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Regional Travel Demand Model and Land Use Model Documentation

Introduction

The Association of Monterey Bay Area Governments (AMBAG) is the federally designated Metropolitan Planning Organization (MPO) for the tri-county Monterey Bay Area. To carry out Metropolitan Transportation Planning activities, AMBAG works closely with the Santa Cruz County Regional Transportation Commission (SCCRTC), the Transportation Agency for Monterey County (TAMC), the Council of San Benito County Governments (SBtCOG), the Monterey Bay Air Resources District (MBARD), Monterey-Salinas Transit (MST), the Santa Cruz Metropolitan Transit District (METRO), Caltrans, Federal Highway Administration (FHWA), Federal Transit Administration (FTA) and all local jurisdictions (18 cities and 3 counties) within the tri-county Monterey Bay Area.

The Monterey Bay Area constitutes California's North Central Coast Air Basin. Situated between the San Francisco Bay Area to the north and San Luis Obispo County to the south, it spans a total of 6,000 square miles. However, urbanized areas constitute less than 150 square miles.

Developing the 2045 Metropolitan Transportation Plan (MTP) and Sustainable Communities Strategy (SCS)

The Metropolitan Transportation Plan (MTP) has a horizon year of 2045 and is scheduled for adoption by the AMBAG Board of Directors in June 2022. One of the first steps in the development of the 2045 MTP/SCS was to evaluate and update the stated goals and objectives from the 2040 MTP/SCS. The AMBAG Board of Directors approved updated goals and policies as well as accepted updated performance measures at its February 2020 meeting. The performance measures were used to evaluate alternative transportation/land use scenarios and relate to each of the goal areas which are as follows:

- Access and Mobility – Provide convenient, accessible, and reliable travel options while maximizing productivity for all people and goods in the region.
- Economic Vitality – Raise the region's standard of living by enhancing the performance of the transportation system.
- Environment – Promote environmental sustainability and protect the natural environment.
- Healthy Communities – Protect the health of our residents; foster efficient development patterns that optimize travel, housing and employment choices and encourage active transportation.
- Social Equity – Provide an equitable level of transportation services to all segments of the population.
- System Preservation and Safety – Preserve and ensure a sustainable and safe regional transportation system.

AMBAG, in coordination with the Regional Transportation Planning Agencies (RTPAs), developed revenue projections and project costs.

The MTP is supplemented by the three county level Regional Transportation Plans (RTPs) prepared by SBtCOG, SCCRTC and TAMC. Therefore, the updates to all four plans, including goals and objectives, transportation project evaluation criteria, revenue projections, etc. were prepared to be consistent with each other.

The Sustainable Communities Strategy (SCS) is an element of the MTP, as required by Senate Bill 375 and shows how regional greenhouse gas (GHG) targets will be achieved through efficient development patterns, infrastructure investments, transportation measures, and policies that are determined to be feasible. The regional GHG targets are measured from a 2005 baseline and for the AMBAG region are a three percent per capita increase by 2020 and a five percent per capita reduction by 2035. If the SCS had not met regional GHG targets, an Alternative Planning Strategy (APS) could have been developed to demonstrate what alternative scenario and additional measures would be needed in order for the region to meet its GHG target.

Development of the Draft 2045 MTP/SCS

In order to evaluate various combinations of transportation and land use strategies that could lead to achieving the GHG targets adopted by the California Air Resources Board (CARB) for the tri-county region, AMBAG worked with the three county RTPAs, local governments, transit agencies and the public to develop and evaluate various strategies, using its upgraded transportation and land use modeling capabilities. The AMBAG Board of Directors selected a preferred scenario that formed the basis for the Draft 2045 MTP/SCS. Please see Chapter 4 and Appendix E for more information on the SCS.

Public Participation Plan and Interagency Coordination

Another requirement of SB 375 is that each MPO adopt a public participation plan for development of the SCS and Alternative Planning Strategy (APS), if one is required. Some of the key requirements of SB 375 related to public participation are:

- Outreach efforts to encourage the active participation of a broad range of stakeholder groups in the planning process, consistent with the agency's adopted Federal Public Participation Plan, including, but not limited to, affordable housing advocates, transportation advocates, neighborhood and community groups, environmental advocates, home builder representatives, broad based business organizations, landowners, commercial property interests and homeowner associations.

- Consultation with congestion management agencies, transportation agencies and transportation commissions as applicable.

- Workshops throughout the region to provide the public with the information and tools necessary to provide a clear understanding of the issues and policy choices. Each workshop, to the extent practicable, shall include urban simulation computer modeling to create visual representations of the SCS and the APS, if one is prepared.

- Preparation and circulation of a draft SCS and APS, if one is prepared, not less than 55 days before adoption of the final MTP.

- At least three public hearings on the draft SCS. To the maximum extent feasible, the hearings shall be in different parts of the region to maximize the opportunity for participation by members of the public throughout the region.

- A process for enabling members of the public to provide a single request to receive notices, information and updates.

For more information on public participation and outreach refer to Appendix D.

Coordination of Modeling Activities with Partner Agencies

AMBAG, as a federally designated MPO, is required to develop and maintain a tri-county Regional Travel Demand Model (RTDM) to meet federal and state requirements. The GHG target set by CARB applies to the tri-county Monterey Bay region. In this context AMBAG and the RTPA staff have established two levels of working committees that regularly met and worked together to develop the region's MTP and RTPs as well as to conduct modeling analysis. While the RTPAs do not maintain or run the RTDM, they were engaged in the consideration of the results of scenario model runs and in the process of refining the alternative scenarios. As the MTP was being developed, AMBAG worked with all of its partners (RTPAs, transit operators and local jurisdictions) as well as the appropriate federal and state agencies to ensure its MTP conforms to all applicable state and federal regulations.

2022 Regional Growth Forecast

In 2019, AMBAG began the process of developing a new forecast with a horizon year of 2045. The regional forecast is based on an analysis of forecasted state and national industry growth compared to the region's historical share of each industry.

The disaggregation of the forecast at jurisdiction level uses shift-share methods for population and employment. These methods essentially calculate future years population and employment based on previous trends. The forecast disaggregation also takes into consideration local land use policies and was developed using a collaborative approach whereby AMBAG incorporated the input of local planners, elected officials and the public. The final forecast is scheduled for adoption in June 2022 along with the 2045 MTP/SCS. The SCS scenarios were developed using this population and employment forecast as a control total in consultation and collaboration with region's local and regional agencies. The technical documentation for the Regional Growth Forecast is included in Appendix A.

Other Key 2045 MTP/SCS Tasks

Other key major tasks include updates to the plan performance measures, environmental justice analysis, new revenue projections, revised cost estimates for projects, programs and services and integration of system and demand management measures into the scenarios. In addition, the 2045 MTP/SCS incorporates recommendations from recently completed or underway studies such as the Central Coast Highway 1 Climate Resiliency Study, 2021 Title VI Plan, 2018 Coordinated Plan, Monterey County Regional Conservation Investment Strategy (RCIS), Santa Cruz County RCIS, Monterey County Active Transportation Plan, various Safe Routes to School Plans, Monterey Bay Area Rail Network Integration Study, Monterey Bay Area Feasibility Study of Bus on Shoulder Operations on State Route 1 and the Monterey Branch Line, Unified Corridor Investment Study, Transit Corridor Alternatives Analysis & Rail Network Integration Study: Watsonville to Santa Cruz, Highway 9/ San Lorenzo Valley Complete Streets Corridor Plan, and Highway 25 Public Transit Study. Other studies that are relevant to the development of the new AMBAG model include the Monterey Bay Origin and Destination Study, the Santa Cruz METRO On-Board Survey, the California Household Travel Survey (CHTS), and the 2017 National Household Travel Survey (NHTS).

Modeling Methodology

Development of the Regional Travel Demand Model

This section provides a comprehensive description of the 2020 AMBAG Regional Travel Demand Model (RTDM) update. The 2020 AMBAG RTDM is an updated travel demand model estimated and calibrated to 2015 conditions. The model was updated to run on TransCAD Version 9.0, which is the latest released version of TransCAD. This insures that the model uses the most advanced and model version of TransCAD available and can take advantage of all updated TransCAD software and performance features. The model interface was updated to TransCAD's modern flowchart interface. The flowchart interface improves model, file, parameter and scenario management. The flowchart interface for the AMBAG model in Figure F-1.

