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TECHNICAL METHODOLOGY FOR ESTIMATING GREENHOUSE GAS EMISSIONS IN THE SUSTAINABLE COMMUNITIES STRATEGY

OCTOBER 2011

Member Agencies

Buellton ■ Carpinteria ■ Goleta ■ Guadalupe ■ Lompoc ■ Santa Barbara ■ Santa Maria ■ Solvang ■ Santa Barbara County

This memorandum describes the general approach to estimating greenhouse gas emissions which the Santa Barbara County Association of Governments (SBCAG) will follow in its forthcoming Regional Transportation Plan (RTP) and Sustainable Communities Strategy (SCS). SB 375 provides:

Prior to starting the public participation process adopted pursuant to subparagraph (F) of paragraph (2) of subdivision (b) of Section 65080, the MPO shall submit a description to the state board of the technical methodology it intends to use to estimate the greenhouse gas emissions from its sustainable communities strategy and, if appropriate, its alternative planning strategy.

Government Code Section 65080(b)(2)(J)(i).

In accordance with the requirements of SB 375, this memorandum was prepared and will be submitted to the California Air Resources Board (CARB) for review. The memorandum also addresses the steps outlined in CARB staff's July 2011 paper describing CARB's SCS review methodology and is intended to present an approach to SCS preparation that will supply the information needed for CARB's review. By describing the technical approach to development of the SCS, this memorandum is also intended to garner CARB's acceptance and endorsement of the SBCAG approach early in the process.

The approach described in the memorandum is based on SBCAG's current work program and SBCAG staff's current understanding of available tools and information. These tools and this information are still under development and this approach may therefore change as SBCAG staff refines its understanding. Also, certain details, such as specific performance measures in Table 2 below, are provided by way of example, but still require SBCAG Board approval before a final list can be stated.

Completing the SBCAG SCS

Work tasks for completing the SCS were taken directly from the requirements for Sustainable Communities Strategies as contained in Government Code Section 65080(b)(2)(B).

Task 1: Identify the general location of uses, residential densities, and building intensities within the region

- a. Forecast future population and employment for the SBCAG region as a whole for the 2020 and 2035 target years as part of SBCAG's updated Regional Growth Forecast (RGF). The RGF will contain growth estimates of population, employment, and households to 2040 based on the Census 2010 residential and related socioeconomic data.
- b. Populate the regional land use model with the socioeconomic and land use data to create a Base Year 2010 scenario of existing land uses, residential densities and building intensities within the Santa Barbara County region. The land use model will replicate existing General Plan land uses using generalized land use categories corresponding to major use categorizations and specifying allowable densities and intensity of development.

Completion of these work tasks will paint a picture of existing land uses and possible future land use scenarios within the Santa Barbara County region and will help to inform the public during the public outreach phase. This work task will rely heavily on the development of the base year estimates in the Regional Growth Forecast as well as the development of the land use and travel models being prepared by SBCAG's consultant.

Task 2: Identify areas within the region sufficient to house all the population of the region, including all economic segments of the population, over the course of the planning period of the regional transportation plan taking into account net migration into the region, population growth, household formation and employment growth

- a. The land use model will be used to allocate forecast growth to future land use scenarios. Since the development of these scenarios will begin with model allocation of forecast growth, all future scenarios considered will accommodate the forecasted population and employment for all target years.
- b. Using the land use model to allocate growth forecast in the RGF, develop a range of future land use scenarios based on public input which accommodate the forecasted population and employment for all target years. Each land use scenario will provide for residential, commercial and industrial land use capacity sufficient to accommodate forecast population and employment growth, beginning with existing base year land uses and re-designating land as may be needed to accommodate forecast growth and future needs.
- c. Select a preferred alternative from among the range of future scenarios developed as described above.

SBCAG's updated RGF will contain estimates of population and employment growth out to the year 2040, which is consistent with the planning period of the RTP. The RGF also accounts for net migration, household formation, and employment growth factors. Forecast years corresponding to SB 375 target years 2020 and 2035 will be included.

Task 3: Identify areas within the region sufficient to house an eight-year projection of the regional housing need for the region

- a. In its role as the MPO for the region, SBCAG will receive the Regional Housing Needs Assessment (RHNA) Determination from the State's Department of Housing Community and Development (HCD).
- b. SBCAG will then prepare a RHNA allocation methodology and report that will ultimately be approved by our local Technical Planning Advisory Committee and Board of Directors.
- c. The RHNA allocation will be incorporated and accounted for within each of the different future scenarios of the SCS. The RHNA allocation will be reflected in the 2020 and all later target years.

