

AMBAG Technical Methodology to Estimate Greenhouse Gas Emissions

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 Unified Air Pollution Control District (MBUAPCD), Monterey-Salinas Transit (MST), the Santa Cruz Metropolitan Transit District (SCMTD), 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 Silicon Valley (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 2014 Metropolitan Transportation Plan (MTP)

The 2014 Metropolitan Transportation Plan (MTP) will have a horizon year of 2035 and will be adopted by the AMBAG Board of Directors no later than June 2014. One of the first steps in the development of the 2014 MTP was to evaluate and update the stated goals and objectives from the current MTP. The AMBAG Board of Directors approved updated goals and policies as well as accepted updated performance measures at its January 2013 meeting. The performance measures will be used to evaluate alternative transportation/land use scenarios and include the following:

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

AMBAG, in coordination with its partner agencies (RTPAs), is in the process of developing revenue projections and estimating project costs.

AMBAG serves only as the MPO and not as a Transportation Management Agency (TMA) for the region. The 2010 MTP is supplemented by the three 2010 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. will be prepared in coordination with each other.

The Sustainable Communities Strategy (SCS)

The SCS will be a new element of the 2014 MTP, as required by Senate Bill 375, to show how regional greenhouse gas (GHG) targets would be achieved through efficient development patterns, infrastructure investments, and/or transportation measures or policies that are determined to be feasible. The regional GHG targets are measured from a 2005 baseline and for the AMBAG region are a zero percent per capita increase by 2020 and a five percent per capita reduction by 2035. If the SCS does not meet regional GHG targets, an Alternative Planning Strategy (APS) must be developed to demonstrate what alternative and additional measures would need to be taken in order for the region to meet its GHG target.

One of the specific requirements for the SCS is to “gather and consider the best practically available scientific information regarding resource areas and farmland in the region” (California Government Code Section 65080(b) (2) B 5). In order to address these requirements, AMBAG will prepare a “Regional Greenprint Element” of the SCS. The Regional Greenprint will include an assessment of existing natural resource areas and farmlands, using existing GIS data layers from a variety of sources. The information used in this assessment will be documented in a form that will be useful in the preparation of the SCS as well as a variety of other regional and local planning efforts, and environmental assessments.

Development and Evaluation of Planning Scenarios and Draft MTP

In order to evaluate various combinations of transportation and land use strategies that will lead to achieving the GHG targets established by CARB for the three-county region, AMBAG will be working with the three county RTPAs, local governments, and transit agencies to develop and evaluate a set of SCS alternative transportation and land use scenarios, using its upgraded transportation and land use modeling capabilities. These scenarios will be developed in consultation with policy makers, stakeholders, and the general public, and will be evaluated based on how each performs in relation to the GHG targets and other performance measures. This comparison of alternative scenarios will allow the AMBAG Board of Directors to select a preferred scenario that will form the basis for the draft MTP/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 Sustainable Communities Strategy (and Alternative Planning Strategy, 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.

In order to properly oversee the development of the 2014 MTP/SCS, an effective project management system has been established. In addition, a three-tier management structure has been created to ensure good coordination among the various public agencies:

- An Executive Steering Committee, which includes the AMBAG Executive Director, RTPA Executive Directors, and senior staff members from transit agencies and Caltrans, will provide project oversight and policy guidance, and will serve as liaison to the respective agency boards of directors.
- The existing Technical Advisory Committees for the three RTPAs, which includes city and county public works directors or designees, will provide input into the transportation planning aspects of the RTPs and MTP.
- The Planning Directors Forum, which includes the planning directors of all cities and counties in the AMBAG region, will provide input into the growth forecast, land use distribution studies, and scenario planning for the RTPs and MTP. (Note: joint meetings of the Technical Advisory Committees and Planning Directors Forum may be held periodically to obtain input at key decision points.)
- Staff Working Group – project staff from AMBAG and the three RTPAs, along with project staff from Caltrans, the transit agencies, and other partner agencies who are directly involved in the preparation of work products included in the MTP integrated work program, will meet regularly to review draft work products and monitor progress on the overall work program. Regional Advisory Committee - created by AMBAG Board and includes appointed representatives from the business, tourism, environmental, education, etc. fields to provide input and feedback into the development of the SCS.