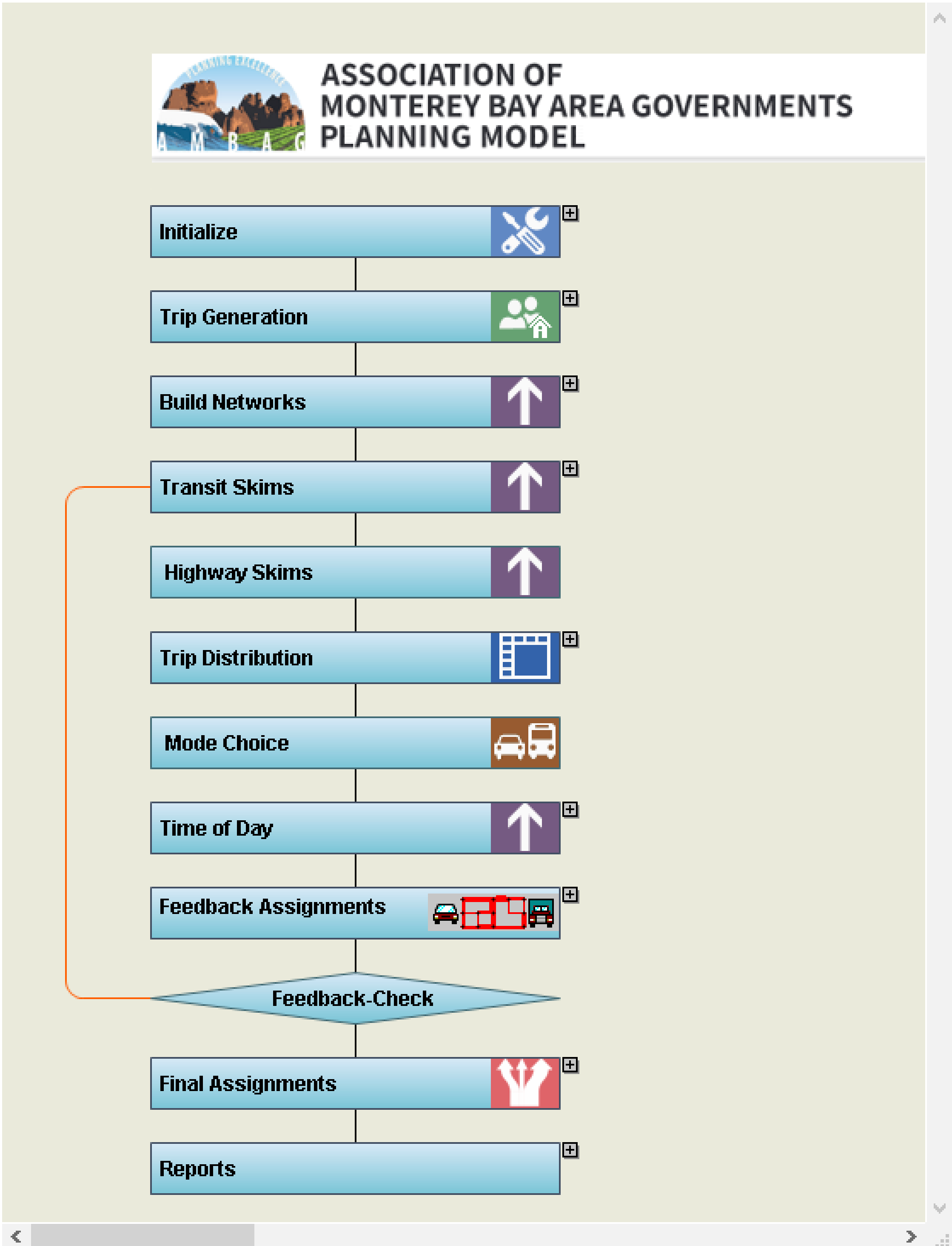
Travel Survey Datasets, and Model Estimation

The 2022 model update was estimated and calibrated using survey data from the 2010 CHTS and 2017 NHTS, Census, employment, and traffic data from that same year. The model utilizes innovative techniques to capture travel behavior at a more individual-based level and incorporates disaggregate level data into some of the modeling stages. The primary reasons for introducing more disaggregate level data into the model was to assist in addressing elements of SB 375, and to pave the way for a possible transition to a tour-based modeling approach in the future. This updated model is a traditional four-step trip-based approach, and as such includes models for Trip Generation, Trip Distribution, Mode Choice, and Trip Assignment. Specific differences compared with traditional approaches is described in more detail later in this document, include a population synthesis to drive the trip generation socioeconomic variables, calculation of the 4D variables (Density, Diversity, Design, and Destinations) using GIS techniques to support inputs to various model stages, the use of person-based trip rates, destination choice model for the trip distribution, and a mode choice component designed and estimated entirely from the survey. The model also employs a highly convergent traffic assignment algorithm.

The model is comprised of four primary time periods, an A.M. Peak Period defined as 6:00 A.M. to 9:00 A.M., a P.M. Peak Period from 4:00 P.M. to 7:00 P.M., a Mid-day Period from 9:00AM- 4:00 P.M. and an Evening Period from 7:00 P.M. to 6:00 A.M. The model is calibrated to Annual Average Daily Traffic (AADT) count data wherever available. The AADT calibration is based on summing the assigned flows for the four periods and comparing them against the AADTs from Caltrans and local jurisdictional count sources. The Percent Root Mean Square Error (%RMSE) is 29.82% system-wide, 15.91% on the freeways, and 23.68% on major arterials. As per the modeling guidance established by FHWA and various peer MPOs, the level of calibration of the current AMBAG RTDM is within the acceptable range and care has been taken to not over fit the base year model to observed conditions. Overall, the AMBAG RTDM maintains appropriate levels of sensitivity and forecasting ability.

Travel behavior in the AMBAG region is especially difficult to simulate for a variety of reasons. First, the region has a high variability in residential density and has a large rural component, particularly in the eastern and southern sections of the area. The region also has high income variability, which further complicates the process of linking the residential and employment zones so necessary to explaining travel behavior in the region. Heavy commuter travel and interregional travel to the San Francisco Bay area and a high number of people telecommuting complicate matters further. In addition, the region has a rich collection of tourist activities and special events occurring on weekends and during different seasons. There are also significant agriculture activities from farm workers making seasonal transient (field-to-field) trips and goods movements by freight modes such as trucks. The region experiences a wide variation in rural and urban characteristics with significantly longer trip lengths in rural areas resulting in higher VMT and peak spreading and a more rapidly aging population in and around coastal communities. The AMBAG RTDM has addressed these aspects well through the deployment of a disaggregated person-based trip generation model and a destination choice model for many of the home-based trip purposes.

Figure F-1: AMBAG Planning Model Flow Chart



Data, Surveys, and Studies Used in Model Development

Data from the recent American community Survey (ACS), Public Use Microdata Sample (PUMS) and Public Use Microdata Area (PUMA) from the US Census Bureau was used in the updated 2022 AMBAG RTDM. The AMBAG 2022 RGF, the 2011-12 CHTS, 2017 NHTS, Employment data procured from multiple sources (EDD, InfoUSA and Dun and Bradstreet), vehicle registration data from DMV, the 2012 External Origin Destination (OD) Study conducted by Fehr & Peers and Air Sage, the SCCRTC Onboard Transit Survey for the Santa Cruz METRO transit system, the City of Watsonville Transit Study, County and Caltrans traffic count data were used for the development, calibration, and validation of the model. In addition, reliable and validated output data from the neighboring MPOs (interregional commute components) and data from the agriculture vanpool program were utilized for the model development.

Following is a summary of the key modeling components and brief description of the methodology/approach applied in the 2022 AMBAG RTDM update.

Update to the Highway, Transit and Bicycle Networks for the 2015 Base Year, 2020, 2035 and 2045 Future Years

AMBAG Staff with the consultant assistant completed a comprehensive review and update to the highway, transit, and bicycle networks for the 2022 model update. AMBAG also employed a web based tool to engage local jurisdictions to review and ground truth key transportation network attributes such as speed, number of lane, and traffic counts. The latest data sets have exceptional geographic accuracy. The updated files include bicycle facilities and other geographic considerations pertinent to transit accessibility. For the 2015, 2020, 2035 and 2045 networks, the consultant worked with AMBAG, the RTPAs and Caltrans staff to determine which infrastructure improvements to include in each scenario.