SBCAG is expected to receive its RHNA Determination in early 2012. Staff will then initiate the RHNA allocation process. The distribution of the eight-year projection of the regional housing need for the region is one of the key requirements that will be included in each of the future alternative transportation/land use scenarios of the SCS.

Task 4: Identify a transportation network to service the transportation needs of the region

- a. SBCAG's RTP will include development of a fiscally constrained transportation network. The sub-tasks involved in developing the transportation network within the RTP are outlined below:

- i. Development of a set of goals, objectives, and performance measures to be used to evaluate the performance of the various scenarios of the RTP.
 - ii. Incorporate recommendations from relevant regional, corridor and subregional studies to update multi-modal highway, rail, and transit networks. Update regional arterial network as needed to reflect changes from local general plans. Compile a fiscally unconstrained, unranked list of projects by category.
 - iii. Establish project evaluation criteria category type (highway, transit, rail, etc.).
 - iv. Develop or revise cost estimates for all projects, including those projects on local streets and roads.
 - v. Apply project evaluation criteria from sub-task iii to projects identified in sub task ii to produce listing of ranked projects by category.
 - vi. Use ranked projects list from sub task v to prepare a fiscally unconstrained integrated transportation network and identify future transportation system management and monitoring systems to be included in the RTP scenarios.
 - vii. Develop updated revenue projections for local, state and federal funding sources.
 - viii. Prepare fiscally constrained RTP network, incorporating ranked projects from sub-task vi that can be funded based on the projected funding identified in sub-task vii.
- b. As needed, develop and analyze additional multi-modal (transit, HOV, managed lanes, bicycle, pedestrian, etc.) network alternatives in the future network scenarios described in Task 1 above.

The transportation network developed within the RTP will serve as the primary indicator of the transportation needs of the Santa Barbara County region. As noted in the California Transportation Commission's RTP Guidelines:¹

While the SCS requirements for the RTP do not change the process used to establish the transportation needs for the region, the SCS forecasted development pattern and transportation network, measures, and policies should complement one another to reduce regional GHG emissions from light duty trucks and automobiles. Decisions to expand or modify the transportation system should be made in recognition of the effects of transportation on development location and density, and also in recognition of the following relationships between land use and transportation:

- Transit investments need supporting levels of land use density and intensity.
- The speed of the network and the cost of travel may influence the location choices of new development.
- Placing land uses closer together and minimizing unnecessary barriers to circulation increases travel choices such that transit, walking, and bicycling

¹ Regional Transportation Plan Guidelines, California Transportation Commission, April 2010.

become viable while also reducing transportation sector energy use and GHG emissions.

Task 5: Gather and consider the best practically available scientific information regarding resource areas and farmland in the region

Complete a Regional Greenprint for the region. This will include mapping areas of sensitive species, habitat conservation, state parks, historic sites, flood zones, forests, and farms subject to Williamson Act restrictions, ground water basins, septic system problem areas, Local Agency Formation Commission Spheres of Influence, and other areas.

The Regional Greenprint will ultimately serve as a visual aid and mapping tool to define constraints to future development. The definition of such constraints will accordingly shape the development of the future alternative land use scenarios.

Task 6: Set forth a forecasted development pattern for the region, which, when integrated with the transportation network, and other transportation measures and policies, will reduce GHG emissions from automobiles and light trucks to achieve, if there is a feasible way to do so, the GHG emission reduction targets approved by ARB

- a. Alternative land use/transportation network scenarios will be defined in the UPlan land use model and evaluated using the TransCAD travel demand model and EMFAC air quality model to determine their performance against predetermined performance measures. Indicators will be set up to compare the base year with each of the future scenarios for each target year to determine attainment of the ARB reduction target. Tables 1 & 2 illustrate how the performance indicators and measures will be utilized.
- b. With decision-maker input and feedback from public outreach, a preferred scenario will be selected by the SBCAG Board from among the range of scenarios studied, taking into account scenario performance, especially with respect to the ARB reduction target.

Staff will then prepare a summary of the results for public workshops in the second phase of public outreach to focus the discussion on reaching consensus on a preferred transportation/land use alternative.

