TECHNICAL EVALUATION OF THE GREENHOUSE GAS EMISSIONS REDUCTION QUANTIFICATION FOR THE ASSOCIATION OF BAY AREA GOVERNMENTS' AND METROPOLITAN TRANSPORTATION COMMISSION'S SB 375 2017 SUSTAINABLE COMMUNITIES STRATEGY

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CALIFORNIA
AIR RESOURCES BOARD

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BACKGROUND

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

On March 9, 2018, the Association of Bay Area Governments (ABAG) and the Metropolitan Transportation Commission (MTC) (from this point forward, referred to as "ABAG/MTC") jointly submitted *Plan Bay Area 2040*, their 2017 SCS, for CARB to review with estimates of 14.3 percent and 15.5 percent reduction in GHG per capita emissions by 2020 and 2035 compared to 2005, respectively. The region's applicable GHG per capita emissions targets are a 7 percent reduction for 2020, and a 15 percent reduction for 2035, compared to 2005. This report reflects CARB's technical evaluation of ABAG/MTC's 2017 SCS GHG quantification.

CARB DETERMINATION

ACCEPT

Based on a review of all available evidence, including model inputs, outputs, the SCS strategies, performance indicators, and implementation efforts so far, CARB accepts ABAG/MTC's determination that its 2017 SCS would, if implemented, meet the applicable targets of a 7 percent reduction for 2020 and a 15 percent reduction for 2035, respectively.

ABAG/MTC's 2017 SCS contains similar land use and transportation strategies as their first SCS, which CARB reviewed and accepted as meeting the targets in April 2014. The region is expecting significantly more growth in the 2010-2040 period than it did in its last plan. For the 2017 SCS, ABAG/MTC used new population and economic growth forecast models, improved inputs and assumptions for the regional growth forecast, and upgraded the land use model for forecasting growth distribution. ABAG/MTC also used updated versions of their travel demand model, CARB's emission factor model (EMFAC), and improved assumptions in calculating auto operating costs. ABAG/MTC adjusted the quantification of some off-model strategies based on findings from previously implemented strategies and review of new strategies. With the recalibration of models, ABAG/MTC updated base year data as well. These modeling improvements and updated assumptions, coupled with increases in anticipated growth in population and employment, and new climate initiatives contributed to changes in the quantification of GHG emissions reductions as compared to the 2013 SCS. CARB staff affirmed that the changes to the quantification methods were reasonable, and that ABAG/MTC's 2017 SCS, if implemented, would meet the applicable targets established by CARB.

SCOPE AND METHODOLOGY

CARB examined ABAG/MTC's modeling inputs and assumptions, model calibration and validation results, model responsiveness to variable changes, and performance indicators using the general method described in CARB's July 2011 document entitled *Description of Methodology for ARB Staff Review of Greenhouse Gas Reductions from Sustainable Communities Strategies Pursuant to SB 375*.[1]

In addition, as ABAG/MTC's 2017 SCS is an update to their adopted 2013 SCS, CARB also considered ABAG/MTC's implementation actions over the past four years. CARB looked for evidence that ABAG/MTC has put in place enabling project investments, programs, incentives, and/or guidance to help demonstrate the region's commitment to implementing its first SCS, and has established a foundation for continued implementation of policies and programs reflected in both the 2013 and 2017 plans.

CHANGES FROM THE REGION'S PREVIOUS SCS GHG QUANTIFICATION

CARB focused its review on identifying and evaluating changes ABAG/MTC made between the current 2017 SCS and the previous 2013 SCS[2] with the potential to affect SCS GHG emissions quantification. This included review for changes made to the land use and transportation strategies included within the SCS, updates to the model and off-model methods used to calculate passenger vehicle-related GHG emissions, and any changes in expected regional land use and transportation performance indicators. Table 1 summarizes the changes in plan assumptions for demographics, land use, and transportation. Table 2 and Table 3 summarize changes in ABAG/MTC's model and off-model GHG emissions calculations.

[1] https://www.arb.ca.gov/cc/sb375/scs_review_methodology.pdf

[2] CARB's acceptance and technical evaluation of ABAG/MTC's first SCS was completed in April 2014, and contains detailed information about the region and about the methods that ABAG/MTC used to quantify GHG emissions. That information is still relevant for this technical evaluation and can be accessed at https://www.arb.ca.gov/cc/sb375/mtc_scs_tech_eval_final0414.pdf.

LAND USE AND TRANSPORTATION STRATEGIES

As a limited and focused update to ABAG/MTC's previous SCS, the 2017 SCS maintains a similar set of land use and transportation strategies. This plan carries over a land use scenario that emphasizes "focused growth" by promoting more compact, mixed-use residential and commercial neighborhoods situated near transit through infill and redevelopment strategies, while preserving open space areas. The 2017 SCS transportation strategies resemble those in the 2013 SCS, with an emphasis on "fix it first" and enhancing and modernizing existing transit and roadway infrastructure. Expansion projects are intended to improve transit efficiency or capacity and add high-occupancy vehicle or toll lanes to roadways.

The 2017 SCS also incorporates updates to the region's forecasted population, employment, and housing growth, land use pattern, and transit network. Table 1 summarizes these changes, and CARB's assessment and findings based on consistency with best available information and practices.

Table 1. Summary of Demographic, Land Use, and Transportation Changes in ABAG/MTC's 2017 SCS Compared to the 2013 SCS

Action	CARB Assessment	Finding
Revised population, employment, and housing growth forecast	Reasonable	The 2017 SCS reflects a 15 to 21 percent increase in population, housing, and employment growth compared to the 2013 SCS. Projected population growth is consistent with current Department of Finance (DOF) projections. ABAG/MTC also included additional housing units for anticipated in-commuters within the plan. See Appendix A for additional detail.
Revised land use to reflect most recent data and updated land use modeling	Reasonable	The growth pattern in the 2017 SCS is updated with the latest local policy information and growth forecast. The 2017 SCS retains much of the same aggregate performance of the 2013 SCS by maintaining existing urban growth boundaries. See Appendix A and Appendix D for additional detail.
Updated transportation project investment list	Reasonable	The 2017 SCS includes approximately 20 percent more funding for transportation projects than the 2013 SCS and maintains a similar overall pattern of investments, with 90 percent of funding to maintain and enhance existing transit and roadway infrastructure, and around two-thirds of funds to public transit. See Appendix A for additional detail.
New Climate Initiative Program strategies and updated benefits calculations	Reasonable	The 2017 SCS Climate Initiative Program is estimated to achieve a higher total GHG emissions reduction compared to the Climate Initiative Program in the 2013 SCS. See Appendix A for additional detail.

MODEL AND OFF-MODEL CALCULATIONS

ABAG/MTC used similar modeling tools to evaluate its 2017 SCS as were used to evaluate its 2013 SCS, but with updated model inputs and assumptions. Modeling tools applied to estimate vehicle miles traveled (VMT) and GHG emissions from the 2017 SCS included the UrbanSim land use model, Travel Model One activity based travel demand model, and the EMFAC 2014 emissions model. ABAG/MTC also applied off-model quantification methods to estimate the emissions reduction benefits of strategies not reflected in the modeling tools. Table 2 summarizes some key changes to modeling inputs and assumptions along with CARB's assessment and findings based on consistency with best available information and modeling practice.

Table 2. Key Changes in Modeling Processes of ABAG/MTC's 2017 SCS Compared to the 2013 SCS

Modeling Component	CARB Assessment	Finding
Auto Operating Cost (AOC)	Reasonable	ABAG/MTC updated their AOC to be consistent with the methodology and assumptions used by other MPOs in the State. Further, ABAG/MTC incorporated pavement condition or state-of-good repair conditions as part of AOC estimates.
Land Use Allocation Model	Reasonable	ABAG/MTC made changes to its Bay Area UrbanSim model. Upgrades include adding household, business, and developer choice models; use of zoning information; incorporating the latest Priority Development Area (PDA) assessment; and updating base year data.
Travel Demand Model	Reasonable	ABAG/MTC used Travel Model One (v0.6), which was calibrated to year 2000 conditions and validated against year 2000, 2005, 2010, and 2015 conditions. This version of the model fixes bugs concerning the destination choice model and the elementary/middle school choice model. It also includes expanded auto mode choice, future high speed rail trips, and representation of

		state-of-good repair conditions on operating costs and transit delays.
EMFAC Model	Reasonable	ABAG/MTC used CARB's most recent EMFAC model (2014), and applied CARB's Methodology to Calculate CO2 Adjustments to EMFAC Output for SB 375 Target Demonstrations.
Sensitivity Analysis	Reasonable	ABAG/MTC conducted additional tests to demonstrate their travel demand model's sensitivity to variables associated with their SCS strategies, including household income and transit frequency. The estimates and impacts are consistent with existing studies. See Appendix A for more detail.

Table 3 summarizes the key changes to off-model strategies and assumptions along with CARB's assessment and findings based on consistency with best available information. See Appendix A for further details on each individual strategy.

Table 3. Key Changes in Off-Model Strategies of ABAG/MTC's 2017 SCS Compared to the 2013 SCS

Off-Model Component	CARB Assessment	Finding
Commuter Benefits Ordinance (CBO)	Reasonable	Estimated GHG emissions reduction increased from the 2013 SCS. Quantification assumptions updated based on 2015 survey data.
Car Sharing	Reasonable	Estimated GHG emissions reduction decreased from the 2013 SCS due to an updated, more conservative adoption rate for traditional and one-way car sharing due to competition from ridesharing services.
Vanpools and Employer Shuttles	Reasonable	Estimated GHG emissions reduction are the same as that in the 2013 SCS.

Regional Electric Vehicle Charger	Reasonable	Estimated GHG emissions reduction increased significantly from this strategy compared to 2013 SCS based on the assumed increase in share of electric miles traveled by plug-in hybrid electric vehicles (PHEVs). This is due to an overall increase in electric range from advances in vehicle technology, and an assumed increase in regional charging sites.
Vehicle Buyback & PEV Incentive	Reasonable	Estimated GHG emissions reductions are approximately the same as the 2013 SCS.
Clean Vehicles Feebate	Reasonable	Estimated GHG emissions reductions are approximately the same as the 2013 SCS.
Smart Driving	Reasonable	Estimated GHG emissions reduction decreased from this strategy compared to 2013 SCS due to delayed implementation.
Targeted Transportation Alternative	Reasonable	New strategy quantified in the 2017 SCS. This strategy will reduce per capita GHG emissions by 1.2 percent and 1.7 percent in 2020 and 2035, respectively.
Trip Caps	Reasonable	New strategy quantified in the 2017 SCS. This strategy will reduce per capita GHG emissions by 0.2 percent and 0.7 percent by 2020 and 2035, respectively.
Expanded Bike Share System	Reasonable	New strategy quantified in the 2017 SCS. This strategy will reduce per capita GHG emissions by 0.02 percent by 2020 and 2035.
Expanded Bicycle Infrastructure	Reasonable	New strategy quantified in the 2017 SCS. This strategy will reduce per capita GHG emissions by 0.03 percent and 0.05 percent by 2020 and 2035, respectively.

REGIONAL LAND USE AND TRANSPORTATION PERFORMANCE INDICATORS

CARB reviewed several land use and transportation performance indicators for ABAG/MTC's 2017 SCS, summarized in Table 4. CARB staff compared these indicators against the empirical literature relationships between each metric, and VMT and/or GHG emissions to understand whether changes were consistent with forecasted GHG emissions reduction trends. Data for this analysis came from ABAG/MTC's modeling data table in Appendix B. Supporting data and charts for performance indicators are provided in Appendix D.

Table 4. Performance Indicators

Performance Indicator	CARB Assessment	Finding
Land Use Indicators		
Residential Density	Consistent with reducing VMT and GHG	Average residential density is projected to increase by 23 percent between 2010 and 2040. See Figure 4 in Appendix D.
Infill Housing Development	Consistent with reducing VMT and GHG	Almost all new housing is projected to be infill development. This would increase the regional share of infill housing from 8 percent in 2020 to 22 percent by 2040. See Figure 5 in Appendix D.
Housing Types	Consistent with reducing VMT and GHG	The proportion of the region's homes that are multi-family is projected to increase from 37 percent in 2010 to 46 percent in 2040. See Figure 6 in Appendix D.
Housing and Employment within PDAs	Consistent with reducing VMT and GHG	The proportion of the region's homes that are found in PDAs is projected to increase from 23 percent in 2010 to 35 percent in 2040, and the proportion of the region's jobs in PDAs is projected to increase from 43 percent to 46 percent during this same time period. See Figure 7 in Appendix D.
Transportation Indicators		
Mode Share for All Trips	Consistent with reducing VMT and GHG	By 2040, non-auto mode share (transit and active transportation) would increase by 2.4 percent and the share of auto trips would fall by 2.4 percent compared to 2010. See Figure 8 in Appendix D.

Transit Ridership	Consistent with reducing VMT and GHG	Per capita transit ridership is projected to increase by approximately 43 percent from 2010 to 2040. See Figure 9 in Appendix D.
Passenger VMT	Consistent with reducing VMT and GHG	Per capita VMT is forecasted to decline by 12 percent from 2005 to 2040 under this plan. See Figure 10 in Appendix D.