Update to the Traffic Analysis Zone (TAZ) Data Layers

Utilizing current estimates and projections for future year socioeconomic characteristics pertinent to the model at various geographic scopes, AMBAG staff and the consultant generated attributes using GIS tools for the 2015 model base year and 2020, 2035 and 2045 future year TAZ data layers. The TAZ geography used in the updated model is an aggregation of 2010 Census Block boundaries. The geography is very similar to that submitted to the Census by AMBAG as part of the TAZ delineation process. The zone structure is comprised of 1,710 TAZs including 37 external zones that serve as the primary gateways to the study area. This consistency ensures a reliable calculation and transfer of important demographic data from the Census data files. Although the TAZ boundaries will remain the same for the horizon years (2035 and 2045) of the model, the socioeconomic characteristics may change significantly by jurisdictions within the region. AMBAG staff in consultation with the 21 local jurisdictions updated land use information for the base and future year TAZ data layers.

Population Synthesis

Anchoring the socioeconomic component of the model is a sophisticated nested population synthesis routine. This routine utilizes data at three levels to derive a synthetic population consistent with attributes found at the Census Block and Block Group levels. The routine utilizes the 5% PUMS from the Census and consistent with the PUMA boundaries. CHTS data points were also utilized to augment the PUMS data, requiring household weights to be re-calculated for the input PUMS data set. The population synthesis utilizes input data at the TAZ level and matches those household and population characteristics where ever possible. Household distributions by size of household, number of vehicles, and income group are matched. In addition, population by workers and non-works are matched.

The following attributes are output at the person and household levels and matched against the TAZ marginal estimates and are later used as inputs into the trip generation model:

For Households:

- Household Size
- Vehicles in Household
- Income Category
- Tenure (own or rent)
- Number of Children under 18 in Household
- Number of persons above 65 years of age in household

For Persons:

- Age
- Employment Status
- Sex
- Enrolled in School
- Education Level Attained
- Race
- Worker Status

Trip Generation Model

In developing the trip generation model, AMBAG, with the consultant's assistance, evaluated increasing the number of explanatory variables. In addition to auto availability, age, and household size, other geographic variables such as lifestyle considerations, presence of young children in the household, and the availability of recreational opportunities were explored for inclusion in the model. A final list of variables included is shown below.

The AMBAG region is a large and diverse area. To better handle such diversity, the AMBAG model estimates a person based trip rate model instead of a household based model. This includes the creation of a synthetic population for the AMBAG region detailing a discrete record of persons and their characteristics to which the trip generation model is applied. Applying person based trip generation models has several advantages. It increases the sample size of data used to estimate the models and better explains the variations in travel behavior. It also provides a better platform on which to quantify the 4D factors (Density, Diversity, Design, and Destinations) and prepares the foundation for a possible transition to an activity based model (ABM).

The above listed population synthesis output attributes are at the person and household levels and matched against the appropriate census aggregation (block or block group) and are used as inputs into the trip generation model.

The trip generation model forecasts trip productions and trip attractions at the zonal level for seven primary trip purposes: Home based Work (HBW), Home based Shopping (HBShop), Home based School (HBSchool), Home based University (HBUniv), Home based Other (HBOther), Non home based-work (NHBW), and Non home based other (NHBO), and Visitors (to shopping and tourism sites). NHBW refers to trips that are non-home-based but have one trip end at a work location. NHBO trips are similar except that neither end of the trip is a work location. The visitor model is split into two market segments: Visitors to Shopping sites (Visitor_Shop) and Visitor to Tourism sites (Visitor_Tourist). The visitor purposes are the only models not fully supported by the travel survey. They are based on previous AMBAG modeling efforts with some modification.

Interregional Trip Estimates and the Assumptions

AMBAG recently conducted an Origin Destination (OD) study using two different methodologies as well as weeklong classified traffic counts. The OD survey results using license plate video survey were used to account for External-External (X-X), External-Internal (X-I), and Internal-External (I-X) and was validated with traffic counts. To develop interregional highway volume at external gateways for the 2022 AMBAG RTDM, staff consulted with neighboring MPO modeling staff (Metropolitan Transportation Commission [MTC], San Luis Obispo Council of Governments and Merced County Association of Governments) to ensure maximum consistency between MPO's assumed gateway volumes. After a careful review of methodology used in the MTC's Plan Bay Area 2050 (PBA 2050), AMBAG adopted MTC's interregional gateways volume assumptions for 2045 MTP/SCS. MTC and AMBAG staff conducted a historical trend analysis for all the common regional gateways, looking at volumes of both commute and non-commute travel. In the PBA 2050 and AMBAG's 2045 MTP/SCS trend line analysis was used to continue scaling up volumes at regional gateways for non-commute travel to reflect increased freight, recreational, and other non-commute trip growth in the Northern California megaregion, while commute trips were assumed to remain fixed at year 2015 levels. Most recent travel demand model update for AMBAG and SLOCOG was conducted under the joint ABM project and same regional gateways volumes were rolled in to 2022 AMBAG RTDM. A table of key regional gateways with baseline and future year volumes used in 2022 AMBAG RTDM is listed in Figure F-2 below.

Figure F-2: Regional Gateways with Volumes

Regional Gateways with Volumes				
ID	**External Gateways**	**2020**	**2035**	**2045**
9005	US 101 (AMBAG North)	98,000	102,220	107,668
9003	Santa Cruz Highway (CA 17)	57,000	53,252	52,012
9007	CA 156 @ 152 E	42,300	39,666	41,710
9006	CA 152-101	29,000	30,248	31,860
9009	US 101 (AMBAG South)	22,600	22,600	35,822
9004	CA 152	6,700	6,326	6,440
9001	CA Route 1 (AMBAG North)	5,000	3,460	3,064
9002	Congress Springs Road SR 9	3,700	2,278	1,990
9010	CA Route 1 (AMBAG South)	2,700	2,700	4,224
9056	Skyline Blvd. SR 35	1,050	1,050	1,050
9008	CA 198	700	700	700

Trip Distribution (Destination Choice Model)

The AMBAG RTDM deployed two primary trip distribution models, a destination choice model and a gravity model for this model component. Traditionally, distribution models have primarily utilized a formulation of a gravity model. Unfortunately, the gravity model's aggregate nature limits its ability to capture the range of individual destination choice behaviors manifested by the population. A destination choice modeling approach has the potential to introduce more behavioral realism and hence generate trip tables that are closer to reality and more sensitive to smart growth land use policies.

A destination choice model also can include variables not typically present in a traditional gravity model. For instance, the home-based-work trip purpose gravity model can be replaced with a work location choice model for workers that predict their work zone. Another clear advantage of the destination choice model is that accessibility measures can be directly input as variables to the choice models. Finally, destination choice models will eliminate the need for ad-hoc adjustments such as the use of K-factors in the gravity model.

Gravity Model

The mode choice model was evaluated to explore avenues for enhancing its structure, utility specifications, and coefficients. Model parameters were compared against Federal Transit Administration (FTA) guidelines to document any instances of values that fall outside of the ranges suggested by the guidelines. Nevertheless, it should be noted that the most appropriate model parameters for the AMBAG region were obtained by re-estimating the model from the latest CHTS and Census data. The non-uniform travel characteristics, demographics, and population densities of the region meant that additional improvements for optimizing the mode choice component of the travel demand model had to be incorporated. Shortest paths were computed from zone to zone based on travel time and estimated congested travel times were skimmed from the least cost paths utilized in the traffic assignment stage. Intra-zonal travel times were computed based on the average time to the nearest 3 zones.

The balanced productions and attractions were obtained from the trip generation stage.

