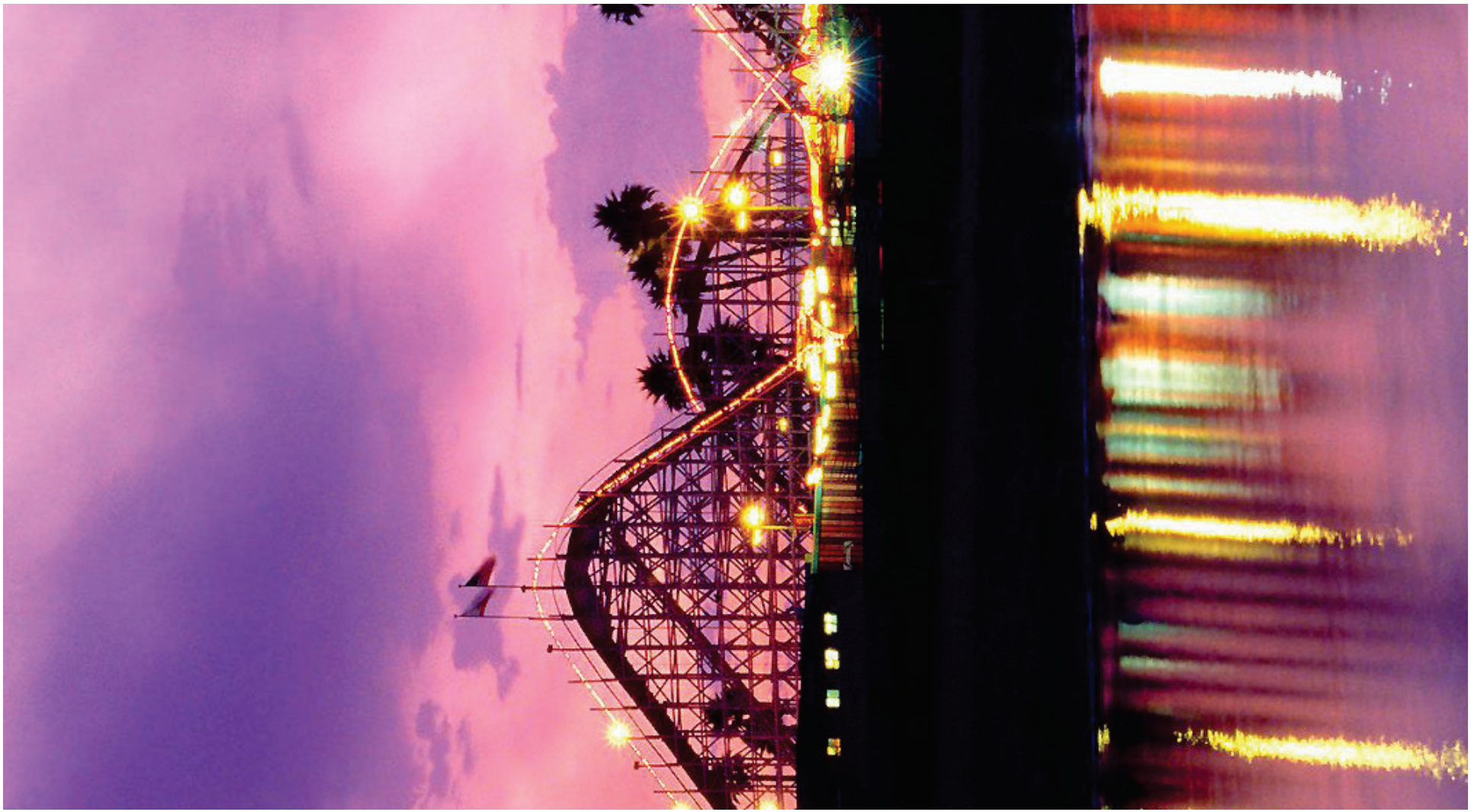
F Regional Travel Demand Model and Land Use Model Documentation



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Appendix F: Activity Based Model (ABM) and Land Use Model Documentation

Introduction

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 transportation and air quality planning requirements. The GHG target set by California Air Resources Board (CARB) applies to the tri-county Monterey Bay region. In this context AMBAG and the region's three RTPAs staff have established two levels of working committees that regularly met and worked together to develop the region's 2050 Metropolitan Transportation Plan/Sustainable Communities Strategy (MTP/SCS).

In order to evaluate various combinations of transportation and land use strategies that could lead to achieving the GHG targets as set by CARB for the tri-county Monterey Bay region, AMBAG worked with the region's RTPAs, local governments, transit agencies, and the public to develop and evaluate multiple transportation and land use scenarios, using Activity Based Model (ABM) and land use modeling tools. These scenarios were evaluated based on how each performs in relation to the GHG targets and other performance measures. Please see Chapter 4 and Appendix E for more information on the SCS scenario planning process.

AMBAG Activity-Based Model (ABM)

AMBAG, along with San Luis Obispo Council of Governments (SLOCOG), Santa Barbara County Association of Governments (SBCAG), and Caltrans District 5 staff, with consulting support from Caliper Corporation and Fehr & Peers completed the development of a Central Coast Supra Regional Activity-Based Model (CCABM) in June 2020 for each MPO. The main goal of this project was to develop a cost-effective and advanced activity based modeling framework for California's Central Coast region and tailor it to three MPO-level functional ABMs. To receive early expert guidance for the ABM framework, in September 2020, together with SLOCOG, SBCAG, and Caltrans District 5, AMBAG conducted a national level virtual peer review for the draft CCABM. Staff of the Central Coast MPOs and members of the consulting teams presented the CCABM ABM framework at the peer review to highlight its structure, data-based model estimations, policy sensitivities, and current policy limitations (often due to lack of relevant data). AMBAG, after receiving valuable guidance from the peer review and conclusion of the project, has begun rolling out envisioned enhancements and those derived from peer review recommendations to the AMBAG ABM for 2050 MTP/SCS.

AMBAG's ABM targeted a few basic requirements aimed at making its ABM practical, locally relevant, tractable, easy to interpret and relatively simple to maintain:

- A data-driven model estimated from locally sourced data, minimizing asserted and transferred model structures and coefficients;
- A model which has decision complexity that reflects the richness of the behaviors observed in the available data;
- A model specification with policy levers relevant to our needs;
- A graphical user interface and an integrated software architecture with sufficient flexibility to maintain and edit a disaggregate database of households and individuals, facilitate day-to-day inspection of model results, scenario analysis, and model maintenance;
- Adequate computational performance to support model application.

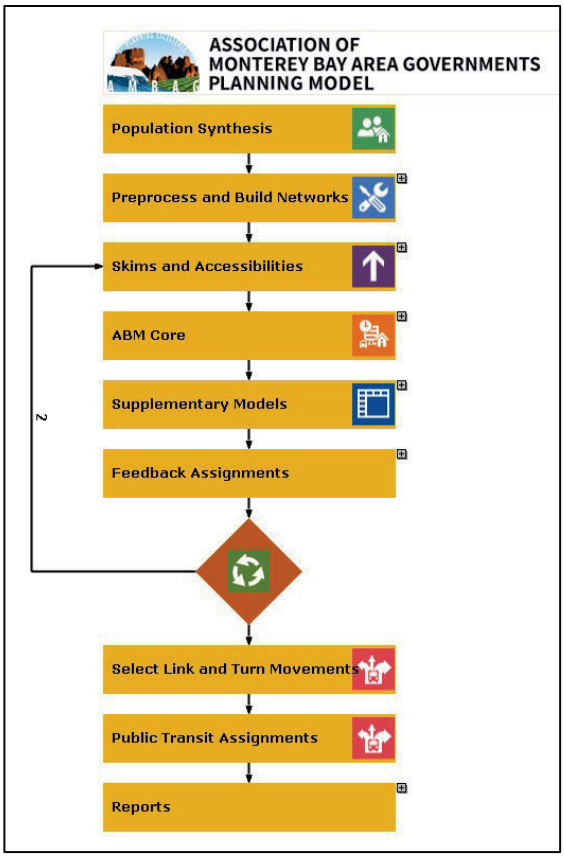
AMBAG's ABM accommodates a fine-grained analysis of tri-county Monterey Bay region's mobility patterns and scenarios. Based on a simulated enumeration of the region's population (persons and their households), the AMBAG ABM has the potential to answer policy questions at the level of individual and household characteristics such as age, gender, income, and auto sufficiency, to provide a nuanced and high-fidelity approach to quantifying and assessing congestion mitigation through an equity lens.