2012 Regional Growth Forecast

In 2012, AMBAG began the process of developing a new forecast benchmarked to the 2010 Census with a horizon year of 2035. Staff contracted with Stephen Levy from the Center for Continuing Study of the California Economy for the development of the regional forecast figures. Stephen Levy's innovative approach places greater emphasis on employment growth as the primary driver of inter-regional migration, using employment to estimate long-term population change. 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. While there is some "catch up" employment forecasted for 2020, the state and national forecasts prepared by Stephen Levy have assumptions of slow recovery trends built into them and therefore the regional forecast also reflects this slow recovery.

The disaggregation of the forecast uses shift-share methods for population and employment. Since

these methods essentially calculate future years based on previous trends the forecast has the recession built into its growth as the trends analysis incorporates the period from 2000 to 2010. 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 will be adopted in June along with the 2014 MTP/SCS. The 2020 and 2035 scenarios for the SCS will be developed using this population and employment forecast in consultation and collaboration with region's local and regional agencies.

Other Key 2014 MTP/SCS Tasks

Other key major tasks include updates to the plan performance measures, economic analysis of investment strategies, enhanced 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. Additionally, the 2014 MTP/SCS will incorporate recommendations from recently completed or underway transportation studies, such as the Commercial Flow Study, the Electric Vehicle Infrastructure for the Monterey Bay Area Study, the Regional Agricultural Vanpool Study, and the Monterey Truck to Rail 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, and the California Household Travel Survey (CHTS).

Modeling Methodology for 2020 & 2035 MTP

AMBAG Regional Travel Demand Model

The primary transportation model that AMBAG employs is a traditional trip-based, four-step Regional Travel Demand Model (RTDM) run in TransCAD version 6.0 platform and includes Monterey, San Benito and Santa Cruz Counties. AMBAG has developed a very comprehensive Model Improvement Plan (MIP) which will address recommended improvements provided by the peer review panel selected under the Federal Highway Administration sponsored Travel Model Improvement Program (TMIP). AMBAG has hired a team of professional consultants lead by Caliper Corporation, Fehr & Peers and Parsons Brinckerhoff. Figure 3 provides a detailed scope and schedule of the model improvement project. The project is on schedule; a calibrated and validated travel demand model for the 2010 base year is expected to be ready by end of March 2013. The model includes detailed transportation and transit networks, as well as a geographically based Traffic Analysis Zone (TAZ) layer containing socioeconomic data for the base year 2010 and forecast years 2020 and 2035.

The trip generation, trip distribution and mode choice models will be estimated and calibrated using the 2010-12 CHTS. The 2010 base year model Highway Assignments will be calibrated and validated against traffic counts collected between of 2010 and 2012 link counts using a Percent Root Mean Square Error (%RMSE) statistic across facility types and volume groups and time periods. Model calibration will be performed using defined screenlines across the same traffic counts data. In addition, high level aggregate calibration statistics will be calculated using 2010-12 Highway Performance Monitoring System (HPMS) VMT data. The 2010 base year version of the model will be used to develop AMBAG's 2014 MTP and SCS.

The AMBAG travel demand model will contain several additional features to assist in answering specific

questions to the region. The modeling approach also contains a '5D' component for measuring sensitivity to urban design (The 5D's are Density, Diversity, Design, Destination and Distance from Transit). The model also includes visitor trip purpose, home based school and college trip purposes. The new AMBAG travel demand model will utilize innovative approaches not typically deployed in traditional RTDM structures. This will include disaggregate level trip generation using a synthetically derived population that describes the population using household characteristics that will assist in being able to better describe and quantify travel behavior. Depending on the richness of the data, the consultant will also explore the use of tours in lieu of traditional trip-based methodologies. This would result in a travel demand model with more of an activity-based pedigree.

Following is a summary of the key modeling components and brief description of the methodology / approach proposed for this model improvement project.

Data, Surveys, and Studies used in Model Development

Data from the recent population and employment forecast, the 2011-12 CHTS, the 2012 External OD study conducted by Fehr & Peers and Air Sage, SCCRTC onboard transit survey for the SCMETRO transit system, the City of Watsonville transit study, county and Caltrans traffic count programs will be used in the development, calibration, and validation of the model. In addition, reliable output data from the California Statewide Model (truck and interregional commute components) and data from the agriculture vanpool program will be also utilized for the model development.