Table 1
SCS Scenario Comparison – ARB Performance Indicators [Example – Table will be the same for 2035]

Indicator	2010 Base Year	2020 Scenario 1		2020 Scenario 2		2020 Scenario 3		2020 Scenario 4	
		Value	% Change from 2010						
Population									
Employment									
Households									
Passenger vehicle trips									
Passenger vehicle miles traveled (VMT)									
VMT per capita									
Passenger vehicle greenhouse gas (GHG) emissions (carbon dioxide – CO ₂)									
Passenger vehicle GHG emissions per capita									
Commute trip mode share % Drive alone % carpool % Transit % Bike % Walk									
Residential density # Housing units per residential acre developed Population per residential acre developed									
Distance of housing and employment from transit % of households within ¼ mile of transit stops % of job sites within ¼ mile of transit stops									
Total bike/walk trip mode share									
Ozone precursor emissions (all vehicles) Reactive organic gases (ROG) Oxides of nitrogen (NO _x)									

Table 2

SCS Scenario Comparison – SBCAG Goals and Performance Measures [currently examples only – still need to be approved by the SBCAG Board]

Goals and Performance Measures	2010 Base Year	2020 Scenario 1		2020 Scenario 2		2020 Scenario 3		2020 Scenario 4	
		Value	% Change from 2010						
<u>ENVIRONMENT</u> On-road fuel consumption per capita % Ag land and open space converted per year									
<u>MOBILITY & SYSTEM RELIABILITY</u> Average total trip travel time Average work trip (commute) travel time Congested VMT % of total auto travel during congested conditions Peak periods All day % of total transit travel in congested conditions Peak periods All day % of Freeway VMT by Travel Speed % of VMT traveling from 0 to 35 mph % of VMT traveling from 35 to 55 mph % of VMT traveling above 55 mph Daily vehicle delay per capita									
<u>EQUITY</u> New affordable housing units by affordability level									
<u>HEALTH AND SAFETY</u> Total bike and walk trips Ratio bike + walk trips to total trips									
<u>PROSPEROUS ECONOMY</u> Avg. commute reduction, time Avg. commute reduction, distance Avg. commuter cost savings									

Task 7: Allow the regional transportation plan to comply with Section 176 of the Federal Clean Air Act

- a. The RTP is expected to be adopted in 2013 and will plan to a horizon year of 2040. This horizon year has been selected to meet the 20-year forecast requirement stipulated by federal transportation regulations and emissions standards.
- b. For the purposes of establishing an ozone emissions budget, the RTP will include an “action-baseline” test utilizing “no build” scenarios for the future target years (2020, 2030, 2035, and 2040). The future scenario years may contain no gaps exceeding 10 years.
- c. Staff will review the transportation control measures (TCMs) in the State Implementation Plan to determine their current status within the regional transportation plan.

According to local County Air Pollution Control District (SBAPCD) staff, possible changes in the federal ozone attainment standard could affect the SBCAG region attainment status. However, these changes may not occur within the time period of the current RTP/SCS. SBCAG staff will formulate the RTP to anticipate possible new, more stringent ozone standards.

Key Components of the SCS

Public Participation Plan

Public outreach and input will be crucial in developing scenarios for the SCS. SB 375 requires that each MPO adopt a public participation plan for the development of the SCS. The RTP & SCS Public Participation Plan will serve as an addendum to SBCAG’s Public Participation Plan 2007, which fulfills the federal requirements for public participation. The SBCAG Public Participation Plan identifies a public outreach process for the RTP and SCS that will be carried out over three phases:

1. *Scoping Phase.* SBCAG will convene meetings with advisory committees and interested stakeholder groups. During the meetings, staff will describe the planning process, explain the significance of SB 375, and outline the general planning “problem” (how to meet the targets for reduction of greenhouse gases and provision of housing required by the Regional Housing Needs Assessment), explain what types of land use and transportation methods the region could use to meet the targets, and provide example scenarios with rough estimates of how much greenhouse gas reduction and appropriate housing provision such examples would provide. (Fall/Winter 2011)
2. *Alternative Transportation/Land Use Scenarios Phase.* SBCAG will involve the interested parties in evaluating various possible future development patterns and alternative transportation/land use scenarios for the region. SBCAG will provide a description of the scenarios it developed after incorporating the input received in the RTP/SCS scoping phase. This will include an explanation of the results of the travel and land use model analysis of each scenario, and how well the scenarios achieve the greenhouse gas and housing targets, as well as the adopted performance measures. Visual representations from CommunityVIZ or other comparable software will be used to help participants visualize various alternatives. (Spring/Summer 2012)
3. *Draft RTP/SCS and Preferred Transportation/Land Use Scenario Phase.* During this phase, SBCAG will provide the draft RTP, including the SCS and, if applicable, Alternative Planning Strategy (APS), for review and comment. The draft documents will identify the preferred alternative, based on and taking into account information received as part of the previous phases. (Fall/Winter 2012)