IMPLEMENTATION OF ABAG/MTC'S FIRST SCS

ABAG/MTC's actions over the past four years demonstrate the region's commitment to implementing their first SCS and establish a foundation for continued implementation of common elements in both the 2013 and 2017 SCSs. However, there will continue to be challenges around housing supply and affordability.

ACCOMMODATING SIGNIFICANT GROWTH IN EXISTING COMMUNITIES

Infill Development

ABAG/MTC's 2017 SCS outlines an ambitious plan to accommodate the region's employment and residential growth within the existing urban footprint, defined as areas with existing urban development and areas within Urban Growth Boundaries. Between 2010 to 2020, the 2017 SCS land use pattern includes only 14,500 acres of land to be urbanized.[3] Farmland Mapping and Monitoring data from the California Department of Conservation suggests that the region is successfully directing growth in ways that protect the region's natural resource and farmland areas. Table 5 compares the plan's forecast rate of urbanization to the observed rate from years 2010-2014.[4] It reveals that the region is urbanizing land more slowly than projected for this time period.

[3] See Appendix B.
[4] This comparison uses the 2017 SCS base year of 2010, up through the most recent data available, 2014. Because land development is highly cyclical, using a longer time period may provide different results.

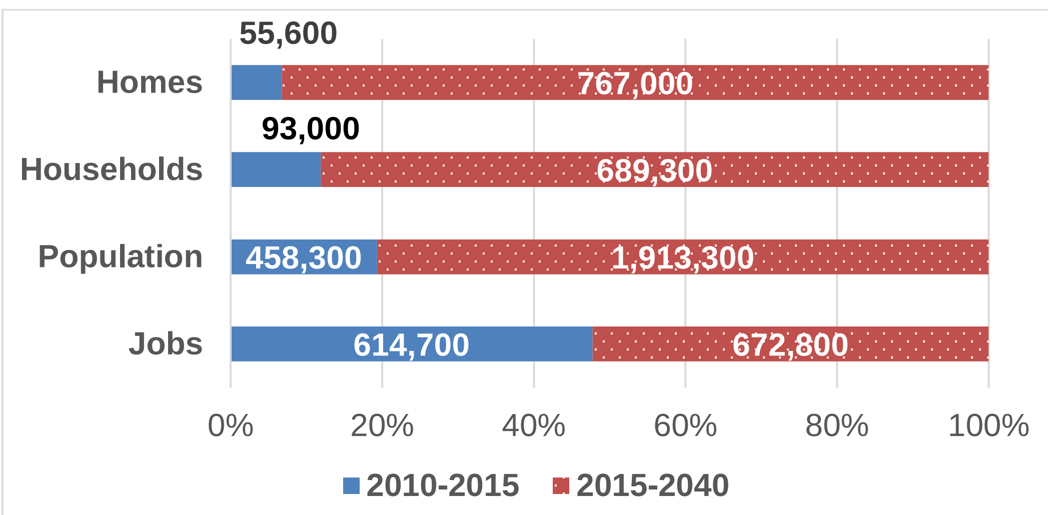
Table 5: Annual Rate of Land Urbanized SCS Forecast vs. Observed (2010-2014)[5]

	2017 SCS forecast (2010-2020)	Observed results (2010-2014)
Annual rate of land urbanized	1,450 acres / year	1,099 acres / year

Housing Supply

The forecasted land use pattern in the 2017 SCS aims to provide sufficient homes to house the region's workers. In recent years, the Bay Area has increased its employment by far more than it has increased its housing supply. As Figure 1 illustrates, in just the five years from 2010 to 2015, the region gained nearly half of the jobs estimated for the 30 year (2010-2040) time period of the 2017 SCS, while only building 7 percent of the homes in that plan.

Figure 1. Growth in the First Five Years of the 2017 SCS[6]



The inability of housing construction to keep pace with job construction has left the Bay Area grappling with a regional housing shortage and affordability crisis.

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[5] RTP/SCS forecast data comes from Appendix B Data Table. Observed results from California Department of Conservation Farmland Mapping and Monitoring Program. Accessed in April 2018 at: http://www.conservation.ca.gov/dlrp/fmmp

[6] MTC and ABAG, 2017a. *Plan Bay Area 2040: Final Regional Forecast of Jobs, Population and Housing.* Accessed in March 2018 at http://2040.planbayarea.org/sites/default/files/2017-07/Regional%20Forecast%20Supplemental%20%20Report_Final_7-2017_0.pdf.

ABAG/MTC readily acknowledges its challenge to keep up with its own expectations around what portion of homes will be multi-family homes. From 2010 to 2020, ABAG/MTC expects 88 percent of approximately 230,000 new homes to be multi-family.[7] According to the California Department of Finance, from 2010 to 2016, approximately 72,000 homes were built, and only 64 percent were multi-family.[8]

The 2017 SCS identifies these concerns, and ABAG/MTC has begun to implement regular assessments and programs to address them.

- In 2015, ABAG/MTC commissioned an assessment of their locally identified Priority Development Areas (PDAs) for infill to assess their readiness for the housing growth proposed for them in the 2013 SCS. The "PDA Assessment Update" report examined a subset of PDAs, representing more than half of all homes in the 2013 SCS.[9] ABAG/MTC found that these PDAs could physically accommodate 114 percent of homes allocated to them. However, given planning, political, market, infrastructure, and other constraints, they are ready to only accommodate 70 percent of needed homes now, or 87 percent under an "amended" scenario assuming policy changes that might realistically occur. These findings raise concerns particularly because the 2017 SCS increases the number of homes planned within PDAs compared to the 2013 SCS, even though the assumed total acreage of PDAs was very similar in both SCSs.

- ABAG/MTC commissioned a 2015 study that assessed how the region's growth in high-wage jobs related to changes in low-wage jobs and housing affordability. It found that high-wage job growth was relatively dispersed around the region, while low-wage jobs are more concentrated in the region's three largest cities, San Francisco, Oakland, and San Jose. During the time period of the study, total housing grew in proportion to total jobs, but there were significant imbalances between wage levels and affordability. The study also found that, in general, new workers are traveling further than existing workers, and new lower-income workers are traveling approximately four times farther than new higher-income workers in San Francisco and San Jose.[10]

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[7] See Appendix B.
[8] California Department of Finance, 2018 (May). *E-5 Population and Housing Estimates for Cities, Counties and the State — January 1, 2011-2018*. Accessed in May 2018 at http://www.dof.ca.gov/Forecasting/Demographics/Estimates/E-5/.
[9] Economic & Planning Systems, Inc. with Community Design + Architecture. November 23, 2015. "PDA Assessment Update." Accessed in February 2018 at https://mtc.ca.gov/sites/default/files/PDA%20Assessment%20Update%20Final.pdf.
[10] Benner, Chris and Alex Karner. 2015 (May). *Job Growth, Housing Affordability, and Commuting in the Bay Area*.

ABAG/MTC recognizes the significant challenges that the region faces around housing production, affordability, and accommodating growth in PDAs, and has begun several efforts to address these issues.

- ABAG/MTC recently committed more funding to its One Bay Area Grant (OBAG) program, for a total of $30 million to date. This includes a recent commitment of an additional $20 million, which includes $7.3 million in funding to local jurisdictions to plan for local transportation improvements and community enhancements that achieve higher density land uses in and around transit stations and PDAs throughout the region. Those funds are prioritized for jurisdictions taking on over 70 percent of the region's housing growth in the 2017 SCS, with priority scoring given to identified Communities of Concern and areas at high risk of displacement.[11]

- ABAG/MTC has also tied OBAG transportation funding to jurisdiction performance in housing construction, and has made funding available only to jurisdictions with an approved housing element.[12] Over the five years from 2017-18 through 2021-22, OBAG funding will provide an estimated $386 million toward road maintenance, streetscape improvements, bicycle and pedestrian infrastructure and other local transportation needs via the County Program.[13]

- ABAG/MTC is also investing funding to make sure that housing growth that does occur provides homes for every income level. In 2011, ABAG/MTC seeded the Transit Oriented Affordable Housing (TOAH) revolving loan fund with a $10 million initial investment, which was matched by $40 million in private capital. By 2015, $30 million in loan financing had supported nearly 900 affordable homes near high-quality transit. In 2015, ABAG/MTC invested another $10 million, which is expected to increase the fund's lending to $90 million and expand its loan product offerings.[14] In February 2018, ABAG/MTC expanded its efforts by committing $10 million to the Bay Area Preservation Pilot loan fund, matched by other groups for a total fund of $49 million. This revolving loan fund allows affordable housing nonprofit groups to purchase existing multi-family

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[11] MTC and ABAG, 2018c, *MTC Resolution No. 4202, Revised and Presentation*. Accessed in April 2018 at http://mtc.legistar.com/gateway.aspx?M=F&ID=1ee4b58d-7df1-4de0-9dd7-af35a74b1dad.pdf.
[12] MTC and ABAG, 2017b, *Plan Bay Area Action Plan*. Accessed in April 2018 at http://2040.planbayarea.org/action-plan.
[13] MTC and ABAG, 2018a. *OBAG 2*. Accessed in April 2018 at https://mtc.ca.gov/our-work/fund-invest/federal-funding/obag-2.
[14] Low Income Investment Fund. 2015 (June). *Metropolitan Transportation Commission Approves $10 Million New Investment in Bay Area Transit-Oriented Affordable Housing Fund*. Accessed in April 2018 at http://www.liifund.org/news/post/metropolitan-transportation-commission-approves-10-million-new-investment-in-bay-area-transit-oriented-affordable-housing-fund/.

buildings near high-frequency transit and allow them to stay affordable for low- and moderate-income renters.[15]

The 2017 SCS also includes an "Action Plan" chapter with a clear set of steps for addressing the region's housing challenges moving forward.

INVESTING IN TRANSPORTATION SOLUTIONS

Project Delivery

Since the last SCS, the Bay Area has implemented, or made substantial progress on a number of significant regional and local transportation projects that help the region be more sustainable and multi-modal.

- Caltrain Extension to Transbay Transit Center (TTC): Phase 1 of the project is now in the final year of construction, and the TTC building was mostly complete as of December 2017, with full completion expected late 2018.

- Bay Area Rapid Transit (BART) Extensions: Notable newly completed service extensions in the BART system include the 10-mile East Contra Costa BART extension, which includes new service between the Pittsburg Bay Point Station and Antioch with two new stations, and the Warm Springs BART extension, which adds an important new connection on the way to Silicon Valley.

- BART Car Replacement: The first of 775 new BART train cars went into service on January 19th with features to improve riders' experience. The train cars are also intended to reduce crowding on the BART system.

- San Francisco Muni Expansions: The Central Subway Project will extend the Muni Metro T Third Line through SoMa, Union Square, and Chinatown in San Francisco. When complete, trains will travel mostly underground, bypassing traffic, and four new stations will be built along the 1.7 mile segment. Construction began in 2011 with completion expected in 2019. Muni's fleet of light rail vehicles will be upgraded and expanded over 10 years. The first five new trains arrived in January 2017.

- Sonoma-Marin Area Rail Transit (SMART): The project will ultimately provide 70 miles of passenger rail service in Sonoma and Marin counties. The initial 43-mile segment opened in 2017 and includes 10 stations (from Sonoma County Airport to Downtown San Rafael).

- Alum Rock-Santa Clara Bus Rapid Transit (BRT): BRT buses started running in

[15] MTC and ABAG. 2018d (February). *News Release*. Accessed in May 2018 at https://mtc.ca.gov/whats-happening/news/mtc-pledges-10-million-new-fund-preserve-affordable-housing

May 2017 on seven miles of limited-stop rapid transit service connecting to downtown San Jose.

- Bay Bridge Bicycle Pedestrian Path: The east span extends over four miles, and opened in 2016, allowing bicycles and pedestrians to access Yerba Buena Island from Emeryville.

IMPLEMENTING CLIMATE INITIATIVES

Both the 2013 and 2017 SCSs include a Climate Initiatives Program to reach their GHG targets. The 2017 SCS builds upon work done to date to pilot-test several strategies and identify the most successful investments. The 2017 SCS retains seven of the original eight programs from the 2013 SCS and adds four additional programs, with a total planned program investment of $526 million[16] in 2035.

In November 2015, ABAG/MTC adopted Resolution No. 4202 (OBAG 2), which allocates $22 million to the Climate Initiatives Program over the next five years. These funds will be for the implementation of electric vehicle strategies and infrastructure, car share expansion, targeted transportation alternatives, and trip caps.

Table 6 summarizes implementation and outcomes, where available, of ABAG/MTC's Climate Initiatives to date. Additional details and Climate Initiatives program descriptions can be found at https://mtc.ca.gov/our-work/plans-projects/climate-change-programs/climate-initiatives-program.