Update the Highway, Transit, and Bike path networks for the 2010 base year, 2020, and 2035 future years

The consultant has completed a comprehensive review and update to the highway, transit, and bike networks for the model update. The latest data sets have exceptional geographic accuracy. The updated files include bike paths and other geographic considerations pertinent to transit accessibility. For the 2020 and 2035 networks, the consultant will work with the AMBAG, RTPAs and Caltrans staff to determine which infrastructure improvements to include in various scenarios.

Update the 2010 base year, 2020, and 2035 future years Traffic Analysis Zone (TAZ) data layers

Utilizing current estimates and projections for future year socio-economic characteristics pertinent to the model at various geographic scopes, the consultant will generate attributes using GIS tools for the model TAZ layer. The TAZ layer for the AMABG region is based on an aggregation of census level geography primarily harnessed from the block and block group level, and is generally consistent with the TAZ layer submitted to the United States Census Bureau in 2009. This consistency insures a reliable calculation and transfer of attribute data from the census-based data files. Although the TAZ boundaries will remain the same for the horizon years of the model, the socioeconomic characteristics may change significantly by county and region. AMBAG and its stakeholders will be critical in obtaining reliable estimates of future year data.

Trip Generation Model

In developing the trip generation model, AMBAG with the consultant's assistance will evaluate increasing the number of explanatory variables. We believe that 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 may be necessary for inclusion in the model.

The AMBAG region is a large and diverse area. To better handle such diversity the 2010 AMBAG model is considering the estimation and application of a person based trip rate model instead of a household based model. This would include 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 would be applied. Applying personbased trip generation models has several advantages. It will increase the sample size of data used to estimate the models and better explain the variations in travel behavior. It also provides a better platform on which to quantify the 5D's and prepares the foundation for a possible transition to activitybased modeling.

Trip Distribution (Destination Choice Model)

The consultant has proposed a destination choice 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 manifest 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 the ground reality and more sensitive to smart growth land use policies.

A destination choice model can also 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.

AMBAG will work closely with Caltrans, and other relevant local and county agencies to determine the most appropriate day and time periods for modeling. At this stage, we envision following time periods for the model:

- AM Peak hour and period (~6~9AM),
- PM Peak hour and period (~4~7PM),
- Mid Day (~9~4PM), and;
- Night (~7PM~6AM).

To the extent possible given the available count data, the AMBAG model will be calibrated for each of the time periods shown above.

A major upgrade to the model will be the deployment of time-period and trip purpose specific parameters. This will include the utilization of separate peak and off-peak period skims, and model parameters. This approach will provide a superior explanation of peak and off-peak travel patterns throughout the region

Mode Choice Model

The current mode choice model will be studied to explore avenues for enhancing its structure, utility specifications and coefficients. Model parameters will initially be compared against FAT 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 will, in all probability, be obtained by re-estimating the model from the latest CHTS and census data. The non-uniform travel characteristics, demographics and population densities of the AMBAG region suggest various avenues for optimizing the mode choice component of the travel demand model. These include:

1. Re-estimating the existing models with the latest survey and model skims.
2. Investigating the impact of moving from the current daily skims to a time-of-day approach that might better match peak and off-peak skims to those perceived and experienced by surveyed travelers.
3. Experimenting with additional nesting structures to better fit the new data.
4. Exploring regional heterogeneity so that mode choice models may vary by sub region.

Including accessibility measures in the utility specifications to assess their impact, especially in explaining non-motorized trips and the prevalence of walk access to transit.