The Public Participation Plan was adopted by the SBCAG Board in August 2011. SBCAG will initiate its first phase of public outreach in fall 2011. The RTP and SCS alternative transportation/land use scenarios will be developed by SBCAG staff following the scoping public outreach phase in winter 2012. Based on technical analysis of the scenarios and input from the public, SBCAG's advisory committees, Board of Directors, local City Councils and the County Board of Supervisors, the preferred transportation/land use alternative will be selected in summer/fall 2012, and the preferred alternative will ultimately be incorporated into the draft RTP and evaluated in the associated Environmental Impact Report (EIR), along with the alternative scenarios. The RTP and EIR are scheduled to be released in spring 2013.

RTP and SCS Goals, Objectives and Performance Measures

SBCAG staff is currently in the process of working with SBCAG member agencies to develop a set of policy goals and objectives for the RTP and SCS. The planning goals will serve as the overall vision for the direction of the RTP, while the objectives will serve the concise strategies for accomplishing the goals. Once the goals and objectives are finalized, performance measures will be selected to allow decision-makers and the public to evaluate differences between the alternative planning scenarios in the RTP and the SCS. The RTP and SCS goals, objectives, and performance measures are currently in development and are scheduled for adoption by the SBCAG Board of Directors in fall 2011.

Updated Regional Growth Forecast

The RGF will provide a countywide forecast to the year 2040 in five-year increments covering the SB 375 target years of 2020 and 2035 for use in long range regional planning. The forecast will serve as an input towards the development of future land use and transportation scenarios considered by the SCS, travel forecasts, air quality impact analysis, regional housing needs, and demand estimates for sewer treatment plants and other facilities. The forecast will contain an overview of future population, employment, and household growth to 2040. A draft RGF is expected to be completed in fall 2011, with public workshops to be convened through the winter 2011-2012. The final RGF is anticipated for adoption by the Board in spring 2012.

Travel Demand Modeling

Current Status

SBCAG currently maintains a countywide regional travel demand model that runs on the TransCAD platform. Staff applies and maintains the model in-house and works in close cooperation with State, regional and local agencies to forecast traffic growth, assess demand for transportation infrastructure improvements, and evaluate corridor alignment alternatives.

The SBCAG model is a traditional four-step, trip-based model (the four steps consisting of trip generation, trip distribution, mode choice, and trip assignment). The mode choice model is a multi-layer logit model that is employed to analyze and predict choices of travel mode. Mode choice outputs include auto (including drive-alone and carpool), transit, bike, and walk trips. Once transit trips are estimated, they are assigned to the transit route network. The 2001 Caltrans Household Survey for Santa Barbara County provides crucial travel information on trip purpose, modes, trip lengths, frequency, and other travel characteristics including time-of-day distributions for model calibration and validation. Peak hour traffic is modeled under three time periods (A.M., P.M. and midday).

Model Improvement Plan

In September 2009, SBCAG submitted an application for Proposition 84 funding to the Strategic Growth Council for improvements to the regional travel demand model. The funding was ultimately awarded and staff is working with a consultant to make upgrades to the model to comply with the requirements of SB 375 and to ensure consistency with the updated RTP Guidelines, including:

- A “4D” variable add-on to the regional travel demand model that will take each of the four “D’s” (Density, Diversity, Design, and Destination) into account during the trip generation, trip distribution, and mode choice model runs. This will allow SBCAG’s regional model to respond to changes to various land use scenarios. For example, the model will account for the various mix of land use types within traffic analysis zones (diversity). Also, the model will be more sensitive to transportation improvements that have traditionally not been accounted for in the past. For example, the model will incorporate walkability factors into the trip generation model.
- The ability to perform sensitivity tests on the model parameters and variables, such as local and system-wide housing and employment growth, income variations, model results with 4D variables turned on and off to measure effects, changing transit frequencies, value of time, auto operating costs, and gas prices.

Base and Forecast Years for Modeling

During the target-setting process, CARB set the year 2005 as the base year for which all MPOs would measure their net change in greenhouse gas emission emissions per capita. Consistent with the base year used for the regional target setting and per ARB staff’s direction, SCBAG will use 2005 as the base year for modeling purposes. Updated 2005 data will be derived from more current 2010 data, backcast to 2005. The SBCAG model employs, as an input, the socioeconomic data produced by the RGF. A number of factors led to the selection of the year 2010 as the basis for updated base year calculations. One of the major features of the updated RGF is the availability of the 2010 Census data. Another factor is the collection and availability of origin-destination surveys on local transit routes for each of the major transit operators in the County. 2010 data will also be able to more accurately reflect the current economic conditions that have been in effect since 2008. This data will enhance the transit network capabilities of the regional model.