Table 6. Implementation of ABAG/MTC's Climate Initiatives Program

Program	Implementation	Included in which SCS
Commuter Benefits Ordinance	As of December 28, 2015, 1.3 million employees in the Bay Area received benefits via the program. ABAG/MTC estimates that 44,400 employees switched from driving alone to an alternative commute mode (e.g., transit, vanpool, carpool, or bicycle) as a result of the Program.[17]	2013, 2017

[16] MTC and ABAG. 2017d (July). *Final Environmental Impact Report*. Accessed in April 2018 at http://2040.planbayarea.org/cdn/farfuture/j4rYVyyr8XsHyZRCy6OJV2NwxTI56KqFLqcb6qX8-pI/1499723588/sites/default/files/2017-07/PBA2040-FEIR-07.10.17_0.pdf

[17] Bay Area Air Quality Management District and Metropolitan Transportation Commission. 2016 (February). *Bay Area Commuter Benefits Program Report to the California Legislature*. Accessed in May 2018 at http://www.baaqmd.gov/~/media/files/planning-and-research/commuter-benefits-program/reports/commuter-benefits-report.pdf.

Car Sharing	In 2014, $2 million was awarded via six grants to initiate or expand car-sharing programs in Santa Rosa, Contra Costa County, City of San Mateo, City of Oakland, City of Hayward, and City of San Rafael.[18] With the exception of San Mateo, all cities are still in the implementation phase of their car share programs.	2013, 2017
Regional Electric Vehicle Charger Network	As of 2015, nearly 90 EVs and 90 Level 2 chargers were deployed to local government agencies. ABAG/MTC estimates a GHG emissions reduction of 172 tons/year.[19]	2013, 2017
Vanpools & Employer Shuttles	ABAG/MTC has coordinated a vanpool program since 1981. As of 2015, there is an operational vanpool fleet in the Bay Area of over 515 vans. For employer shuttles, estimates indicate that technology company shuttles operating between San Francisco and Silicon Valley, transport close to 17,500 people per workday.[20]	2013, 2017
Trip Caps	ABAG/MTC reports that several South Bay cities, including Mountain View, Sunnyvale, Cupertino and Menlo Park, have enacted trip caps.[21]	2017
Bike Share	The Bay Area bike share program started in August 2013, with approximately 700 bikes across 70 stations.[22] About half of the stations are located in San Francisco, and the other half are divided among the cities of Palo Alto, Redwood City, Mountain View, and San Jose.	2017

[18] MTC and ABAG. 2018b (February). *Bay Area Car Sharing Implementation Strategy.*
[19] MTC and ABAG. 2017d (July). *Final Environmental Impact Report*. Accessed in April 2018 at http://2040.planbayarea.org/cdn/farfuture/j4rYVyyr8XsHyZRCy6OJV2NwxTI56KqFLqcb6qX8-pI/1499723588/sites/default/files/2017-07/PBA2040-FEIR-07.10.17_0.pdf
[20] MTC and ABAG. 2017c. *Plan Bay Area 2040: Final Travel Modeling Report*. Accessed in March 2018 at. http://2040.planbayarea.org/sites/default/files/2017-07/Travel_Modeling_PBA2040_Supplemental%20Report_7-2017_0.pdf
[21] MTC/ABAG. 2017c. *Plan Bay Area 2040: Final Travel Modeling Report*. Accessed in March 2018 at. http://2040.planbayarea.org/sites/default/files/2017-07/Travel_Modeling_PBA2040_Supplemental%20Report_7-2017_0.pdf
[22] MTC/ABAG. 2015. *Climate Initiatives Program: Evaluation Summary Report*. Accessed in April 2018 at https://mtc.ca.gov/sites/default/files/CIP%20Evaluation%20Summary%20Report_7-13-15_FINAL.pdf

Bicycle Infrastructure	As of 2005, the Bay Area had over 6,500 miles of bike lanes and trails, and this number is projected to increase to over 11,300 miles by 2035. Regional bike commute mode share has nearly doubled since 2005. Since the last SCS, over 10 percent more people are commuting to work by bike. [23]	2017
Smart Driving	This program is anticipated to begin in 2020.	2013, 2017
Targeted Transportation Alternatives	ABAG/MTC has not yet implemented this program.	2017
Vehicle Buyback and PEV Incentive	This program is anticipated to begin in 2020.	2013, 2017
Clean Vehicles Feebate Program	This program is anticipated to begin after 2020 as it requires legislation to grant ABAG/MTC and the Bay Area Air Quality Management District implementation authority.	2013, 2017

OTHER FINDINGS AND RECOMMENDATIONS

Off-Model Strategy Documentation and Monitoring

CARB staff is aware that some of the climate initiatives in the 2017 SCS (i.e., CBO, targeted transportation alternative, trip caps) could result in participation from the same individuals, geographies, and type of vehicle trips to achieve VMT and/or GHG emissions reductions. For example, an individual can receive benefits from his/her employer through the CBO, and live in a residential area that is also served by the targeted transportation alternative program. ABAG/MTC intends to target different travel characteristics of residents and/or employees in the region through these strategies to reduce GHG emissions, however, there is potential for some amount of overlap and associated double-counting to occur. CARB staff recommends ABAG/MTC clearly distinguish the population, geographies, and type of trips affected by each strategy to more conservatively estimate participation rates and the associated off-model GHG emissions reduction.

[23] U.S. Census Bureau, 2016. American Community Survey 1-Year Estimate S0801. Accessed in May 2018 at https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk.

In addition, as ABAG/MTC implements the Climate Initiatives Program, CARB staff recommend ABAG/MTC conduct surveys or establish monitoring programs to track implementation progress and effectiveness of the strategies in affecting regional travel behavior. For example, for the vehicle buyback and feebate programs, ABAG/MTC can consider tracking the vehicle retirements and purchase records to document that vehicles are removed from the fleet as intended. For the car sharing strategy, ABAG/MTC can monitor effectiveness by collecting annual car sharing member participation and use data, such as trip length and number of trips. For more details on CARB staff's recommendations for these off-model strategies, please see Appendix A.

REFERENCES

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APPENDIX A: FURTHER DISCUSSION OF 2017 SCS CHANGES

POPULATION, EMPLOYMENT, AND HOUSING GROWTH FORECAST

Preparing the regional forecast for ABAG/MTC's 2017 SCS involved a multiagency effort among ABAG, MTC, and local jurisdiction planning staff. ABAG developed regional totals for population, households, employment, output, and income, and the geographic distribution was established by ABAG, MTC, and input from local jurisdiction planners at several stages.

The forecast used for the 2017 SCS is higher than in the previous plan. The 2017 SCS plans for approximately 15 to 21 percent more growth from 2010-2040 than the 2013 SCS, as shown in Table 7.

Table 7. New Growth Forecast for 2010-2040 in ABAG/MTC's 2017 vs. 2013 SCS

	2013 SCS	2017 SCS	% difference
Population	2,044,805	2,471,700	+21%
Households	700,088	817,700	+17%
Dwelling units	660,002	789,800	+20%
Jobs	1,119,951	1,287,500	+15%

The growth forecast is higher largely because the region experienced significant growth between 2010 and 2015. For instance, it added 660,000 new jobs, over half of the job growth previously forecast for the 2010-2040 time period, as shown in Figure 1, earlier in this report. The forecast also newly includes almost 40,000 homes for in-commuters that were not included in past plans, to comply with the legal settlement between ABAG/MTC and the Bay Area Building Industry Association, which required the region to assume no net increase in in-commuting over the baseline year.[24]

[24] Building Industry Association Bay Area v. Association of Bay Area Governments Settlement, 2014. *Alameda County Superior Court Case No. RG13692098*. Accessed March 2018 at https://www.planbayarea.org/sites/default/files/pdf/files/files10181.pdf in April 2018.

This population forecast is consistent with the forecast by the California Department of Finance (DOF).[25] For 2040, the year when the estimates differ the most, ABAG/MTC estimates that population would be 2.2 percent higher than DOF. **Table** 8 below compares the estimates of population in the 2017 SCS against the most current DOF projections.

Table 8. Comparison of Population Projections in 2017 SCS to DOF Population Projections

	ABAG/MTC	DOF	Difference
2010	7,155,800	7,172,289	-0.2%
2020	7,899,300	7,969,865	-0.9%
2035	9,119,000	9,070,034	0.5%
2040	9,627,500	9,393,614	2.4%

CARB staff also compared the employment estimates to those of the Economic Development Department (EDD)[26]. While an exact comparison could not occur due to differing geographies and time horizons, this review did not raise any concerns about the Bay Area's employment estimates.

LAND USE SCENARIO

The 2017 SCS employs many of the same planning assumptions, trends, and land use strategies found in the 2013 SCS. As in 2013, all of the region's growth would occur within urban growth boundaries and on under 5 percent of its land. The 2017 SCS would include a 15 percent increase in households and 2 percent increase in jobs in Priority Development Areas (PDAs) compared to the 2013 SCS. The 2017 SCS also includes a greater emphasis on multi-family housing, which is projected to be 78 percent of new housing, compared to 70 percent in the 2013 SCS.

[25] California Department of Finance. Demographic Research Unit, 2018 (March). *Total Estimated and Projected Population for California and Counties: July 1, 2010 to July 1, 2060 in 1-year Increments*. Estimate produced February 2018. Accessed March 2018 at http://www.dof.ca.gov/Forecasting/Demographics/Projections/documents/P1_County.xlsx.
[26] California Economic Development Department. 2017. *2014-2024 Occupational Employment Projections by County. Estimates for every county in the Bay Area.* Accessed in November 2017 at http://www.labormarketinfo.edd.ca.gov/data/employment-projections.html.

APPLICATION AND IMPROVEMENT OF MODELING TOOLS

CARB staff's full evaluation of the modeling assumptions, structure, and modeling tools for the 2013 SCS is still relevant in the current evaluation of the modeling tools used for the 2017 SCS .[27] Table 2 in the main text of this report identifies the key updates and changes to these modeling tools. The following sections include more detail about the updates to the travel demand model and off-model strategies.

Land Use Modeling

While the overall clustering of where growth would occur remains similar to the 2013 SCS, some significant changes do occur at the jurisdiction level. The 2017 land use scenario forecasts more growth in some areas and less growth in others, compared to the 2013 SCS. This change likely results primarily from updates ABAG/MTC made to its *Bay Area UrbanSim*, or land use development simulation model.

The land use modeling in the 2017 SCS is significantly more sophisticated than what was used in the 2013 SCS. For 2013, growth allocations followed historic trends and local general plans. For this SCS, ABAG/MTC incorporated *UrbanSim* sub-models that reflect decision-making by households, businesses, and developers, along with local zoning and a recent assessment of PDAs. ABAG/MTC staff reviewed the model in consultation with local planners, comparing its outputs to historical growth patterns, testing a number of possible regional strategies, and adjusting internal assumptions and the local land use policy database to better match expected patterns.

Off-Model Strategies/Climate Initiatives Program

For the SCS strategies that were not well captured by the travel model, ABAG/MTC continued to quantify GHG emissions reduction benefits based on survey data, emission rates from CARB's EMFAC model, and local understanding of characteristics of the region. The following is a summary of CARB's assessment and findings from each off-model strategy included in the 2017 SCS. ABAG/MTC accounted for 11 off-model strategies, 4 of which were newly quantified in the 2017 SCS. For strategies that continued from the 2013 SCS, CARB staff provide a comparison of the potential GHG emissions reduction benefits between the 2013 and 2017 SCS. For new strategies, a detailed description of the strategy is provided, along with CARB staff's assessment of ABAG/MTC's quantification.

[27] CARB. 2014 (April). *Technical Evaluation of the Greenhouse Gas Emissions Reduction Quantification for the Association of Bay Area Governments' and Metropolitan Transportation Commission's SB 375 Sustainable Communities Strateg*y. Available at https://www.arb.ca.gov/cc/sb375/mtc_scs_tech_eval_final0414.pdf.

Commuter Benefit Ordinance

Compared to the estimates in ABAG/MTC's 2013 SCS, its 2017 SCS estimated higher GHG emissions reduction in 2020 and 2035 for the Commuter Benefit Ordinance (CBO) strategy in Table 9.

Table 9. GHG Emissions Reduction from Commuter Benefits Ordinance

Analysis Year	2013 SCS	2017 SCS
2020	-0.1%	-0.4%
2035	-0.3%	-0.4%

The methodology ABAG/MTC applied to quantify the GHG emissions reduction from the CBO strategy is same as its 2013 SCS, however, the assumptions were based on an evaluation of the CBO conducted in 2015. This evaluation included a random sample survey of over 1,400 Bay Area employees.

In its next SCS, CARB staff recommends that ABAG/MTC closely monitor the potential overlap or double-counting with other similar off-model strategies that target reducing GHG emissions from commute trips (e.g., targeted transportation alternatives and trip caps). CARB staff recommend ABAG/MTC monitor the implementation areas and affected population, and account for the effectiveness of this strategy.

Car Sharing

Compared to the estimates in ABAG/MTC's 2013 SCS, its 2017 SCS estimated slightly lower GHG emissions reductions in 2020 and 2035 for the car sharing strategy in Table 10.