Friction Factor Computation

To compute the friction factors, the origin and the destination zone for each trip in the survey data was obtained using the analysis tools in TransCAD. The trip length for each trip was determined based on the shortest path matrix. Using the survey weights, the trip length frequencies were determined on a minute by minute basis for each of the trip purposes. The trip frequencies were plotted versus trip travel time intervals, and gamma function curves were fitted to match the observations. It was generally observed that the best fit was obtained by using two sets of gamma curves for each trip purpose. One curve was used to model the initial and the peak region of the observations (generally around 1 – 15 minutes) and the other curve was employed to model the tail region of the observations (> 15 minutes). The trip interval used to aggregate trip frequencies was 1 minute for all trip purposes. Friction factors were estimated for both Urban and Rural zone sets due to significant differences in observed trip lengths and travel behavior in the CHTS.

Mode Choice Model

The updated mode choice model for the AMBAG RTDM utilizes a nested logit-based model structure. The model is fully estimated using the combined 2010 CHTS and 2017 NHTS survey records and as such only includes variables found to be significant. For the model update, one of the objectives was to estimate mode choice models that include 4Ds explanatory variables, the idea being that the model should be responsive to these parameters.

The mode choice model was evaluated to explore avenues for enhancing its structure, utility specifications, and coefficients. Model parameters were compared against Federal Transit Administration (FTA) guidelines to document any instances of values that fall outside of the ranges suggested by the guidelines.

Independent Variables, A-priori Hypotheses, and Estimation Setup

The combined household survey was analyzed to identify variables that might be useful in explaining mode choice behavior in the AMBAG area. In addition, various zonal and OD-based skim variables were tagged to the survey to include the effects of geographic context, accessibility and network congestion.

At the zonal level, a Central Business District (CBD) dummy was generated to capture the unobserved and perceived benefits of destinations in the more urbanized areas of Santa Cruz, the Monterey Peninsula, and Salinas. Average transit stop densities were also computed at both the origin and destination ends of trips. Parking cost at the destination trip end was considered for the auto modes, with half the cost used for carpool trips. However, these effects were found to be either insignificant or resulted in counter-intuitive coefficient signs.

Congested highway and transit skims (including in-vehicle and egress walk times) were tagged to the survey, making sure that AM and PM peak period trips used the skims from the appropriate time of day. Highway skims were used for the school bus mode.

Even with the additional records that were available in the combined survey, the dataset contained limited trip records that used transit as the mode of travel. This data limitation meant that the transit mode could not be reliably estimated. A practical work-around to include transit in the mode choice models is discussed later.

Weighted nested and multinomial logit model estimations were conducted using the Nested Logit Estimation procedure. Adjusted rho squared ($(\bar{\rho})^2$) values, denoted henceforth as rho_bar_squared, are reported as a measure of model fit to the survey data. Standard t-statistics are presented as an indicator of the relevance of the different variables in the mode choice context.

Mode Choice Model Estimation Results

This section summarizes the final estimated model specifications and utility coefficients identified for various trip purposes. One objective was to estimate separate mode choice models for the peak and off-peak periods. However, no significant difference was observed for any of the purposes. A combined model was therefore estimated for each of the purposes.

The estimated models are a series of logit models (multinomial or nested) that vary by trip purpose and by peak/off-peak periods. For most purposes, the following travel modes are estimated:

- Auto drive alone
- Auto shared ride (carpool)
- Walk
- Bike

School Bus and Other modes were added as needed to capture purpose-specific situations.

As stated earlier, the limited sample sizes in the travel survey (particularly with transit as the chosen mode) prevented a deeper nesting structure, the estimation of more sub-modes, and the inclusion of variables such as transit fare and transit in-vehicle travel time. Asserted models give you the ability to define more detailed and complex models, however their parameters and coefficients may not be consistent with survey observations.

A full complement of mode-specific constants was estimated in each case, typically using the bike mode as the base. Where the t-statistics of the constants were found to be low, they were still retained (at a lower confidence level) to maintain model estimation integrity in the face of missing variables.

In some cases, the Auto nest (comprised of Drive Alone and Shared Ride modes) was retained in the model while the corresponding logsum coefficient was fixed at 1. This was done because the estimation procedure did not identify a coefficient significantly different from 1.

Systematic utilities for the various modes are denoted by V_DA(Drive Alone), V_SR(Shared Ride), V_Bike, V_Walk, V_SB(School Bus) and V_Transit.

The mode choice constants were subsequently re-calibrated to better match the weighted shares observed in the household survey. Separate sets of constants were estimated to differentiate between peak and off-peak effects.

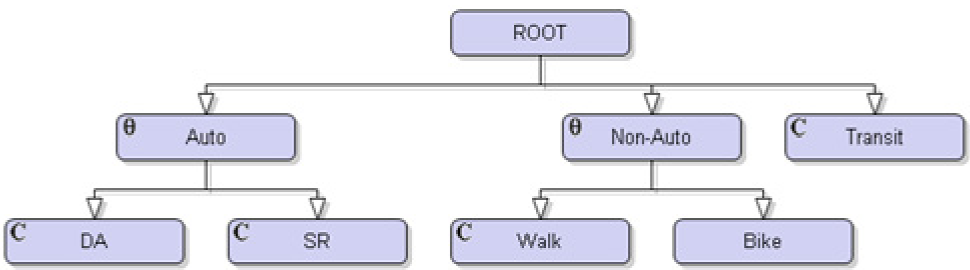
Figure F-3: Mode Choice Model Coefficients

Mode Choice Model Coefficients	
Coefficient	**Description**
C_DA	Mode-specific constant for Drive Alone
C_SR	Mode-specific constant for Carpool
C_Walk	Mode-specific constant for Walk
C_Bike	Mode-specific constant for Bike
C_SB	Mode-specific constant for School Bus
C_Transit	Mode-specific constant for Transit
B_Time	Generic travel time coefficient
B_Time_DA	Travel time coefficient for Drive Alone
B_Time_CP	Travel time coefficient for Carpool
B_Time_Other	Travel time coefficient for Transit and Non-Motorized modes
B_TransitAccess	Coefficient for transit accessibility to jobs
B_Egress	Coefficient for transit egress time
B_CBD	Coefficient for CBD dummy
B_Park	Coefficient for auto parking cost at the destination zone
B_AOC	Coefficient for cost-per-mile auto operating cost
B_Monterey	Coefficient used to better capture un-observed transit travel behavior unique to trips interacting within the MST service area (NHBO trips only).
B_TotEmpDensity	Coefficient for total employment density at trip origin
B_IntDensity	Coefficient for intersection density at trip origin
B_StopDensity	Coefficient for transit stop density at trip origin
B_Diversity1	Coefficient for retail, service employment and HH diversity at trip origin
B_Diversity2	Coefficient for retail employment and HH diversity at trip origin
B_JobMixDiversity	Coefficient for job mix diversity at trip origin
B_RSE_Density	Coefficient for retail and service employment density at trip origin
Theta (Auto)	Logsum coefficient for Auto nest
Theta (Non-Auto)	Logsum coefficient for Non-Auto nest

Many 4Ds variables were considered in the mode choice models. Of the 4Ds variables tested, only the total employment density variable was ultimately included as the one having sufficient explanatory power and being statistically significant. The limited sample size of trip records in the survey may have played a role in the lack of 4Ds variables successfully included, while the CBD dummy showed greater explanatory power than other 4D variables tested.

Note that the bus mode is used as the base alternative with a mode specific constant of zero. The nesting structure of each model, along with a list of each model variable and coefficient and rho-squared result, is presented below:

Figure F-4: Model Structure



While the equations above indicate separate skims for HOV and general-purpose travel lanes, no such distinction exists in the AMBAG highway network. The highway skims and highway HOV skims were assumed to be the same for model estimation. The utility specification still allows the flexibility to use HOV-specific skims in the future.

Figure F-5: Mode Estimates

Mode Estimates	
Coefficient	**Estimate**
C_DA	5.33
C_SR	4.35
C_Walk	4.77
C_Transit	-0.35
B_Time	-0.0078
B_TotEmpDensity	0.056
B_WalkDist	-1.181
B_BikeDist	-0.871
B_StopDensity	0.0059
B_TransitAccess	0.069
B_JobMixDiversity	0.114
B_AOC	0.0054
B_ParkCost	-0.026
Theta (Auto)	0.63
Theta (Non-Auto)	0.15
Rho_bar_squared	0.43

It should be noted that the transit mode was never chosen for any of the HBW trips in the survey. A transit mode was subsequently added to the estimated model to allow AMBAG to test for transit effects in scenario analysis. The generic travel time coefficient from the other modes was transferred to the transit mode, and local knowledge was used to estimate it's constant to produce a 1.5% transit mode share. The following tables shows observed and modeled mode shares by trip purpose, after adjusting the mode specific constants to better replicate the shares indicated in the household survey and to account for modes that were underreported in the survey.

