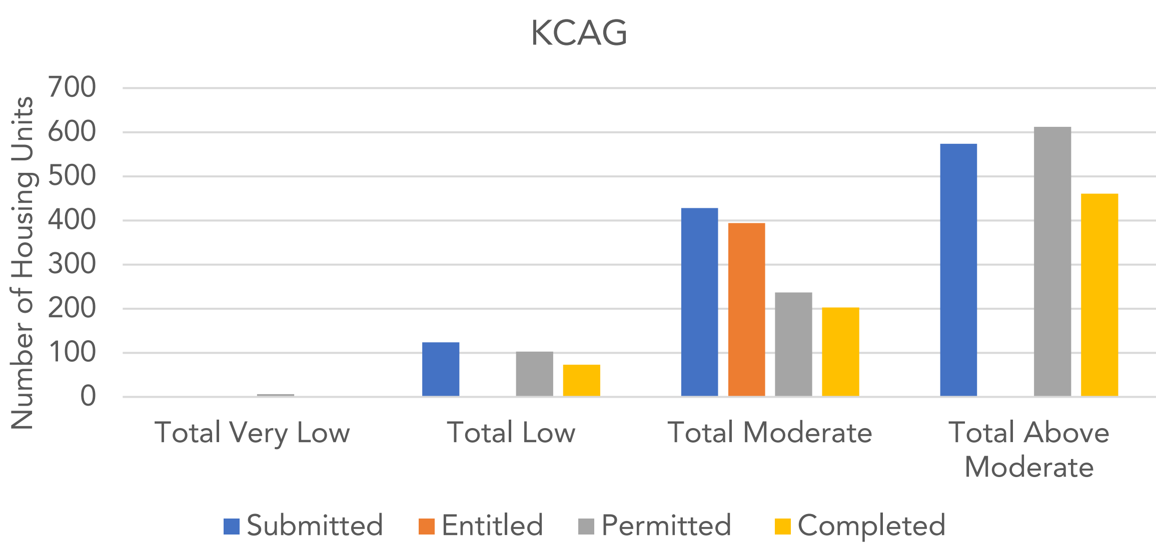

SACOG
Number of Housing Units
30,000
25,000
20,000
15,000
10,000
5,000
0
Total Very Low
Total Low
Total Moderate
Total Above Moderate
Submitted
Entitled
Permitted
Completed

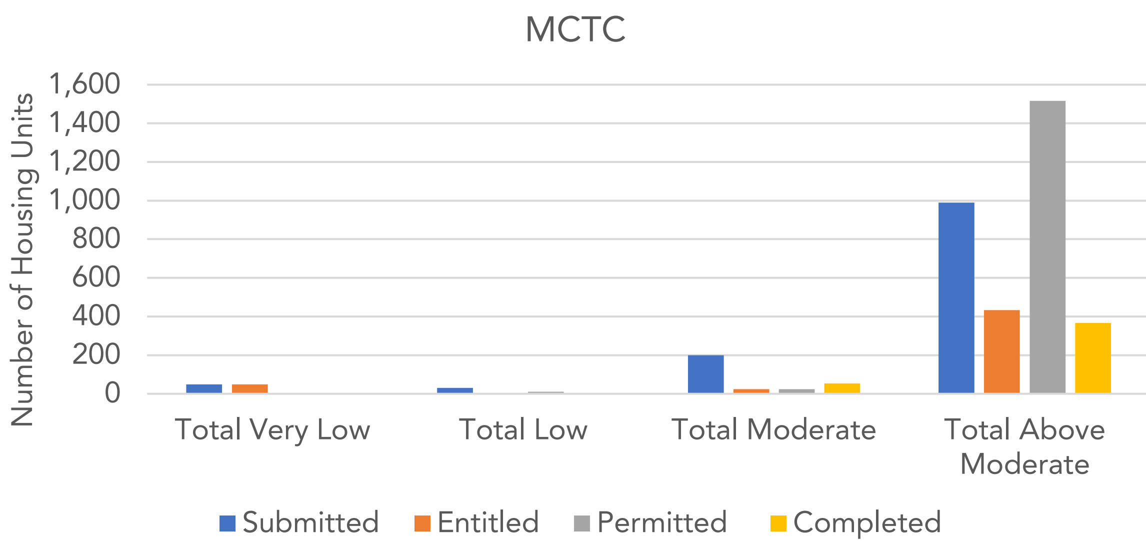


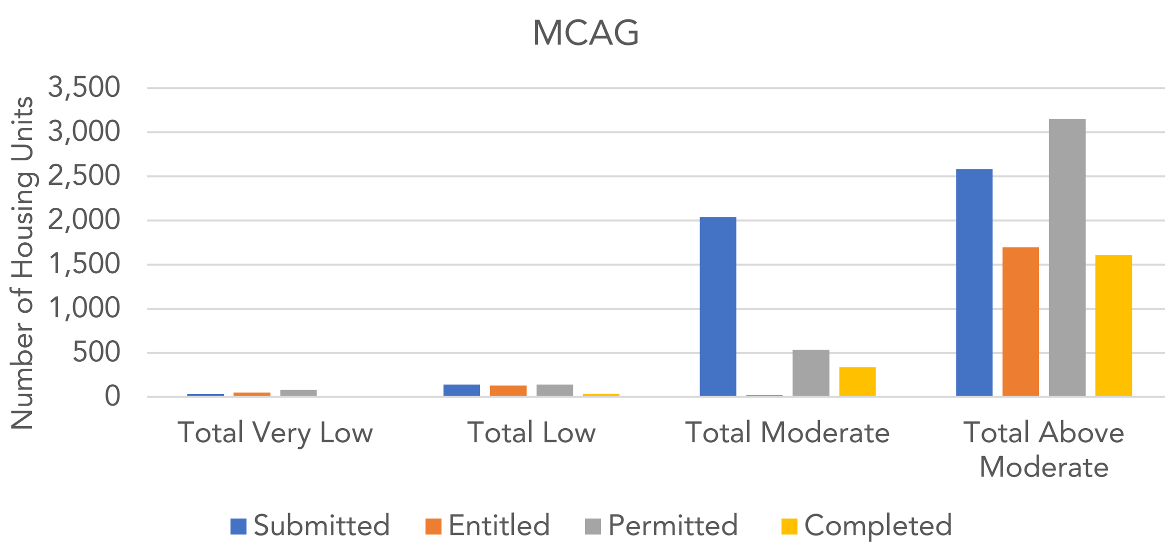
SJV MPO regions

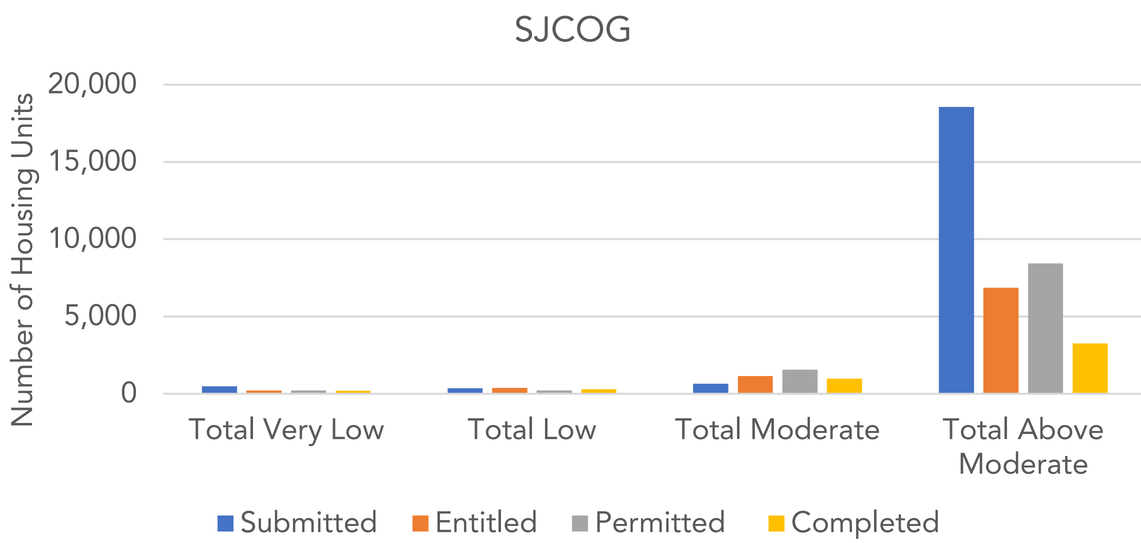


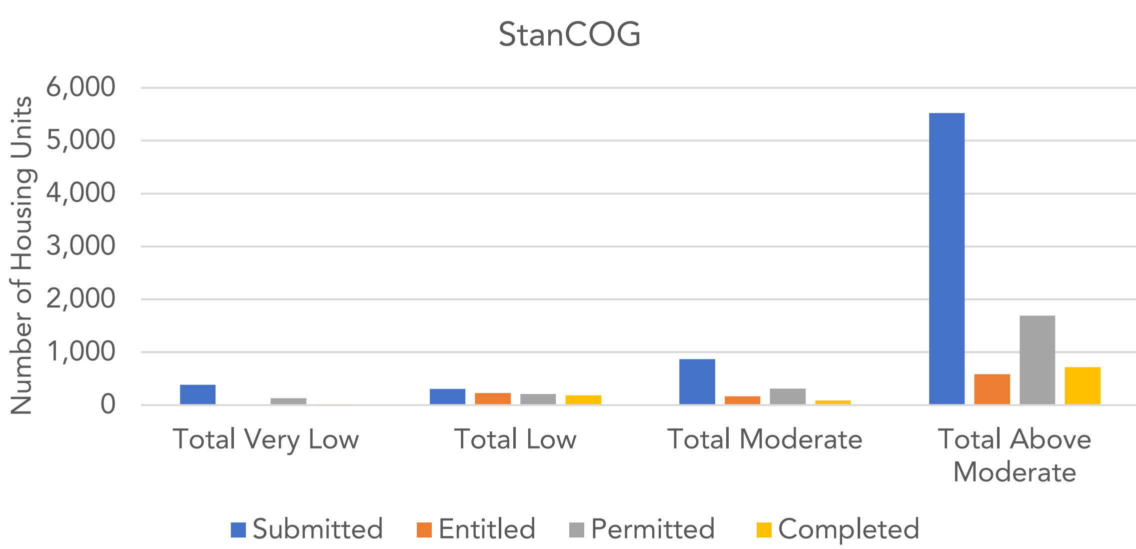

KCOG
Number of Housing Units
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Total Very Low
Total Low
Total Moderate
Total Above Moderate
Submitted
Entitled
Permitted
Completed

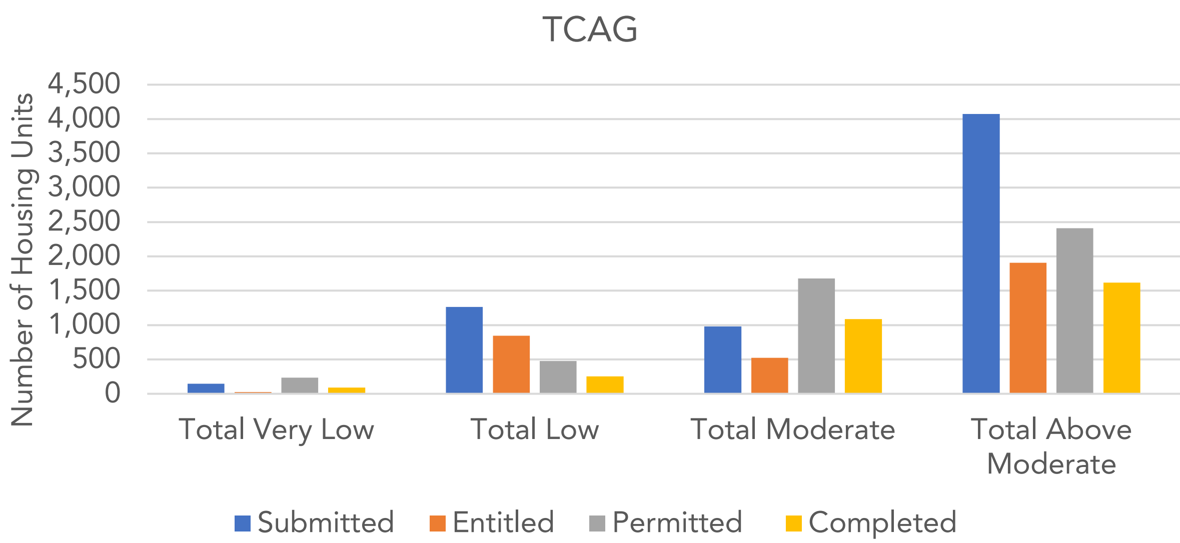

KCAG
Number of Housing Units
700
600
500
400
300
200
100
0
Total Very Low
Total Low
Total Moderate
Total Above Moderate
Submitted
Entitled
Permitted
Completed


MCTC
Number of Housing Units
1,600
1,400
1,200
1,000
800
600
400
200
0
Total Very Low
Total Low
Total Moderate
Total Above Moderate
Submitted
Entitled
Permitted
Completed

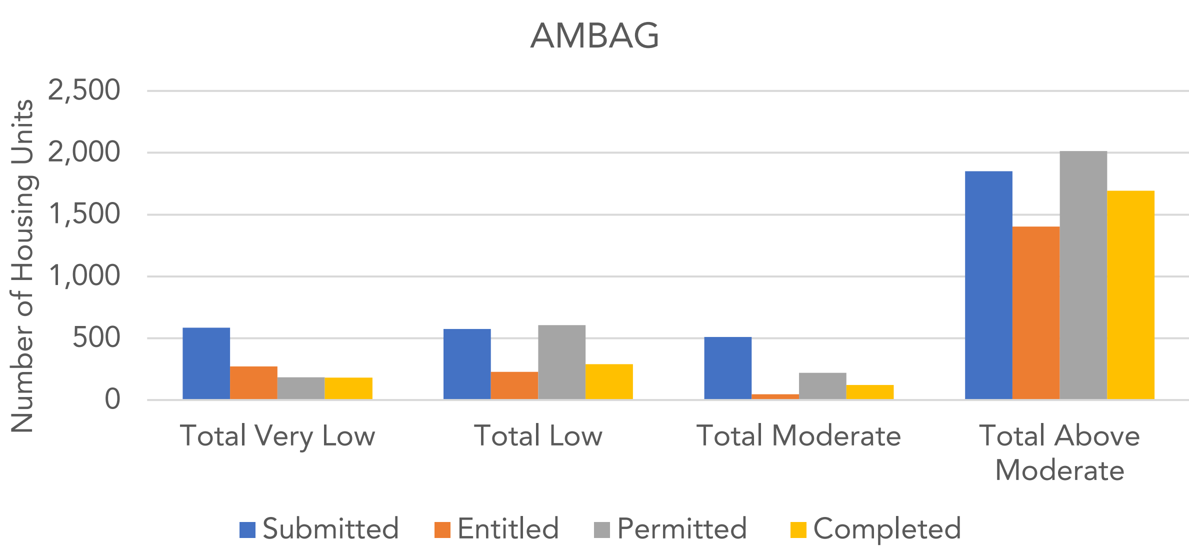

MCAG
Number of Housing Units
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Total Very Low
Total Low
Total Moderate
Total Above Moderate
Submitted
Entitled
Permitted
Completed

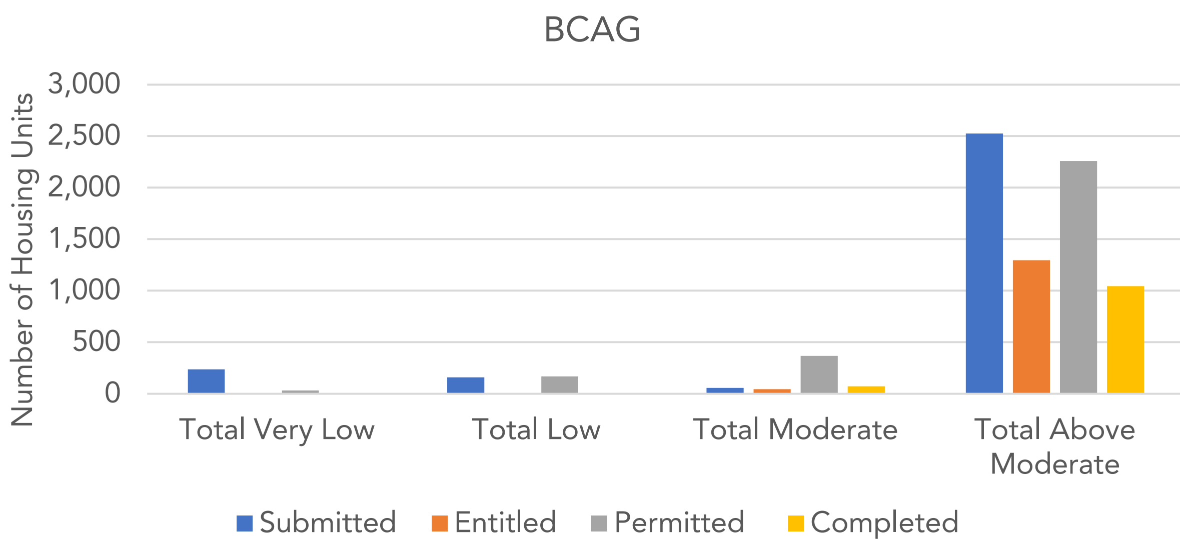

SJCOG
Number of Housing Units
20,000
15,000
10,000
5,000
0
Total Very Low
Total Low
Total Moderate
Total Above Moderate
Submitted
Entitled
Permitted
Completed