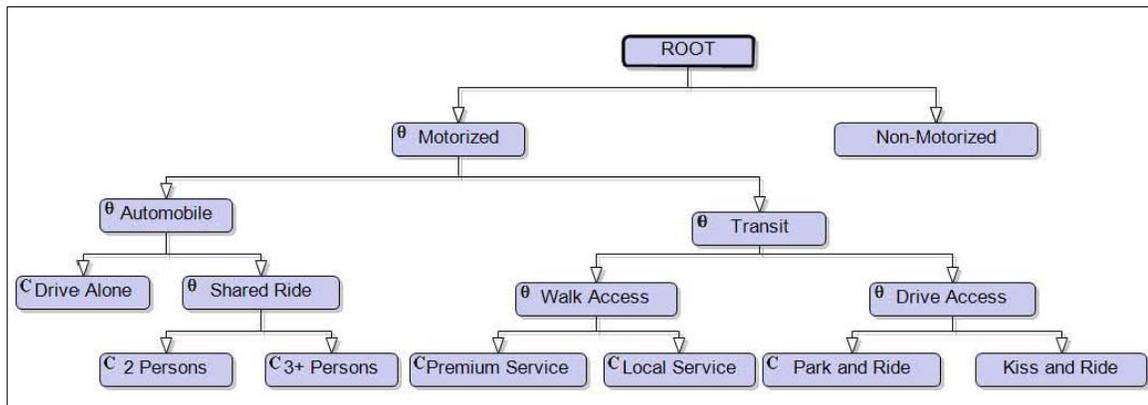


Figure 1 Mode choice Model structure

If a destination choice modeling framework is selected for the trip distribution stage, then a natural extension is to evaluate a combined mode-destination choice model that simultaneously captures the joint nature of the choice context. Such a joint approach is expected to improve the efficiency and accuracy of the model outputs.

An important consideration in the development of the mode choice model will be the integration with the recently developed stand-alone AMBAG bike model. Wherever possible, the consultant will incorporate concepts from this modeling effort to achieve consistency between the two approaches, including, but not limited to the bicycle skims. Great care has been taken to insure consistency between the bicycle networks used both models.

Highway and Transit Assignment

For highway assignment the consultant will utilize 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 will provide AMBAG with the ability to more accurately quantify project benefits and explain the highway assignment results in a clearer context.

Transit assignment will be 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 will include walk and bike access, along with park and ride functionality for both access (AM) and egress (PM). 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 FTA.

Model sensitivity testing and updating 5D post processing tool:

AMBAG is updating the current 5D post processing tool using 2010 CHTS and census data. Fehr & Peers will assist in this crucial task of the Model Improvement Plan. The details of this task will become better defined during model calibration which will primarily occur in April - May 2013. When the impacts of certain policy scenarios cannot be measured in the Regional Travel Demand Model, AMBAG will rely on "off-model" techniques based on academic literature reviews, collaboration with other MPOs and consultation with ARB's Policies and Practices Guidelines. Any off-model techniques used will be fully documented and justified in the final MTP/SCS and/or model technical documentation.

Inter-regional trip estimates and the assumptions:

AMBAG recently conducted an Origin Destination (OD) study using two different methodologies as well as week long classified traffic counts. The OD survey results will be used to account for such trips (X-X, X-I and I-X) and will be validated with traffic counts. AMBAG will also consult with MTC/VTA, SLOCOG and Merced CAG modeling staff.

EMFAC Model

AMBAG will use most recent emission factors (EMFAC) model to calculate GHG emission for 2020 and 2035 for the SCS as required by California Government Code 65080. As outlined in the modeling methodology and shown in the MIP flow chart (Figure 2), after each SCS scenario model run, the model outputs will go through postprocessor (off-Model Techniques to Measure GHG) and apply off model adjustment. The postprocessor tool is designed to export input tables (for the region as a whole) for EMFAC (Figure: 2).

Land Use Model

AMBAG will use UPlan to translate changes in land use to inputs for the RTDM. UPlan is a raster based tool and therefore careful consideration will be given to determining the grid cell size. AMBAG staff will ensure that the grid cell size maintains a balance of spatial accuracy and reasonable run time. The outputs of UPlan include population, housing and employment which will be fed into model at the traffic analysis zone level.

Currently AMBAG is using a place based typology system to conceptualize changes in land use across the region. The typologies act as a crosswalk between the 21 jurisdiction general plans and provide a common language for specifying land use change, they include specifications for density and intensity of land use. These typologies will be categorized into UPlan classifications and using industry accepted standards for jobs per square foot, UPlan will translate the floor to area ratios into employment. Dwelling units per acre is already included within the typology system and can be aggregated to the traffic analysis zone geography using UPlan.

Coordination of Modeling Activities

AMBAG as a federally designated MPO is required to develop and maintain a tri-county 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 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 RTDM, they will be engaged in the consideration of the results of scenario model runs and in the process of refining the alternative scenarios. As the MTP is being developed, AMBAG will work 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.

Figure 2: AMBAG Model Improvement Plan (MIP)