Figure F-6: Observed Peak Mode Shares by Trip Purpose

Observed Peak Mode Shares by Trip Purpose								
Trip	Drive-Alone	Shared Ride	Walk	Bicycle	Transit	School Bus	Other	Total
HBW	77.5	16.5	2.4	1.5	1.9	0	0	100
HBShop	35.6	52.5	8.1	2.7	1.1	0	0	100
HBSchool	2.1	50.2	33.1	4	10.6	9.3	0	100
HBUniv	55.3	11.7	1.3	12.8	18.9	0	0	100
HBOther	25.9	54	15.3	3.1	1.2	0	0.5	100
NHBW	70.3	19.5	7.7	0.5	0.7	0	1.3	100
NHBO	26.2	58.9	9.7	0.2	0.7	0	0.3	100

The corresponding shares from the AMBAG model are presented below, showing an accurate replication of the survey data:

Figure F-7: Modeled Peak Mode Shares by Trip Purpose

Modeled Peak Mode Shares by Trip Purpose								
Trip	Drive-Alone	Shared Ride	Walk	Bicycle	Transit	School Bus	Other	Total
HBW	77.5	16.5	2.5	1.6	1.9	0	0	100
HBShop	35.5	52.4	8.2	2.7	1.2	0	0	100
HBSchool	2.1	49.8	33.6	3.9	0	10.5	0	100
HBUniv	55.8	11.9	1.3	12.7	18.2	0	0	100
HBOther	25.8	53.9	15.4	3.1	1.3	0	0.5	100
NHBW	70.3	19.4	7.8	0.5	0.7	0	1.3	100
NHBO	27.2	61.2	10.3	0.2	0.7	0	0.3	100

Off-Peak Models

Figure F-8 shows the target mode shares for off-peak-period trips:

:

Figure F-8: Observed Off-peak Mode Shares by Trip Purpose

Observed Off-peak Mode Shares by Trip Purpose								
Trip	Drive-Alone	Shared Ride	Walk	Bicycle	Transit	School Bus	Other	Total
HBW	76.6	14.6	5.1	2.3	1.4	0	0	100
HBShop	32.4	56.6	8.3	1.6	1.1	0	0	100
HBSchool	2.8	49.4	37.7	4.4	0	5.7	0	100
HBUniv	68.1	9.5	2.8	11.4	7.9	0	0	100
HBOther	29.5	53.1	13.3	2.6	1	0	0.5	100
NHBW	68.6	14.1	10.4	1.6	3.4	0	1.9	100
NHBO	29.4	58	10.3	1	0.6	0	0.7	100

The corresponding shares from the AMBAG model are presented below, showing an accurate replication of the survey data:

Figure F-9: Modeled Off-peak Mode Shares by Trip Purpose

Modeled Off-peak Mode Shares by Trip Purpose								
Trip	Drive-Alone	Shared Ride	Walk	Bicycle	Transit	School Bus	Other	Total
HBW	76.5	14.6	5.2	2.3	1.4	0	0	100
HBShop	32.3	56.5	8.4	1.6	1.2	0	0	100
HBSchool	2.8	49	38.3	4.3	0	5.6	0	100
HBUniv	68.1	9.7	2.9	11.4	7.9	0	0	100
HBOther	29.4	53	13.4	2.6	1.1	0	0.5	100
NHBW	68.5	14	10.5	1.6	3.6	0	1.8	100
NHBO	29.3	57.8	10.5	1	0.6	0	0.7	100

*The mode choice model was adjusted to yield observed ridership shares not represented in the survey. For HBUniv trips, the output shares were adjusted using guidance from a 2012 Santa Cruz METRO on-board travel survey. For HBW trips, the regional target transit share was assumed to be in the vicinity of 1%.

Truck Model

A simplified truck model was inserted into the model stream to estimate Internal-to-Internal truck trips. IX-XI truck trips and XX truck trips are already factored into the model since the IX –XI and XX trips are based on external station traffic counts that include truck trips. The truck model is based on The Southern California Association of Government's (SCAG) 2003 truck model, which estimates truck trip rates based upon employment variables. The employment categories were re-categorized into the AMBAG employment categories, and the trip rates were then re-estimated based upon the AMBAG employment categories. Truck trip generation, distribution, and time-of-day models were added to the model stream. The truck distribution model utilized a Gravity Model with separate friction factor curve definitions for light, medium, and heavy trucks. The friction factors are calculated using a generalized cost formulation that considers operating cost per hour (dollars), fuel efficiency (miles per gallon), operating cost per distance (dollars), and fuel price (dollars per gallon).

Time of Day Analysis

A major upgrade to the model is the deployment of time period and trip purpose specific parameters. This includes the utilization of separate peak and off peak period skims, and model parameters. This approach provides a superior explanation of peak and off peak travel patterns throughout the region

AMBAG worked closely with Caltrans, and other relevant regional and local agencies to determine the most appropriate day and time periods for modeling. The model uses the following time periods:

- A.M. peak hour and period (6:00-9:00 A.M.)
- P.M. peak hour and period (4:00-7:00 P.M.)
- Mid-day (9:00 A.M.-4:00 P.M.)
- Night (7:00 P.M.-6:00 A.M.)

Using the available count data, the AMBAG RTDM was calibrated for each of the time periods shown above.

Highway and Transit Assignment

For highway assignment the AMBAG RTDM utilized a state of the practice and highly convergent traffic assignment methodology known as Origin-Based User Equilibrium. This method improves significantly on previous highway assignment methods by providing a more stable solution to the highway assignment problem. This provided AMBAG RTDM with the ability to more accurately quantify project benefits and explain the highway assignment results in a clearer context.

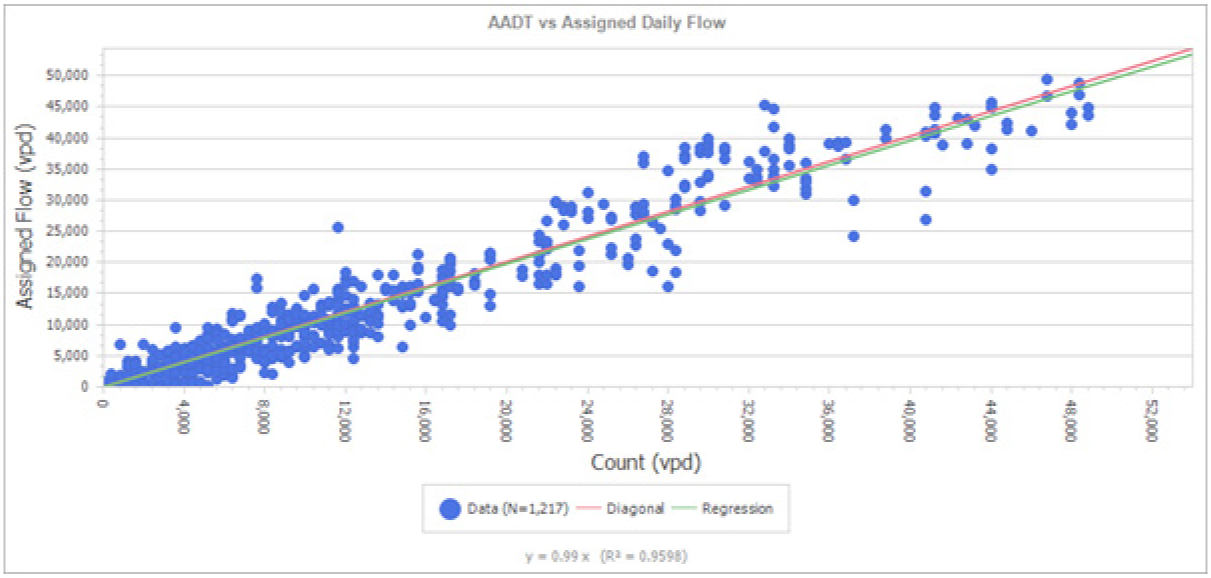
In the highway assignment step, trips from the origin destination matrix are assigned to the highway network to determine flows on links and route choices between any origin and destination. In the AMBAG model, four assignments are performed: A.M. peak period trips (6:00-9:00 A.M.), P.M. Peak period trips (4:00-7:00 P.M.), Mid-day (9:00 A.M.-4:00 P.M.), and Evening/Night (7:00 P.M.- 6:00 A.M.).