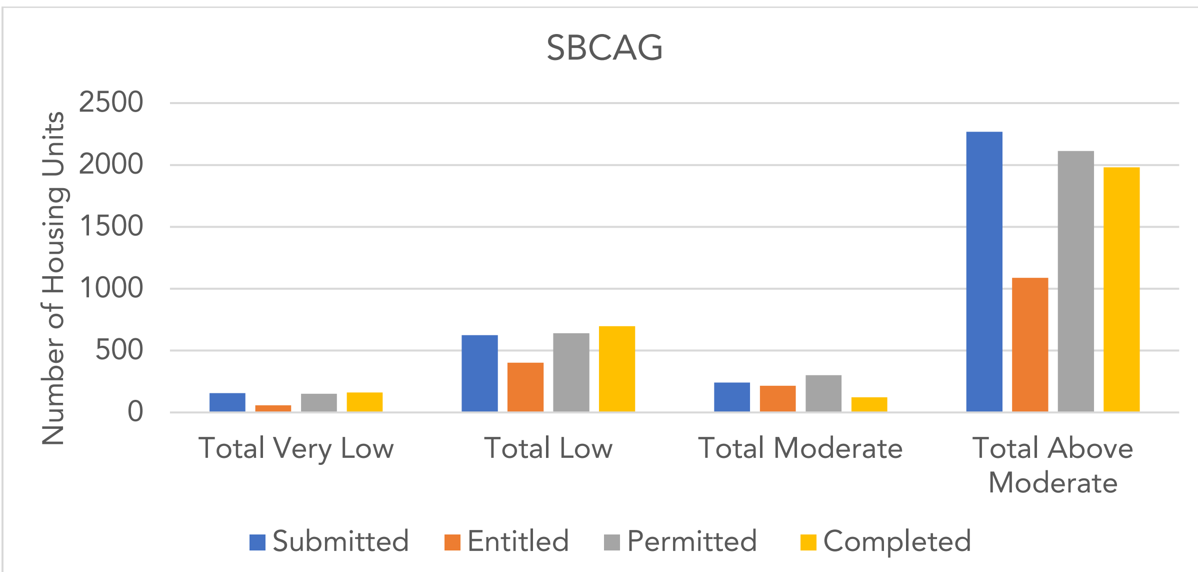

StanCOG
Number of Housing Units
6,000
5,000
4,000
3,000
2,000
1,000
0
Total Very Low
Total Low
Total Moderate
Total Above Moderate
Submitted
Entitled
Permitted
Completed

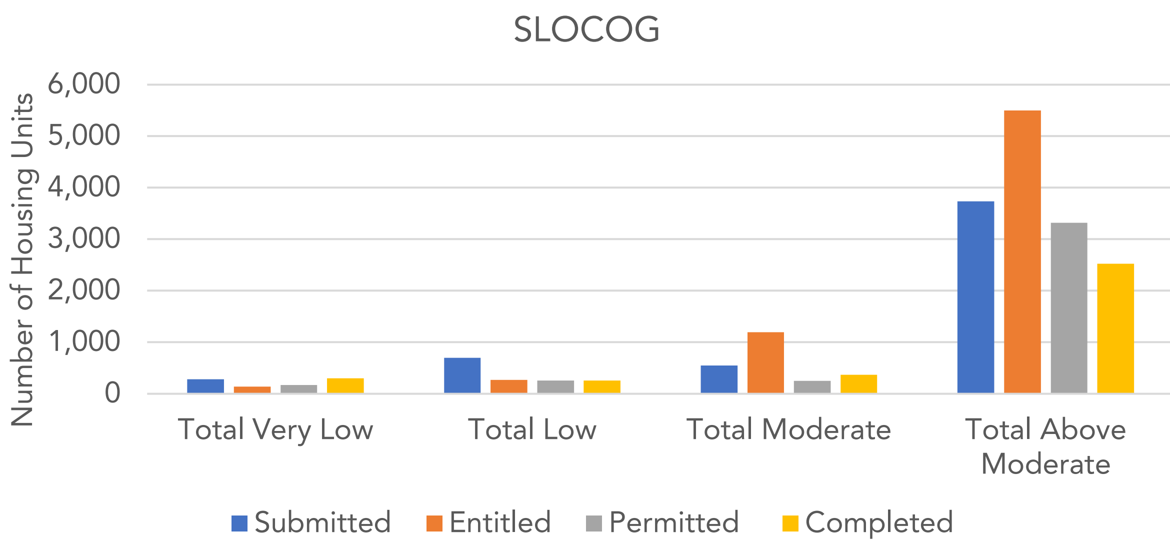


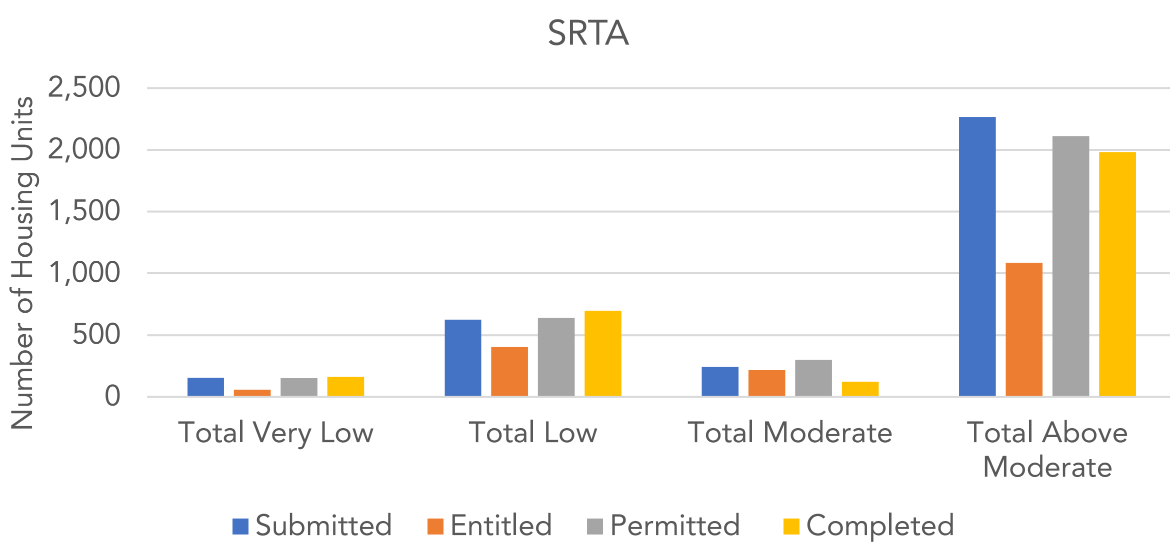
Coastal and Northern California MPO regions




BCAG
Number of Housing Units
3,000
2,500
2,000
1,500
1,000
500
0
Total Very Low
Total Low
Total Moderate
Total Above Moderate
Submitted
Entitled
Permitted
Completed


SBCAG
Number of Housing Units
2500
2000
1500
1000
500
0
Total Very Low
Total Low
Total Moderate
Total Above Moderate
Submitted
Entitled
Permitted
Completed





Units with Density Bonus or Inclusionary Deed Restrictions

CARB staff also analyzed the number of deed-restricted housing units within each MPO region based on the Housing Element Implementation and APR Data Dashboard.[51] This is another new housing metric in the 2022 SB 150 report. It reports the number of housing units built in 2018-2020 that are considered affordable to very-low, low, and/or moderate-income households due to local programs or policies,

[51] Housing Element Implementation and APR Data Dashboard, Page 13: https://www.hcd.ca.gov/apr-data-dashboard-and-downloads (data accessed on September 8-10, 2021)

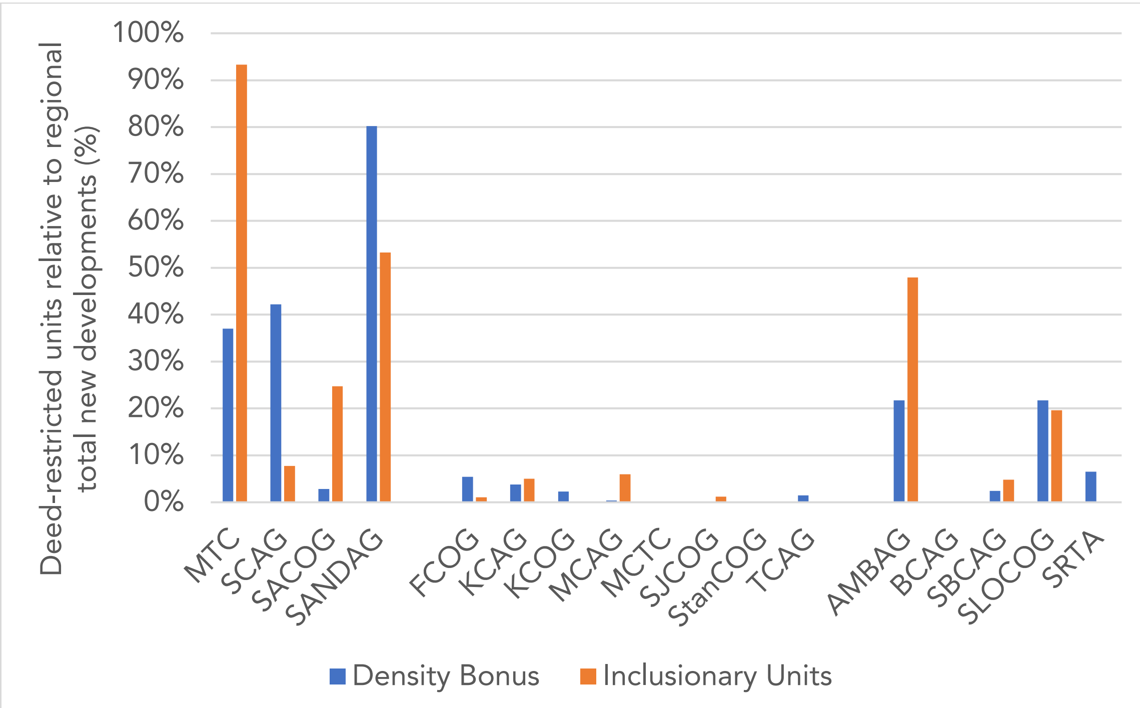
specifically density bonuses and inclusionary housing ordinances. Therefore, it is also a housing metric that shows the progress of affordable housing development in regions and whether jurisdictions are using these mechanisms to build affordable housing.

Figure 48 shows the total number of housing units with deed restriction under two programs/policies: units approved using a density bonus (Density Bonus) and units approved pursuant to a local inclusionary housing ordinance (Inclusionary Units). This report only includes the unit count in each type and did not add them up because some projects could use both deed restriction types, and adding the units from both types will double count those units.

Data show that within the Big 4 MPO regions, SCAG and MTC use the deed restriction ordinances (e.g., density bonus and inclusionary housing) for the most number of new housing units. In contrast, the SACOG region has the least amount of new housing units with these two deed restriction types, suggesting that SACOG is not using these mechanisms to promote affordable housing projects to the same extent as the other three MPO regions. In the SJV MPO regions, the FCOG region has the most significant number of density bonus units, followed by KCOG and TCAG; the MCAG region has the greatest number of inclusionary units, followed by FCOG and SJCOG. On the lower end, the MCTC region and StanCOG region both have no density bonus or inclusionary units. Among the remaining small MPOs, the AMBAG and SLOCOG have the most density bonus and inclusionary units, while the BCAG region has none.

CARB staff also compared the relationship between affordable housing developments in each MPO region and the utilization of these two tools. Data shows the MPO regions that have least number of very low and low income housing units used minimal deed restriction programs. On the other hand, MTC and SANDAG used most deed restriction programs to build housing units. However, the rate of newly-built very low and low income housing units are different, which suggests affordable housing development is affected by other factors. Both the density bonus and inclusionary unit requirements are non-subsidy-based tools that can be used to create housing that is a mix of market-rate and affordable. In summary, this analysis shows that these tools can be an important source of housing production, while additional local efforts may also be needed to fully meet affordable housing goals.

Figure 48. Percentage of Density Bonus and Inclusionary Units relative to regional total new developments in 2018-2020



Note: Th unit count in both deed restriction types is shown separately because some projects could use both types; adding the units from both types will double count those units.

Summary

CARB staff has analyzed seven housing-related performance metrics across California regions. CARB staff found mixed trends in California's housing development. For example, many MPO regions are building more multi-family housing units, which can support compact development and reduce VMT and GHG. On the other hand, RHNA housing permit trends and housing cost burden rates indicate that housing development in California is still falling behind the housing demand in all regions. In addition, the actions are not equitable across all income categories. Therefore, these metrics indicate that while some aspects of California's housing development are shifting towards sustainable communities in a way that can support the SB 375 program, much work remains to be done to close the remaining gaps.

INVESTMENTS IN TRANSPORTATION CHOICES AND DEVELOPMENT

Funding for SCS projects comes from local, regional, state, and federal funding programs. Financing trends can explain whether a region is shifting towards implementing projects and programs that support alternative modes of transportation and reduce VMT and GHG emissions.

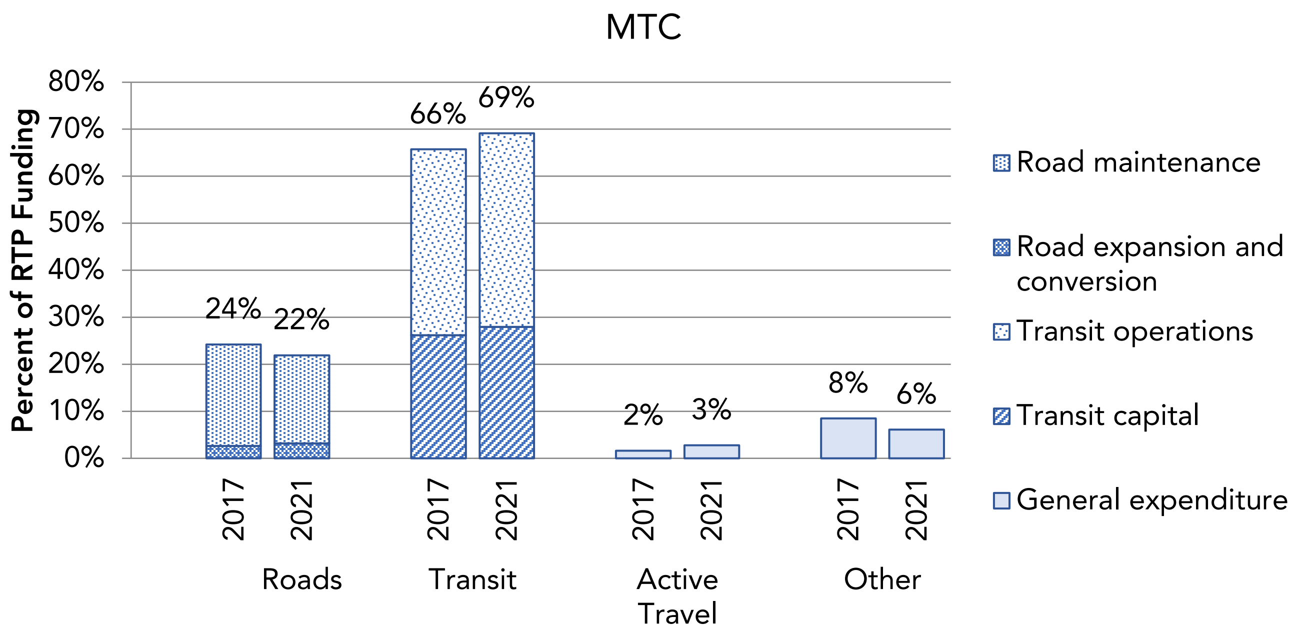
CARB staff compared investment data by mode for the two most recent long-term regional transportation plans (RTPs) in each region to analyze transportation funding and spending. RTPs are essential for understanding what transportation expenditures are planned over the next two to three decades. CARB staff requested additional information where necessary from MPOs. RTPs typically cover a period of two or three decades and must cover at least 20 years. The RTPs provide a fiscally constrained list of transportation expenditures that can be paid by funds that are reasonably expected to be available. These documents are updated every four years. CARB staff analyzed the following metrics in this theme:

- Total spending planned in RTP, by mode
- California Climate Investments (CCI) funding by project category and funds that target priority populations
- Public transit capital and operating expenses