SBCAG completed a regional traffic data collection program at over 200 roadways throughout the County in April 2010. The sample sites selected directly correspond with the sites that are monitored by the State Department of Transportation as part of the Highway Performance Monitoring System program. In addition, Caltrans has recently made its count station data available via the Performance Monitoring System (PeMS) website. The data collected from the regional count program and from the PeMS site will be placed within the GIS module of the TransCAD platform and will be available for the model’s base year calibration process.

Both of the data sets mentioned above contain count data for 24-hour time periods for at least 7 days, so true peak period estimations can be performed and, therefore, more time periods can be modeled. The expansion of time periods will make the model more sensitive to congestion effects by the time of day and allow the model to discern between the heavy congestion of the P.M. periods versus the more moderate congestion experienced during the “shoulder” periods (such as 2:00-4:00 P.M. or 7:00-9:00 P.M.).

Forecast years to be modeled in the RTP and SCS will include years 2020 and 2035, consistent with what has been recommended by CARB for the regional target setting. The RTP will also consider 2030 (to meet federal requirements that not more than a 10-year gap exist between model years) and 2040 (the plan horizon year).

Inter-regional and External-to-External Trip and VMT Assumptions

“Inter-regional” and “External-to-external” trips will be defined within SBCAG’s SCS as presented in ARB’s Recommendations to the Regional Targets Advisory Committee (RTAC) Pursuant to SB 375, as follows:²

Inter-regional trips begin in one MPO region and end in another MPO region after crossing their shared boundary.

External-to-external trips begin outside of an MPO region, travel across some portion of the region, and end outside of the region (through trips).

The RTAC developed a methodology for external and inter-regional trips during the target-setting process. The methodology, as described in the RTAC report, is outlined below:

For the first trip type (inter-regional trips), the Committee recommends that the travel associated with an MPO-to-MPO trip generally be split equally between the two MPOs. In most cases, each region has an equal opportunity to affect emissions from trips that regularly cross over their shared boundary and therefore should equally share responsibility for reducing those emissions. However, ARB may adjust trip assignments in extraordinary cases based on consultation with affected MPOs.

In general, however, the Committee recommends that an MPO should not be responsible for through trips and should take responsibility for half of the trip that has either an origin or destination with the MPO region.

SBCAG quantified inter-regional travel in its report to the RTAC in May 2010.³As stated in SBCAG’s report to the RTAC, our region experiences a significant number of interregional commute trips from Ventura County due to the high cost of housing in the South Coast area of Santa Barbara County. The South Coast region also draws a significant number of tourism-related trips, particularly during the spring and summer seasons.

SBCAG will work with its neighboring MPOs (SLOCOG and SCAG) to determine the fair share of inter-regional trips and VMT to include in the SCS, as supported by data, according to the guidelines adopted by the RTAC.