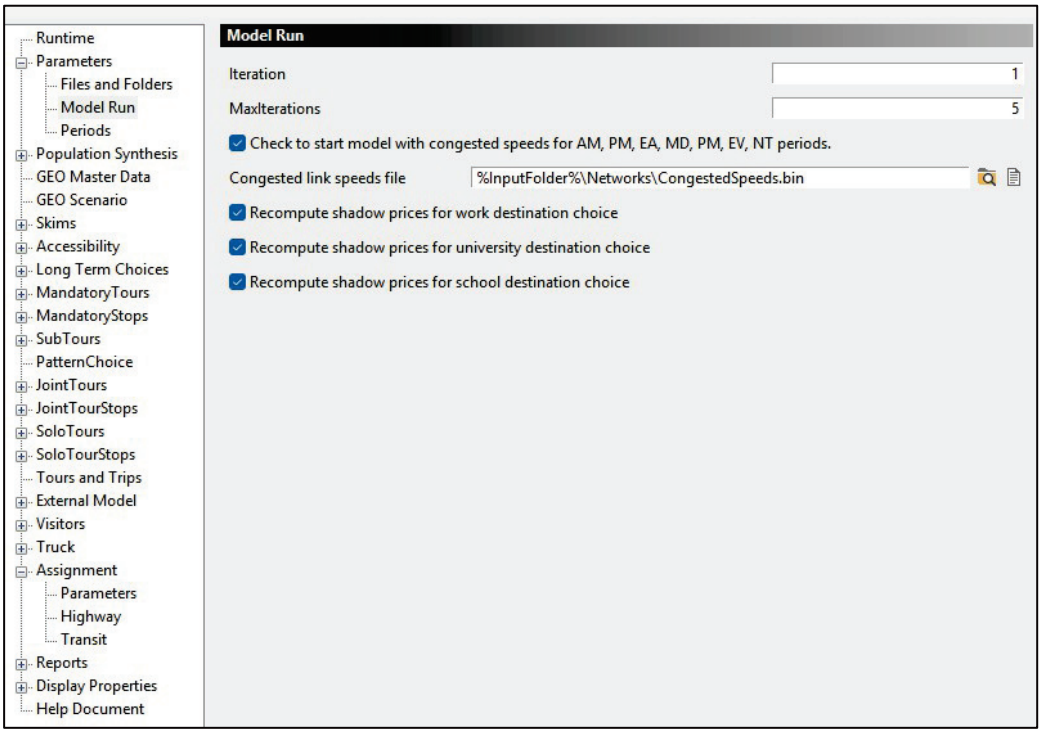
To facilitate and support AMBAG's 2050 MTP/SCS goals, we developed a realistic and policy-relevant ABM based on observed data. This model customized the larger multi-MPO CCABM to AMBAG with the following core guiding principles:

- The ABM should be easy to use with a single, flexible graphical interface;
- The ABM must be built on (and validated to) local data;
- The model must predict activity locations accurately, as they have a significant impact on all subsequent demand forecasting steps and resulting Vehicle Miles Travel (VMT);
- The model must handle within-household interactions (e.g. auto usage and joint tour participation);
- The sequence of model components should be consistent and not require post-model adjustments.

AMBAG's ABM platform leverages TransCAD's modern flowchart (Figure F-1) graphical user interface, which gives access to the entire model (including all inputs/outputs, parameters and coefficients) in one place. All scenario runs can also be managed and analyzed through flowchart. All files and databases are stored in native TransCAD formats for a self-contained modeling experience. AMBAG's ABM also uses five feedback loops to capture the complex interactions between demand (Land Use) and multi model transportation network supply through skim and accessibility calculations.

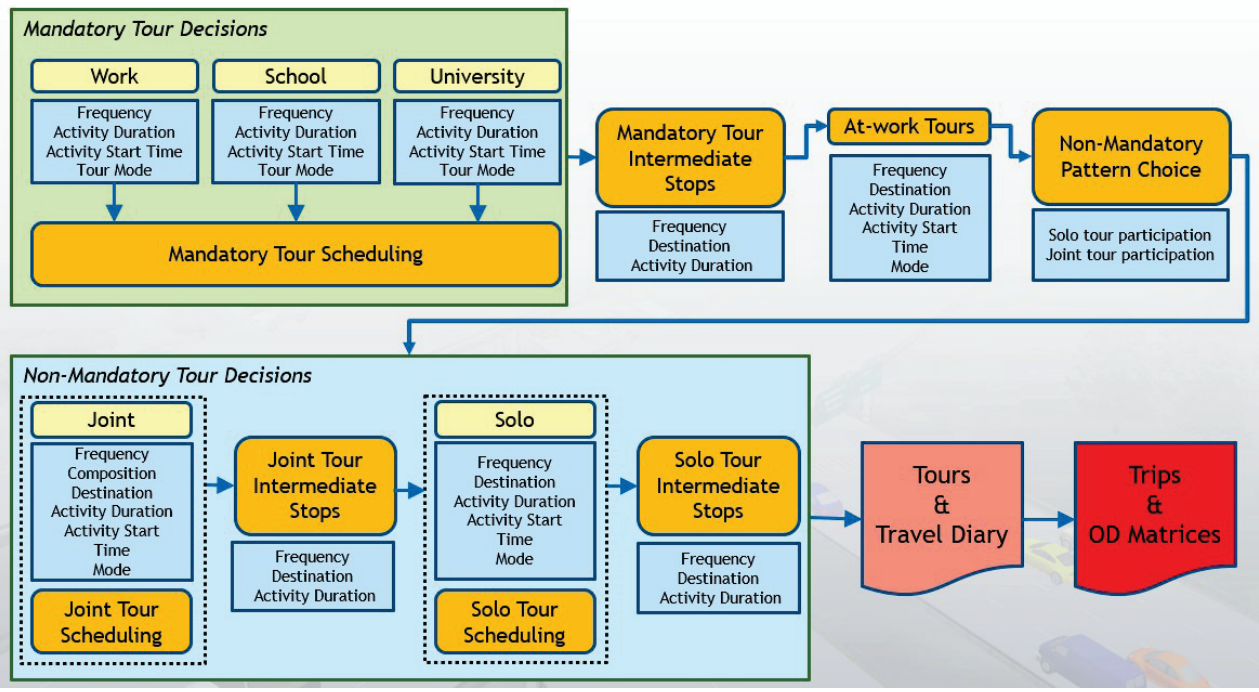
Figure F-1: ABM Flowchart and Model Parameters User Interface





The AMBAG ABM's structure is broadly described in Figure F-2. It begins with an enhanced population synthesis implementation that simulates a list of households and persons that match aggregate demographic totals from the real population for the base year of 2022, as well as the forecast years (2035 and 2050). The resulting accurate enumeration of the region's residents is then leveraged to apply detailed, person and household-level models of activity and travel choices. The decisions include both long-term and short-term aspects: driver license holdings, school/college student status, the decision to travel for work and other activities, and a host of related choices (activity purpose, destination location, travel mode, time of day, activity duration, stops along the way, multi-person/joint travel, etc.). All these decisions are modeled at the level of complete tours for consistency and behavioral realism. Special care is taken to account for household dynamics related to children's school pick-up/drop-off needs as well as within-household carpool tradeoffs based on vehicle use. The model's implementation is designed for internal consistency as well as fast running times for realistically complex yet practical ABM.