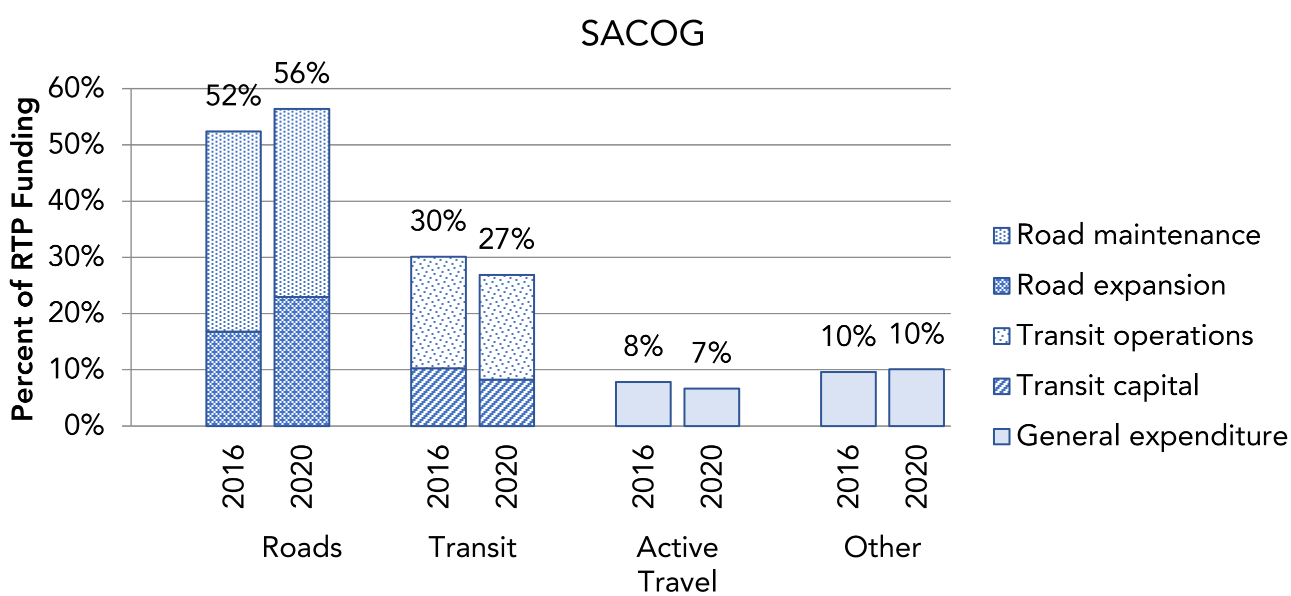
Total Spending Planned in RTP (By Mode)

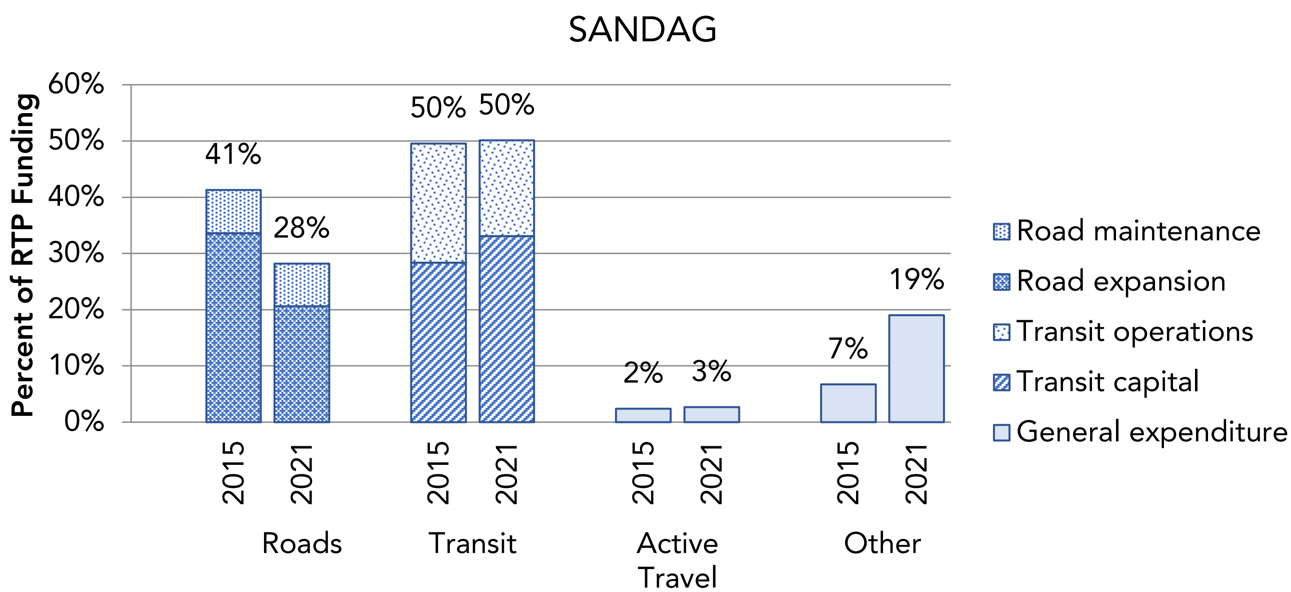
The analysis found that over $1.5 trillion (in an escalated year of expenditure dollars) will be spent during the life of California's adopted RTP/SCSs across all 18 regions. **Figures 49, 50, and 51** compare the RTP planned expenditure by mode in each MPO region between their two most recent RTPs. Of the Big 4 MPO regions, only SANDAG experienced a substantial change in allocation in spending between their two most recent plans. SANDAG's 2021 RTP saw a significant decrease in spending on roads relative to its prior RTP. SANDAG's "Other" category increased primarily due to grants supporting focused growth and Transportation System Management (TSM)/Intelligent Transportation Systems (ITS).

Figure 49. Comparison of RTP expenditure by mode between the two most recent RTPs for big 4 MPOs

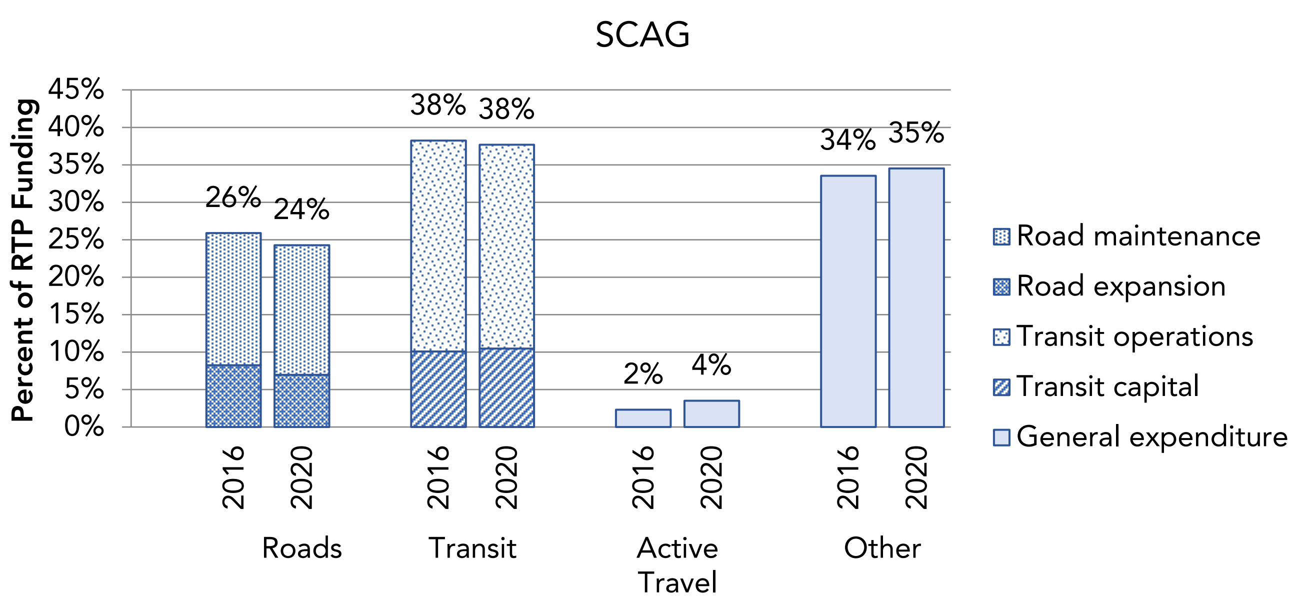


Note: Road expansion and conversion includes a project for a future managed lanes network, which would be implemented through a mix of HOV conversions, general purpose lane conversions, and capacity expansions wherever it is deemed infeasible.





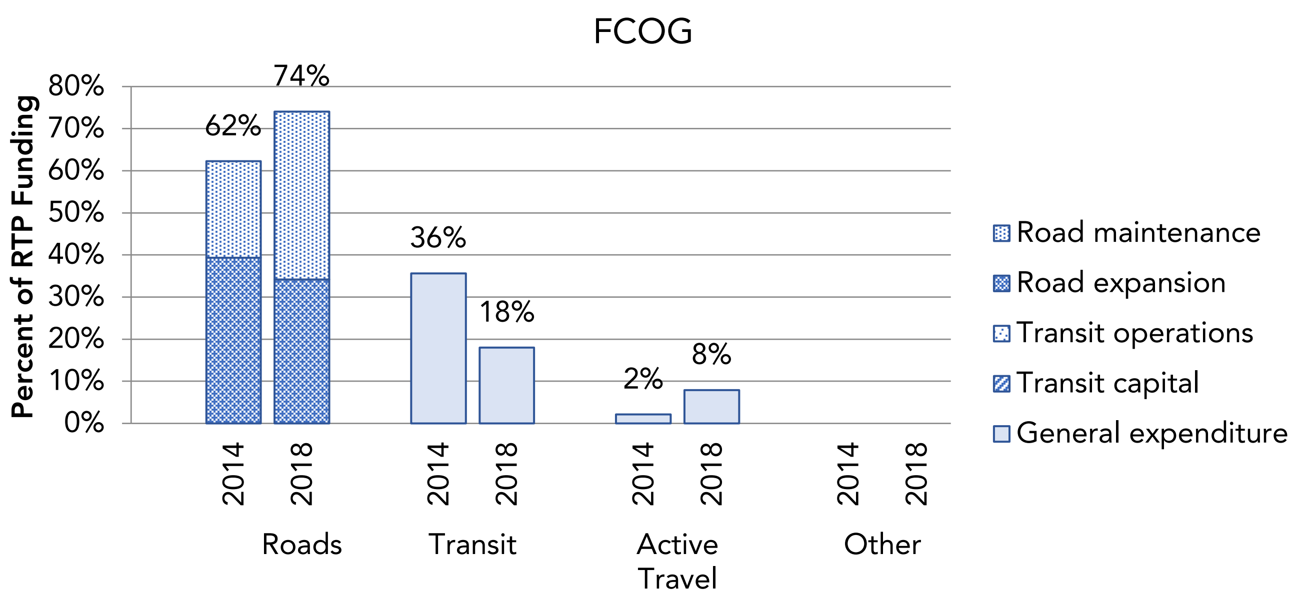
Note: Unlike other regions, SANDAG 2021 RTP reflects real 2020 dollars instead of year-of-expenditure dollars.

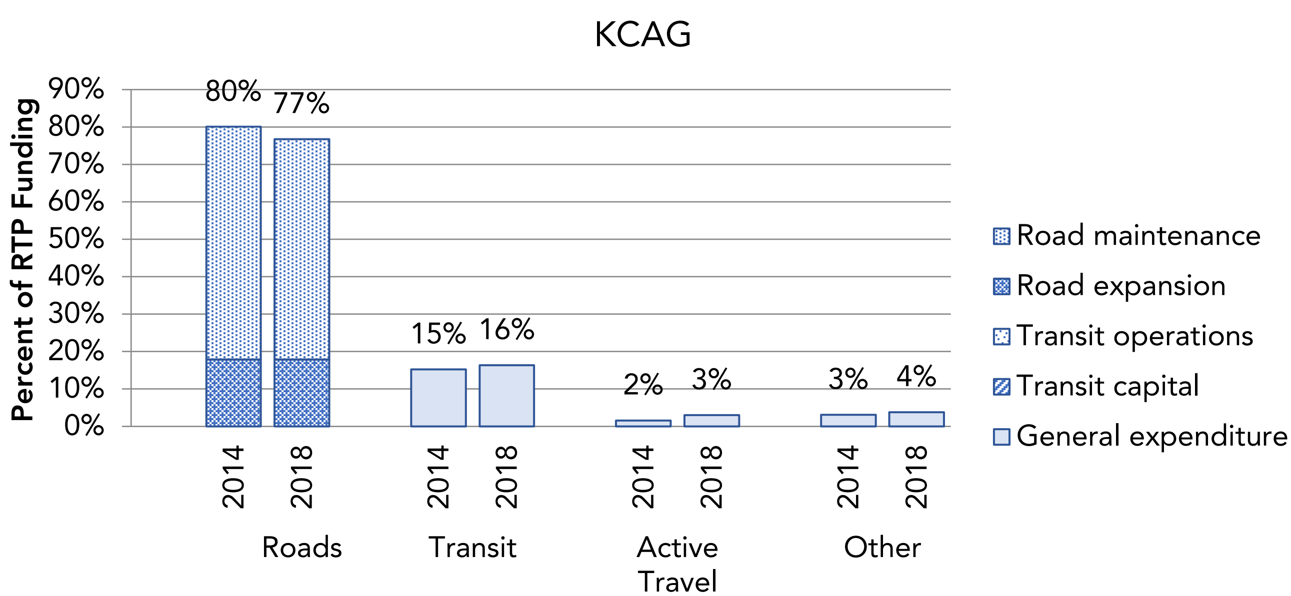


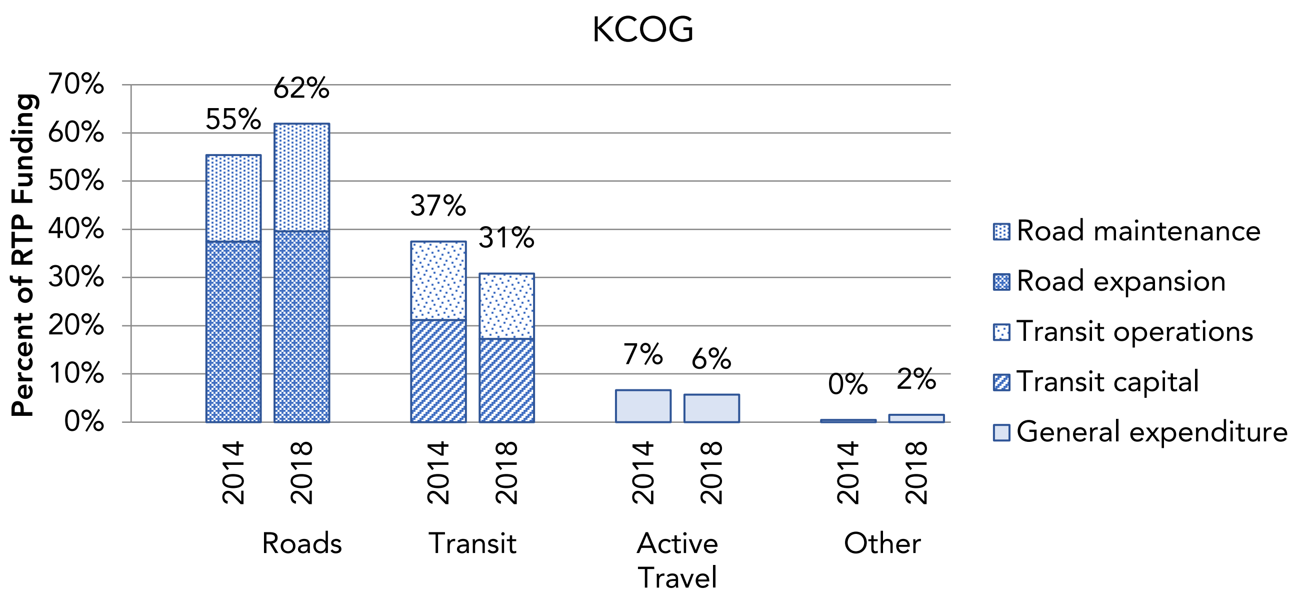
Note: Aviation/Airport Ground Access Improvement expenditures are included in the road expansion and transit capital categories.