Model Performance

The following model performance criteria were used to calibrate the model:

- Graphically display a scattergram of model daily volumes versus average annual daily traffic (AADT). The volumes should be in line with the AADT, with few outliers.
- Calculate the correlation and R2 between model volumes and counts. R2 values should be greater than 0.88. The correlation between daily counts and model flows was 0.95.
- Compare model flows versus counts by functional class and volume group type. Model volumes should be within certain standard percentage ranges of counts within the groupings.
- Compute Root Mean Square Error (RMSE) between volumes and counts. Volumes should be within certain stand RMSE values within the groupings.

Figure F-10: Model Daily Volumes versus AADT



Daily Model Volumes vs. Counts, %RMSE by Functional Class

Transit assignment was performed using TransCAD's Pathfinder methodology. This methodology is a generalization and significant improvement of the highly-regarded Optimal Strategies approach and far superior to typical Urban Transportation Planning System (UTPS) methodologies. The transit assignment includes walk and bike access, along with park and ride functionality for both access (A.M.) and egress (P.M.). The Pathfinder methodology has been deployed successfully across the United States, and has gained wide acceptance from the FTA. For the transit assignments peak and off-peak transit trips are assigned separately and then aggregated for time of the day assignments into a total transit flow table.

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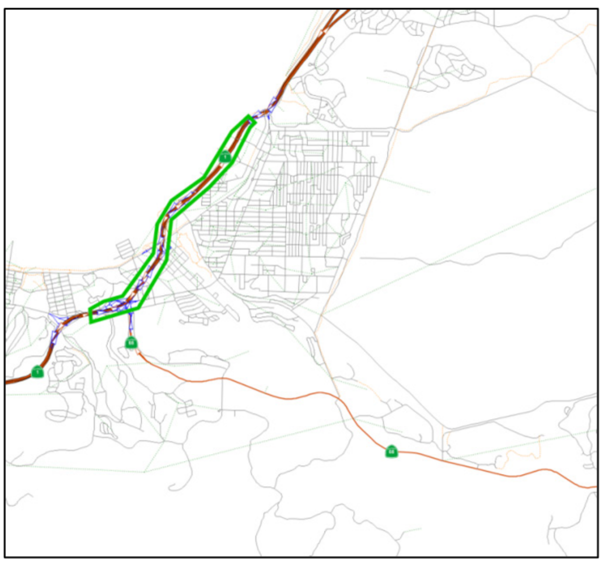
Figure F-11: Daily Model Volumes versus Counts, % RMSE by Functional Class

Daily Model Volumes vs. Counts, % RMSE by Functional Class					
Link Type	**Segments**	**Total Count**	**Total Flow**	**% Difference**	**% RMSE**
Freeways	97	3,152,660	3,235,057	2.61	15.91
Major Arterials	416	5,621,781	5,548,051	-1.31	23.68
Minor Arterials	320	1,491,063	1,270,568	-14.79	46.64
Major Collectors	172	556,229	334,137	-39.93	65.44
Minor Collectors	58	87,937	68,994	-21.54	63.12
Local Roads	110	155,238	84,742	-45.41	87.31
Ramps	22	105,199	103,542	-1.58	44.87
All Counts	1,217	11,386,939	10,860,735	-4.62	29.82

Feedback

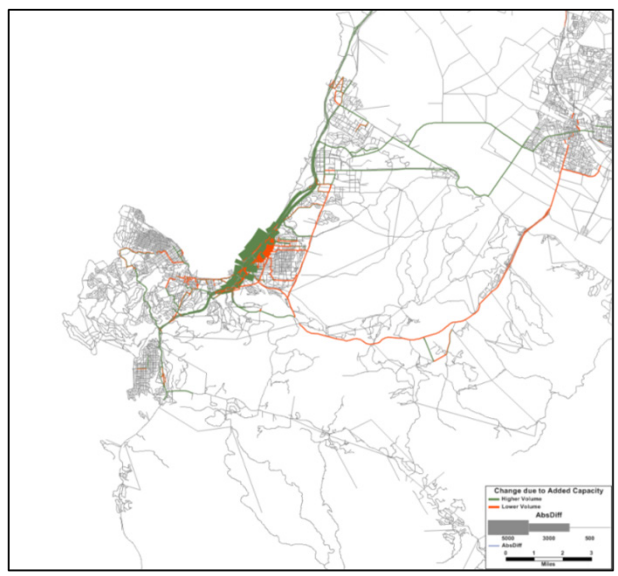
After the end of the highway assignment step, the congested travel times are used to update the input travel times into the both the highway and transit networks. Both the highway and transit skimming routines then use these congested times to produce congested highway and transit skim matrices. The logic of feedback is that the congested times are a more accurate measure of travel time than the initial free flow times, and can have a profound effect on the trip distribution and mode choice stages steps. During the feedback process, all models following the skimming stage are run again until an updated set of congested times is found following the highway assignment. This loop continues until a set number of feedback iterations are completed. The Multiple Successive Averages (MSA) method is used to calculate the congested time resulting from each feedback iteration. A total of 5 feedback loops are performed in the AMBAG RTDM. Five loops were found to be sufficient to ensure stability in the final solution. Due to the peak period definitions and the high variance in flow at the start of the peak and the remaining hours, skims for the peak period utilized AM skims derived from the hours 7:00-9:00 A.M. The assignment results are reported for all three hours of this period, however. Mid-day skims are used for the off-peak periods, utilizing a four-hour capacity.

Figure F-12 : Highway 1 Widening 4 to 6 lanes



CA 1 was widened within the area highlighted in green. The associated capacity per lane, speed, etc. were automatically updated based on the lookup table by facility type and number of lanes.

Figure F-13: Area of Influence for Widening Project



The magnitude, direction and area of influence for the widening is appropriately sensitive for traffic assignment. Distribution and mode choice were not investigated since the widening was limited and few alternatives are available in the corridor.

Sensitivity Testing Results

AMBAG with the help of consultant (Caliper and Fehr and Peers) jointly conducted a model sensitivity test for modified land use changes (density and diversity), added highway capacity, transit fare, and additional bus rapid transit (BRT)/light rail transit (LRT) transit services using the update 2045 No Build RTDM.

The conclusions of these tests demonstrate the model's sensitivity to land use and transportation changes. For changes where the model is not sensitive, potential enhancements or post-processing methods is recommended. For additional technical details please refer to the 2022 AMBAG RTDM Technical Documentation Report.

Added Roadway Capacity

The model is appropriately sensitive during traffic assignment for roadway widening projects in terms of route selection. The influence of roadway capacity on trip generation, distribution, mode choice, and GHG emission were not evaluated.

Modified Land Use

The changes in land use and the formulation of the mode choice model were not significant enough to cause a change in mode. As a result, the implication of the land use change on VMT is determined by the location and magnitude of the land use rather than the density, diversity and other D factors. Post-processing for active transportation, Transportation Demand Management (TDM), and density were recommended to apply where necessary for 2045 MTP/SCS.

Added Transit Service and Fare Change

The model is not sensitive to changes in transit services and fare change (free transit or double the existing fare). The mode choice model estimation based on survey data resulted in a fairly static mode split model. As such, the change to transit shifted trips from local bus to BRT or LRT, but overall mode shares remained constant. Although these tests were conducted in isolation to determine model sensitivity, it is recommended that scenarios be developed to maximize the sensitivity by incorporating multiple strategies cohesively. For example, additional infill or density should be accompanied with enhances transit service along the route, and stops should be placed within walking distance.

Off-Model Adjustments

Off-model adjustments are commonly used to evaluate and estimate VMT/GHG emissions reductions from various strategies to which regional travel demand models (RTDM) and land use models are not sensitive. These off-model adjustments are based on evidence from empirical research that demonstrate the potential for VMT/GHG emissions reductions from particular strategies found in 2045 MTP/SCS.