Figure F-2: AMBAG ABM Flow Chart



The results of the ABM are summarized into a travel diary that represents a microscopic snapshot of every household's daily activity schedule. This resident demand is then aggregated and merged with other demand modeled at a more aggregate trip level: truck, visitor, and external trips. The summarized total of this demand is then assigned to highway and public transit networks to assess level of service and to inform the iterative adjustment of daily decisions and schedules in response to congestion. The converged model generates a wealth of outputs at the person, household and network levels. These outputs are processed via

customized reports and dashboards to aid policy analysis and decision-making, while also generating policy-sensitive VMT data for emissions modeling.

The ABM traditionally requires a household travel survey on which a majority of the component models would be estimated. Each individual AMBAG ABM component has been rigorously and scientifically estimated/calibrated to replicate the AMBAG region's observed data (2012 CHTS, 2017 National Household Travel Survey, ACS 2014-2018 (5 years average datasets), and appropriate Big Data sources (processed by Caliper) as closely as possible.

AMBAG's ABM forecasts long-term and within-day decisions for a synthetic population that directly accepts land use model forecasts of key distributions of household (size, income) and person (age, gender, work status) demographics. The AMBAG model assigns each household and person applicable demographic variables, as shown in the Table F-1 and F-2 below.

Table F-1: Person Level Variables

Person-Level Variables	Description	Purpose in ABM
PersonID	Unique identifier for each person	Tracks individuals across households and trips
HouseholdID	Household to which the person belongs	Links person to household characteristics
Gender	Male/Female	Socio-demographic factor affecting activity patterns
Age	Age in years	Determines activity participation and mode choice
IndustryCategory	Industry sector	Used for employment-based travel behavior
WorkIndustry	Specific work industry	Refines employment-related travel modeling
ClassOfWorker	Worker classification (e.g., private, government)	Impacts commute behavior and scheduling
UnivGQStudent	University group quarter student status	Identifies students living in dorms or group housing
UnivTAZ	TAZ of university attendance	Assigns trips related to education
License	Driver license status	Determines eligibility for auto trips
WorkerCategory	Worker type (full-time, part-time, etc.)	Affects daily activity patterns
WorkDays	Number of days worked per week	Determines frequency of commuting trips
AttendUniv	Attending university	Defines education-related travel

Table F-2: Household Level Variables

Household-Level Variables	Description	Purpose in ABM
TAZID	Traffic Analysis Zone ID	Geographic allocation of households for trips
HouseholdID	Unique household identifier	Links members to household context
WEIGHT	Population expansion weight	Scales synthetic households to represent the regional population
HHSize	Household size	Determines number of trips generated
Vehicles	Number of vehicles in household	Impacts mode choice and vehicle availability
Inc_Category / IncomeLevel	Household income group	Influences travel behavior, auto ownership, and VMT
Kids_Category/Kids/PreSchKids	Children counts and categories	Influences trip chaining, school trips, and childcare trips
Seniors/Seniors_Category	Elderly household members	Impacts travel frequency and mode choice
Adults/AdultFemales	Adult counts by gender	Influences household activity participation
Females/Males	Total household gender composition	Used in person-level simulations
Workers	Number of employed adults	Determines work-based trips
KidsPerAdult/KidsPerNonWorkingAdult	Dependency ratios	Helps define activity participation
AvgWrkIncCategory	Average worker income category	Captures employment income effects
UnivGQ/UnivGQStudent/UnivTAZ	University group quarter information	Defines student-related travel
License	Driver license	Household-level vehicle access check
WorkerCategory/WorkDays/AttendUniv	Household-level aggregated work/student activity	Used for scheduling daily trips

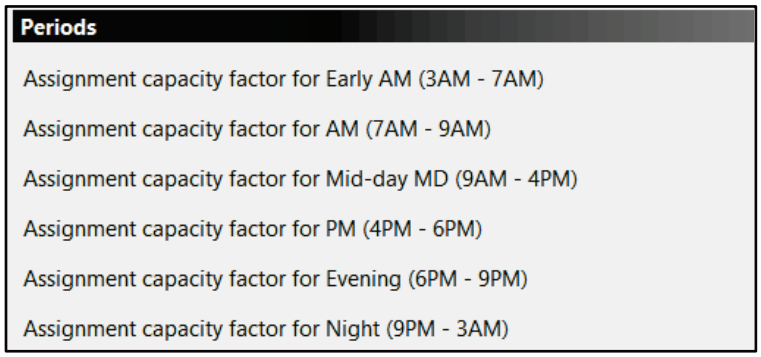
The ABM generates daily activity patterns anchored on mandatory work, school and college/university tasks, and fills the remaining time with non-mandatory activities as necessary. The patterns are automatically consistent in space and time and allow the user to customize the priority order of joint and solo non-mandatory activities. A unique approach captures household-level activity participation decisions to select household members for each joint activity. The model also incorporates variables sensitive to remote and hybrid work (specific to different work industry types).

The AMBAG ABM also includes detailed handling of intra-household vehicle allocations and child pick-up/drop-off (PUDO) dynamics so that the most important mandatory activities are accurately captured. A nested destination choice architecture is adopted to robustly capture location choices despite the typically sparse spatial coverage of household travel surveys at the

zone level. This approach has been repeatedly shown to accurately capture regional origin-destination (OD) patterns at the district and county levels.

AMBAG's ABM operates on a built-in Time Manager that synchronizes various within-day decisions by keeping track of used blocks of time at the person level, so that subsequent modeling decisions are based on the latest available estimates of individuals' free time. The ABM's definition of time periods is broadly described in Figure F-3 for Early AM, AM, Mid-day, PM, Evening. and Night.

Figure F-3: Time Periods



Inter-Regional and External – External Travel

AMBAG conducted an Origin-Destination (OD) study in 2012 using two different methodologies and collected week-long classified traffic counts. The OD survey results were used to account for external trips (X-X, X-I and I-X) and have been validated with traffic counts. There is no change in the methodology regarding estimation of inter-regional travel. The external gateways numbers were derived in consultation with adjacent MPO's (MTC and SLOCOG) modeling staff and incorporated into the AMBAG ABM for the years 2035 and 2050. Per the November 2019 Final Sustainable Communities Strategy Program and Evaluation Guidelines, AMBAG includes 100 percent of I-X and X-I VMT in its SB 375 GHG emission reduction target achievement.

Transportation Network Companies (TNC) and Autonomous Vehicles

Due to lack of data on TNC demand and supply from external sources as well as in the household travel survey and given the absence of local research on long-term demand shifts due to TNC operations, the AMBAG ABM currently does not include any assumptions regarding TNCs or autonomous vehicles. As stated above, some of our local jurisdictions have implemented local bike share programs, but AMBAG has no plans or programs to work with TNCs or autonomous vehicles at this time.

Auto Operating Costs

Auto operating costs (AOC) are modeled in the skimming and mode choice steps of the AMBAG ABM. With skimming, closer destinations are chosen if operating costs are higher. In mode choice, high auto operating costs discourage auto travel and encourage alternative modes (such

as transit, bike, and walk). For this round, the AMBAG ABM utilizes the CARB AOC calculator to derive AOC for the years 2022, 2035, and 2050.