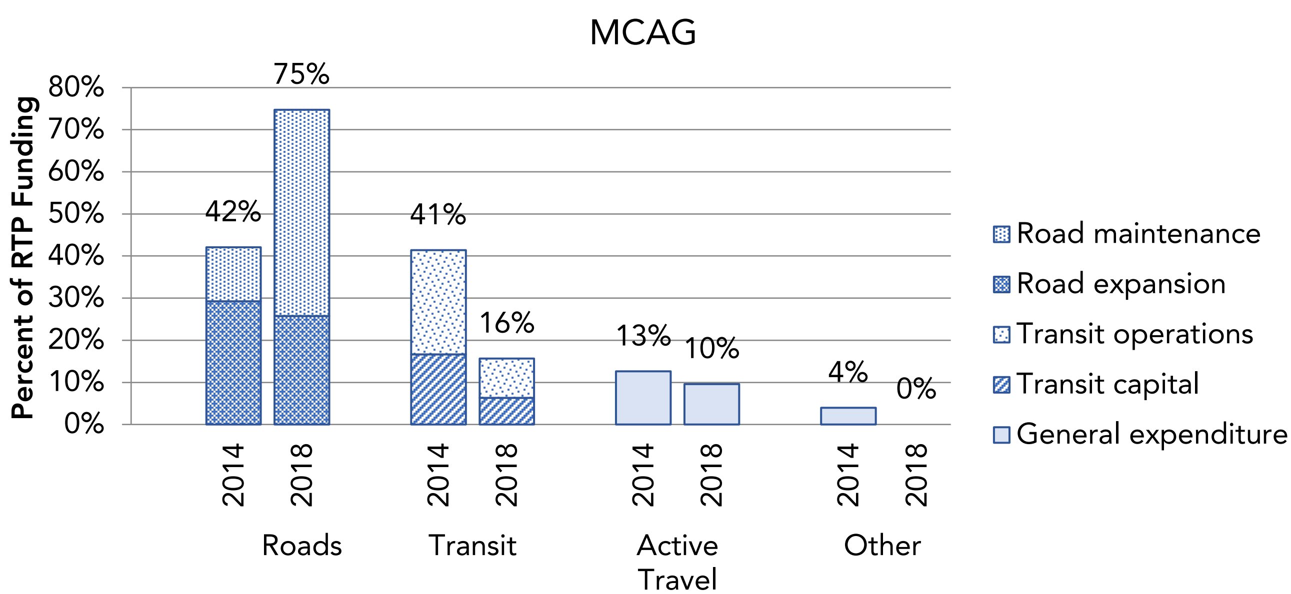
Many SJV MPOs experienced little change or an increase in road spending between their two most recent RTPs. Notable exceptions include StanCOG and TCAG, which both saw decreases in road spending and increases in transit spending.

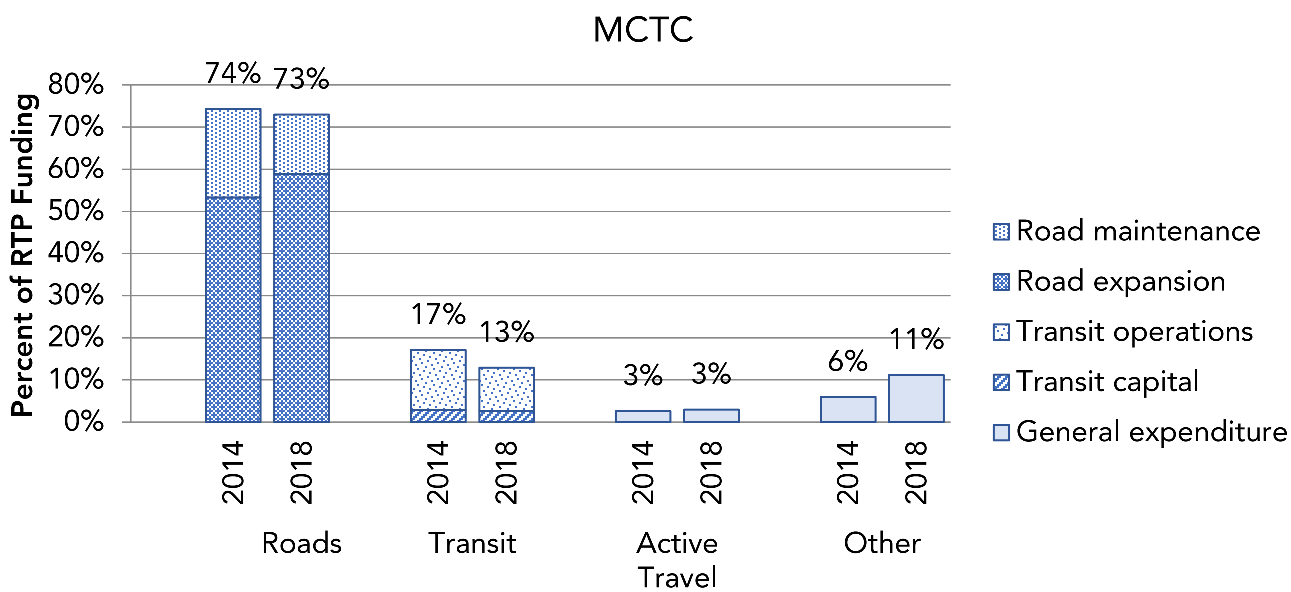
Figure 50. Comparison of RTP expenditure by mode between the two most recent RTPs for SJV MPOs

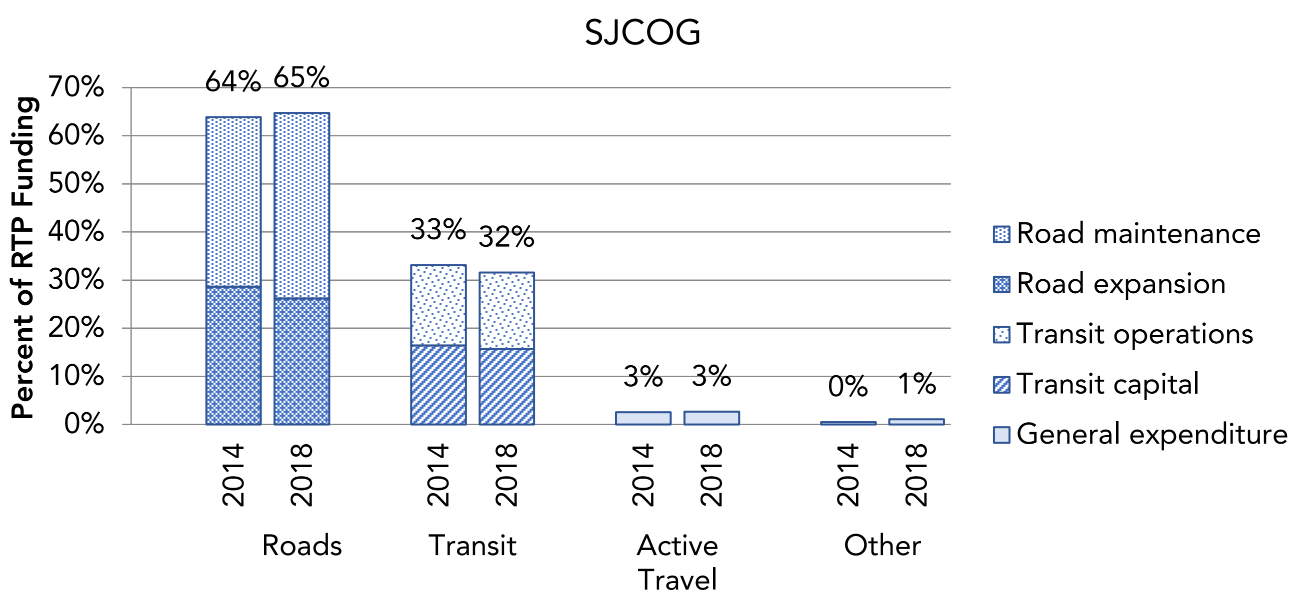


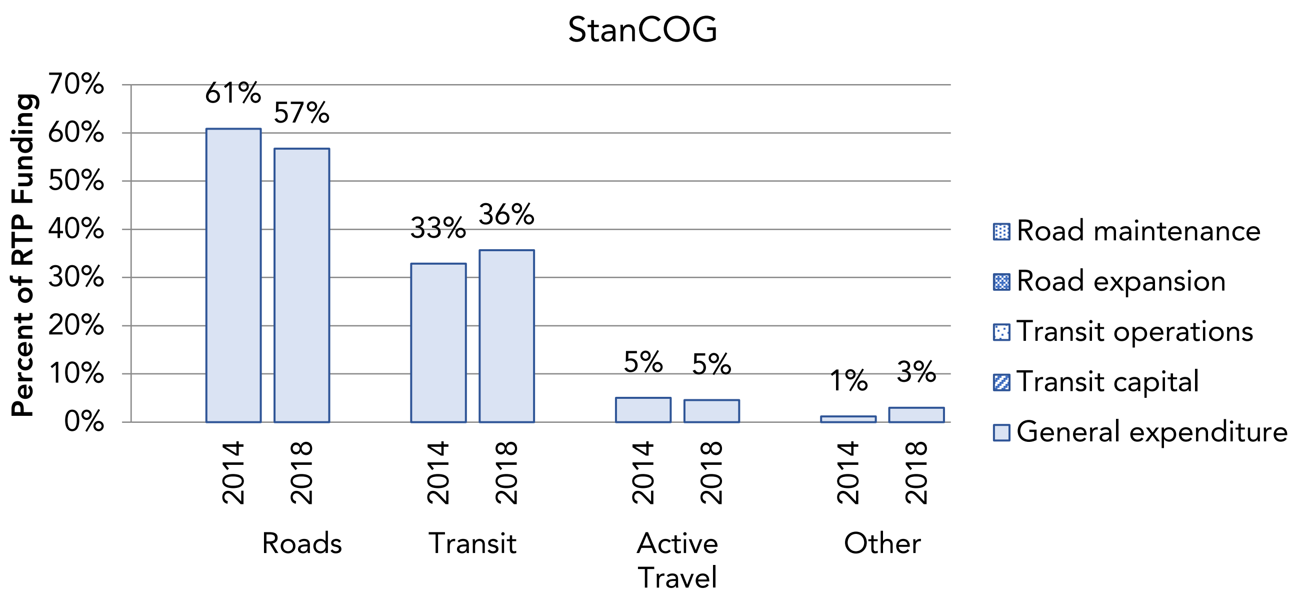


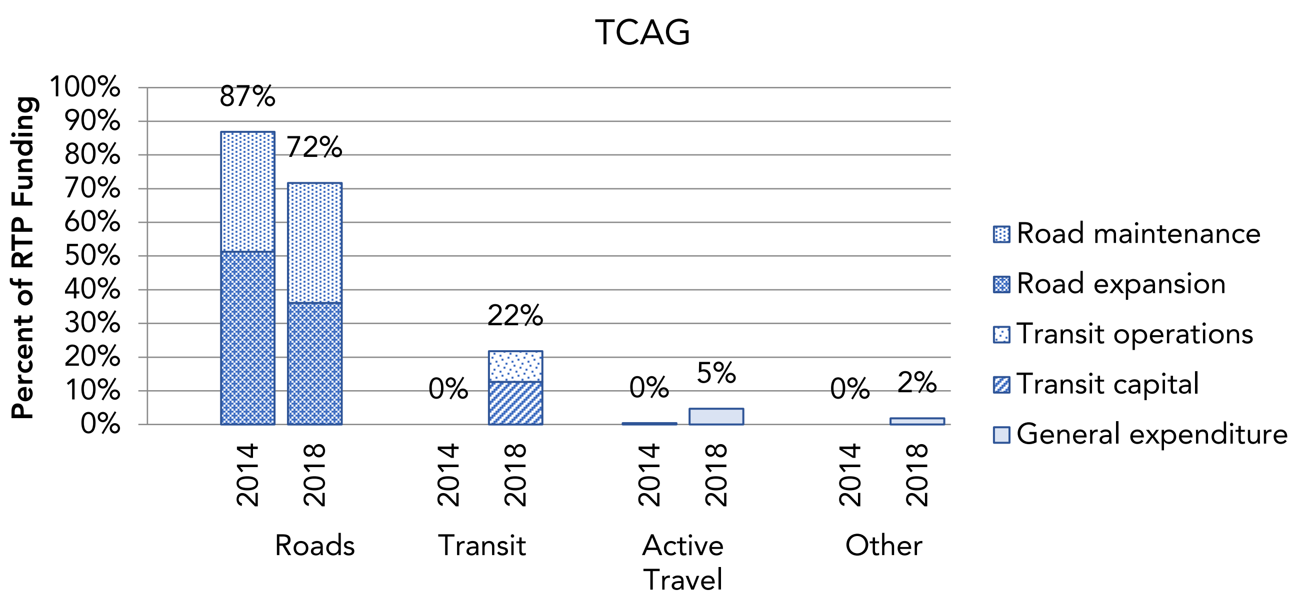

KCOG
Percent of RTP Funding
70%
60%
50%
40%
30%
20%
10%
0%
55%
62%
37%
31%
7%
6%
0%
2%
2014
2018
Roads
Transit
Active Travel
Other
Road maintenance
Road expansion
Transit operations
Transit capital
General expenditure


MCAG
Percent of RTP Funding
80%
70%
60%
50%
40%
30%
20%
10%
0%
42%
75%
41%
16%
13%
10%
4%
0%
2014
2018
Roads
Transit
Active Travel
Other
Road maintenance
Road expansion
Transit operations
Transit capital
General expenditure


MCTC
Percent of RTP Funding
80%
70%
60%
50%
40%
30%
20%
10%
0%
74%
73%
17%
13%
3%
3%
6%
11%
2014
2018
Roads
Transit
Active Travel
Other
Road maintenance
Road expansion
Transit operations
Transit capital
General expenditure

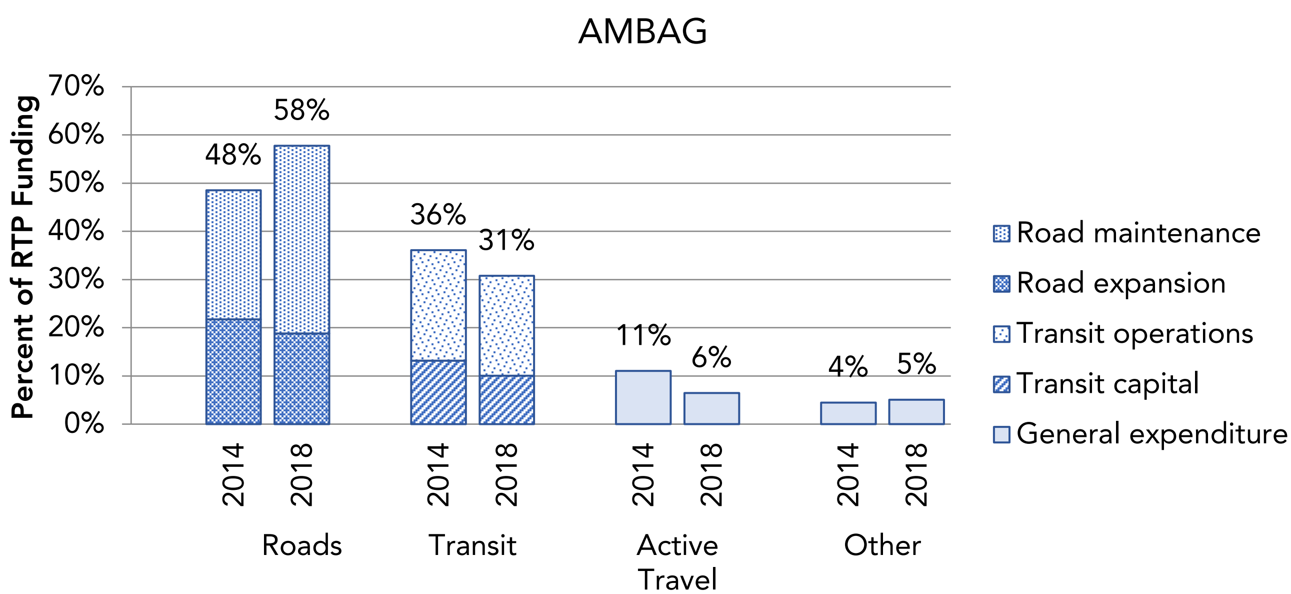

SJCOG
Percent of RTP Funding
70%
60%
50%
40%
30%
20%
10%
0%
64%
65%
33%
32%
3%
3%
0%
1%
2014
2018
Roads
Transit
Active Travel
Other
Road maintenance
Road expansion
Transit operations
Transit capital
General expenditure

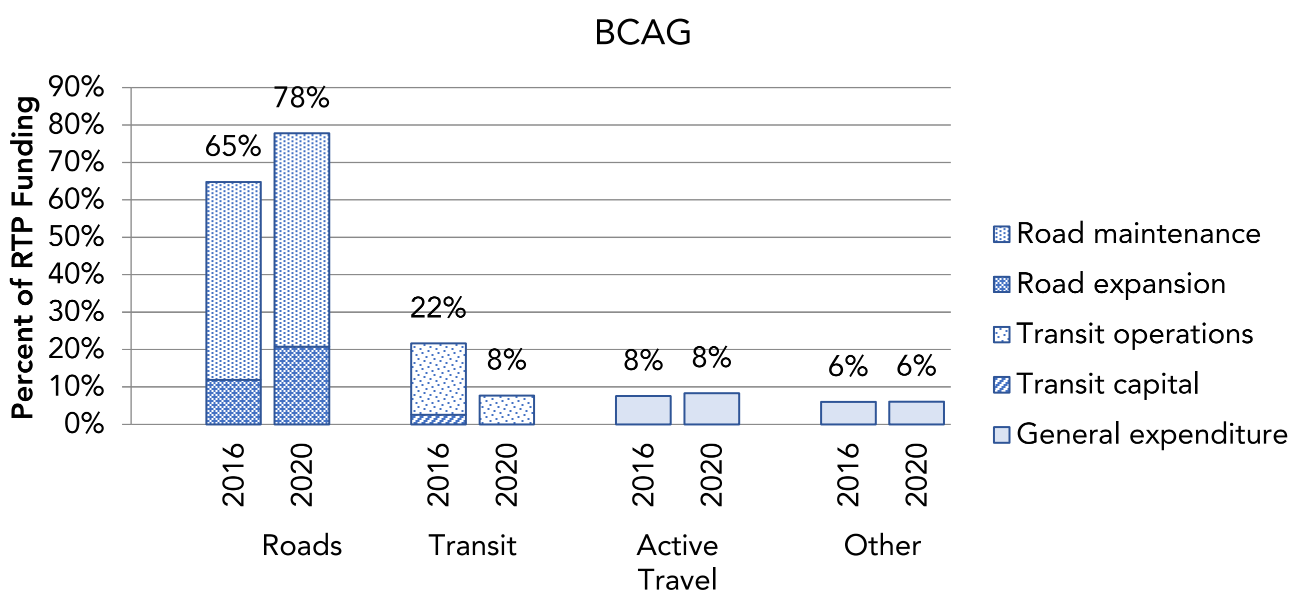

StanCOG
Percent of RTP Funding
70%
60%
50%
40%
30%
20%
10%
0%
61%
57%
33%
36%
5%
5%
1%
3%
2014
2018
Roads
Transit
Active Travel
Other
Road maintenance
Road expansion
Transit operations
Transit capital
General expenditure