Figure F-14 provides a summary of projects by category as they are included in the 2045 AMBAG MTP/SCS preferred scenario. All together the 2045 MTP/SCS includes 855 projects and total committed funding for SCS implementation is $13.5 billion (in today's Dollars). As shown in the table below, over $11.3 billion (84%) of the AMBAG 2045 MTP/SCS preferred scenario investment is dedicated to transit, roadway operation and maintenance, and other alternative mode of transportation improvements (TDM, TSM and Active Transportation) with supportive infill and higher density mixed land use development. It is expected that the 2045 MTP/SCS with the substantial investment in these non-modelable projects and programs will accelerate the implementation of the adopted SCS and promote sustainable modes of travel, clean vehicle technologies and traffic operational improvements (ITS/TSM) with in the Monterey Bay Area which will help improve air quality.

Figure F-14: Summary of Projects by Category in the 2045 MTP/SCS Preferred Scenario

Expenditures by Project Categories *	Total in Today's Dollars
Active Transportation / Transportation System & Demand Management- Total	**$1,235,005**
Active Transportation (AT)	$998,515
Transportation Demand Management (TDM)	$127,238
Transportation System Management (TSM)	$109,252
Roadways & Other Projects - Total	**$8,280,759**
Highway - New Capacity	$1,595,185
Highway - Operations & Maintenance	$1,959,444
Local Streets and Roads	$602,115
Local Streets and Roads - Operations & Maintenance	$3,478,389
Other	$645,626
Transit - Total	**$4,023,970**
Paratransit Operations and Capital	$514,069
Transit - New Capacity	$614,124
Transit - Operations	$2,406,729
Transit - Fleet Rehab and Capital	$489,048
Grand Total	**$13,539,734**

* Total Expenditures by Project Type (all figures in 1,000's)
Source: AMBAG, SBtCOG, SCCRTC and TAMC

2045 MTP/SCS Off Model Strategies

Where the impacts of certain policy scenarios cannot be measured in the 2022 RTDM, AMBAG relied on “off-model” techniques based on academic literature reviews, collaboration with other MPOs and consultation with CARB’s Policies and Practices Guidelines.

Off-model adjustments were made for three programs or bundles of projects that are included in the 2045 MTP/ SCS:

1. Work From Home (WFH)
2. Travel Demand Management (TDM): such as Agriculture workers vanpool program, employer-based trip reduction, ridesharing, and car sharing programs3. Compute Root Mean Square Error (RMSE) between volumes and counts. Volumes should be within certain stand RMSE values within the groupings.
3. Regional Electric Vehicle Chargers and Electric Vehicle (EV) Incentive programs
4. Transportation System Management (TSM) such as intersection improvements, round about development, ramp metering, variable message signs, incident management, and deploying Intelligent Transportation Systems (ITS)
5. Active Transportation (AT) projects, education and promotional programs, and;

6. Transit enhancements and mix land use development around High Quality Transit.

All these six strategies were also included in the region's previous 2035 and 2040 MTP/SCS. Continuing implementation of these VMT and GHG reduction strategies with modification as well as allocating more funding will help not only achieving region's GHG target but it will further improve environmental quality of the region and provide enhance mobility options to citizens and businesses.

In the 2045 MTP/SCS, the primary GHG emission calculation methodology and approaches remain unchanged but the data used for inputs and assumptions have been updated to reflect current condition with new data and research where available. The GHG emission quantification approaches and results are summarized in the following section by strategy.

Working From Home

The new "working-from-home economy," which is likely to continue long past the coronavirus pandemic that spawned it, poses new challenges – from a ticking time bomb for inequality to an erosion of city centers – according to Stanford economist Nicholas Bloom.

The survey results from several nationwide surveys conducted during the COVID-related economic shutdown provide a snapshot of the emerging new reality.

- Forty-two percent of the U.S. labor force is now working from home full time, accounting for more than two-thirds of economic activity, while another 33 percent are not working — a testament to the savage impact of the lockdown recession. The remaining 26 percent are working on their business's premises, primarily as essential service workers.
- As companies consider relocating from densely populated urban centers in the wake of the COVID-19 crisis, cities may suffer while suburbs and rural areas benefit.
- Several corporations are developing plans for more work-from-home options beyond the pandemic. Working from home is here to stay, but post-pandemic will be optimal at about two or three days a week.
- The Atlanta Federal Reserve and the University of Chicago indicated that the share of working days spent at home is expected to increase fourfold from pre-COVID levels, from 5 percent to 20 percent. Typical plan is that employees will work from home one to three days a week and come into the office the rest of the time.

Figure F-15 provides estimated VMT/GHG reductions as a result of 15% of the Monterey Bay region workers of the WFH employment categories are estimated to work from home for the year 2020 and 2035.

Figure F-15: Work at Home Off-Model Adjustments

Work at Home Off-Model Adjustments		
Category	**2020**	**2035**
Total Workers	180,870	191,829
% work at home Modeled	5.00%	5.00%
Work at home workers	9,044	9,591
Off-Model Adjustments		
% work at home	20.00%	15.00%
Work at home workers	36,174	28,774
Additional work at home workers	27,131	19,183
Miles reduce per weekday	15	15
VMT reduce per weekday	406,958	287,744
GHG reduce per weekday	374,490	259,174
% GHG Reduction	2.71%	1.81%

Source: AMBAG Regional Growth Forecasts (public/government sector, self-employed, service and education)* and AMBAG RTDM

Travel Demand Management (TDM)

Regional Transportation Planning Agencies (RTPAs), CalVans and other agencies within the Monterey Bay area have coordinated agriculture and general vanpools, car share and bike share programs to encourage people to use alternative commute option with help reduce roadway congestion and GHG emission from transportation sector. The CalVans(https://calvans.org/), a California Vanpool Authority sponsored agency, operates an agriculture vanpool program in the Monterey Bay area as well as other parts of the California. General vanpool program recruitment has consisted of online passenger and driver matching, employer outreach, startup subsidy to encourage continued participation when a passenger is lost, discounted/free parking permits, and various other incentives. In 2015, there were 82 agriculture vanpool fleet in operation within the Monterey Bay Area. Each van carries an average of 12 workers with average of 40 miles of round trip per day. The vanpool program was included in previous MTP/SCS plans and all the operators within the Monterey Bay area are projected to continue supporting vanpool program in 2045 and beyond.

AMBAG assumes this incentive will significantly increase the vanpool fleet. Combined with growth in Monterey Bay Area population, employment, and community's commitment for VMT/GHG reduction, the size of the AMBAG area vanpool fleet is expected to reach 318 vans by 2035 and 379 vans by 2045, after which the number of vanpools is assumed to stabilize. Region's RTPAs works with vanpool groups, CalVans, University campus, commute with Enterprise and other vanpool operators, to provide technical assistance such as ride matching tools, identification of incentives (e.g., parking and bridge toll discounts), and social media promotional resources to help form and fill vanpools. Figure F-16 summarizes the VMT/GHG reductions realize from CalVans agriculture vanpool program only.

Figure F-16: Agriculture Vanpool Program Related to VMT/GHG Reduction

Agriculture Vanpool Program related VMT/GHG reduction		
	2020	**2035**
Agriculture Vans	228	318
Round Trip Miles	40	40
Average Passenger/Van	12	12
Total VMT driven	9,120	12,720
VMT Reduction (12-1=11 persons)	100,320	139,920
GHG Reduction (Lbs)	92,316	126,028
Per Capita GHG reduction	0.67	0.88

Average occupancy = 12 people, Average round trip in Mile = 40 Miles

Source: CalVan (Agriculture Vanpool provider)

Regional Electric Vehicle Chargers and Electric Vehicle (EV) Incentives

Electric vehicles (EVs) have the potential to significantly reduce GHG emissions from motor vehicles. In the Monterey Bay Area, Central Coast Community Energy (CCCE) and the Monterey Bay Air Resources Board (MBARD) public agencies are providing below listed programs to promote EV including both plug-in hybrid electric vehicles (PHEVs), battery electric vehicles (BEVs), and associated EV service equipment (EVSE).