Highway Assignment

For highway assignment AMBAG utilizes a state-of-the-practice and highly convergent traffic assignment methodology known as Origin-based User Equilibrium. This method has improved highway assignment methods by providing a more stable solution to the highway assignment problem. This improvement provides AMBAG with the ability to more accurately quantify project benefits and explain the highway assignment results in a clearer context. In the AMBAG ABM, six assignments are performed: Early AM (3:00-7:00 AM), AM (7:00-9:00 AM), Mid-day (9:00 AM-4:00 PM), PM (4:00-6:00 PM), Evening (6:00-9:00 PM), and Night (9:00 PM - 3:00 AM). The results presented below (Table F-3 and Table F-4) are based on daily flows which are calculated by summing the results of all six period assignments and then compared against annual average daily traffic (AADT), whichever is available for the count location. As shown in Tables F-3 and F-4, the model's daily volumes versus AADT count as well as model's VMT against highway performance monitoring system (HPMS) VMT estimates are well within the FHWA's established acceptable threshold. Travel time validation to sample OD pairs also compares favorably (Table F-5).

Table F-3: Model Flow and Traffic Counts

Functional Class	% RMSE	No. of Segments	Total Model Flow	Total Traffic Count	% Difference
All Counts	32.44	1225	10834621	11402075	-4.98
Caltrans Counts	24.56	536	7997128	7861607	1.72
Freeways	17.54	97	3296813	3152660	4.57
Major Arterials	25.56	416	5577714	5621781	-0.78
Minor Arterials	50.71	326	1198195	1503899	-20.33
Major Collectors	69.82	174	305220	558529	-45.35
Minor Collectors	69.35	58	66233	87937	-24.68
Local Roads	95.61	110	76637	155238	-50.63
Ramps	44.66	22	105131	105199	-0.06

Table F-4: Model VMT and HPMS VMT

County	Model VMT	HPMS VMT	% Difference
Monterey	9,785,596	10,561,530	-7.3%
San Benito	1,603,527	1,637,840	-2.1%
Santa Cruz	4,622,302	4,883,240	-5.3%
AMBAG	16,011,425	17,082,610	-6.3%

Table F-5: Time of Day Validation

Origin	Destination	Time of Day	Time (Minutes)	
			Model	Google
Carmel by the Sea	Santa Cruz	AM	58.5	50-70
		PM	68.5	55-80
North-West	Santa Cruz	AM	33.2	30-45
		PM	33.2	30-45
South-East	North-West	AM	165.9	140-170
		PM	173.4	140-170
Hollister	Santa Cruz	AM	69.0	50-80
		PM	71.3	65-110
Hollister	Carmel by the Sea	AM	57.1	50-70
		PM	55.7	50-70
San Benito	Santa Cruz	AM	102.4	85-110
		PM	103.0	90-120
Del Monte/Marina	Monterey	AM	24.7	26-35
		PM	24.8	28-40

Transit Assignment

Transit assignment was performed using Pathfinder methodology in TransCAD. In the Pathfinder method, generalized cost is minimized. Generalized cost is computed using weighted values of in-vehicle, access, egress, transfer, dwelling, and waiting times and other costs such as transfer penalty costs and fares. 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 (AM) and egress (PM). Peak and off-peak transit trips are assigned separately. A post-process routine aggregates these assignments into a total transit flow table by transit agency. The Pathfinder methodology has been deployed successfully across California (in addition to other states in the United States) and has gained

wide acceptance from the Federal Transit Administration. The model boardings by transit operator are summarized in Table F-6.

Table F-6: Transit Weekday Boardings

Agency Name	Model	Observed
Monterey-Salinas Transit	8,245	5,491
San Benito County Express	315	219
Santa Cruz Metro	10,613	9,312
Total	19,172	15,022

Feedback

After the end of the highway assignment step, the congested travel times are used to update the input travel times into 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 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 is performed in the AMBAG ABM. Five loops were found to be sufficient to ensure stability in the final solution.

TAZ Disaggregation of Regional Growth Forecast and Land Use Model

The AMBAG Board of Directors approved the 2026 Regional Growth Forecast for internal planning use only at its October 9, 2024 meeting. Staff used the 2026 Regional Growth Forecast to disaggregate at the Transportation Analysis Zone (TAZ) level. During the year and a half long Regional Growth Forecast (RGF) development process, staff had a series of meetings with each local planning directors to discuss the RGF methodology, SCS strategies, and its alignment with their respective general plan assumptions. The forecast disaggregation process at the TAZ level also takes into consideration local land use policies, county level parcel data, employment data procured from California Employment Development Department (EDD), 2020 Census, and 2018-2022 ACS 5-year estimates datasets for the base year 2022 land use allocation. The 2022, 2035, and 2050 scenarios for the SCS were developed using this population and employment forecast in consultation and collaboration with region's local and regional agencies as well as using newly developed land use allocation model for the future years (2035 and 2050).

The TAZ disaggregation process is based on robust information leveraging the above mentioned data, consultations with 21 local jurisdictions before, during, and after the Regional Growth Forecast (RGF) process, and the land use development and monitor tracking tool, CalBuilds. The TAZ distribution is for all years 2022, 2035, and 2050. During the RGF process the local land use assumptions were determined in consultation and coordination with all the local jurisdictions.

Also, AMBAG leverages local jurisdiction knowledge of land use with the AMBAG GIS Portal. The GIS Portal is an interactive web-based application that captures local jurisdiction feedback and allows edits for their local land uses using standardized typologies called PlaceTypes and Opportunity Areas for focused growth areas for inclusion into 2050 MTP/SCS.

Development Monitoring and Tracking Tool - CalBuilds

Under a collaborative grant funded project which was completed in June 2024, AMBAG along with Butte County Association of Governments (BCAG), San Luis Obispo Council of Governments (SLOCOG), Shasta Regional Transportation Agency (SRTA), and Tahoe Regional Planning Agency (TRPA) developed an open-source GIS based land use development and monitoring tracking tool named CalBuilds as shown in Figure F-4. AMBAG managed the project and developed it with consultant assistance from Manhan Group. CalBuilds is available for use by the 21 local jurisdictions for both their internal agency use while simultaneously assisting AMBAG in providing information of upcoming and recently built developments for both commercial and residential builds. For commercial developments, building size and by development types, use type, floor area (sq. ft.), and percentage of use by type. Also, for residential developments CalBuilds tool tracks total number of housing units and affordable units. Each entry has tracking of development by status (completed, in construction, planning, projected, unverified, and deselected) for both commercial and residential projects (Figure F-5).