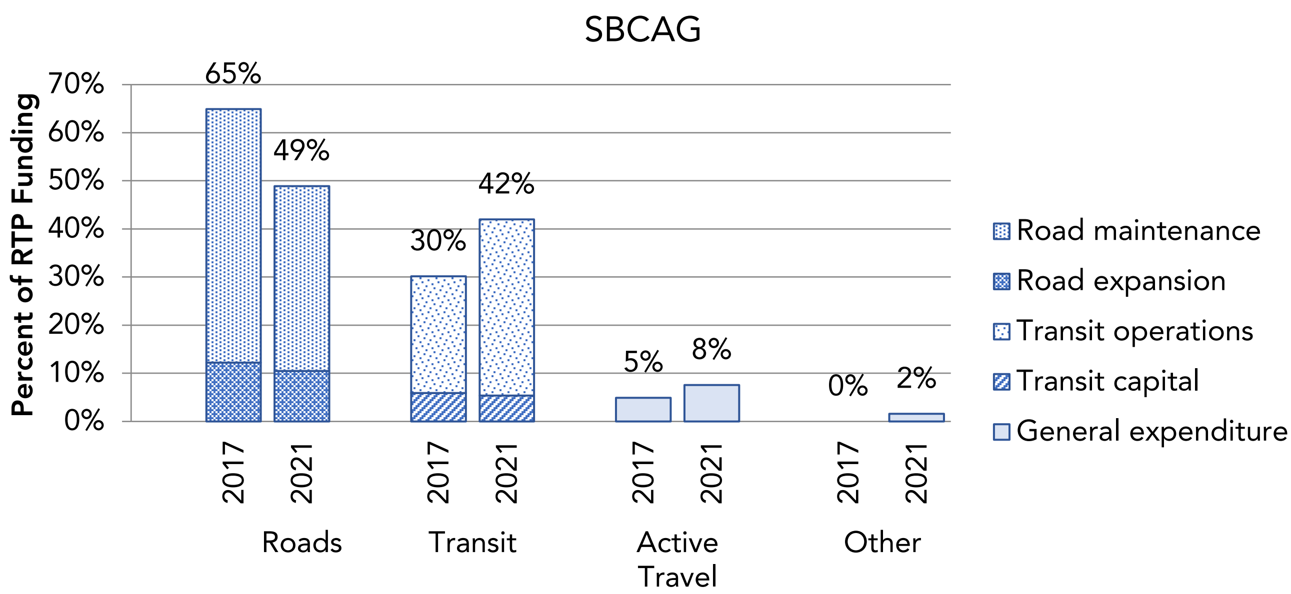

TCAG
Percent of RTP Funding
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
87%
72%
0%
22%
0%
5%
0%
2%
2014
2018
Roads
Transit
Active Travel
Other
Road maintenance
Road expansion
Transit operations
Transit capital
General expenditure

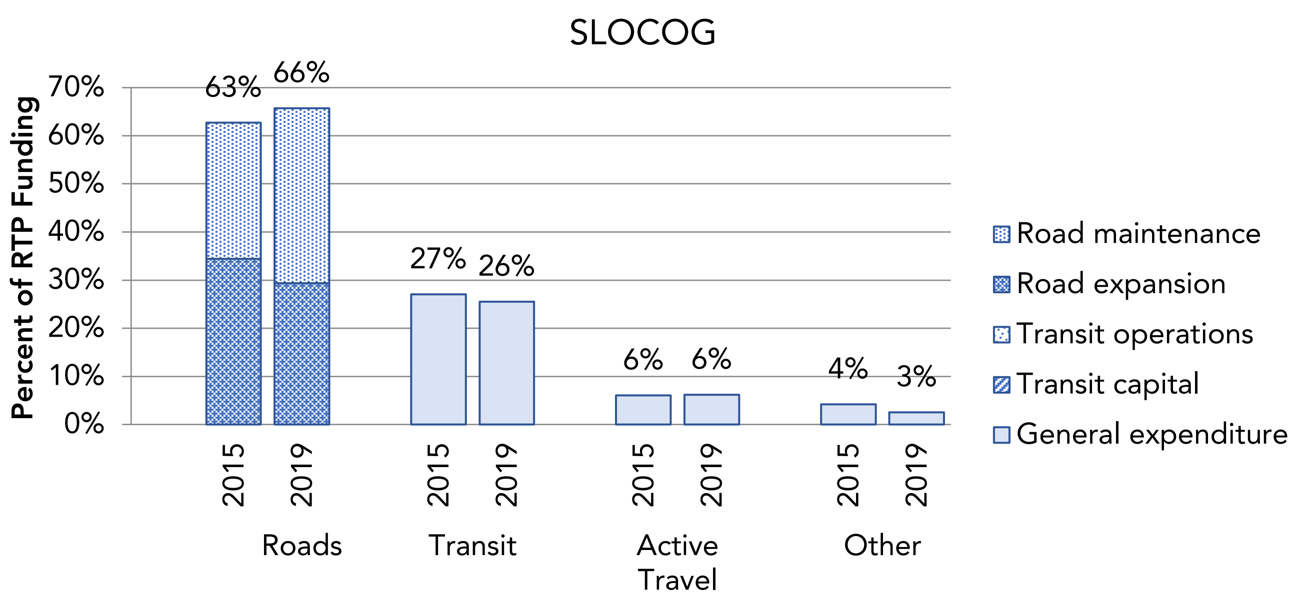
Several coastal and northern California MPOs experienced increases in spending on roads and decreases in spending for transit and active travel. Exceptions include SBCAG and TMPO / TRPA, who both saw significant decreases in road spending.

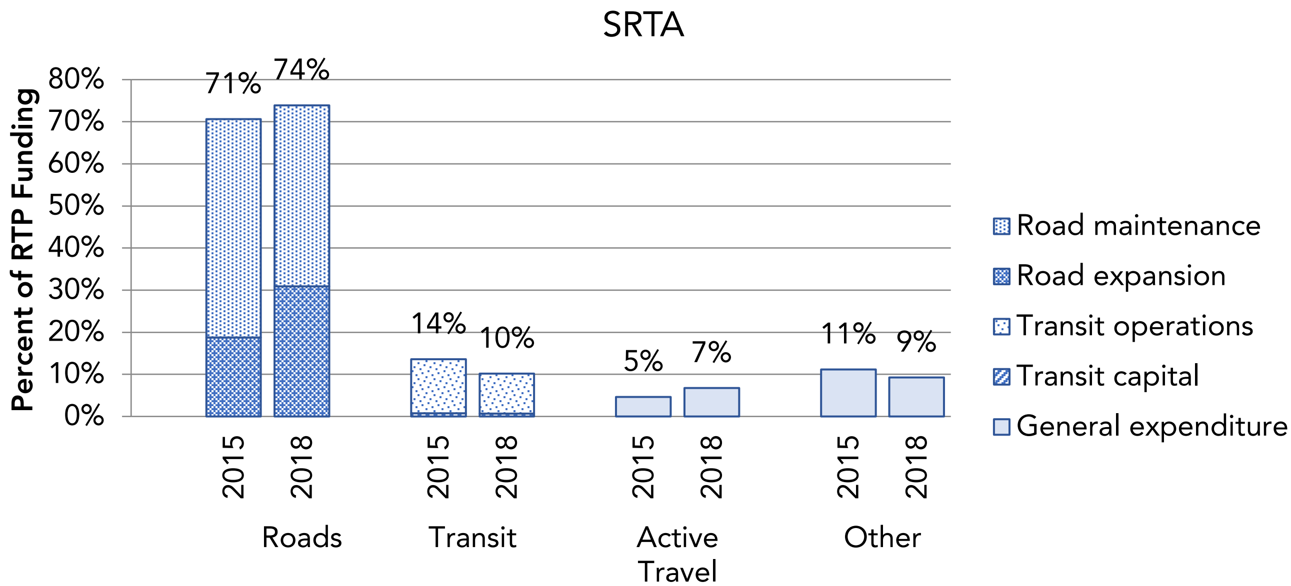
Figure 51. Comparison of RTP expenditure by mode between the two most recent RTPs for coastal and northern California MPOs

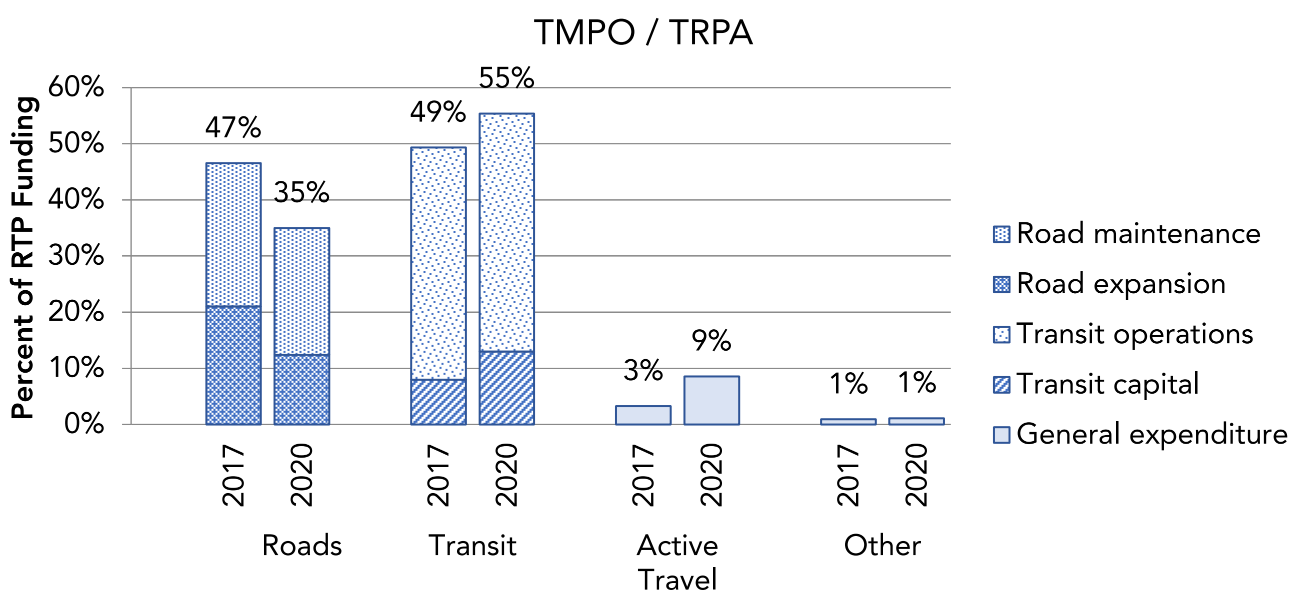





SBCAG
Percent of RTP Funding
70%
60%
50%
40%
30%
20%
10%
0%
65%
49%
30%
42%
5%
8%
0%
2%
2017
2021
2017
2021
2017
2021
2017
2021
Roads
Transit
Active Travel
Other
Road maintenance
Road expansion
Transit operations
Transit capital
General expenditure


SLOCOG
Percent of RTP Funding
70%
60%
50%
40%
30%
20%
10%
0%
63%
66%
27%
26%
6%
6%
4%
3%
2015
2019
2015
2019
2015
2019
2015
2019
Roads
Transit
Active Travel
Other
Road maintenance
Road expansion
Transit operations
Transit capital
General expenditure





Caveats

1. Funding Allocation

Funding changes (or lack of changes) may be attributable to several factors. MPOs have discretionary authority over only a portion of the funds in RTPs, and that portion differs by region. Local governments, county transportation commissions, and transit agencies are examples of authorities with decision-making power over funds in the RTPs. Certain funding sources also have constraints attached. For example, local transportation authorities manage funds from self-help transportation sales tax measures, which often identify specific transportation projects as part of the package put to voters. Further, many transportation funding sources specify how money can be used, making it difficult for transportation agencies to shift funding from one mode to another. For example, under Article 19 of the California Constitution, funds collected from motor vehicle taxes may not be used for public transit maintenance and operation costs.

2. Regional Comparison

Caution should be used in comparing across regions, as regions categorize spending differently from one another. For instance, many road projects include improvements to bicycle and pedestrian infrastructure. Furthermore, buses and bicycles use roadways, so they may benefit from road maintenance. In addition, a single project can sometimes significantly skew percentages, particularly in smaller regions. For example, suppose one RTP included high-speed rail and the previous one did not. That might appear to be a significant increase in transit funding between the plans, even though the remainder of the plan was essentially unchanged.

3. Forecasting Revenues

Forecasting transportation revenues and expenditures several decades into the future requires making many assumptions. Revenue sources may shift as policies change. Capital projects and the spending to support them may reflect detailed long-term plans but, in some cases, are based upon the cost estimates to build out short-range plans, then extrapolated. As new technologies such as automated vehicles accelerate the pace of change in the transportation sector, the uncertainty around these forecasts increases.

California Climate Investments

Background

California Climate Investments is a statewide initiative that invests Cap-and-Trade dollars in programs and projects that reduce GHG emissions, strengthen the economy, and improve public health and the environment. The Legislature appropriates money from the Greenhouse Gas Reduction Fund (GGRF) to agencies administering California Climate Investments programs. CARB and the over 20 agencies and departments administering California Climate Investments programs work together to track and report progress and project outcomes resulting from GGRF funding.

California Climate Investments is one of the major state funding sources that advances SCS implementation by supporting regional and local planning efforts to increase infill housing development and reduce VMT. In addition, this fund also supports transportation options to improve access to key destinations through alternative modes such as public transit, active transportation, and shared mobility. This analysis aims to track the types of programs and projects funded that can implement SCS strategies to reduce GHG and VMT. Further, this analysis could also inform efforts to identify where additional funding is needed to implement SCS strategies.

Data Source

CARB staff analyzed the list of projects that uses California Climate Investments to reduce GHG emissions and support priority population benefits by MPO region. This analysis was conducted between June and September 2021 and is based on the 2021 mid-year dataset and project list.[52] A couple of limitations related to this dataset should be noted. First, a number of projects implemented span multiple geographic boundaries (e.g., a transit bus line crossing county lines). Second, when it is not feasible to associate a project with a single MPO region, the same project data are included in each MPO region that benefits from the investment. This method of attribution increases the total number of projects implemented[53]. Finally, project locations used in this analysis are based on information reported to CARB. Therefore, the project location for vehicle vouchers is based on the voucher recipient's census tract, as reported by program staff. In some cases, vehicles may have been redomiciled elsewhere since this information was reported.

[52] The 2021 Mid-year Data Update Detailed Dataset and Project List are available at http://www.caclimateinvestments.ca.gov/annual-report.

[53] See the Project List at https://www.arb.ca.gov/sites/default/files/classic/cc/capandtrade/auctionproceeds/cci_2021mydu_all_implemented_projects.xlsx for a more detailed explanation of the methodology CARB used to evaluate projects that cross geographic boundaries.

Method

Project Type Assignments

CARB staff characterized each project within the detailed dataset as belonging to a discrete set of project types. These project types were determined by referencing available data points, known facts about individual subprograms and the projects they fund, and through conversations with program staff and administering agencies. The project types selected for inclusion directly relate to SCS strategies. These project types advance affordable housing, clean transportation, and other strategies in each MPO region and therefore can provide valuable information about how GGRF funds are supporting investments that can help implement SCSs. An important caveat is that certain programs support investments in multiple project types. When this occurred, those programs' investment was [divided between / counted in both of] the project type categories.

Project Type Generalization

The project types assigned in the initial step informed a subsequent generalization step, wherein specific project types were sorted into categories determined in consultation with the SB 150 team. These categories were chosen to best map project types to SCS strategies identified by MPOs as focus areas for work to reduce VMT and to the challenge areas identified during interviews for this SB 150 report. **Table 6** below shows the programs and project types included in each project category for this analysis.