Table 10. GHG Emissions Reduction from Car Sharing

Analysis Year	2013 SCS	2017 SCS
2020	-2.6%	-2.4%
2035	-2.6%	-2.3%

Compared to the 2013 SCS, the assumed adoption rates of traditional car sharing decreased slightly due to ABAG/MTC's understanding that the introduction of ridesharing services will be used by potential car sharing members. Unique to the 2017 SCS is that ABAG/MTC accounted for the GHG emissions reduction benefits from non-traditional car sharing strategy (i.e., one-way car sharing) separately. ABAG/MTC assumed that by 2035, 20 percent of Bay Area car sharing members will be participating in a one-way car sharing program rather than a traditional program, and by 2040 this will increase to 25 percent. ABAG/MTC's assumption for traditional car sharing program also include the peer-to-peer (P2P) car sharing service. However, given the limited evidence on the GHG emissions reduction benefits from P2P car sharing, CARB staff recommends that ABAG/MTC consider conducting a regional study on the current deployment and operation of P2P car sharing, which may serve as the basis for benefits from this particular strategy in the next SCS.

Vanpools and Employer Shuttles

ABAG/MTC estimated a 0.3 and 0.4 percent per capita GHG emissions reduction from vanpool and employer shuttles strategy for 2020 and 2035, respectively as shown in Table 11. These estimates are the same as those in the 2013 SCS.

Table 11. GHG Emissions Reduction from Vanpools and Employer Shuttles

Analysis Year	2013 SCS	2017 SCS	
2020	-0.3%	Vanpools	-0.1%
		Employer Shuttles	-0.2%
2035	-0.4%	Vanpools	-0.2%
		Employer Shuttles	-0.2%

Regional Electric Vehicle Chargers

The regional electric vehicle chargers program is a continuation of a strategy from ABAG/MTC's 2013 SCS carried into the 2017 SCS. Compared to the 2013 SCS, the 2017 SCS claims substantially higher GHG emissions reduction benefits from the implementation of regional electric vehicle chargers in 2035 mainly due to the increased share of electric miles traveled by plug-in electric vehicles (PHEVs) as shown in Table 12.

Table 12. GHG Emissions Reduction from Regional Electric Vehicle Chargers

Analysis Year	2013 SCS	2017 SCS
2020	-0.1%	-0.4%
2035	-0.3%	-1.4%

Since the 2013 SCS, ABAG/MTC has refined the assumed number of available chargers in the region by including Pacific Gas and Electric's (PG&E) charger program and has targeted a change of PHEV electric miles from 40 percent to 80 percent, which is approximately double what was assumed for 2035 in the 2013 SCS. CARB staff agree that it is reasonable for ABAG/MTC to assume a greater impact of charging infrastructure on PHEVs than was assumed in the previous SCS.

Vehicle Buyback & Plug-in Electric Vehicle Incentive

Table 13 summarizes the GHG emissions reduction benefits from the vehicle buyback and plug-in electric vehicle (PEV) incentive strategy. The strategy is to offer owners of old cars money to scrap their cars and buy new PHEVs or battery electric vehicles (BEVs). In its 2013 SCS, ABAG/MTC estimated that 47,000 trades would be facilitated in 15 years (between 2020 and 2035) for an incentive of $1,000 for PHEVs and $2,000 for BEVs. In the 2017 SCS, ABAG/MTC increased the incentives to $1,500 per new PHEV and $2,500 per new BEV purchase, and estimated 94,000 trades over 15 years. Though the additional deployed EVs in the 2017 SCS were assumed to double due to increase in program funding, the differences in the assumptions of EV population and emission factors led to similar estimates of GHG emissions reduction benefits between the 2013 and 2017 SCSs.

Table 13. GHG Emissions Reduction from Vehicle Buybacks and PEV Incentive

Analysis Year	2013 SCS	2017 SCS
2020	0.0%	-0.0%
2035	-0.5%	-0.4%

Overall, CARB staff found ABAG/MTC's methodology and results reasonable, and similar to that in the 2013 SCS. To track implementation of this strategy, CARB staff recommends that ABAG/MTC keep and present the records of model year and make/model of the retired vehicles, and make/model of the replacement vehicle purchased with incentives to document that vehicles traded under the program are removed from the fleet as intended.

Clean Vehicles Feebate

ABAG/MTC's 2017 SCS continued to apply the same method to quantify the GHG emissions reduction benefits from the clean vehicle feebate strategy. The estimated benefit of this strategy was similar, and is summarized in Table 14.

Table 14. GHG Emissions Reduction from Clean Vehicles Feebate

Analysis Year	2013 SCS	2017 SCS
2020	0.0%	0.0%
2035	-0.7%	-0.8%

Overall CARB staff found ABAG/MTC's methodology reasonable, however, CARB staff recommends that ABAG/MTC keep and present the records of model year and make/model of the retired vehicles, and make/model of the replacement vehicle purchased with incentives to document that vehicles traded under the program are removed from the fleet as intended.

Smart Driving

In the 2013 SCS, ABAG/MTC estimated the smart driving strategy would achieve a 1.8 percent and 1.5 percent per capita GHG emission reduction by 2020 and 2035, respectively. However, ABAG/MTC has experienced a delay in implementing this program until 2020, and updated its estimate of the GHG emission reduction benefit accordingly to 0 percent and 0.8 percent by 2020 and 2035, respectively. The comparison between the 2013 and 2017 SCS estimates are summarized in Table 15.

Table 15. GHG Emissions Reduction from Smart Driving

Analysis Year	2013 SCS	2017 SCS
2020	-1.8%	0.0%
2035	-1.5%	-0.8%

In 2015, ABAG/MTC also expanded its smart driving investments into a region-wide program called Drive Smart Bay Area. One major component of this strategy is to incentivize fuel economy meters throughout 2035. While retrofitting older cars may increase the average fuel economy of the existing vehicle population, the majority of new vehicles, that will dominate the fleet over time, will already be equipped with real time diagnostic systems. If ABAG/MTC continues to implement this strategy in its next SCS, CARB staff suggest ABAG/MTC monitor the effectiveness of this strategy over time to improve the quantification of GHG emissions benefits.

Targeted Transportation Alternatives

This is a new off-model strategy in ABAG/MTC's 2017 SCS, which uses a personalized travel outreach and assistance approach to encourage residents and employees to reduce SOV trips by promoting the variety of travel options available in targeted areas of the region. ABAG/MTC estimates this strategy will reduce per capita GHG emissions by 1.2 percent and 1.7 percent in 2020 and 2035, respectively.

Given this is a new strategy in the region, ABAG/MTC's estimates of GHG emissions reduction benefit from targeted transportation alternatives rely on survey data and penetration rates from two community-based travel marketing programs from Portland, Oregon. The methodology ABAG/MTC followed was reasonable, however, CARB staff recommend that for its next SCS, ABAG/MTC closely monitor the potential overlap or double-counting with other similar off-model strategies that target reducing GHG emissions from commute trips (e.g., CBO and trip caps). CARB staff recommend ABAG/MTC monitor the implementation areas and affected population, and account for the effectiveness of this strategy.

Trip Caps

This is a new off-model strategy in ABAG/MTC's 2017 SCS, which sets limits on the number of vehicle trips to and from new office and commercial development. Participating property owners need to conduct regular traffic counts to monitor compliance with trip caps and report results to transportation or planning agencies, which levy fines or other penalties on employers that exceed their caps. Current trip cap participants in the ABAG/MTC region include Mountain View, Sunnyvale, Cupertino, and Menlo Park. ABAG/MTC estimates trip caps will reduce per capita GHG emissions by approximately 0.2 percent and 0.8 percent by 2020 and 2035, respectively.

CARB staff reviewed the assumptions and methodology ABAG/MTC applied to estimate the GHG emissions reduction from trip caps, and found it reasonable. However, ABAG/MTC's assumption that trip caps would be most likely applied to new office or commercial development may overestimate the GHG emissions reduction benefits of the strategy because all TAZs with more jobs than residents are assumed to represent employment centers. In addition, as stated previously, CARB staff recommends that ABAG/MTC closely monitor the potential overlap or double-counting with other similar off-model strategies that target reducing GHG emissions from commute trips (e.g., CBO and targeted transportation alternatives). CARB staff recommend ABAG/MTC monitor the implementation areas and affected population, and account for the effectiveness of this strategy by conducting traffic counts within affected geographies in the region.

Expanded Bike Share System

While the bike share strategy was included in the 2013 SCS, it was not quantified at that time. ABAG/MTC has quantified bike sharing as an off-model strategy in the 2017 SCS. Bike share systems provide bicycles that members of the public can borrow and use for limited durations (typically under a day) in exchange for a fee. ABAG/MTC estimates a nominal 0.03 and 0.02 percent GHG emissions reduction benefit for 2020 and 2035, respectively. Bike share reduces GHG emissions by enabling users to take short-distance trips by bicycle instead of by car, and in some cases bike share can eliminate longer trips by enabling users to connect to transit. ABAG/MTC applied an equation developed by the Institute for Transportation and Development Policy to estimate the daily trips by bike share bicycles. ABAG/MTC then converted the number of bike share bicycle trips to VMT reductions (and then emissions reductions) based on

ABAG/MTC's evaluation of their pilot Bay Area Bike Share program results. CARB staff found the assumptions and methodology ABAG/MTC used to estimate GHG emissions reduction from the bike share strategy reasonable.

Expanded Bicycle Infrastructure

While expanding bicycle infrastructure was included in the 2013 SCS, it was not quantified at that time. ABAG/MTC has quantified expanded bicycle infrastructure as an off-model strategy in the 2017 SCS. ABAG/MTC estimates this strategy will reduce per capita GHG emissions by 0.03 and 0.06 percent by 2020 and 2035, respectively.

In order to estimate GHG emissions reduction due to expanded bicycle infrastructure, ABAG/MTC collected data on current and planned bicycle infrastructure, which included an inventory of bicycle lanes and trails in the region. The impact on bicycle mode share was then estimated based on research conducted by Dill and Carr[28], which estimates the absolute increase in bicycle mode share based on the number of bicycle lane-miles per square mile of land. Dill and Carr observed that if bike lane density increases by one lane-mile per square mile, bicycle mode share goes up by an absolute one percent, e.g., if the baseline mode share is 2 percent, it will increase to 3 percent. This increase in bicycle mode share was then converted to reductions in vehicle trips, VMT, and carbon dioxide (CO_2) emissions. CARB staff found the assumptions and methodology ABAG/MTC applied to estimate GHG emissions reduction from the expanded bicycle infrastructure strategy reasonable.

[28] Dill, J., and T. Carr. 2003 *Bicycle Commuting and Facilities in Major U.S. Cities: If Your Build Them, Commuters Will Use Them – Another Look*, Transportation Research Board 1828, National Academy of Sciences, Washington, D.C.

Overall GHG Emissions Reduction from Climate Initiatives/Off-Model Strategies

Table 16 summarizes the allocated funding for each off-model strategy that is included in the 2017 SCS, as well as the corresponding GHG emissions reductions in 2020 and 2035.

Table 16. Summary of GHG Emissions Reduction from Off-Model Strategies

Off-Model Strategy	Investment ($ millions)	% CO_2 Emission Reduction from 2005*	
		2020	2035
Commuter Benefits Ordinance	$0	-0.4%	-0.4%
Car Sharing	$15.6	-2.4%	-2.3%
Vanpools and Employer Shuttles	$0	-0.3%	-0.4%
Regional Electric Vehicle Charger	$76	-0.4%	-1.4%
Vehicle Buyback & PEV Incentive	$188	0.0%	-0.4%
Clean Vehicles Feebate	$16.5	0%	-0.8%
Smart Driving	$191	0%	-0.8%
Targeted Transportation Alternatives	$38.7	-1.3%	-1.9%
Trip Caps	Not Available	-0.2%	-0.8%
Expanded Bike Share System	$0	-0.03%	-0.02%
Expanded Bicycle Infrastructure	Not Available	-0.03%	-0.06%
TOTAL	**$526**	**-5.0%**	**-9.5%**

*Note: Totals may not sum exactly due to rounding.

EXPECTED TRANSPORTATION REVENUES AND EXPENDITURES

The 2017 SCS includes significantly more transportation funds than the previous SCS. As Table 17 shows, expenditures in the 2017 SCS total $303 billion (in nominal or Year of Expenditure (YOE) dollars[29]) over 24 years, or approximately $12.6 billion per year on average. This annual average is 21 percent higher than that of the 2013 SCS, which includes $292 billion in spending (YOE) over 28 years.