Figure F-4: Screenshot of CalBuilds Tool

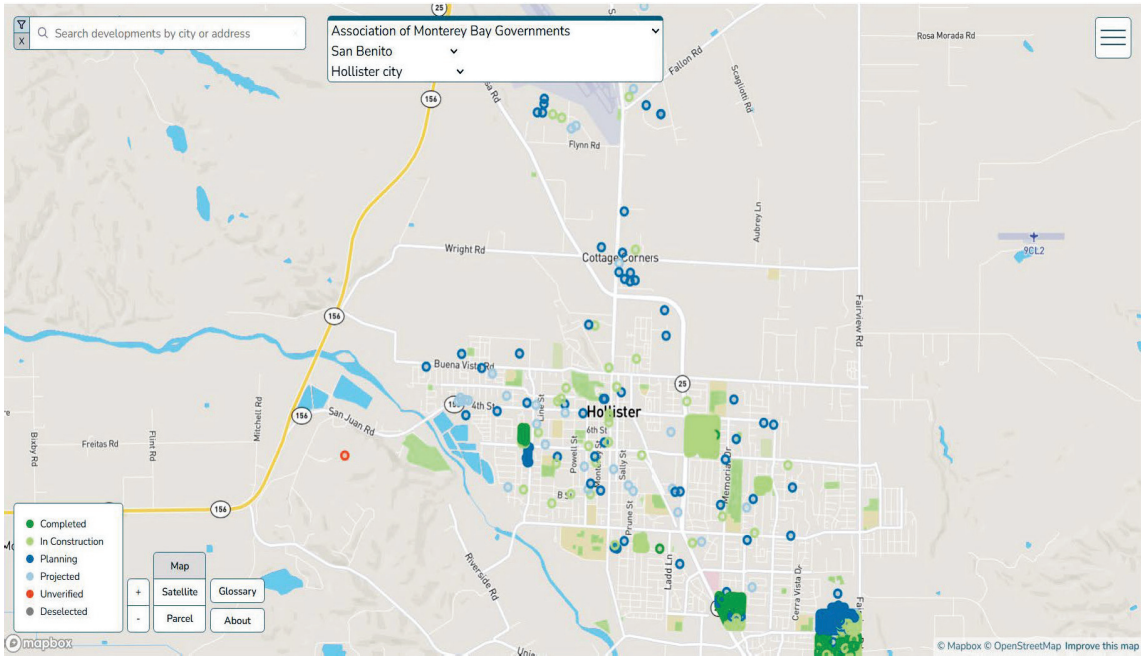
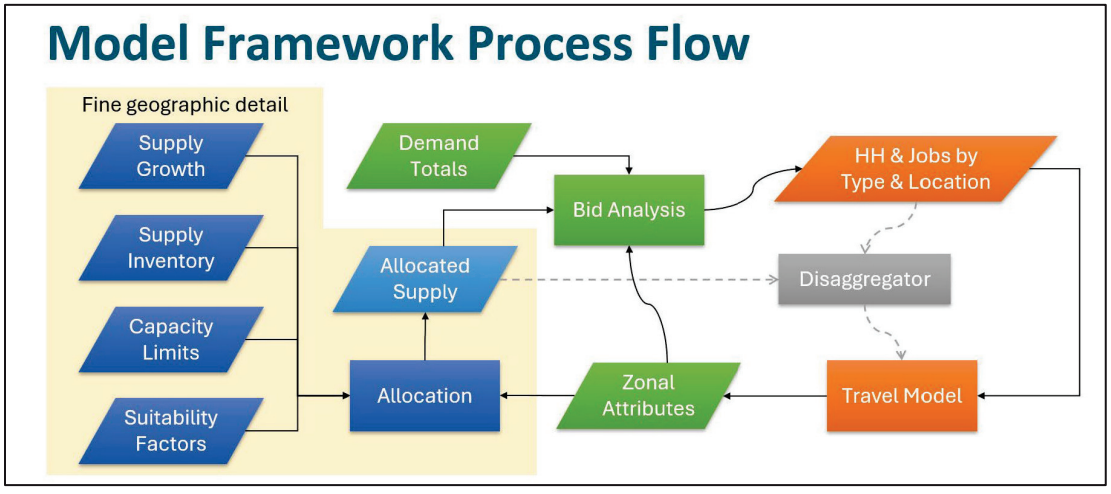


Figure F-5: Screenshot of CalBuilds Tool

Land Use Model - CommunityViz

The AMBAG Region CommunityViz Model v. 3.1 is the product of a regionwide initiative to develop more consistent and replicable methods for allocating future year socioeconomic data to TAZs as used in the AMBAG ABM. The model framework and flow (Figure F-6) normalizes the data collection process, model architecture, and data output formats used in the region and provides more efficient processes and tools while recognizing the inherent relationships between land use, transportation, and urban forms for studying the components of a sustainable regional transportation system.

Figure F-6: Model Framework Process Flow



The planning area for the AMBAG Region CommunityViz Model v. 3.1 covers Monterey, San Benito, and Santa Cruz counties which is 5,206 square miles and includes 237,049 parcels. The model includes environmental features of rivers, mountains, national forest, flood hazard areas, wetlands, and proximity to the Pacific Ocean bind the region together and blur political boundaries.

CommunityViz v. 3.1 land use model allowed AMBAG to perform in-depth scenario planning for 2050 MTP/SCS. This land use model represents a set of analytical processes created to evaluate the influence of different development types, locations, patterns, and intensities on the efficiency of a proposed transportation system. Visualization of the interaction between land use, urban form, and transportation decisions, as well as the causational factors that explain the push-pull relationships between them, provides more transparency of the analytics. AMBAG will also use CommunityViz land use tool to better showcase the results to engage the public and stakeholders while providing community leaders with the information needed to evaluate the consequences of potential actions.

Building on this momentum, the Federal Highway Administration, Environmental Protection Agency, and other federal agencies actively promote the use of scenario planning by state departments of transportation, metropolitan planning organizations, rural planning organizations, and local governments to better integrate transportation and land use decisions for preparing a metropolitan transportation plan. Evaluating the relationship between land use, urban form, and regional travel behavior in a scenario planning analysis produces several benefits. When considered together, decisions and investments regarding all three elements can have a significant impact on the AMBAG planning area:

- The impacts to sensitive land uses may be minimized when facilities identified for transportation investments are located after considering appropriate land use patterns and development intensities for the area.

- Prime locations for development may be stimulated if transportation investments consider available capacity or appropriate mobility options.

- Complementary activities may be placed next to existing or planned transportation infrastructure, making the most of land use opportunities and transportation investments.

- The quantity and location of travel demand may be influenced by land use decisions, making the possibility of real choices for various modes of travel both accessible and attractive.

- New development locations, types, patterns, and intensities in an area could significantly improve transportation system performance without spending significant transportation dollars (extending existing system capacity with demand-side solutions before making expensive investments).

- A study of land use, urban form, and travel behavior in a single theater brings together all the decision makers for instilling real change — local governments, state departments of transportation, regional planning agencies, the development community, special interest groups, etc.

Allocation of AMBAG region's socioeconomic data was computed for various scenarios in the CommunityViz Model v. 3.1 at TAZ level reporting, which streamlines the workflow for running the AMBAG ABM. Output data of the land use model is normalized for the AMBAG planning area and formatted for direct input into the ABM software using post-processing tools, saving time and translating errors from several data sources.

AMBAG ABM Sensitivity Tests

To evaluate the sensitivity of the AMBAG ABM, the following tests were performed:

- Add capacity to a roadway facility
- Modify land use and job housing mix
- Add BRT, LRT service, and transit fare

Summary of Sensitivity Tests

Based on the model sensitivity tests conducted, the model is sensitive to some changes while not sensitive to others. For those where the model is not sensitive, potential enhancements will be investigated and implemented in next update cycle and for this cycle, post-processing methods is included as appropriate in the section below. Transportation Demand Management (TDM), Transportation Systems Management (TSM), Work from Home (WFH) and active transportation were not evaluated in the travel model. Results from the sensitivity testing are included in the detailed model technical document and user's guide; however, a summary of the sensitivity is shown below.

Added Roadway Capacity

The model is appropriately sensitive during traffic assignments for roadway widening projects in terms of route selection. 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. The influence of roadway capacity on activity patterns, destination choice, mode choice, and GHG were not evaluated.

Modified Land Use

The model was tested for sensitivity to employment change as well as household and job mix. ABM's sensitivity to job was tested by adding 1000 additional jobs (Retail, Service, office and health sectors) nearby a large retail center with mixed use development expected to occur in future. No other changes were made in model inputs or parameters. In comparing the link volume, the main connector to the area observed 35 to 67% increase in the link volume and

VMT as compared to the base year model output.

The ABM model is sensitive to Household and Job mix land use modifications. The resulting link volume showed the main connectors to the nearby highway with an observed 28% volume and VMT increase- as compared to 66% increase in employment increase scenario in the link volume and VMT as compared to the base year model output.