1. Electric Vehicle Incentive Program – BEV purchase/lease rebate (MBARD)
2. Electrify Your Ride – incentive for BEV or PHEV and EVSE (CCCE)
3. Electric School Bus Program (CCCE)

The costs of installing charging stations can be high, and there are other barriers (e.g., onsite electrical capacity) that may also limit the potential for deploying charging at workplaces. These programs are designed to help overcome EV adoption barriers by providing financial assistance to residents, interested employers, retailers, parking management companies, etc. A regional network of charging infrastructure will provide drivers an opportunity to plug in while at work, which is where most vehicles spend their time parked when not at home. This will mean that PHEVs are able to travel more miles using electricity and fewer miles using gasoline, reducing GHG emissions. CCCE believes programs like Electrify Your Ride makes clean vehicles more affordable and accessible across all income groups in Monterey Bay Area region.

Electrify Your Ride – EV and EV Charger Rebate Program by CCCE

The Electrify Your Ride Program offers incentives for new/used BEV or PHEV, and for the purchase and install of Level-2 EV charging equipment. Eligible applicants include homeowners, property owners, commercial businesses, and public agencies. CCCE understands that making the switch to electrifying our transportation and buildings may include updating or replacing electrical panels on older buildings.

As per the Figure F-17, CCCE invested $2.4 million into the tri-county over the past two years and will continue investing.

Figure F-17: Cumulative Financial Incentive Provided by CCCE

Cumulative Financial incentive provided by CCCE						
Program Type	**CCCE Program**	**Customer Type**	**Monterey**	**San Benito**	**Santa Cruz**	**Total**
Electric Vehicle	Electric School Bus Program	Public Agency	$646,936	-	$191,165	$838,101
Electric Vehicle	Electrify Your Ride Program	Commercial	$5,000	$2,000	-	$7,000
Electric Vehicle	Electrify Your Ride Program	Public Agency	$4,000	-	$2,000	$6,000
Electric Vehicle	Electrify Your Ride Program	Residential	$225,800	$23,000	$213,700	$462,500
Electric Work	Electrify Your Ride Program	Commercial	-	-	$1,986	$1,986
Electric Work	Electrify Your Ride Program	Residential	$27,121	$5,910	$42,847	$75,878
EV Charger	Electrify Your Ride Program	Commercial	-	-	$1,986	$1,986
EV Charger	Electrify Your Ride Program	Residential	$13,200	$4,856	$19,409	$37,465
EV Charger	Central Coast Incentive Project	Commercial	$180,308	$106,947	$712,745	$1,000,000
Grand Total	**-**	**-**	**$1,102,365**	**$142,713**	**$1,185,838**	**$2,430,917**

Source: CCCE Energy Programs-Annual Reporting FY 20/21

AB 2766 Motor Vehicle Emission Reduction Grants

California Assembly Bill 2766 (AB 2766), signed into law in 1990, permits Monterey Bay Air Resources District (MBARD) to allocate a $4.00 per vehicle registration surcharge fee towards grant projects that reduce motor vehicle emissions such as roundabouts, adaptive traffic signal control systems, medium to heavy-duty vehicle electrification and light-duty zero emission vehicle incentives. Funds may also be used for related planning, monitoring, enforcement, and technical studies pursuant to the California Clean Air Act. Funds are available to public and private agencies as well as residents in Monterey, San Benito and Santa Cruz Counties.

Monterey Bay Electric Vehicle Incentive Program by MBARD

The MBARD EV Incentive program has run consecutively for the past 5 years. This fiscal year's program, which opened on July 1, 2021 will represent 6 years of operation. The program annual average budget has been $400,000. Over the past 5 years, 100% of allocated funds have been granted as incentives to purchase EVs. The total number of electric vehicles incentivized is 1,360.

The other component of the MBARD Clean Vehicle Program is the Public Agency EV Voucher Replacement Program. Over the same 5-year period, MBARD awarded $280,000 to public agencies toward the replacement of 28 gasoline-powered light duty vehicles with EVs.

The MBARD Plug-In Monterey Bay EV Infrastructure Program has run for 5 consecutive funding cycles beginning in MBARD FY 2016-17. The total amount of program funding to date is $5,942,687. The EV infrastructure Program installation breakdown is as follows:

- Level 2 Charging Stations: 106
- DCFC Stations: 35

Figure F-18: MBARD Light Duty EV Incentive Program

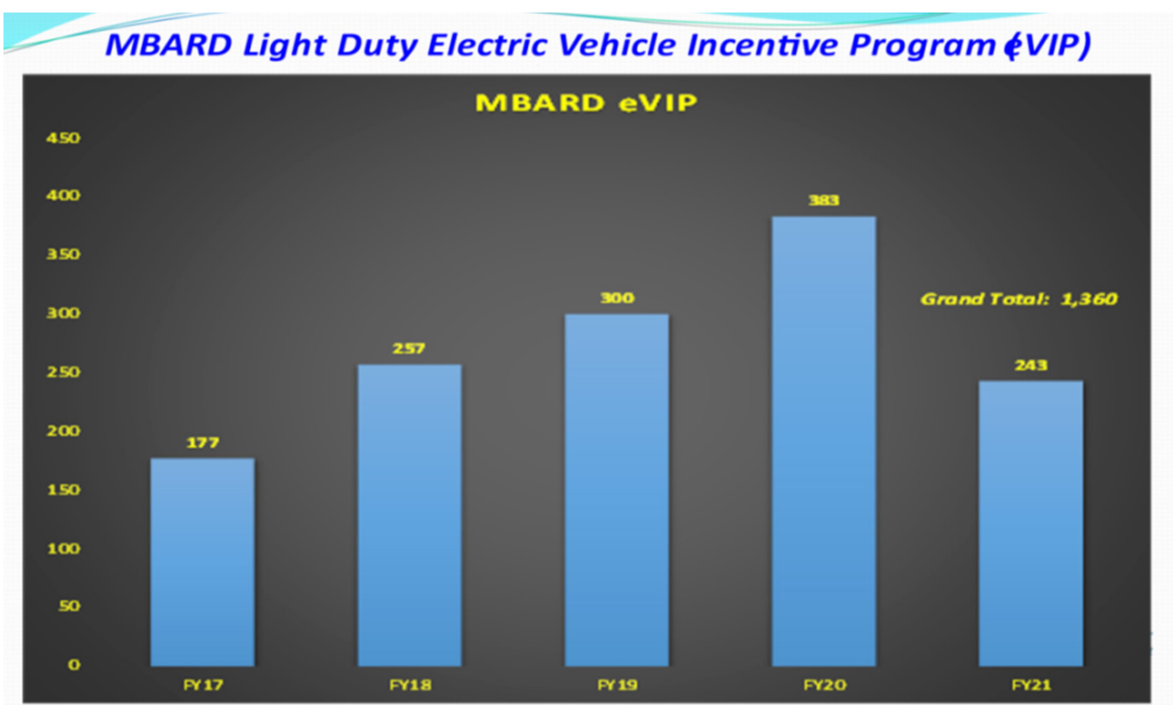


Figure F-19: GHG Calculation- Regional EV Chargers and EV Incentives Program

GHG calculation Regional EV Chargers and EV Incentives Program		
	2020	2035
Estimated Electric Vehicles Chargers	190	961
Daily eVMT	8,141	34,980
GHG reduction	3,554	15,269
Per capita GHG reduction	0.03	0.11

Data Source: MBARD and 3CE EV incentive program

EMFAC Model

AMBAG used the 2014 EMission FACtors model (EMFAC2014) to calculate GHG (CO2) emissions for the SCS as required by California Government Code 65080. For the 2045 MTP/SCS EIR purposes, AMBAG used the most current 2017 EMission FACtors model (EMFAC2017) to calculate air quality impact analysis. EMFAC is a California specific air quality emission computer model developed by CARB that calculates daily emissions of air pollutants from all on-road motor vehicles including passenger cars, trucks and buses for calendar years 1970 to 2050.
In the EMFAC model, the emission rates from each of the motor vehicle types are multiplied by the vehicle activity data to calculate vehicle emissions. The GHG emissions analysis for passenger vehicles, (LDA, LDT1, LDT2 and MDV vehicle types), uses the automobile VMT by speed class from the AMBAG RTDM model run for each scenario.