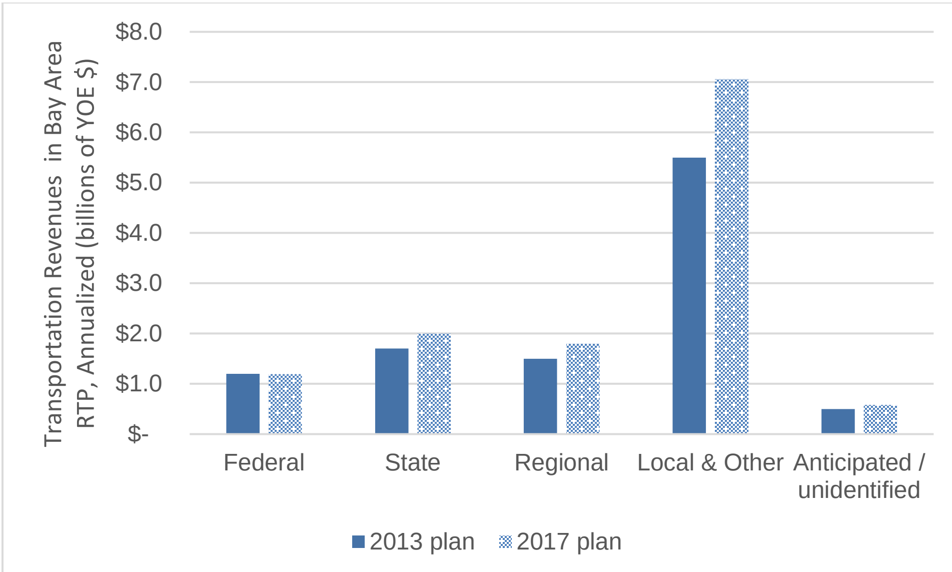
Table 17. Transportation Dollars Allocated by the 2013 and 2017 SCS

	2013 SCS	2017 SCS
Length of plan	28 years	24 years
Total transportation funds (YOE $)	$292 billion	$303 billion
Average annual funds[30] (YOE $)	$10.4 billion	$12.6 billion

In both plans, over two-thirds of projected funding comes from regional and local sources, such as transit fares, sales taxes, parcel taxes, and bridge tolls. As Figure 2 illustrates, the majority of the increase in funds between the two plans comes from local funding sources, such as a new property tax to support the Bay Area Rapid Transit (BART) system and an increase in estimated revenues from county transportation sales taxes. Smaller increases come from regional funds such as bridge toll increases, and from state funds such as High Speed Rail. Total federal funds did not change significantly, but shifts in transit funding allow more emphasis on core capacity, and shifts in roadway funding increase focus on freight.[31] The revenue forecast did not specifically include funding from SB 1.

[29] Both plans share a 2.2 percent inflation rate.
[30] The receipt and expenditure of transportation revenues will vary over time. Annual averages are provided simply to compare plans of two different durations.
[31] MTC and ABAG. 2017 (July). *Plan Bay Area 2040 Final Plan*. Accessed in April 2018 at http://2040.planbayarea.org/sites/default/files/2017-07/Investment%20Strategy_PBA2040_7-2017.pdf

Figure 2. Transportation Funds By Source, 2013 and 2017 SCS



The 2017 SCS would invest regional transportation funds in a pattern similar to that in the 2013 SCS. Table 18 summarizes the two plans' investment allocations. Both plans direct around 90 percent of funding towards strengthening the current transportation network and just 10 to 12 percent toward expanding it. Both spend around two-thirds of funds on public transportation.

Table 18. Comparison of Transportation Spending by Mode in ABAG/MTC's 2013 and 2017 SCS

Investment Category	2013 SCS	2017 SCS
Streets and Roads: Operations and Maintenance	32%	28%
Streets and Roads: Expansion and Modernization	5%	3%
Transit: Operations and Maintenance	54%	47%
Transit: Expansion and Modernization	7%	18%
Other (e.g., Focused Growth, Debt Service)	1%	6%
Total	100%	100%

Notes:
All funds in YOE $, categories may not sum exactly to 100% due to rounding.
Comparison of investment categories was summarized by CARB staff based on information provided by ABAG/MTC.

The 2017 SCS would spend approximately three-quarters (75 percent) of funds to maintain and operate current transit and roadway infrastructure. Another 18 percent of funds would modernize and expand current transit infrastructure, including improving bus service and core BART capacity, and 3 percent of funds would expand roads and highways, particularly the regional Express Lane network.

While the main categories of spending remain similar, changes have occurred to the list of projects to be funded.

Both the 2013 and 2017 SCSs include significant transit expansions, including BART to Silicon Valley and extending Caltrain to downtown San Francisco. As discussed earlier in this report, several transit expansions in the 2013 project list were partially or substantially completed. In the 2017 SCS, High Speed Rail is now the most expensive project. In addition to these expansions, both plans include enhancements such as Caltrain electrification. The 2017 SCS also includes enhancements to BART's Transbay core capacity, MUNI fleet expansion, and the Clipper card program. In both plans, the largest roadway investments are approximately $6 billion for the Regional Express Lane Network.

APPENDIX B: DATA TABLE

Modeling Parameters	2005 (If available)	2010 (Base Year)	2020		2035		2040 (Plan Horizon Year)		Data Source(s)
			w/ projects	w/o projects	w/ projects	w/o projects	w/ projects	w/o projects	
DEMOGRAPHIC*									
Regional Growth Forecast Population	7,096,500	7,155,800	7,899,300	7,899,300	9,119,000	9,119,000	9,627,500	9,627,500	tazData
Synthetic Modeled Population	6,978,983		7,890,070	7,890,070	9,075,512	9,075,512	9,560,782	9,560,782	Travel Model One Population Synthesizer
Group Quarters Population	144,600	126,500	140,700	140,700	166,600	166,600	176,100	176,100	tazData
Total Number of Households	2,499,100	2,609,000	2,882,000	2,882,000	3,281,100	3,281,100	3,426,700	3,426,700	tazData
Persons Per Household	2.78	2.69	2.69	2.69	2.73	2.73	2.76	2.76	tazData
Auto Ownership Per Household	1.73	1.72	1.73	1.73	1.70	1.74	1.70	1.75	Travel Model One, householdData_3
Total Number of Jobs	3,575,900	3,410,900	4,136,200	4,136,200	4,548,600	4,548,600	4,698,400	4,698,400	tazData
Average Unemployment Rate (%)	5.8%	5.5%	4.5%	4.5%	4.9%	4.9%	5.1%	5.0%	Synthesized Population
Average Household Income YEAR$	92,700	92,800	95,600	95,500	95,700	96,100	95,900	96,400	Synthesized Population
LAND USE*									
Total Developed Acres		550,600	565,100	562,800	577,400	583,700	578,100	605,700	UrbanSim Parcels and Buildings Table
Commercial Developed Acres		167,500	177,500	178,000	178,100	179,200	178,700	180,000	UrbanSim Parcels and Buildings Table
Residential developed acres		383,100	387,700	384,700	399,300	404,500	399,400	425,600	UrbanSim Parcels and Buildings Table
Total Acreage Developed (new)			14,500	12,100	26,700	33,100	27,500	55,000	table calculation

Modeling Parameters	2005 (If available)	2010 (Base Year)	2020		2035		2040 (Plan Horizon Year)		Data Source(s)
			w/ projects	w/o projects	w/ projects	w/o projects	w/ projects	w/o projects	
Housing Vacancy Rate		4.9%	3.0%	2.7%	2.4%	2.4%	3.0%	3.0%	UrbanSim Top Sheet
Total Housing Units		2,741,700	2,971,200	2,960,900	3,362,500	3,362,900	3,531,500	3,532,400	UrbanSim Top Sheet
Total Single-Family Detached Housing Units		1,730,400	1,757,900	1,804,600	1,867,500	2,018,600	1,895,100	2,117,100	UrbanSim Top Sheet
Total Large-Lot Single Family Detached Housing Units (>= 4 acres)		14,500	14,500	14,500	14,500	14,400	14,500	14,400	UrbanSim Parcels and Buildings Table
Total Conventional-Lot Single Family Detached Housing Units (in-between)		1,510,700	1,538,300	1,584,900	1,648,800	1,798,900	1,677,200	1,897,300	UrbanSim Parcels and Buildings Table
Total Small-Lot Single Family Detached Housing Units (3000 sqt and smaller)		205,200	205,100	205,200	204,200	205,300	203,400	205,400	UrbanSim Parcels and Buildings Table
Total Multi-Family Housing Units		1,011,300	1,213,300	1,156,300	1,495,000	1,344,300	1,636,400	1,415,300	*UrbanSim Top Sheet*
Total infill Housing Units			229,500	191,700	620,100	542,900	787,900	677,200	UrbanSim Parcels and Buildings Table
Average Density (dwelling units/acre)		7.46					8.52	8.04	UrbanSim Parcels and Buildings Table
PROXIMITY TO TRANSIT*									
Total households w/in 1/3 mile of transit stations & stops	2,129,500	2,223,400	2,445,400	2,443,700	2,802,500	2,724,700	2,939,400	2,828,000	Travel Model One, householdData_3
Total households w/in 2/3 mile of	2,373,400	2,456,700	2,715,300	2,713,500	3,111,900	3,042,200	3,259,000	3,158,700	Travel Model One,

Modeling Parameters	2005 (If available)	2010 (Base Year)	2020		2035		2040 (Plan Horizon Year)		Data Source(s)
			w/ projects	w/o projects	w/ projects	w/o projects	w/ projects	w/o projects	
transit stations & stops									householdData_3
Total work places w/in 1/3 mile of transit stations & stops	2,472,000	2,618,700	3,208,300	3,225,900	3,532,000	3,532,400	3,644,000	3,653,300	Travel Model One, wsLocResults_3
Total work places w/in 2/3 mile of transit stations & stops	2,746,800	2,895,200	3,546,600	3,560,200	3,909,400	3,912,300	4,043,600	4,048,600	Travel Model One, wsLocResults_3
Transit Stations and Stops in PDAs									
Percent Housing in PDAs		23%	26%	25%	32%	26%	35%	26%	UrbanSim Top Sheet
Percent Employment in PDAs		43%	45%	45%	45%	45%	46%	45%	UrbanSim Top Sheet
Average Density (dwelling units/acre) in PDAs		23.6	24.8	24.1	29.3	25.6	32.0	27.0	UrbanSim Parcels and Buildings Table
TRANSPORTATION SYSTEM*									
Freeway and General Purpose Lanes -Mixed Flow, auxiliary, etc. (lane miles)	5,400	5,500	4,200	5,500	2,400	5,500	2,400	5,500	Travel Model One, roadway assignment
Freeway Managed Lanes (lane miles)	0	0	1,600	200	3,700	200	3,700	200	Travel Model One, roadway assignment
Arterial/ Expressway (lane miles)	9,600	9,700	9,800	9,800	9,900	9,800	9,900	9,800	Travel Model One, roadway assignment
Collector and Local (lane miles)	5,500	5,500	5,500	5,500	5,600	5,500	5,600	5,500	Travel Model One, roadway assignment

Modeling Parameters	2005 (If available)	2010 (Base Year)	2020		2035		2040 (Plan Horizon Year)		Data Source(s)
			w/ projects	w/o projects	w/ projects	w/o projects	w/ projects	w/o projects	
Regular Transit Bus Operation Miles	44,200	41,300	42,400	41,800	44,300	41,800	43,800	41,800	Travel Model One, transit assignment
Light Rail Operation Miles	1,000	1,200	1,500	1,200	1,500	1,200	1,500	1,200	Travel Model One, transit assignment
Heavy Rail Operation Miles	2,000	2,300	3,000	3,000	3,400	3,000	3,400	3,000	Travel Model One, transit assignment
Commuter Rail Operation Miles	4,000	3,600	4,600	4,600	4,600	4,600	4,600	4,600	Travel Model One, transit assignment
Transit Total Daily Vehicle Service Hours	2,500	2,300	2,500	2,400	2,500	2,500	2,500	2,500	Travel Model One, transit assignment
Bike and Pedestrian Lane (class I & II) Miles									Not modeled explicitly.
ACTIVITY, TOUR and TRIP DATA*									
Activity for Full-Time Workers									
Mandatory	1,996,200	2,064,900	2,437,600	2,435,200	2,570,400	2,547,700	2,614,500	2,581,600	Travel Model One, tours
Non-Mandatory	239,600	267,200	344,300	347,900	418,100	426,500	446,300	459,500	Travel Model One, tours
Home (including telecommuting)	194,300	215,300	292,000	291,900	364,900	370,600	393,500	404,800	Travel Model One, tours
Total Number of Tours	9,036,600	9,173,700	10,249,900	10,261,800	11,600,000	11,590,800	12,134,500	12,100,500	Travel Model One, tours
Tours by Tour Purpose (please use space below to identify)									
e.g. At-Work Tour	705,600	719,800	853,800	852,900	900,700	899,600	917,000	909,200	Travel Model One, tours
e.g. Mandatory Tour	3,931,000	4,000,100	4,620,500	4,613,400	4,986,900	4,950,100	5,119,600	5,079,200	Travel Model One, tours
e.g. Non-Mandatory Tour	4,400,000	4,453,800	4,775,600	4,795,500	5,712,500	5,741,100	6,097,900	6,112,100	Travel Model One, tours