Sensitivity to Transit New Transit Service, Frequency, and Fare

The model was tested for transit frequency, new BRT route and fare tested independently. The model was found to be sensitive to all variables.

Results, model was sensitive to adding in new BRT route. Model results attracted new transit ridership even though of short headway of route and due to overall attractiveness of using BRT. The transit travel time, cost, wait time, and walk/drive time at both ends as compared to no or very little congestion on parallel roadway may be contributing to lower attractiveness for new BRT.

The model is sensitive to changes in the transit fare but only for shorter trips and other purpose trips. This is due to shifting in the mode for shorter transit trips and for other trip purposes as compared to longer Home Base Work (HBW) trips. The model shows it is not attractive for longer HBW trips which resulted in comparatively less VMT reduction. Although these tests were conducted in isolation to determine model sensitivity, in the development of the MTP/SCS, scenarios were developed to maximize the sensitivity by incorporating multiple strategies cohesively. For example, additional infill or density accompanied by enhances transit service along the route and stops.

There will be some areas where quantification of off-model strategies will also be required, including active transportation infrastructure, telecommuting-remote work (Work from Home), Agriculture workers vanpool programs, incentives for EV public charging infrastructure, ZEV rebates and home chargers.

EMFAC Model

Per CARB's guidance, AMBAG will be using CARB's EMission FACtors (EMFAC2014) model to calculate GHG emission for 2022, 2035, and 2050 for the SCS as required by California Government Code 65080. The AMBAG ABM will export speed bin files after each SCS scenario model run and the model outputs will go through a postprocessor. The postprocessor tool is designed to export input tables by county for EMFAC. After EMFAC model runs and calculation of per capita GHG if needed, AMBAG will be applying Off-Model adjustments techniques to measure GHG due to some policy variables for which AMBAG ABM is not sensitive (per model sensitivity analysis). Just as documented in the region's 2045 MTP/SCS, AMBAG will be documenting technical details and methodology used to calculate and apply Off-Model adjustments for certain important variables/policies. AMBAG will be applying CARB's recommended methodology to calculate CO2 adjustment to the EMFAC output for SB 375 target demonstration (EMFAC 2011-2014 adjustment factor is 5.5%) as used in 2045 MTP/SCS.

Quantification Approaches for 2050 MTP/SCS Strategies

The transportation and land use strategies proposed for AMBAG's 2050 MTP/SCS were quantified using the AMBAG ABM and land use model to the best extent possible. In some areas quantification of off-model strategies were required, including active transportation infrastructure, telecommuting-remote work (Work from Home), Agriculture workers vanpool programs, incentives for EV public charging infrastructure, ZEV rebates and home chargers. 2050 MTP/SCS strategies that were incorporated into the 2050 MTP/SCS were quantified and are listed in Table F-7.

Table F-7: 2050 MTP/SCS Strategies

AMBAG 2050 MTP/SCS Strategies	Quantification Approach
Land Use and Housing	
Transit Oriented, Infill, Mixed Use Increase Commercial and Employment Near HQP Area	AMBAG ABM & Land Use Model AMBAG ABM & Land Use Model
Transportation Network and Infrastructure	
High Quality Transit Routes Active Transportation Infrastructure Telecommuting / Remote Work (WFH) Agricultural worker vanpools EV Public Charging Infrastructure and Incentives for ZEV and charger	AMBAG ABM and /or off-model Off-model Off-model Off-model Off-model

Agriculture Workers Vanpool Program

Between 2011 and 2020, the agriculture workers vanpool program continued to expand as the agricultural vanpool program has been widely accepted by an increasing number of agricultural employers. Currently, CalVans is the only public entity nationwide approved by the Federal Department of Labor to provide H-2A (temporary agricultural worker visa) transportation. California's agricultural workers are the backbone of the agricultural economy but often lack reliable transportation options that can safely transport them to the state's most remote agricultural sites. As a result, many resort to driving antiquated, high polluting, unregistered, and uninsured vehicles because it is their only means to get to work. Supplying agricultural workers safe transportation has always been CalVans' mission. As demonstrated during this pandemic, CalVans provided transportation for thousands of essential workers to work sites across California, while millions sheltered in place. Even during the pandemic, agricultural vanpools have not slowed as Table F-8 demonstrates.

In October 2023, CalVans acquired 393 Ford eTransit electric passenger vans to further provide disadvantaged communities an efficient and reliable means of getting to and from work. In collaboration with the Affordable Housing and Sustainable Communities (AHSC) projects, CalVans will provide key housing projects with all electric transit vehicles to serve the Affordable Housing Community residents and their surrounding community with safe, telematics-driven, clean transportation while removing vehicles from California roadways.

AMBAG staff collected below listed data from CalVan Authority (all passengers, hours, and miles driven by each vanpool, as well as passenger lane miles). The passenger lane miles, less the miles the vanpool traveled gives you the miles that were reduced through vanpooling, as opposed to the riders driving by themselves to work. Table F-8 summarizes the activity for 9 years of vanpools operation for AMBAG region:

Table F-8: Monterey County: Historical Passengers, Miles & Passenger Lane Miles

Reporting Year	Passengers Total	Miles Total	Pass Lane Miles Total	Annual VMT reduced	Per Capita VMT
19-20	785,256	1,972,320	22,563,659	20,591,339	28.73
18-19	640,906	1,866,164	21,567,922	19,701,758	33.65
17-18	539,532	1,618,907	18,352,399	16,733,492	34.02
16-17	432,047	1,454,760	16,838,862	15,384,102	38.97
15-16	366,908	1,293,118	15,299,887	14,006,769	41.70
14-15	254,197	788,291	9,050,562	8,262,271	35.60
13-14	177,972	646,273	6,129,161	5,482,888	34.44
12-13	131,090	403,481	4,294,297	3,890,816	32.76
11-12	117,033	389,749	3,982,283	3,592,534	34.03
10-11	74,053	292,848	2,624,019	2,331,171	35.43
San Benito County	24,590	75,743	854,277	778,534	34.74
				Average:	34.92

Source: CalVans August 2020 Board Meeting Agenda item

Using vanpool data trend and future trendline and applying average trip length the off-model adjustment is calculated as shown below in Table F-9.

"The largest growth this past year has been in the Monterey and Ventura/Santa Barbara areas for farm labor. The growth reflects the adoption of the program by growers in both regions." (*Source: CalVans June 11, 2020 Board Meeting Agenda, pages 4-5*)

Table F-9: Agriculture Vanpool Program Off-Model Reduction

		AMBAG area CalVan Ag Vanpools #	
		Year	Agriculture Vans
Agriculture Vans		2010	20
Round Trip Miles**		2013	59
Average Passenger/Van*		2015	73
Total VMT driven by vanpool		2020	172
VMT Reduction (12-1)		2024	253
GHG Reduction (Lbs) @ 0.89 ratio		2025	298
% GHG reduction			
	-0.87%	2050	379
	2035		
VMT	14,979,846		
GHG lbs	13,420,307		
GHG/VMT Ratio	0.90		
*Average occupancy = 12 people	** Average round trip in Mile =34.5		

Telecommuting/Remote Work (WFH)

AMBAG staff conducted a study to understand Work from Home (WFH) pattern in the Monterey Bay area. The study approach, methodology, and findings were used to calculate off-model adjustments.

Introduction

The emergence of remote work arrangements resulting from the COVID-19 pandemic has led to a transformative shift in transportation dynamics. This shift, characterized by novel changes in commuting behaviors, presents a challenge for current transportation modeling frameworks, including the ABM. The direct effects of increased WFH practices on traffic patterns cause a necessity for integrating WFH data into our forecasting models to enhance the accuracy of traffic predictions. Unfortunately, such data integration has yet to be achieved, highlighting a critical gap in our current understanding and modeling capabilities.