Interaction with the Land Use Model

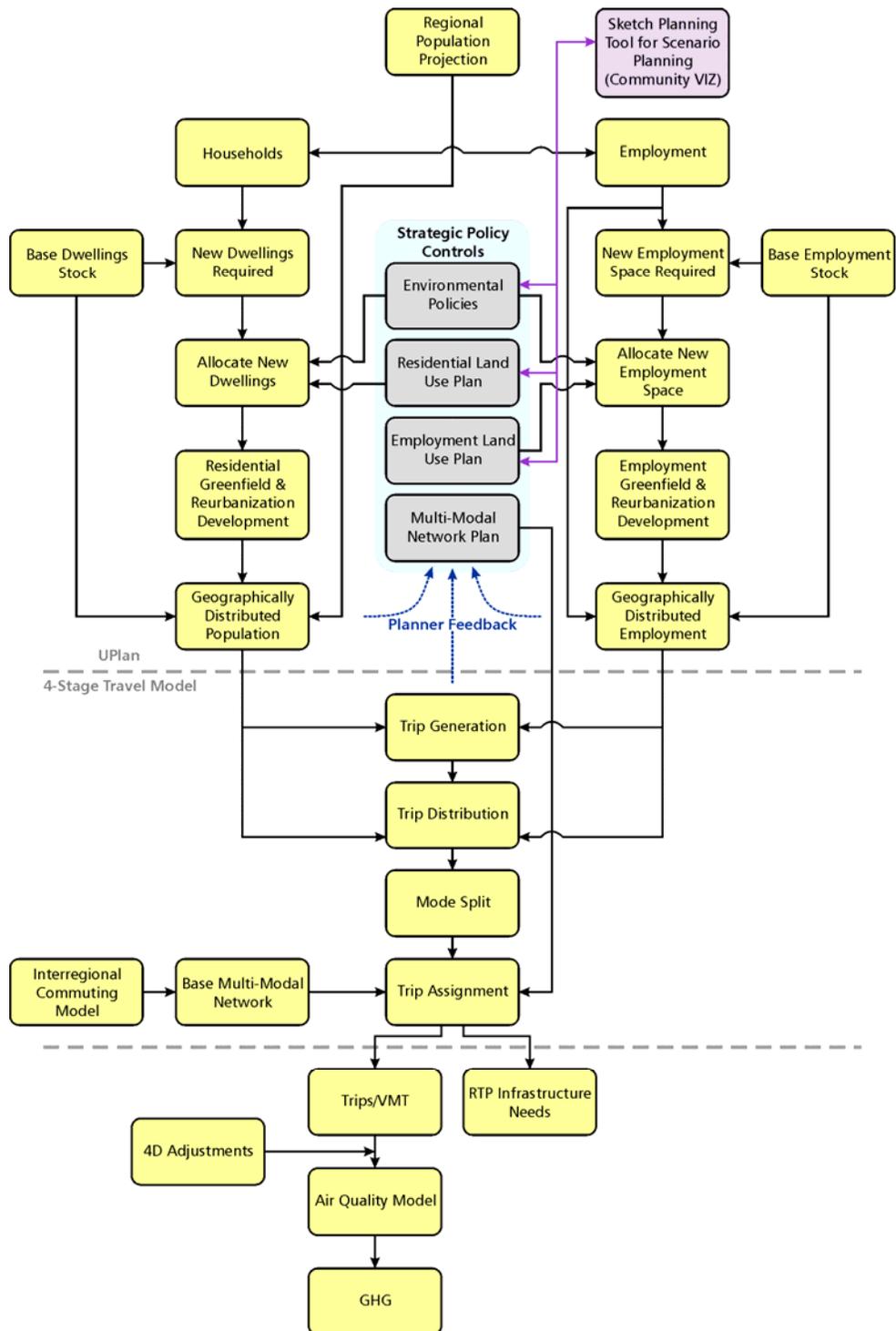
As noted above, in September 2009, SBCAG submitted an application for Proposition 84 funding to the Strategic Growth Council for improvements to the regional travel demand model. Within the application, one of the major data gaps identified by SBCAG was a lack of modeling capacity in addressing land uses at the micro-level, particularly on issues related to land use alternatives, transit-oriented development, density, mixed use, and the pedestrian environment. To address these gaps, SBCAG is currently working with its consultant to develop a land use model which will allow for evaluation of alternative future land use planning scenarios on the transportation network.

² [Recommendations of the Regional Targets Advisory Committee \(RTAC\) Pursuant to Senate Bill 375,](http://www.arb.ca.gov/cc/sb375/rtac/report/092909/finalreport.pdf)
<http://www.arb.ca.gov/cc/sb375/rtac/report/092909/finalreport.pdf>

³ [Preliminary Analysis of Alternative Greenhouse Gas Emission Reduction Strategies for the SBCAG Region,](#)
SBCAG, May 6, 2010.

Under the scope of work approved by the SBCAG Board, the consultant will integrate the land use model (UPlan) with the travel demand model by writing software to connect the two software products seamlessly through the model interface. The UPlan model database will be built and integrated with the UPlan software and will be run as part of the travel demand model stream. A flow chart illustrating the interaction between the land use model and the travel demand model is shown in Figure 2.

Figure 2 – Interaction between UPlan Land Use Model and SBCAG Travel Demand Model ⁴



⁴ Caliper Scope of Work, SBCAG Staff Report to Board of Directors, April 21, 2011.
<http://www.sbcag.org/Meetings/SBCAG/2011/03%20March/approved%20March%20mins.pdf>

Off-Model Methodologies to Measure Greenhouse Gas Emissions

During the regional target-setting process, SBCAG performed an assessment of its modeling capabilities. This later proved helpful in identifying work that needed to be done for the Model Improvement Plan within the application for Prop 84 funding to the Strategic Growth Council. The model upgrade will be complete prior to completion of the RTP and SCS, so it is anticipated that many of the data gaps identified in the Model Improvement Plan will be filled. However, it is to be expected that the model cannot describe all types of traveler behavior, projects, and/or policies. For those factors that cannot be captured by the model, staff will fully document assumptions and methodologies used to derive the off-model greenhouse gas emissions estimates. Examples of documents from which SBCAG staff have utilized methodologies in the past include the following:

- Multi-Pollutant Emissions Benefits of Transportation Strategies, Federal Highway Administration & ICF International, November 2006.
- Benefits Estimates for Selected TCM Programs, U.S. Environmental Protection Agency, March 1999.
- Carl Moyer Program Guidelines-Cost Effectiveness Calculation Methodologies (Appendix C), California Air Resources Board, April 2011.
- Land Use Impacts on Transport, How Land Use Factors Affect Travel Behavior, Victoria Transport Policy Institute, July 2011.

Sensitivity Analysis

As mentioned in ARB's document, *Description of Methodology for ARB Staff Review of Greenhouse Gas Reductions from SCS Pursuant to SB 375*, "Sensitivity analyses examine the effect that specific changes within a model have on model outputs. It involves systematically changing one model input variable at a time to see how sensitive the model outputs, such as VMT, are to changes in the variable."⁵ The ARB review methodology states that:

In performing its review, ARB staff will determine the most relevant variables or groups of variables to provide information on the resulting elasticities, and request that each MPO conduct sensitivity analyses. Depending on the SCS and the capabilities of the MPO model, ARB staff may request MPO-specific sensitivity tests of either individual strategies or groups of strategies. Staff will then review the model sensitivity results, and compare them with available empirical literature or other pertinent information to determine if the MPO's elasticities fall within a reasonable range.

Table 3 below shows policy categories and associated land use and transportation factors that are known to reduce greenhouse gas emissions. The table also shows SBCAG's capacity to analyze each land use and transportation strategy within the SCS. Note that availability of sensitivity testing for "off-model" measures is still being assessed.

⁵ Description of Methodology for ARB Staff Review of Greenhouse Gas Reductions from Sustainable Communities Strategies Pursuant to SB 375, California Air Resources Board, July 2011.

Table 3

SBCAG Capacity to Evaluate GHG Policy Variables and Reduction Measures in the SCS Sensitivity Analysis

Policy Category	Potential GHG Reduction Measure	Analysis Methodology Tool
Land Use Measures	Modify distribution of households, population, or jobs	UPlan / TransCAD
	Rebalance the mix of land uses	UPlan
	Increase the level of density	UPlan
	Improve the pedestrian environment	TransCAD
Road Projects	Add high occupancy vehicle (HOV) lanes	TransCAD
Transit Improvements	Construct new transit lines	TransCAD
	Increase service (e.g., increase transit headways, increase network connectivity)	TransCAD
	Upgrade transit service (e.g., change from bus to light rail)	TransCAD
	Improve accessibility (e.g., change bike/walk access distance to transit stations or stops, change auto access distance to transit stations)	TransCAD
Pricing Measures	Change in transit fares	TransCAD
	Change in auto operation cost	TransCAD

SBCAG will coordinate with ARB staff to determine which measures to include in the sensitivity analysis and will work in tandem with our consultant to complete the analysis. Since GHG emissions are not a direct output of the travel demand model, the main indicator of output during the sensitivity analysis will be VMT. Within its initial scope of work, our consultant has identified the following parameters and variables for sensitivity testing, in order of priority:

- Local and systemwide housing growth
- Local and systemwide employment growth
- Local and systemwide income variations
- Travel demand model results with 4Ds equations “turned on” and then “turned off” to measure the effect of the 4Ds variables
- Changing transit frequencies
- Value of time
- Auto operating costs
- Gas prices

Emissions Modeling

Using the output from the regional travel demand model (vehicle miles traveled (VMT), trips, VMT by speed class), SBCAG staff will utilize the California Air Resources Board's Emission Factors (EMFAC) model and the Pavley I/Low Carbon Fuel Standard post-processing tool to estimate greenhouse gas emissions for the RTP and SCS. The greenhouse gas emissions will be represented as tons of carbon dioxide (CO₂) per day. The two emissions modeling components are described below in greater detail.

ARB's Emissions Factor (EMFAC) Model

Two basic quantities are required to calculate a given emissions estimate: an emission factor and an activity factor. In general, the emission factor is the amount of emissions generated by a certain amount of motor vehicle activity. A countywide on-road mobile source emission estimate is calculated by summing the product of the vehicle activity (VMT and trips) and the emissions factors contained in the EMFAC emissions model developed by ARB.