Table 6. California Climate Investment project types, project categories, and programs included in this analysis

California Climate Investments Project Types	Project Category	Program
Renewable, low-carbon transportation fuel and infrastructure	Charging Infrastructure	Community Air Protection Funds
Conservation easement	Land Conservation	Sustainable Agricultural Lands Conservation
Affordable housing development	Land use/ housing	Affordable Housing and Sustainable Communities
		Sustainable Agricultural Lands Conservation
Planning		Transformative Climate Communities
Community transportation needs assessment		Affordable Housing and Sustainable Communities

California Climate Investments Project Types	Project Category	Program
Community transportation needs assessment	Transportation	Car Sharing and Mobility Options Pilot
		Community Air Protection Funds
		Low Carbon Transit Operations Program
Transit services		Rural School Bus Pilot Project
		Sustainable Transportation Equity Project
		Transformative Climate Communities
		Transit and Intercity Rail Capital Program
		Zero-Emission Truck and Bus Pilot
Active transportation		Active Transportation Program
		Affordable Housing and Sustainable Communities
		Agricultural Worker Vanpools in San Joaquin Valley
		Car Sharing and Mobility Options
		Car Sharing and Mobility Options Pilot
Shared mobility services	Transportation Mobility	Clean Mobility for Schools
		Climate Ready Program
		Sustainable Transportation Equity Project
		Transformative Climate Communities
		Urban Greening Program

Spatial Data and MPO Assignments

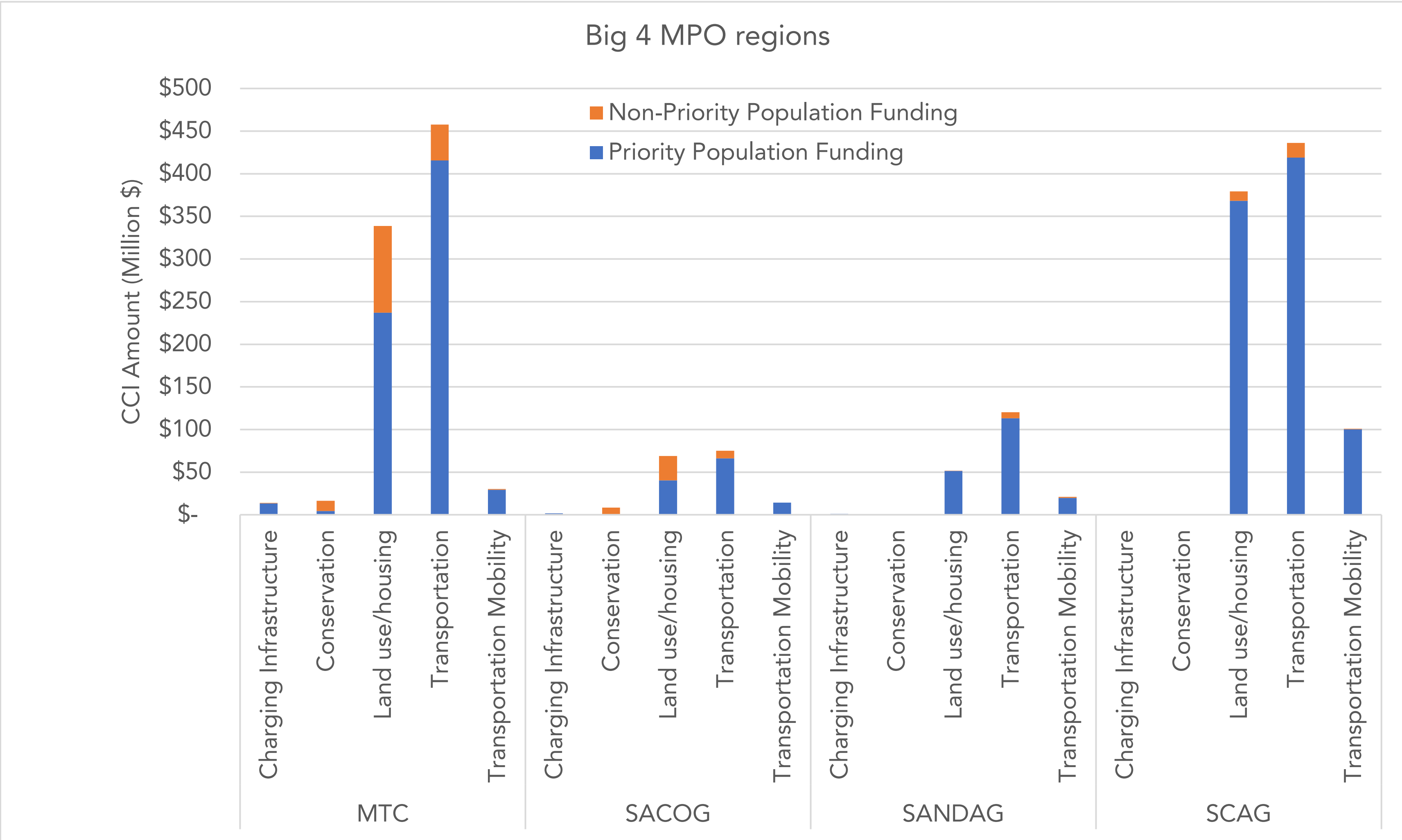
The California Climate Investment dataset used to perform this analysis does not provide the county or MPO as a feature of individual records. To perform county assignments and subsequent MPO region aggregation, staff created a "unique ID" by concatenating several fields that identified the county information for projects subject to this analysis. Staff manually looked up and entered county information for this subset of records using address information included in the detailed dataset. Staff then assigned the appropriate MPO to data summarized at the county level using the county information. In cases of cross-boundary projects, each project was counted once for each MPO region in which the project occurs.

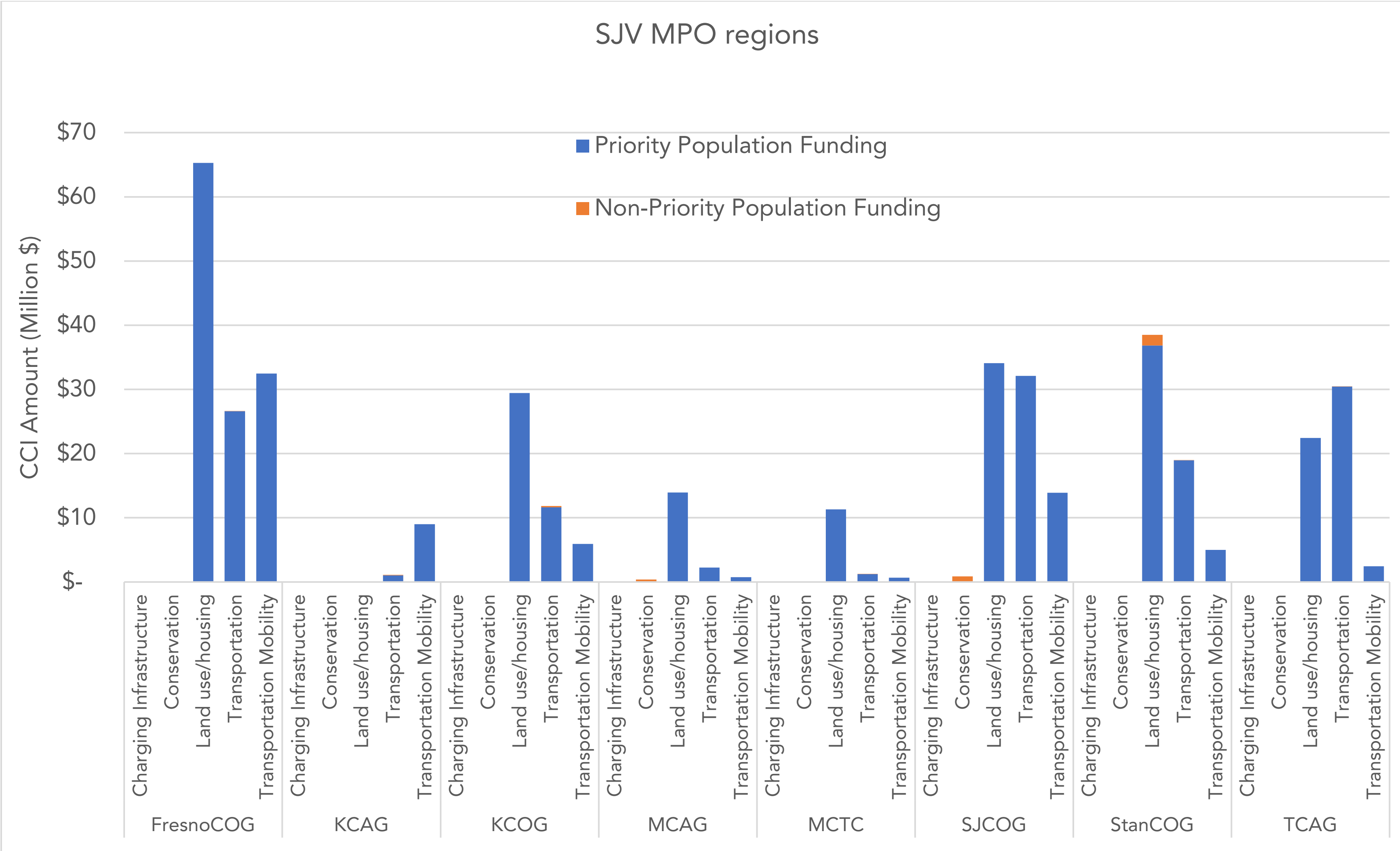
Results

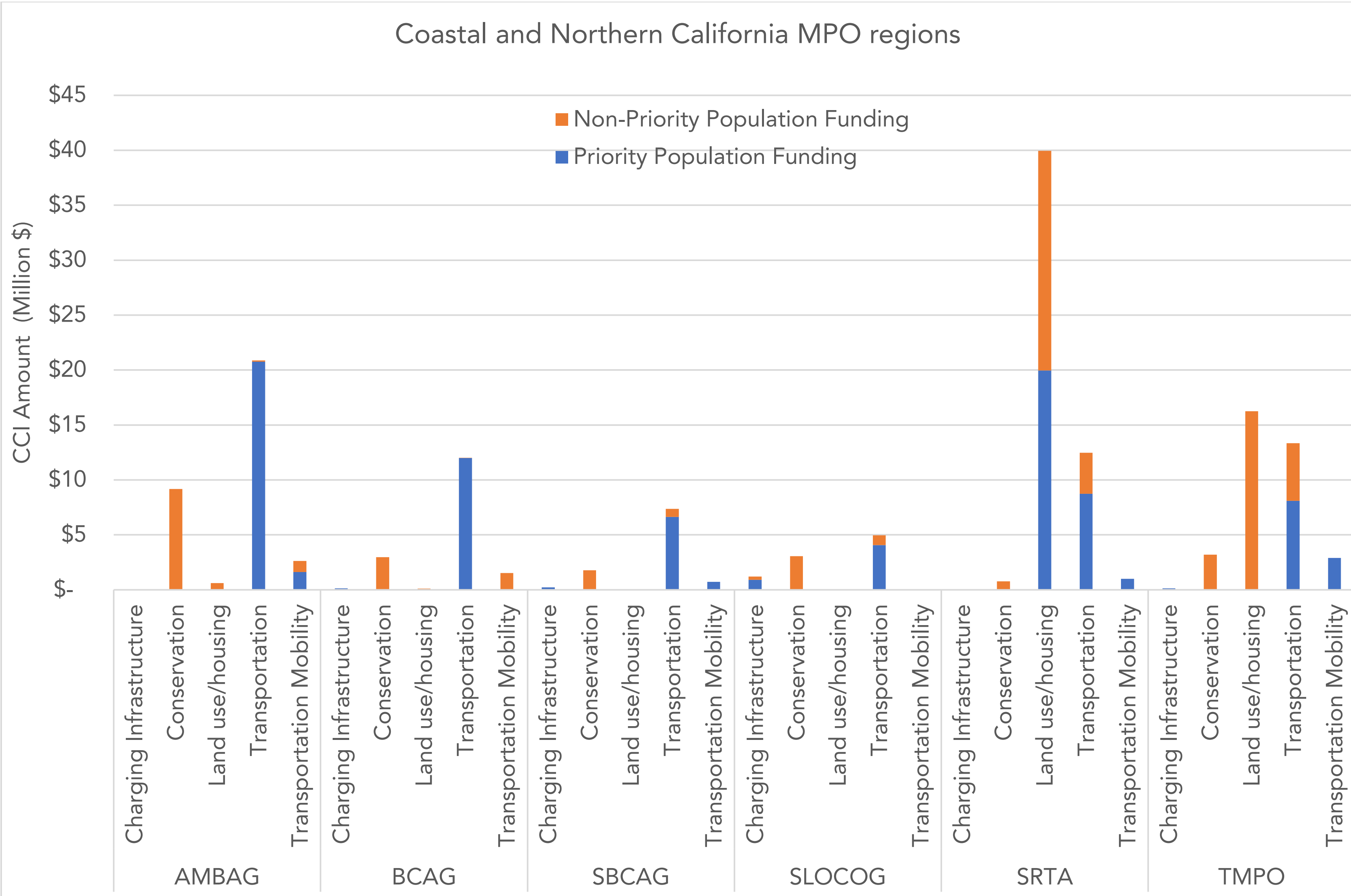
This analysis illustrates which MPO regions have successfully accessed California Climate investment funds to support various VMT and GHG reducing strategies. Further, the distribution of funds by project type shows which strategies from SCSs are implemented and where additional funding may be valuable to accelerate implementation of SCS.

Figure 52 shows the amount of California Climate Investment funding in individual MPOs by project category and funds that target priority populations. Land use/housing and transportation are the two categories that received the most funding in many MPO regions that are related to SCS goals. The distribution of investments from these two categories is very close across the Big 4 MPO regions. In the SJV, the land use/housing category received the most investments in 6 MPO regions, while the TCAG region received the most investment in the transportation category. In the coastal and northern California MPOs, all MPO regions received comparable investments in the transportation category but minimal investments in land use/housing projects in AMBAG, BCAG, SBCAG, and SLOCOG regions. For regions in the Big 4 and SJV MPOs, the majority of California Climate Investment funding was spent in priority population areas. In the coastal and northern California MPO regions, the investment is relatively evenly distributed between priority population areas and non-priority population areas. In other words, a significant portion of funding from these sources was spent in priority population areas.

Figure 52. California Climate Investment funding by category in all MPOs and priority population areas




SJV MPO regions
Priority Population Funding
Non-Priority Population Funding
CCI Amount (Million $)
$70
$60
$50
$40
$30
$20
$10
$-
Charging Infrastructure
Conservation
Land use/housing
Transportation
Transportation Mobility
FresnoCOG
KCAG
KCOG
MCAG
MCTC
SJCOG
StanCOG
TCAG


Coastal and Northern California MPO regions
Non-Priority Population Funding
Priority Population Funding
CCI Amount (Million $)
$45
$40
$35
$30
$25
$20
$15
$10
$5
$-
Charging Infrastructure
Conservation
Land use/housing
Transportation
Transportation Mobility
AMBAG
BCAG
SBCAG
SLOCOG
SRTA
TMPO

Public Transit Spending

The public transit spending metric compares the capital and operating expenses in MPOs. It reflects a region's investment pattern in the public transit system and how the public transit system is funded in each region. A higher share of capital expense in a region generally suggests transit network expansion. Since public transit is a key strategy in most MPOs' SCS plans to reduce regional VMT and GHG, transit network expansion could be important to implement this strategy and support the regional SCS goals. However, operations and maintenance expenditures are also necessary, and a region with high operations and maintenance expenditures may be pursuing a less capital-intensive approach to supporting travelers making a mode shift to transit, such as providing high-frequency bus service along key corridors and increasing passenger comfort and safety. CARB staff analyzed the annual capital and operating expense reports in every transit agency published by NTD[54] from 2016 to 2020[55] and calculated the total capital and operating expenses in each MPO region.

Figure 53 shows total capital and operating expense patterns by MPO region. It shows that the annual operating expense increased in all MPO regions over the analyzed period, and the capital expenses are generally lower than the operating cost for all MPO regions. Among the Big 4 MPO regions, MTC has the highest capital-to-operating expense ratio of 0.70, which means the total capital expenditures in the 2016-2020 period is 0.7 times the region's operating expense in the same period, suggesting a relatively high amount of investments in new public transit projects. The capital-to-operating expense ratios are 0.65, 0.53, and 0.19 in the SCAG, SANDAG, and SACOG regions, respectively. Data show that the SACOG region has the smallest ratio in this MPO group and is much lower than the other three MPO regions. SACOG is spending less on capital expansion than its operating expenses compared to other Big 4 regions. Considering that SACOG has the lowest per capita transit ridership (Figure 24) and lowest per capita service hour (Figure 25) among the Big 4 MPO regions, additional investment in new public transit projects is needed in the region to improve the public transit system.