Significance

Understanding the WFH trend is crucial for AMBAG due to its direct influence on traffic flow patterns. This understanding is necessary for enhancing our capability to precisely model and analyze transportation dynamics. At a broader level, insights gained from studying this trend are instrumental in guiding our decision-making processes. They enable us to prioritize infrastructure projects effectively and allocate resources, funding, time, and effort towards initiatives that promise the most substantial benefits for the wider Monterey Bay community.

Approach

To address the challenge of lacking data on the impact of remote work practices on traffic patterns within the Monterey Bay area, several strategic measures are proposed:

1) **Policy Review and Employer Engagement:** Review remote work policies implemented by major employers in the Monterey Bay area. This can be achieved by examining publicly available Human Resources (HR) policies on company websites, analyzing job postings for remote work opportunities, and directly engaging with HR departments to understand their stance on remote work and schedule flexibility.

2) **Data Collection and Analysis:** Develop a database capturing information about the region's largest employers. This database includes metrics such as the proportion of employees eligible for remote work and the frequency (days per week) of remote work practice. This will facilitate an in-depth analysis of remote work trends and their potential impact on commuting patterns.

3) **Job Classification Assessment:** Categorize occupations based on their suitability for remote work. This assessment helps in distinguishing between roles that can effectively be performed remotely and those that necessitate physical presence.

4) **Employment Data Integration:** Leverage existing employment data for the Monterey Bay area to segregate positions into remote and non-remote categories. This step involves querying existing job data to isolate roles conducive to remote work, thereby providing a clearer picture of the workforce's distribution between remote and onsite work arrangements.

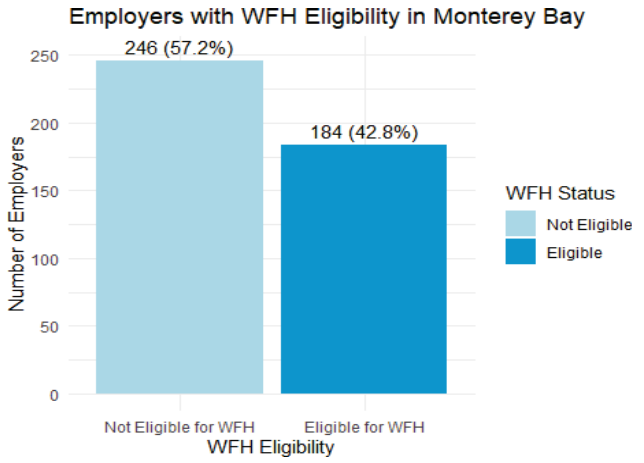
5) **Literature Review:** Review of existing research studies that explore the relationship between the transition to remote work post-COVID-19 and its effects on transportation dynamics. This review should aim to extract relevant findings and methodologies that could be applied or adapted to the Monterey Bay context, with appropriate citations for future reference.

These approaches collectively aim to fill the data gap and enhance our understanding of remote work's implications on traffic flows, ultimately informing more effective transportation planning and resource allocation for the Monterey Bay area.

Considerations

The feasibility of working from home can significantly vary across different departments within the same entity. It is not adequate to broadly categorize an entire organization or facility as either accommodating or not accommodating remote work. A more nuanced approach is required, necessitating an examination of the proportion of employees within Monterey Bay's largest organizations who are permitted to work remotely. Figure F-7 depicts the employers with work from home eligibility in the Monterey Bay area. This examination extends beyond mere permission, to include an analysis of the specific remote work policies in place. These policies may include, for instance, that certain employees are eligible for remote work, but only for a limited number of days each week. Such distinctions are crucial for accurately understanding and assessing the landscape of remote work practices and their implications on traffic patterns and transportation planning within the Monterey Bay area.

Figure F-7: WFH Eligible Employers



The total number of employees in firms (>100 employees) eligible for WFH is: 55,544.

The total number of employees in firms (>100 employees) not eligible for WFH is: 66,749.

Source: Employment Development Department. (n.d.). Employment Data for California. Retrieved from https://www.edd.ca.gov/

Preliminary Analysis

The selected employers represent 35.4% of the employees studied in the Monterey Bay area. Tables F-10 through F-13 shows various work from home metrics as researched by AMBAG.

Table F-10: Employers Selected for Study

	Total Employers	Website or Job posting	Email/Phone	No response
AMBAG Region total	430	147	78	205

Table F-11: Work From Home Benefit Offered Ey Employer

Survey Results (WFH) benefit offered	2 Days	3 Days	Flexible	Not offered
	119	62	23	21

Table F-12: Work From Home by Employment Category

Employment Categories	**2035**
Agriculture	44,182
Industrial	21,592
Construction	44,259
Wholesale	35,183
Retail	39,841
FIRE (Financial, Investment, Real Estate etc..)	39,506
Education	29,328
Health	48,066
Services	70,691
Public	28,588
Self-Employed	16,458
Total	417,694
WFH Workers Categories	184,571

Table F-13: Work From Home Off-Model Adjustments

	2035
Total Workers in work at home categories	184,571
Off model Adjustments	
% work at home	10.00%
Work at home workers	**18,457**
Work at home workers	18,457
Mile reduce per weekday (Average Trip length)	15.00
VMT reduce per weekday	276,857
GHG reduce per weekday (GHG/VMT = 0.89)	**248,033**
% GHG Reduction	1.85%
Off Model Adjustment (% reduction)	-1.85%

Transportation Electrification Programs

The following information is an excerpt from Central Coast Community Energy (3CE) program Energy Programs Portfolio Evaluation Report, FY 2023-2024 of Central Coast Community Energy (3CE):

> *3CE's Energy Programs support local communities and 3CE customers by providing funding and services to accelerate regional electrification, reduce greenhouse gas emissions, and benefit local economies. 3CE's annual Energy Programs supports the agency in achieving its goals and helps to identify additional opportunities to promote affordable access to electrification and reduction of greenhouse gas emissions, for the benefit of 3CE customers.*

In FY 2023-24, 3CE offered 11 Energy Programs to residential, commercial, agricultural, and member agency customers. The incentives offered through these programs supported 3CE customers in transitioning their homes, workplaces, and transportation from fossil-fuel power to clean-energy solutions.

Over FY 2023-24, 3CE distributed $11 million in incentives across these 11 programs and support services, a $1.8M (16%) increase from FY 2022-23. Approximately $3.9 million, or 36% of the incentive funds distributed, were to projects in underserved communities – awarded to income-qualified customers, Title 1 schools, and small to medium-sized agricultural businesses. The electrification projects incentivized by 3CE's Energy Programs resulted in a reduction of 3,758 metric tons of CO2e in FY 2023-24, equivalent to taking 968 gas-powered passenger vehicles off the road and avoiding nearly 10.5 million gas-powered miles driven, based on the average mileage for a passenger vehicle in California. FY 2023-24 was 3CE's fourth full year of administering and implementing energy programs. 3CE offered 11 Energy Programs as indicated in Table F-14. The incentives available through these programs supported 3CE customers in transitioning their homes, workplaces, and transportation from fossil-fuel powered to clean-energy solutions.