Modeling Parameters	2005 (If available)	2010 (Base Year)	2020		2035		2040 (Plan Horizon Year)		Data Source(s)
			w/ projects	w/o projects	w/ projects	w/o projects	w/ projects	w/o projects	
Trips by Tour Purpose									
e.g. At-Work Tour	1,575,200	1,606,200	1,906,400	1,904,700	2,009,700	2,007,100	2,045,500	2,028,600	Travel Model One, trips
e.g. Mandatory Tour	10,358,100	10,520,100	12,064,400	12,061,100	12,993,600	12,949,400	13,312,200	13,281,100	Travel Model One, trips
e.g. Non-Mandatory Tour	12,011,600	12,128,400	12,917,800	12,972,700	15,478,200	15,583,800	16,549,600	16,613,800	Travel Model One, trips
Travel Time and Distance									
Average Trip Length (miles)	6.5	6.3	6.4	6.4	6.4	6.5	6.3	6.5	Travel Model One, trips
Average Auto Trip Length (miles)	7.0	6.9	6.9	6.9	6.8	7.0	6.7	7.0	Travel Model One, trips
Average Transit Trip Length (miles)	9.2	9.3	9.8	9.8	10.0	10.0	9.8	10.1	Travel Model One, trips
Average Bike Trip Length (miles)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	Travel Model One, trips
Average Walk Trip Length (miles)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	Travel Model One, trips
PERCENT PASSENGER TRAVEL MODE SHARE*									
For All Trips									
Drive Alone	48%	48%	47%	47%	47%	47%	47%	47%	Travel Model One, trips
Share Ride	37%	36%	35%	35%	35%	35%	35%	36%	Travel Model One, trips
Public Transit (all)	**15%**	**16%**	**18%**	**18%**	**18%**	**17%**	**18%**	**17%**	**Travel Model One, trips**
Public Transit (Regular Bus)	2%	2%	3%	3%	3%	3%	3%	2%	Travel Model One, trips
Public Transit (Express Bus)	0%	0%	0%	0%	0%	0%	0%	0%	Travel Model One, trips
Public Transit (Light Rail/Ferry)	1%	1%	1%	2%	1%	1%	1%	1%	Travel Model One, trips
Public Transit (Heavy Rail)	1%	1%	2%	2%	2%	2%	2%	2%	Travel Model One, trips

Modeling Parameters	2005 (If available)	2010 (Base Year)	2020 w/ projects	2020 w/o projects	2035 w/ projects	2035 w/o projects	2040 (Plan Horizon Year) w/ projects	2040 (Plan Horizon Year) w/o projects	Data Source(s)
Public Transit (Commuter Rail)	0%	0%	0%	0%	0%	0%	0%	0%	Travel Model One, trips
Non-Motorized (Bike)	1%	1%	1%	1%	1%	1%	1%	1%	Travel Model One, trips
Non-Motorized (Walk)	9%	10%	10%	10%	10%	10%	10%	10%	Travel Model One, trips
Peak Period									
Drive Alone	47%	47%	47%	47%	46%	46%	46%	46%	Travel Model One, trips
Share Ride	38%	37%	35%	35%	35%	36%	35%	36%	Travel Model One, trips
Public Transit (all, including walk/bike)	**15%**	**16%**	**19%**	**18%**	**19%**	**18%**	**19%**	**18%**	**Travel Model One, trips**
Public Transit (Regular Bus)	3%	3%	4%	3%	4%	3%	4%	3%	Travel Model One, trips
Public Transit (Express Bus)	0%	0%	0%	0%	0%	0%	0%	0%	Travel Model One, trips
Public Transit (Light Rail/Ferry)	1%	1%	2%	2%	2%	2%	2%	2%	Travel Model One, trips
Public Transit (Heavy Rail)	2%	2%	2%	2%	2%	2%	2%	2%	Travel Model One, trips
Public Transit (Commuter Rail)	0%	0%	0%	0%	0%	0%	0%	0%	Travel Model One, trips
Non-Motorized (Bike)	1%	1%	1%	1%	1%	1%	1%	1%	Travel Model One, trips
Non-Motorized (Walk)	9%	9%	9%	9%	9%	9%	9%	9%	Travel Model One, trips
Transit Boardings									
Bus	1,004,700	1,063,600	1,519,500	1,448,300	1,869,200	1,518,400	1,958,400	1,555,700	Travel Model One, transit assignment
Light Rail	168,800	210,700	383,100	409,400	422,200	460,100	460,000	479,000	Travel Model One, transit assignment

Modeling Parameters	2005 (If available)	2010 (Base Year)	2020		2035		2040 (Plan Horizon Year)		Data Source(s)
			w/ projects	w/o projects	w/ projects	w/o projects	w/ projects	w/o projects	
Heavy Rail (BART)	312,500	360,400	523,100	508,600	662,500	566,900	684,300	586,300	Travel Model One, transit assignment
Other	29,400	30,800	72,200	44,400	105,600	44,100	106,200	45,100	Travel Model One, transit assignment
VEHICLE MILES TRAVELED*									
Average Daily VMT Per Resident By County Of Residence									
San Francisco	7.7	7.1	6.7	6.6	6.5	6.8	6.4	6.8	Travel Model One, trips
San Mateo	16.8	16.4	16.0	16.0	15.7	16.0	15.3	15.5	Travel Model One, trips
Santa Clara	15.6	15.3	15.1	15.1	14.7	15.5	14.2	15.5	Travel Model One, trips
Alameda	16.2	15.4	14.9	14.9	14.5	14.7	14.1	14.3	Travel Model One, trips
Contra Costa	18.9	18.7	18.3	18.7	17.7	18.3	17.2	18.0	Travel Model One, trips
Solano	18.2	18.1	18.0	18.8	17.9	18.2	17.3	17.5	Travel Model One, trips
Napa	18.7	17.9	18.8	19.6	19.0	19.8	18.8	18.8	Travel Model One, trips
Sonoma	18.4	17.8	18.1	18.7	18.1	18.5	17.7	18.0	Travel Model One, trips
Marin	19.6	18.3	18.2	18.3	18.4	18.4	18.3	18.1	Travel Model One, trips
All Counties	16.0	15.4	15.1	15.2	14.7	15.3	14.3	15.1	Travel Model One, trips
Average Daily VMT Per Worker By County Of Workplace									
San Francisco	12.9	12.4	10.9	11.6	10.9	12.0	10.5	11.9	Travel Model One, trips
San Mateo	29.2	28.6	27.1	27.4	27.0	27.7	26.5	27.9	Travel Model One, trips
Santa Clara	25.5	24.3	23.0	23.1	22.3	24.0	21.7	24.0	Travel Model One, trips

Modeling Parameters	2005 (If available)	2010 (Base Year)	2020		2035		2040 (Plan Horizon Year)		Data Source(s)
			w/ projects	w/o projects	w/ projects	w/o projects	w/ projects	w/o projects	
Alameda	26.4	24.8	23.1	23.5	22.8	24.0	22.2	23.7	Travel Model One, trips
Contra Costa	27.7	26.4	25.5	25.7	25.2	24.9	24.6	24.2	Travel Model One, trips
Solano	22.0	20.8	20.1	20.0	20.6	20.7	20.2	20.1	Travel Model One, trips
Napa	28.0	26.2	23.9	24.2	26.0	25.4	25.8	25.3	Travel Model One, trips
Sonoma	23.0	22.2	20.9	20.8	21.0	22.1	20.7	21.7	Travel Model One, trips
Marin	32.9	33.0	31.3	32.1	31.2	31.9	30.8	31.2	Travel Model One, trips
All Counties	24.3	23.0	21.4	21.7	21.2	22.2	20.7	22.1	Travel Model One, trips
Modeled Regional VMT									
Total VMT per weekday (all vehicle class) (miles)	149,996,000	151,767,600	165,603,500	166,431,400	187,922,200	192,045,900	193,737,400	198,912,900	Travel Model One, Assigned Roadway Network - E2014 Output
Total VMT per weekday for passenger vehicles (ARB vehicle classes LDA, LDT1, LDT2, and MDV)	136,429,400	138,202,500	152,404,100	153,156,100	172,793,800	176,687,600	177,846,800	182,744,600	Travel Model One, Trip Tables x Distance Skims - E2014 Output
Total II VMT per weekday for passenger vehicles (miles)	117,933,000	117,341,800	129,197,000	129,953,300	145,295,100	149,098,100	148,901,200	153,728,400	
Total IX/XI VMT per weekday for passenger vehicles (miles)	18,443,100	20,789,700	23,128,100	23,124,200	27,407,000	27,498,300	28,849,200	28,920,700	

Modeling Parameters	2005 (If available)	2010 (Base Year)	2020		2035		2040 (Plan Horizon Year)		Data Source(s)
			w/ projects	w/o projects	w/ projects	w/o projects	w/ projects	w/o projects	
Total XX VMT per weekday for passenger vehicles (miles)	53,400	71,000	78,900	78,600	91,700	91,100	96,500	95,500	
CONGESTED TRAVEL MEASURES*									
Congested weekday VMT on freeways (miles, V/C ratios > 0.75)	15,062,650	13,826,419	18,701,826	20,449,666	23,062,938	28,678,498	25,265,740	31,081,686	Travel Model One, Assigned Roadway Network
Congested weekday VMT on all other roadways (miles, V/C ratios > 0.75)	5,506,803	5,662,381	8,301,256	8,649,727	11,044,232	13,351,396	12,190,232	15,171,954	Travel Model One, Assigned Roadway Network
Congested VMT by Speed Bin									
Assigned VMT at Travel Speeds ≤ 15 MPH	258,168	276,178	563,006	869,577	1,190,857	2,606,975	1,358,271	3,433,170	Travel Model One, Assigned Roadway Network
Assigned VMT at 15 < Travel Speeds ≤ 30 MPH	4,498,186	4,863,043	7,202,774	8,010,788	9,014,084	13,047,883	10,256,743	15,707,818	Travel Model One, Assigned Roadway Network
Assigned VMT at 30 < Travel Speeds ≤ 45 MPH	8,311,238	7,133,546	11,396,698	12,867,529	14,198,146	17,362,567	15,292,671	17,167,117	Travel Model One, Assigned Roadway Network
Assigned VMT at 45 < Travel Speeds ≤ 60 MPH	7,501,862	7,216,034	7,840,603	7,351,500	9,704,083	9,012,468	10,548,287	9,945,535	Travel Model One, Assigned Roadway Network
Assigned VMT at Travel Speeds > 60 MPH	0	0	0	0	0	0	0	0	Travel Model One, Assigned Roadway Network

Modeling Parameters	2005 (If available)	2010 (Base Year)	2020		2035		2040 (Plan Horizon Year)		Data Source(s)
			w/ projects	w/o projects	w/ projects	w/o projects	w/ projects	w/o projects	
Total Assigned VMT	20,569,453	19,488,801	27,003,082	29,099,394	34,107,170	42,029,893	37,455,972	46,253,640	Travel Model One, Assigned Roadway Network
CO2 EMISSIONS*									
Total CO2 emissions per weekday (all vehicle class) (tons)	79,000	80,200	73,400	73,900	59,800	61,700	60,400	62,800	EIR, Table 2.5-10 - E2014 Output
Total SB375 CO2 emissions per weekday for passenger vehicles (ARB vehicle classes LDA, LDT1, LDT2, and MDV) (tons)	60,900	62,200	68,500	69,000	77,400	80,400	79,900	83,900	EIR, Table 2.5-7 - E2014 Output
Total II CO2 emissions per weekday for passenger vehicles (tons)	52,700	52,800	58,000	58,500	65,100	67,800	66,900	70,500	E2014 Output
Total IX/XI CO2 emissions per weekday for passenger vehicles (tons)	8,200	9,400	10,400	10,400	12,300	12,500	13,000	13,300	
Total XX CO2 emissions per weekday for passenger vehicles (tons)	0	0	0	0	0	0	0	0	
Total SB 375 CO2 (with EMFAC adjustment)	63,500		68,900	69,500	77,700	80,700	80,200	84,200	EIR, Table 2.5-10 - E2007 Output

Modeling Parameters	2005 (If available)	2010 (Base Year)	2020		2035		2040 (Plan Horizon Year)		Data Source(s)
			w/ projects	w/o projects	w/ projects	w/o projects	w/ projects	w/o projects	
Total Climate Policy Initiatives Program Reductions (tons)	0	0	-3,620	0	-7,840	0	-7,680	0	EIR, Table 2.5-7 - E2014 Output
INVESTMENT (millions) (YEAR of Expenditure in $)**									
Total Plan Period Investment (comparison of PBA 2040 vs PBA)							$303 billion	$292 billion	PBA Table 17, PBA 2040 Table 4.4
Highway Capacity Expansion							$10 billion	$15 billion	Plan reflects highways and roads in total
Other Road Capacity Expansion									
Transit Capacity Expansion							$21 billion	$21 billion	Plan reflects transit in total.
Bus Transit Capacity Expansion									
Transit - Maintain and Sustain Existing Infrastructure							$173 billion	$159 billion	Plan reflects transit in total or by operator.
Rail Transit - Maintain and Sustain Existing Infrastructure									
Other (Support focused growth, operate/maintain/ modernize existing Hwy/Rd infrastructure, debt service/reserve							$99 billion	$97 billion	
TRANSPORTATION USER COSTS AND PRICING (2000$)*									

Modeling Parameters	2005 (If available)	2010 (Base Year)	2020		2035		2040 (Plan Horizon Year)		Data Source(s)
			w/ projects	w/o projects	w/ projects	w/o projects	w/ projects	w/o projects	
Perceived Vehicle Operating Costs ($2000 dollars per mile)	$ 0.15	$ 0.16	$ 0.18	$ 0.18	$ 0.16	$ 0.16	$ 0.17	$ 0.17	Travel Model One assumptions for good pavement
Gasoline Price ($2000 dollars per gallon)	$ 2.24	$ 2.51	$ 3.32	$ 3.25	$ 3.93	$ 3.86	$ 4.24	$ 4.17	Travel Model One assumptions

* w/o Project = No Project Definition from EIR or a business as usual definition

** w/o Project = refers to MTC's first SCS, "*Plan Bay Area*"

APPENDIX C: SENSITIVITY ANALYSIS

As part of the SCS review process, CARB requested ABAG/MTC to perform two sensitivity tests to examine the sensitivity of the travel model to the changes in key modeling variables that were crucial in the planning and modeling process of the 2017 SCS. ABAG/MTC conducted several sensitivity tests in support of CARB's evaluation of its 2013 SCS, the results of which are described in CARB staff's technical evaluation of ABAG/MTC's 2013 SCS.[32] CARB staff did not request ABAG/MTC staff to duplicate any sensitivity tests that were completed in 2013 because the results are still valid for the 2017 SCS. CARB and ABAG/MTC staff identified additional variables such as household income and transit frequency for all service providers for additional sensitivity testing in support of the 2017 SCS.