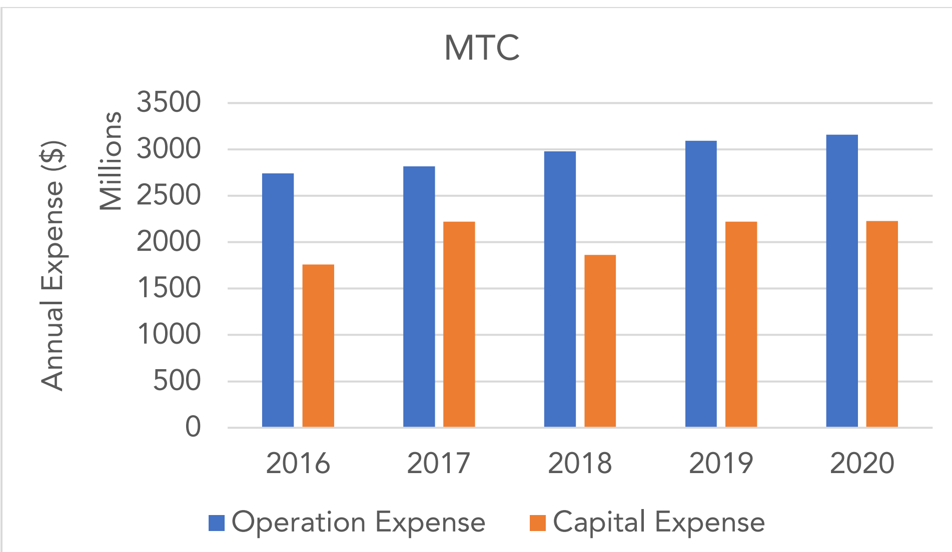
In the SJV regions, while the annual operating expenses increased in all MPO regions, the size of capital expenses and the total expenses varied greatly across regions. For example, SJCOG has the highest total public transit expenses among all SJV MPOs of $490 million over the 5 years, while MCTC only spent $14 million, which is on the lower side. Compared to the Big 4 MPOs, the SJV MPOs also show lower capital-to-operating expense ratios except for the SJCOG and StanCOG regions, which suggests that there might be very minimal new transit projects in the SJV regions. Considering

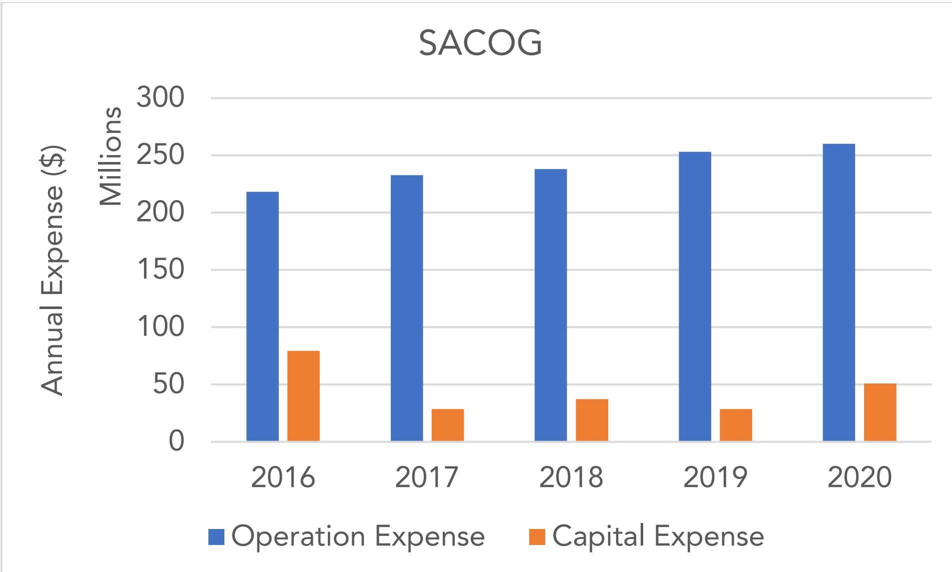
[54] The National Transit Database : https://www.transit.dot.gov/ntd/ntd-data
[55] Prior years data are not analyzed due to changes in the reporting format of NTD

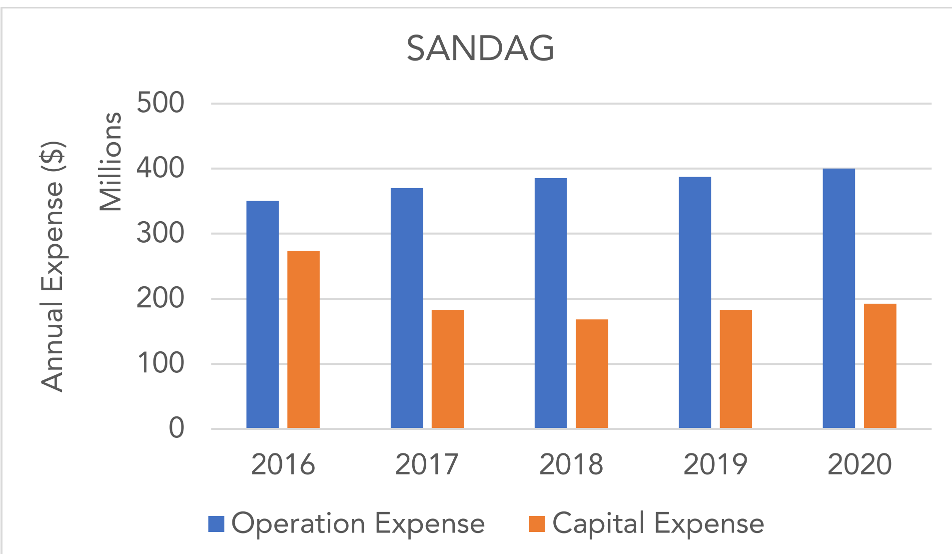
the SJV region currently has some of the lowest public transit ridership and mode share, which also has the smallest transit systems in California, this observed investment pattern implies that the public transit system may not improve as projected in the near future and could affect SJV MPOs' achievements of their SCS targets. For the coastal and the northern California regions, CARB staff observed similar patterns as the SJV region in that the capital expenses in these regions are relatively low. The observed public transit expense patterns in California show strong regional variations. The low capital investments in many MPO regions may not be sufficient to implement their SCSs and achieve SB 375 targets.

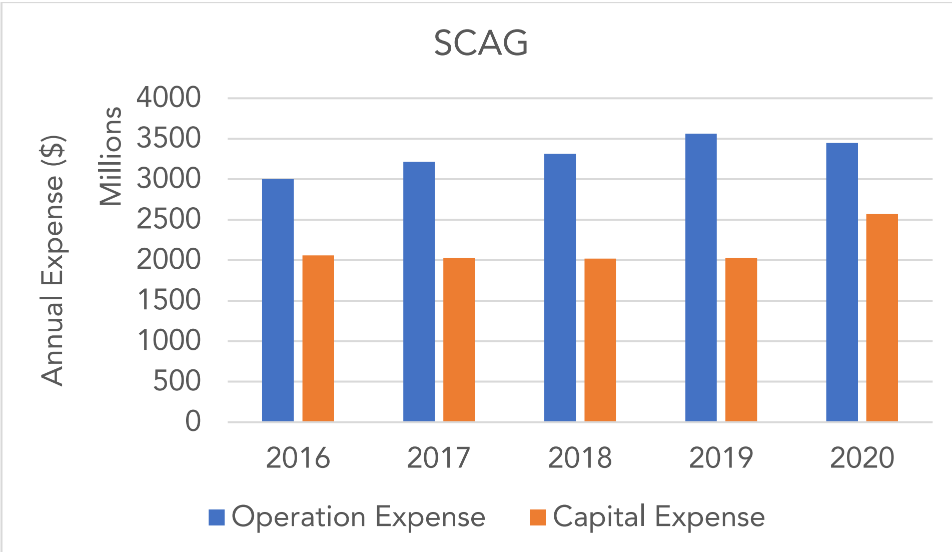
Figure 53. Public transit total capital operating expenses by MPO regions from 2016 to 2020

Big 4 MPO regions

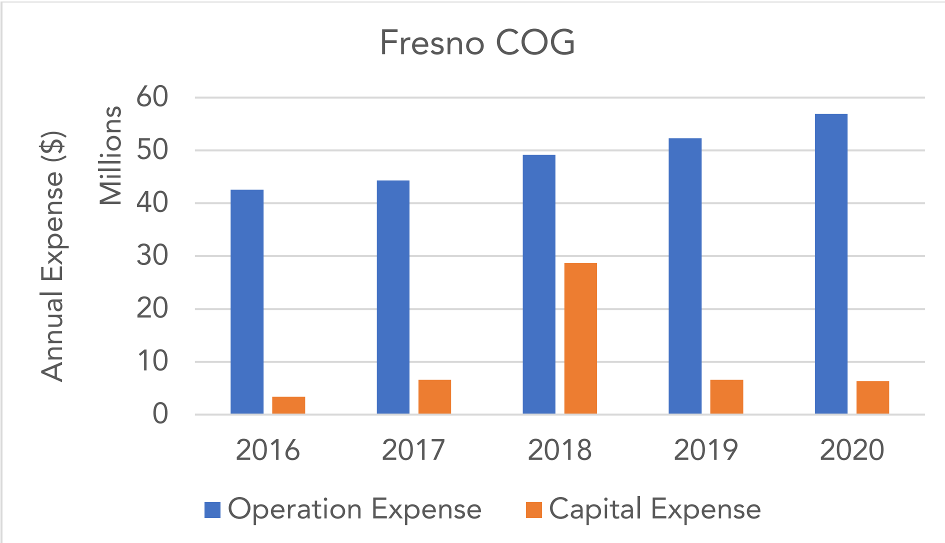


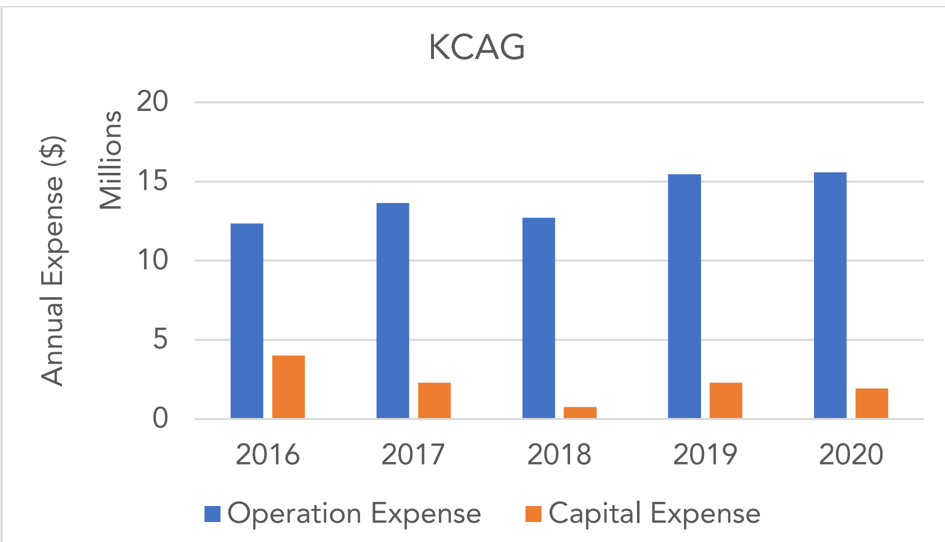

SACOG
Annual Expense ($)
Millions
300
250
200
150
100
50
0
2016
2017
2018
2019
2020
Operation Expense
Capital Expense

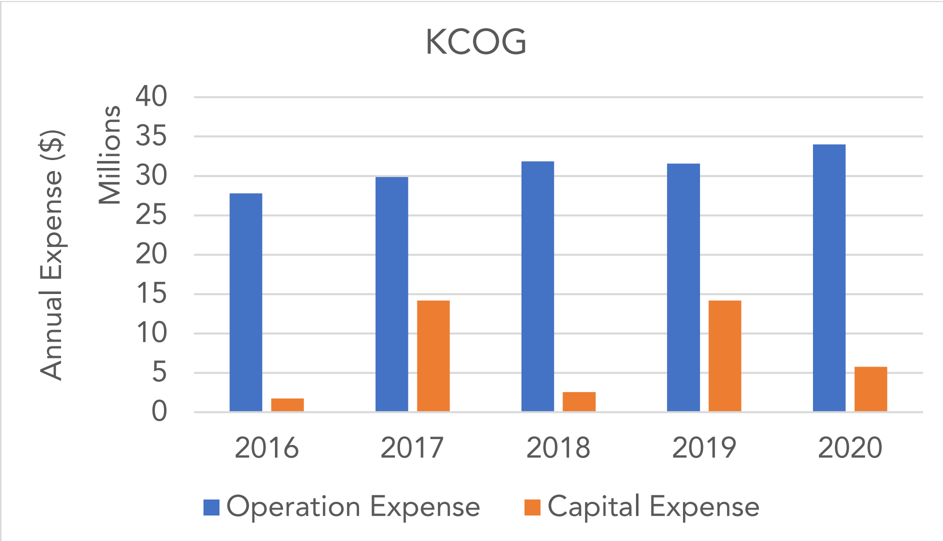

SANDAG
Annual Expense ($)
Millions
500
400
300
200
100
0
2016
2017
2018
2019
2020
Operation Expense
Capital Expense

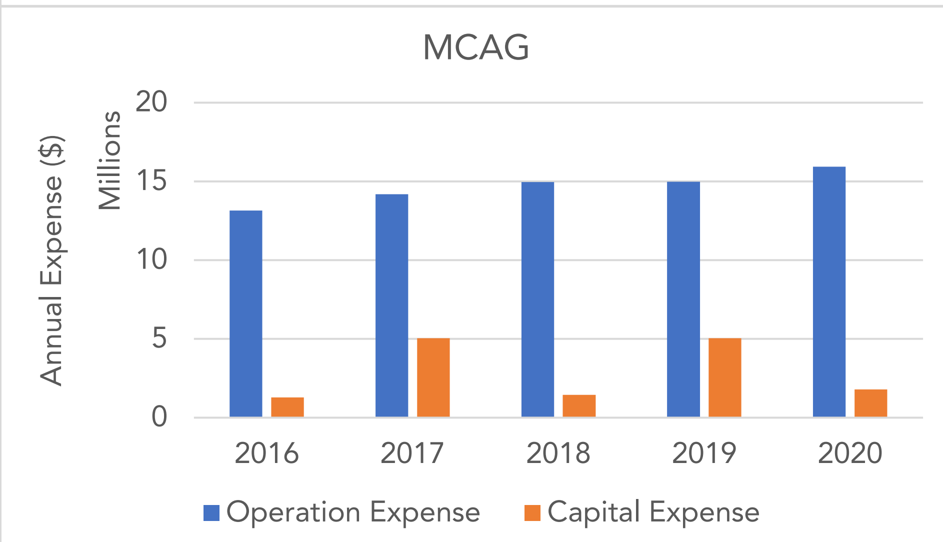

SCAG
Annual Expense ($)
Millions
4000
3500
3000
2500
2000
1500
1000
500
0
2016
2017
2018
2019
2020
Operation Expense
Capital Expense