Table F-14: 3CE New and Used Vehicle Rebates in FY 23-24

New Vehicle Type	Base	Tier 1	Tier 2
		400-201% Federal Poverty Level for the 48 Contiguous States, 2023 (gross annual income)	<200% Federal Poverty Level for the 48 Contiguous States, 2023 (gross annual income)
Battery Electric	$2,000	$3,000	$4,000
Plug-in Hybrid Electric	N/A	$2,000	$3,000
Electric Motorcycle	$1,000	$2,000	$2,000
Used Vehicle Rebates			
Battery Electric	$1,000	$2,000	$3,000
Plug-in Hybrid Electric	N/A	$1,000	$2,000
Electric Motorcycle	N/A	N/A	N/A
Level 2 Charger Rebates	$400	Up to $700	Up to $700
EV Readiness Rebates	Up to $2,000	Up to $3,000	Up to $4,000

Electrify Your Ride Program

3CE's Electrify Your Ride (EYR) program incentivizes residential and commercial electrification through rebates for the purchase or lease of an electric vehicle (EV), for purchase of Level 2 and Direct Current Fast Chargers, and for electrical work necessary to install chargers. In addition, EYR provides technical assistance for EV infrastructure build-out at publicly accessible commercial sites and at multifamily residential properties. The FY 2024-25 budget for EYR is $4.1 million. Incentives are available on a first-come, first-served basis until funding is fully awarded. To promote greater adoption of transportation electrification in disadvantaged and low income communities, higher incentive amounts are available for income-qualified customers and multifamily-unit buildings. In FY 2024-25, 3CE has distributed over $2,171,000 in EYR rebates across five counties, supporting over $25 million in EV and EV charger purchases. The EV purchases have resulted in over 2,349 MT CO2e avoided, which is equivalent to removing 548 gas cars off the road for one year.

Plan Your Fleet Program

3CE's Plan Your Fleet (PYF) program provides planning, design, and engineering consulting to Member Agencies to accelerate fleet electrification and EV charging infrastructure development across the Central Coast. The FY 2024-25 budget for Plan Your Fleet is $650,000.

The following jurisdictions have engaged with the Plan Your Fleet program so far, this fiscal year:

- City of Capitola
- City of Carmel-by-the-Sea
- City of Monterey
- City of Salinas
- City of Soledad

Charge Your Fleet Program

3CE's Charge Your Fleet (CYF) program provides rebates for the purchase and installation of Level 2 or Level 3 (DC Fast Charger) EV chargers. Member agencies are eligible for up to $150,000 in funding support each fiscal year. *3CE's FY 2024-25 CYF budget totals $1 million.*

In FY 2024-25, the program incentivized 68 chargers totaling nearly $173,000 and is engaged with additional member agencies who are in the process of installing EV chargers, including the City of Monterey and City of Carmel-by-the-Sea. 3CE expects increased participation later in the fiscal year as Member Agencies who took part in FY 2023-24's Plan Your Fleet program implement their plans.

Electrify Your Fleet Program

3CE's Electrify Your Fleet (EYF) program provides incentives to member agencies to purchase or lease electric fleet vehicles. Applications are accepted until program funds are spent. 3CE member agency applicants are eligible to be awarded up to $150,000 in EYF incentives in a single program year. In FY 2024-25, 3CE has budgeted $1.1 million for EYF.

In FY 2024-25, 3CE received two EYF applications. MBARD worked with member agencies who are in the process of purchasing electric fleet vehicles including the City of San Juan Bautista, City of Santa Cruz, City of Watsonville, and the County of Monterey and expects increased participation later in the fiscal years.

Table F-15: Electric School Buses and Electric Shuttle Van for FY 2023-24

County	Applicant Type	Total Funding	Total # of E-Buses/Vans	% ofFunding to Title 1 School or Low-Income Community
Monterey	1 School District	$200,000	21	100%
San Benito	1 School District	$75,168	1	0%
Santa Cruz	2 School Districts	$243,254	2	0%
TOTAL:	4 School Districts	$518,422	24	39%

Monterey County saw the most significant impact per dollar, with $200,000 supporting a fleet of 21 e-buses/vans. Notably, 100% of this funding reached Title 1 or Low-Income communities, meeting 3CE's primary equity goals.

Santa Cruz County received the highest total funding amount ($243,254) split across two school districts, though these did not fall under the Title 1/Low-Income priority designation for this specific cycle.

San Benito County successfully added one e-bus to its fleet with a $75,168 investment.

Across these three counties, 3CE distributed $518,422 to modernize four school districts. This resulted in 24 new zero-emission vehicles (buses and vans) entering service, with exactly half of the total funding directly benefiting disadvantaged student populations.

FY 2024-25, 3CE has distributed $580,978 in rebates for four electric school buses and one electric shuttle van in four counties (including Santa Barbara County). These rebates have helped enable over $2.1M in electric bus purchases.

Monterey Bay Air Resources District (MBARD) Program

Since MBARD initiated the AB 2766 grant program 34 years ago, the MBARD Board of Directors has authorized $40.4 million to over 613 projects in Monterey, San Benito, and Santa Cruz counties. The following are current AB 2766 motor vehicle emissions reduction programs: Clean Air Management Program, Clean Vehicle Program, Electric Vehicle Incentive Program, and Zero Emissions School Bus Programs.

Clean Air Management Program

These projects are identified as fixed assets for which travel activity data is available to calculate the expected reductions in motor vehicle emissions. Typical projects include battery charging stations, multi-use paths, bike lanes, bicycle infrastructure, chargers, storage, and racks.

Projects in this category are scored based on calculated emissions reduced. Applicants must submit travel activity data for the project as indicated in the application attachment, FY 2025-2026 Activity Data Spreadsheet. A quantifiable cost-effectiveness (C/E) score for these projects is used to rank projects. C/E is expressed in dollars per ton of pollutant reduced in conjunction with the project's total annual emission reduction in tons. Maximum funding per project will be $200,000.

Clean Vehicle Program

Incentivizes public agencies to replace internal combustion engine pool and fleet vehicles with zero-emission, battery-electric vehicles.

- *Medium and Heavy-Duty Fleets* – All replacement vehicles must be 100% battery electric. Leveraging other funds outside of the AB 2766 program may be used to offset incremental project costs. The incentive amount is up to $200,000.

Electric Vehicle Incentive Program

The Electric Vehicle Incentive Program incentivizes residents within Monterey, San Benito, and Santa Cruz counties to purchase or lease plug-in hybrid, battery-electric, or hydrogen fuel cell vehicles.

Electric Vehicle Incentive Program FY 2025-2026 (EVIP) is now open to residents, non-profit organizations, and government agencies of the Monterey, San Benito, and Santa Cruz counties. As of July 30, 2025, there is $451,500 remaining in project funds.

Zero Emission School Bus Program

The Monterey Bay Air Resource District (MBARD) is excited to offer school districts, Offices of Education, and public charter schools of Monterey, Santa Cruz and San Benito counties an opportunity to participate in the FY 2024-25 Zero Emission School Bus Program (ZESBP) and

receive up to $400,000 for a zero emission school bus and up to $20,000 for EV infrastructure.

Table F-16: GHG Reductions for EV Workplace/Public Charging

PHEV= 121,060	Lbs CO2 Reduced (eVMT=228,800)
60.53	tons CO2 reduced
0.90%	**% GHG reduction for 2035**
Year	2035
SB 375 VMT	14,979,846
SB 375 GHG	13,420,307
GHG/VMT Ratio	0.90
Population	794,720

Source: Methodology used to calculate GHG reduction (Appendix E, page 79)

Coordination of Modeling Activities

AMBAG, as a federally designated MPO, is required to develop and maintain a tri-county ABM 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 county level RTPA staff have established two levels of working committees that regularly meet and work together to develop the region's MTP and RTPs as well as to conduct scenario planning and modeling analysis. While the RTPAs do not maintain or run the ABM, they will be engaged in the consideration of the results of scenario model runs and in the process of refining the alternative scenarios. During the 2050 MTP/SCS developed, AMBAG worked with all partner agencies (RTPAs, transit operators, and local jurisdictions) as well as the appropriate federal and state agencies to ensure its MTP/SCS conforms to all applicable state and federal regulations.