HOUSEHOLD INCOME

Household income has a direct impact on the mode of transportation and travel characteristics (e.g., frequency, distance) of individuals and households. Higher income allows an individual or a household to be able to afford automobile ownership compared to the lower-income counterpart. ABAG/MTC conducted four tests (i.e., 10 percent decrease from baseline, 25 percent decrease from baseline, 10 percent increase from baseline, 25 percent increase from baseline) to examine the potential impact of average household income in the region on household auto ownership. Table 19 summarizes the results of the household auto ownership distribution by test scenario of household income. As expected, vehicle ownership changes directly according to the change in household income, except for the one-vehicle household category that demonstrates an inverse relationship.

Table 19. Impact of Household Income on Auto Ownership

Test Scenario	Household Auto Ownership Distribution				
	0 veh	1 veh	2 vehs	3 vehs	4+ vehs
25% Decrease from Baseline	10.3%	33.8%	36.6%	13.3%	6.1%
10% Decrease from Baseline	9.9%	33.4%	36.9%	13.5%	6.3%
Baseline	**9.7%**	**33.1%**	**37.2%**	**13.6%**	**6.5%**
10% Increase from Baseline	9.5%	32.8%	37.4%	13.7%	6.6%
25% Increase from Baseline	9.2%	32.5%	37.7%	13.9%	6.8%

[32] CARB. 2014 (April). *Technical Evaluation of the Greenhouse Gas Emissions Reduction Quantification for the Association of Bay Area Governments' and Metropolitan Transportation Commission's SB 375 Sustainable Communities Strateg*y. Available at https://www.arb.ca.gov/cc/sb375/mtc_scs_tech_eval_final0414.pdf

Cornut (2016)[33] finds the elasticity of household auto ownership with respect to income to be 0.47. Based on CARB staff's analysis of the modeled elasticities from the above test scenarios, ABAG/MTC's results are consistent with the empirical literature. The change in auto ownership for the one-vehicle household category is subtle but not directionally relating to income. MTC staff explained that one-vehicle ownership is more based on household need rather than income level, and that the one-vehicle ownership coefficient was found to be insensitive to household income.

TRANSIT FREQUENCY

In CARB's review of the 2013 SCS, ABAG/MTC conducted transit frequency tests specifically on the Bay Area Rapid Transit service (BART). To study the travel model's sensitivity to the region-wide transit system, CARB requested ABAG/MTC to conduct sensitivity tests on transit frequency of all transit combined by applying a similar testing methodology as that used in the 2013 SCS review.

Table 20 summarizes the results of regional VMT of each test scenario of transit system frequency. As expected, regional VMT decreases as overall transit headway decreases (or transit service becomes more frequent), and vice versa.

Table 20. Impact of Transit Frequency (all Transit Combined) on Regional VMT

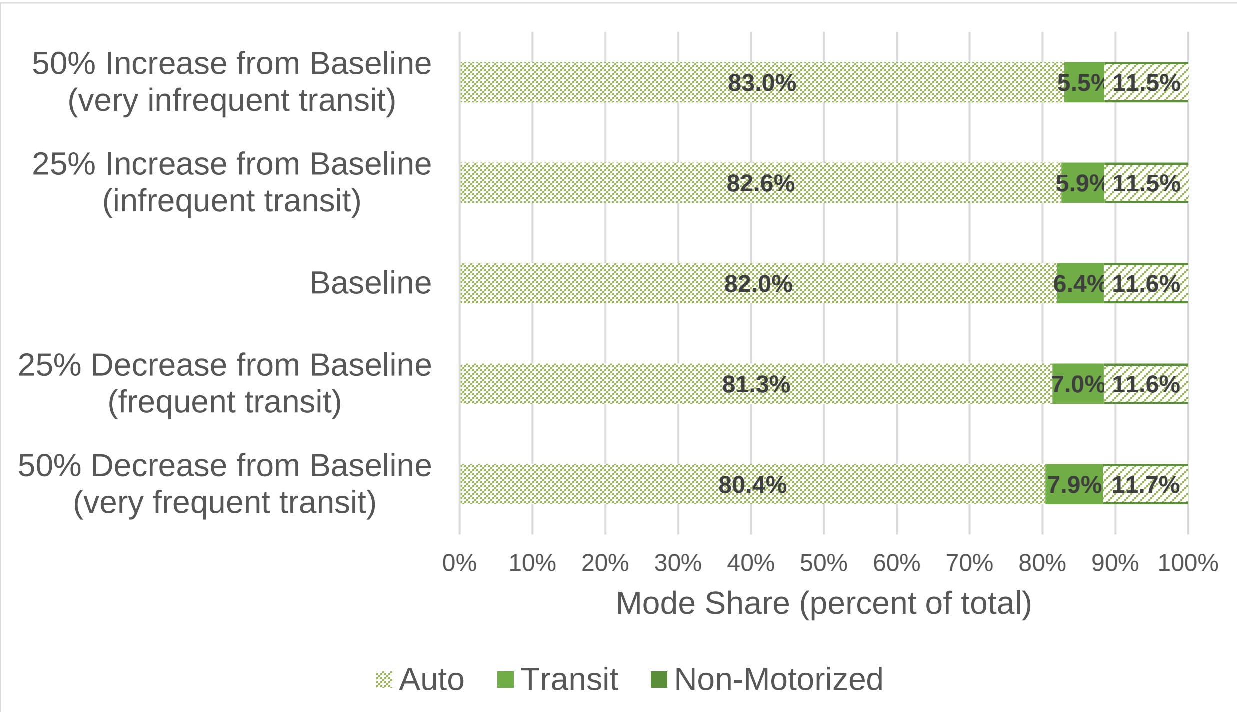
Test Scenario	VMT	% Change from Baseline
50% Decrease from Baseline (very frequent transit)	155,104,534	-2.1%
25% Decrease from Baseline (frequent transit)	157,002,705	-0.9%
Baseline	158,406,824	0.0%
25% Increase from Baseline (infrequent transit)	159,540,920	0.7%
50% Increase from Baseline (very infrequent transit)	160,402,375	1.3%

Figure 3 displays the corresponding change in mode share distribution to the change in transit headway/frequency. The model results demonstrate a direct relationship

[33] Cornut, Benoit. 2016. Longitudinal Analysis of Car Ownership and Car Travel Demand in the Paris Region Using a Pseudo-Panel Data Approach. Transportation Research Procedia 13 (2016) 61-71. https://ac.els-cdn.com/S2352146516300072/1-s2.0-S2352146516300072-main.pdf?_tid=9cb491a4-7ad5-44dc-9c45-95bff6509f67&acdnat=1525284911_5883065c70c8ac095e9ebb4da123bad7

between transit frequency and transit mode share, as transit frequency increases and the corresponding mode share also increase, and vice versa.

Figure 3. Impact of Transit Frequency (all Transit Combined) on Mode Shares



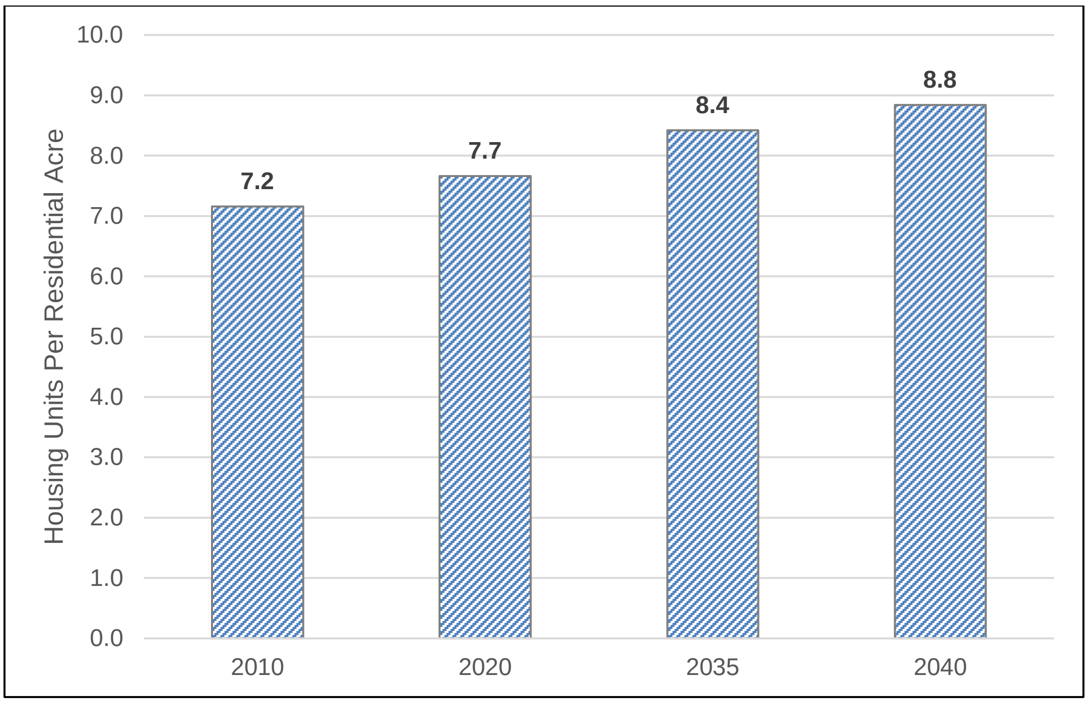
APPENDIX D: PERFORMANCE INDICATORS

LAND USE INDICATORS

Land use influences the travel behavior of residents including both mode choice and trip length. The evaluation focused on four land use related performance indicators to determine whether they support ABAG/MTC's forecasted GHG emissions forecast: residential density, infill housing development, housing types, and housing and employment within Priority Development Areas (PDAs).

Residential Density

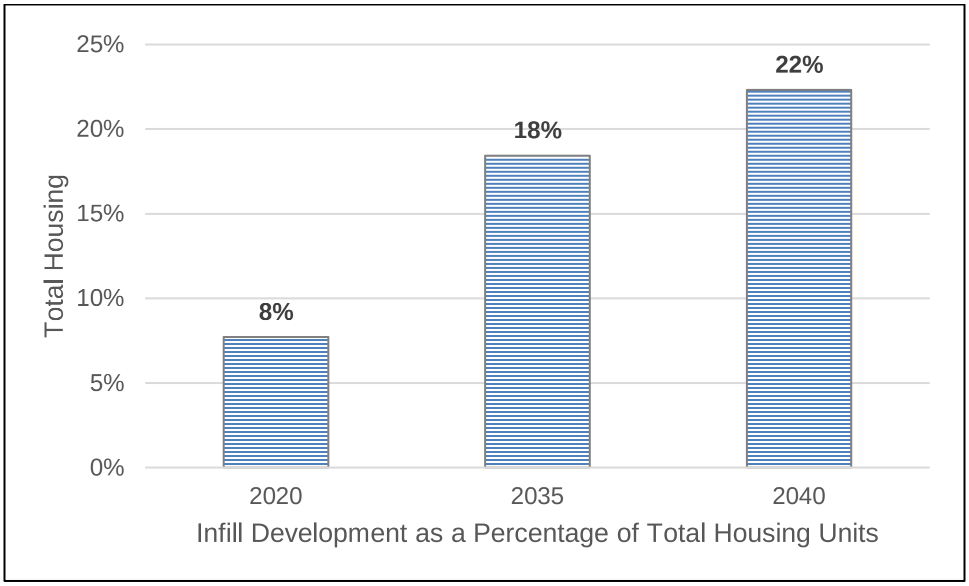
Figure 4: Residential Density



ABAG/MTC projects that between 2010 and 2040 the region's residential density will increase by about 23 percent. Based on the land use data provided by ABAG/MTC, overall residential density will increase from 7.2 to 8.8 dwelling units per acre between 2010 and 2040 (Figure 4).