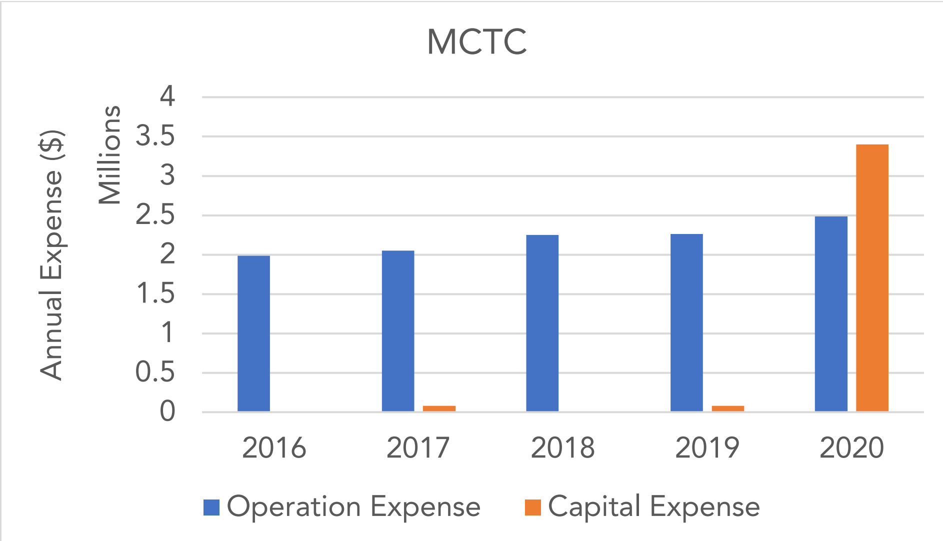
SJV MPO regions

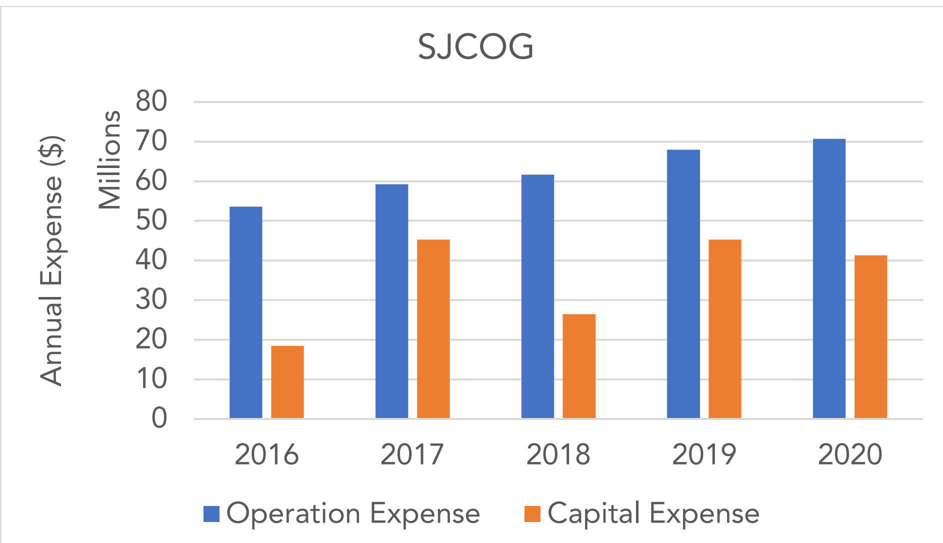


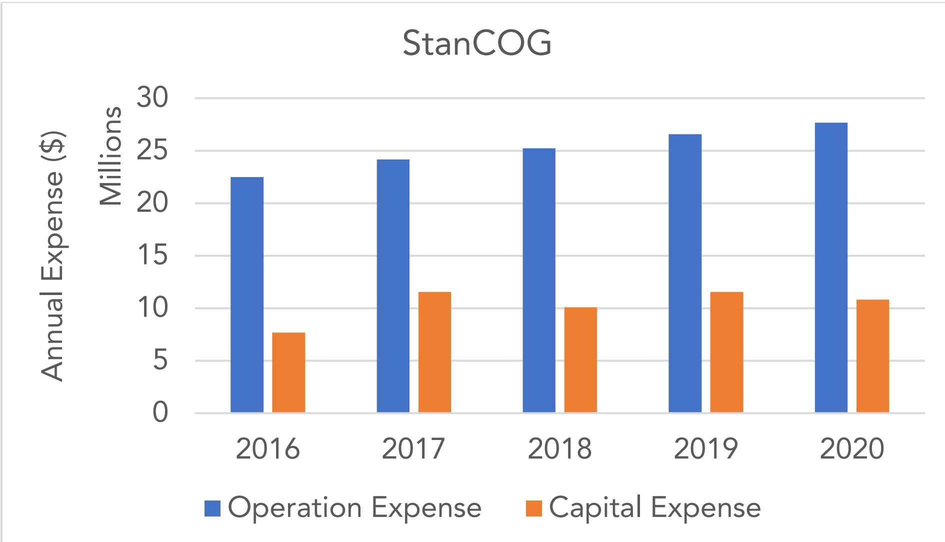


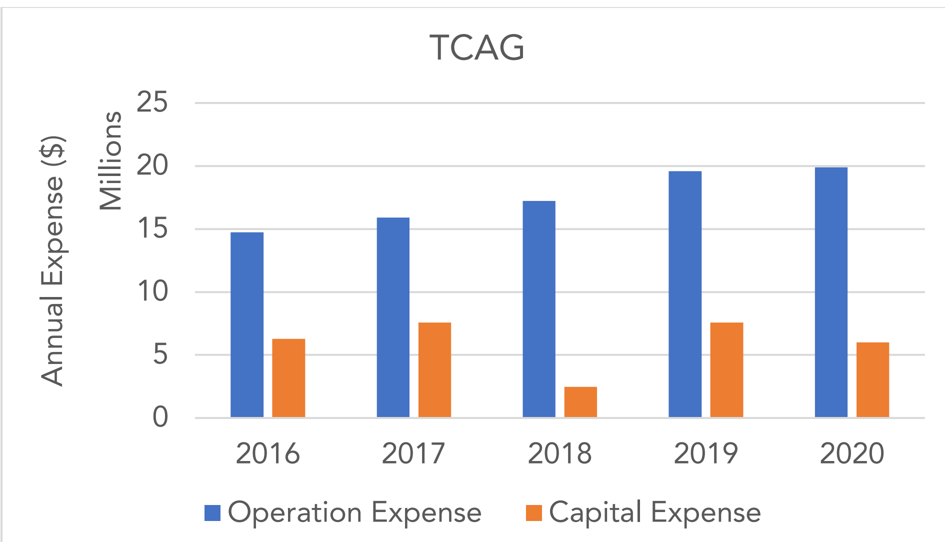

KCOG
Annual Expense ($)
Millions
40
35
30
25
20
15
10
5
0
2016
2017
2018
2019
2020
Operation Expense
Capital Expense


MCAG
Annual Expense ($)
Millions
20
15
10
5
0
2016
2017
2018
2019
2020
Operation Expense
Capital Expense

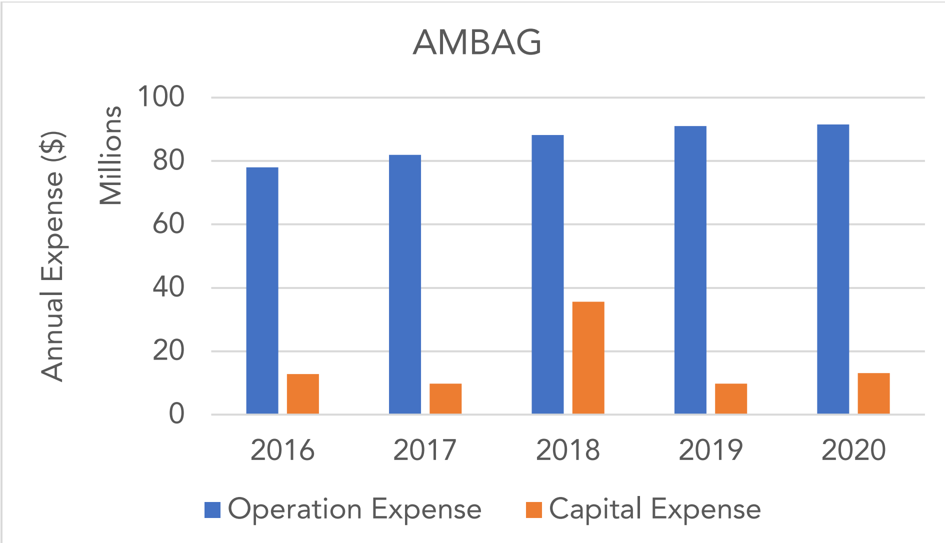

MCTC
Annual Expense ($)
Millions
4
3.5
3
2.5
2
1.5
1
0.5
0
2016
2017
2018
2019
2020
Operation Expense
Capital Expense

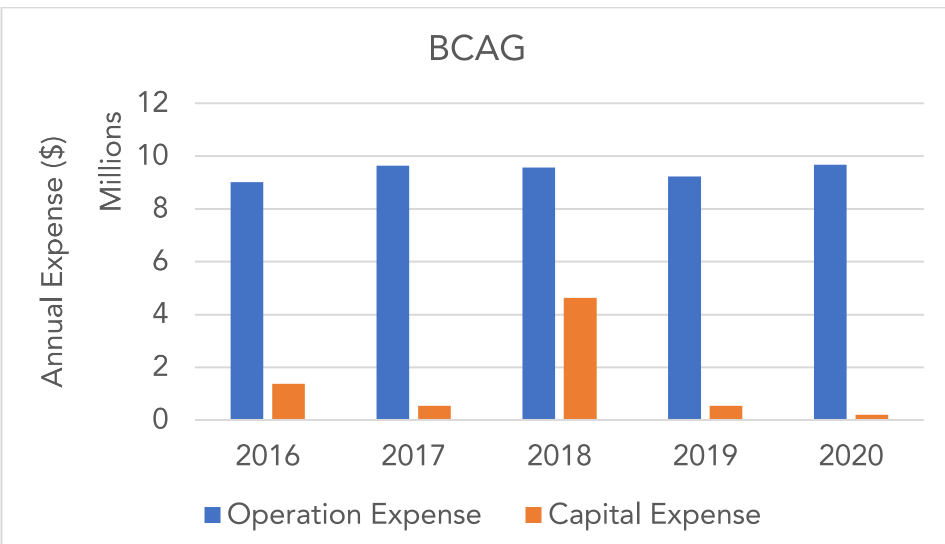

SJCOG
Annual Expense ($)
Millions
80
70
60
50
40
30
20
10
0
2016
2017
2018
2019
2020
Operation Expense
Capital Expense

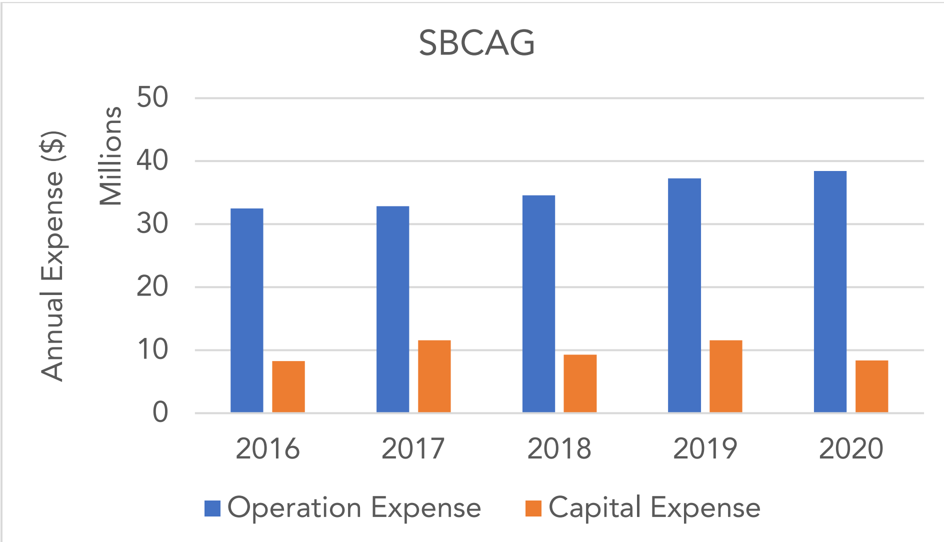

StanCOG
Annual Expense ($)
Millions
30
25
20
15
10
5
0
2016
2017
2018
2019
2020
Operation Expense
Capital Expense

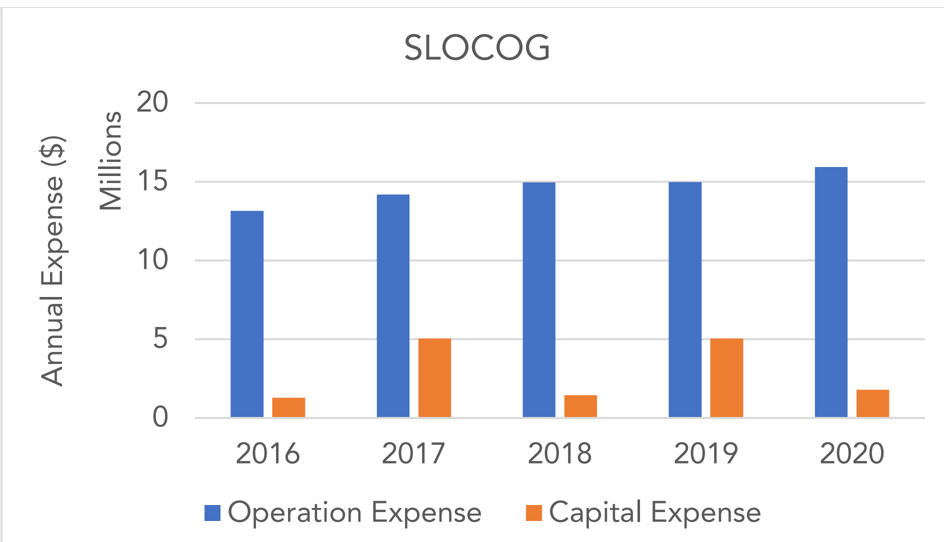

TCAG
Annual Expense ($)
Millions
25
20
15
10
5
0
2016
2017
2018
2019
2020
Operation Expense
Capital Expense

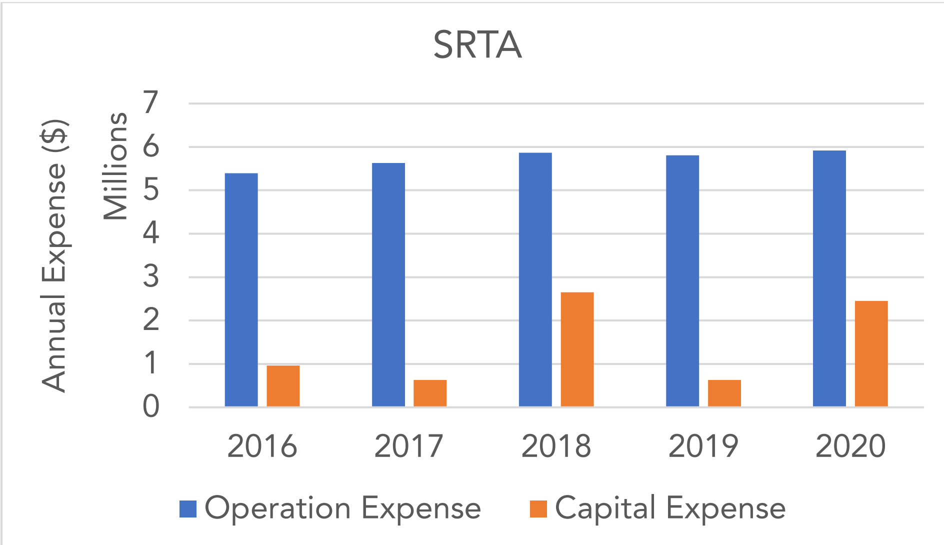
Coastal and Northern California MPO Regions






SBCAG
Annual Expense ($)
Millions
50
40
30
20
10
0
2016
2017
2018
2019
2020
Operation Expense
Capital Expense


SLOCOG
Annual Expense ($)
Millions
20
15
10
5
0
2016
2017
2018
2019
2020
Operation Expense
Capital Expense


SRTA
Annual Expense ($)
Millions
7
6
5
4
3
2
1
0
2016
2017
2018
2019
2020
Operation Expense
Capital Expense

Supplemental Information

Tables S1-S3 provide the average VMT regional share of each MPO from 2010 to 2019. The results are analyzed based on the average of the three datasets: HPMS, vehicle registration/Smog Check Program, and CEC fuel sales, as described above. Data show that the VMT shares do not change substantially over the past decades for most MPOs.

Table S1. Regional VMT shares in the Big 4 MPO regions

Year	MTC	SACOG	SANDAG	SCAG
2010	17%	6.1%	8.9%	49%
2011	18%	6.1%	8.9%	49%
2012	18%	6.2%	8.9%	48%
2013	18%	6.1%	8.8%	48%
2014	18%	6.0%	9.0%	48%
2015	18%	6.2%	9.0%	48%
2016	18%	6.2%	8.9%	48%
2017	18%	6.2%	8.9%	48%
2018	18%	6.2%	8.9%	48%
2019	18%	6.3%	8.9%	47%

Table S2. Regional VMT shares in the San Joaquin Valley MPOs

Year	FCOG	KCAG	KCOG	MCAG	MCTC	SJCOG	StanCOG	TCAG
2010	2.3%	0.4%	2.4%	0.8%	0.4%	1.9%	1.4%	1.1%
2011	2.3%	0.4%	2.4%	0.7%	0.4%	1.9%	1.3%	1.1%
2012	2.3%	0.4%	2.4%	0.7%	0.4%	1.9%	1.3%	1.1%
2013	2.3%	0.4%	2.4%	0.7%	0.4%	1.9%	1.3%	1.0%
2014	2.3%	0.4%	2.4%	0.7%	0.4%	1.9%	1.3%	1.1%
2015	2.3%	0.4%	2.4%	0.7%	0.4%	2.0%	1.4%	1.1%
2016	2.3%	0.4%	2.5%	0.7%	0.4%	1.9%	1.4%	1.1%
2017	2.4%	0.4%	2.5%	0.7%	0.4%	2.0%	1.4%	1.2%
2018	2.4%	0.4%	2.5%	0.7%	0.4%	2.0%	1.4%	1.2%
2019	2.4%	0.5%	2.5%	0.7%	0.5%	2.1%	1.4%	1.2%

Table S3. Regional VMT shares in the remaining Coastal and Northern California MPO Regions

Year	AMBAG	BCAG	SLOCOG	SRTA	TMPO	SBCAG
2010	1.9%	0.5%	0.9%	0.6%	0.1%	1.1%
2011	1.8%	0.5%	0.9%	0.6%	0.1%	1.1%
2012	1.8%	0.5%	0.9%	0.6%	0.1%	1.1%
2013	1.8%	0.5%	0.9%	0.6%	0.1%	1.1%
2014	1.8%	0.5%	0.9%	0.6%	0.1%	1.1%
2015	1.8%	0.5%	0.9%	0.6%	0.1%	1.1%
2016	1.8%	0.5%	0.9%	0.5%	0.1%	1.1%
2017	1.8%	0.5%	0.9%	0.6%	0.1%	1.0%
2018	1.8%	0.5%	0.9%	0.6%	0.1%	1.1%
2019	1.8%	0.5%	0.9%	0.6%	0.1%	1.1%