The EMFAC model generates an output of carbon dioxide (CO₂) emissions, which will be used as the overall indicator of greenhouse gas emissions, per the recommendations of the Regional Targets Advisory Committee. In order to calculate the CO₂ emissions within EMFAC, VMT, vehicle trips, and VMT by speed class distributions will be extracted from the travel demand model for the baseline and each of the target years (2010, 2020, and 2035) and alternative transportation/land use scenarios within the future years. This extracted information will then be input into the EMFAC model. The CO₂ emissions associated with vehicle starts are accounted for in the EMFAC model based on the distribution of vehicle starts by vehicle classification, vehicle technology class, and operating mode. EMFAC adds these vehicle starts to the running emissions to compute total on-road mobile source emissions. Then the CO₂ emissions for the four vehicle classes that meet the passenger vehicle definition as specified by the Regional Targets Advisory Committee can be extracted from the EMFAC output and reported:

1. Light-duty autos (LDA)
2. Light-duty trucks (LDT1) (less than 3,750 lbs.)
3. Light-duty trucks (LDT2) (3,751-5,750 lbs.)
4. Medium-duty trucks (MDT) (5,751-8,500 lbs.)

Pavley/Low Carbon Fuel Standard (LCFS)

Two regulatory measures that will significantly reduce emissions directly from passenger vehicles are the Pavley standards and Low Carbon Fuel Standard (LCFS). A brief description of these measures and current regulatory status is provided below in Table 4.

Table 4

Description of Pavley and Low Carbon Fuel Standard Control Measures

State Control Measure	Description	Current Status
Pavley Phases I & II: GHG emission standards for light-duty vehicles	The Pavley standards seek to reduce GHG emissions from light-duty vehicles to the maximum extent technologically feasible. ARB is currently enforcing the Phase I standards for model years 2009 and up. The standards will be strengthened under Phase II starting in 2012.	ARB is working with U.S. EPA and the National Highway Traffic Safety Administration to propose new GHG standards for model year 2017-2025 passenger vehicles. Studies indicate that the new standards are technologically feasible and will save consumers money over the life of the vehicle because lower fuel use accompanies reductions of GHG. Technologies to achieve the new standards include engine and emission control advancements, wider application of advanced hybrid technology and greater use of stronger and lighter materials. ⁶
Low carbon fuel standard	The LCFS requires fuel providers to reduce the carbon intensity of transportation fuels sold in the state, dramatically expanding the market for alternative fuels. The LCFS will reduce carbon content in all passenger vehicle fuels sold in California by at least 10% by 2020 and more thereafter.	The LCFS was implemented statewide in early 2010

The most recently updated version of EMFAC (EMFAC2011) now incorporates these standards, so a post-processing is no longer required to calculate their effect.

When SBCAG staff used a post-processing tool to analyze EMFAC2007 outputs during the regional target setting analysis in 2010, it found that the implementation of the Pavley and LCFS measures would provide significant reductions in greenhouse gas emissions in future years in Santa Barbara County. For the SCS and RTP, SBCAG will assume that the Pavley and LCFS are in place for the future years and will utilize the EMFAC2011 model to account for the effect of these standards.

Demonstrating Compliance with the Regional GHG Target

The critical analysis of the SCS will be to demonstrate compliance with the regional GHG targets set by CARB. SBCAG will incorporate a regional GHG targets analysis into the second phase of the public participation/outreach phase of the RTP/SCS process. Compliance with the regional GHG targets will be a key factor in determining the preferred transportation and land use alternative during this phase. If a transportation/land use scenario does not meet the regional GHG target, it would need to be adjusted or removed from consideration. Table 5 illustrates how the regional GHG target analysis will be completed.

⁶ ARB Fact Sheet: Facts About the Advanced Clean Cars Program, July 11, 2011, http://www.arb.ca.gov/msprog/zevprog/factsheets/advanced_clean_cars_eng.pdf

Table 5

Regional GHG Target Analysis (Example Table)

Scenarios	Base Year CO₂ per capita	2020 CO₂ per capita	Base Year-2020 Delta / % Change	2035 CO₂ per capita	Base Year-2035 Delta / % Change
Baseline					
No Build					
#3 (tbd)*					
#4					
#5					
#6					
#7					

*Other future scenarios to be determined from public workshops, ad hoc committee and SBCAG board of directors.

Note that the analysis will only include the years for which the regional targets are required (base year, 2020, and 2035). The RTP will include additional scenario years (2020, 2030, 2040) to comply with federal law. It should also be noted that the RTP will also include estimates of CO₂ per capita for each of the scenario years for the preferred alternative.