Infill Housing Development

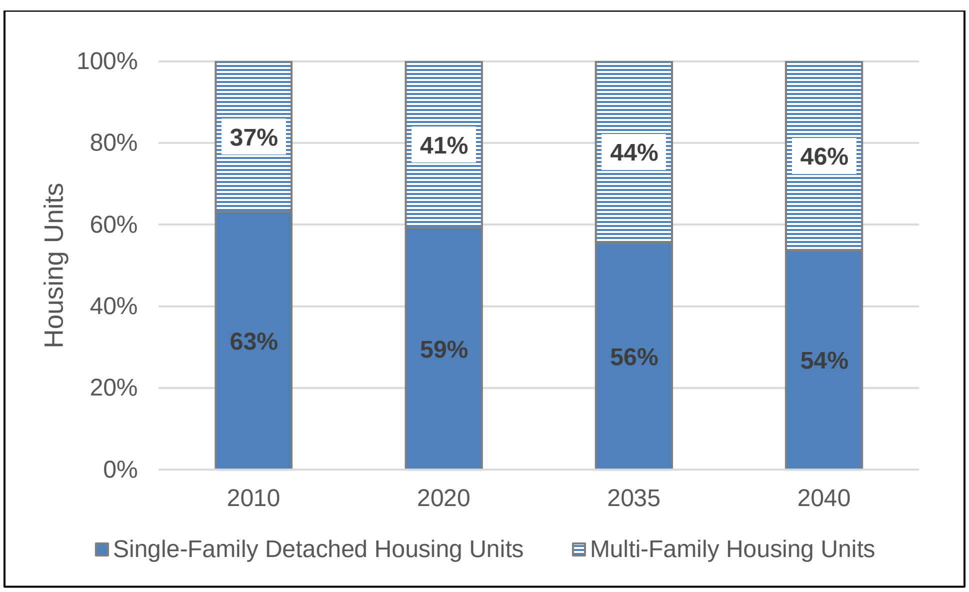
Figure 5: Infill Housing Development



As shown in Figure 5, if implemented, the SCS will increase the percentage of infill housing from 8 percent in 2020 to 22 percent in 2040. Almost 100 percent of new housing development will be infill development.

Housing Types

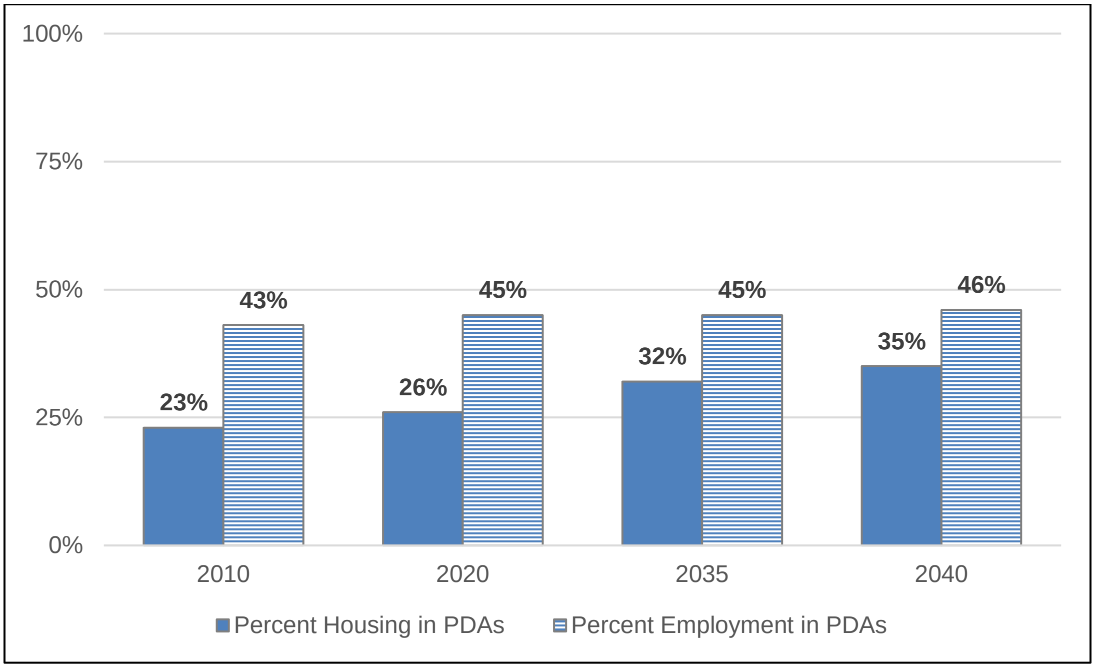
Figure 6: Share of Single-Family and Multi-Family Housing Units



Between 2010 and 2040, ABAG/MTC shows an increase in multi-family housing units relative to the total number of housing units. Currently, multi-family housing units make up 37 percent of the region's total housing stock, increasing to 46 percent by 2040, and single-family detached housing units will decrease from 63 percent in 2010 to 54 percent in 2040 (Figure 6).

Housing and Employment within PDAs

Figure 7: Percentage of Housing and Employment within PDAs



In developing the future land use pattern, ABAG/MTC assumed an increase of housing within PDAs from about 23 percent in 2010 to 35 percent in 2040. Employment within PDA's will also increase slightly, from 43% of total employment in 2010 to 46% in 2040 (Figure 7).

TRANSPORTATION INDICATORS

CARB staff evaluated three transportation-related performance indicators to determine whether the trends support the reported GHG emission reductions, including passenger vehicle miles traveled (VMT), mode share, and transit ridership.

Mode Share

Figure 8: Mode Share Change for All Trips

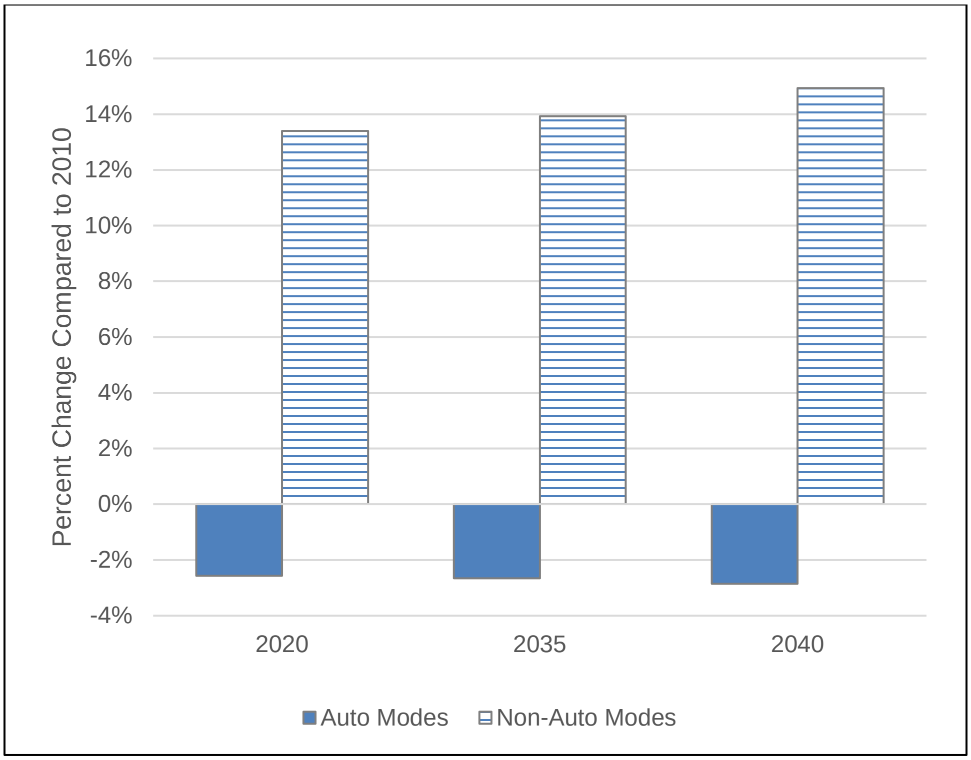
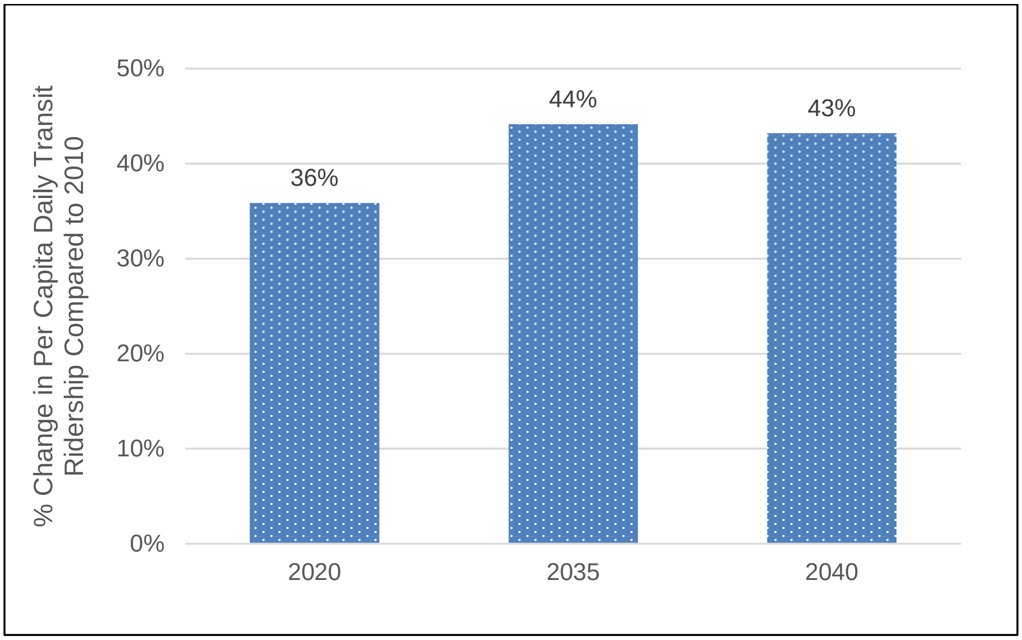


Figure 8 shows the expected mode share in 2020, 2035, and 2040 compared to 2010. By 2040, the trend shows an increase in non-auto mode share and a decrease in auto mode share.

Transit Ridership

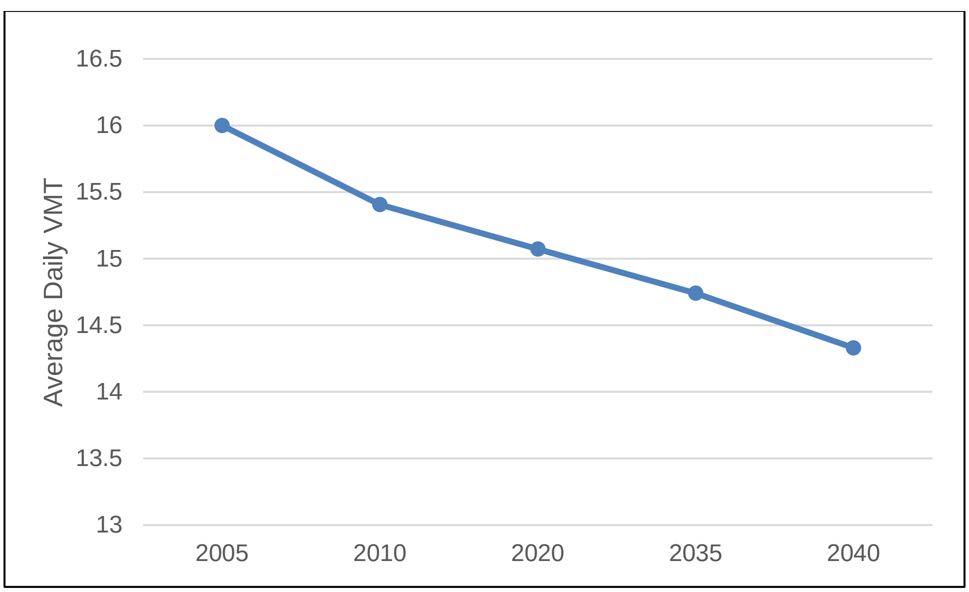
Figure 9: Transit Ridership



ABAG/MTC anticipates that per capita transit ridership will increase by 36 percent in 2020, and 44 percent in 2035 compared to 2010 (Figure 9).

Passenger Vehicle Miles Traveled

Figure 10: Per Capita Passenger VMT Trends



The 2017 SCS, as expected, shows a decline in per capita passenger vehicle VMT over time. VMT per capita decreases by about 6 percent between 2005 and 2020 and about 12 percent between 2005 and 2040, as shown in Figure 10. The quantification of GHG emissions from passenger vehicles is a function of both VMT and vehicle speeds.