June 7, 2013   File Number 3100000

Mr. Richard Corey
Executive Officer
California Air Resources Board
1001 I Street
Sacramento, CA 95814

Dear Mr. Corey:

SUBJECT: Technical Methodology to Estimate Greenhouse Gas Emissions from the San Diego Association of Governments Sustainable Communities Strategy

California Government Code 65080(b)(2)(I)(i) requires each Metropolitan Planning Organization to 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. The enclosed document outlines the planning and modeling methodology the San Diego Association of Governments (SANDAG) intends to use to estimate the greenhouse gas emissions from its sustainable communities strategy and alternative planning strategy, if necessary. I am pleased to inform you the upcoming SANDAG Regional Plan will use an open, activity-based model that will be fully integrated with our new Production Exchange, Consumption, and Allocation System (PECAS) land use and economic model. This advancement will allow for a more detailed review of the interaction between land use and transportation in this plan.

Sincerely,

GARY L. GALLEGOS
Executive Director

GGA/CDA/bga

Attachment: Technical Methodology to Estimate Greenhouse Gas Emissions

This report outlines key San Diego Forward: The Regional Plan (Regional Plan) planning efforts and inputs, including a description of its transportation and land use modeling platform. The Regional Plan serves as the San Diego Association of Governments (SANDAG) long-range planning document for the San Diego region, and it also functions as the Regional Transportation Plan and its Sustainable Communities Strategy (2050 RTP/SCS), which will comply with state and federal regulations including California Senate Bill 375 (Steinberg, 2008) and federal air quality conformity.

The Regional Plan brings together the updates of the SANDAG Regional Comprehensive Plan, the long-range blueprint planning document, and the 2050 RTP/SCS. A unified document provides San Diego residents a more accessible document that includes an overall vision for the region with a concrete implementation program. SANDAG anticipates the Regional Plan and its Environmental Impact Report (EIR) will be adopted by the Board of Directors in summer 2015.

What's New in the Regional Plan

The Regional Plan will continue to build on the planning and implementation progress since the adoption of the 2050 RTP/SCS in October 2011. The list below highlights some of the planning work that has been taking place in the San Diego region since 2011:

- An early action program to advance design and construction of projects included in the Regional Bicycle Plan

- A strategy to implement a broader Active Transportation Program that would include Safe Routes to School and Safe Routes to Transit

- Evaluation of alternative land use and transportation scenarios to further reduce projected Greenhouse Gas (GHG) emission levels

- Completion of a new transportation, land use, and economic modeling framework including an Activity-Based Transportation Model and Production Exchange, Consumption, and Allocation System (PECAS)

- Testing public health analytical tools for potential future planning work

- Development of a Regional Transit Oriented Development strategy to foster a greater level of development that supports investments in public transit

- Development of a Regional Complete Streets Policy for use at the regional and local level

In addition to the planning work, SANDAG and its partners are implementing the 2050 RTP/SCS, including the delivery of the following projects:

- SuperLoop Bus Service connecting the University of California San Diego and the adjacent major employment and housing centers of the North University area

- Expansion of the Bayshore Bikeway in Chula Vista

- New Bus Rapid Transit Stations and Managed Lanes along the Interstate 15 corridor

- Completion of the State Route 905 connecting the Otay Mesa International Port of Entry to the Interstate 5 and Interstate 805 corridors

- Double tracking of the COASTER and Amtrak LOSSAN corridor through northern San Diego County, including improved pedestrian crossings and tidal lagoon enhancements

- Completion of eight Smart Growth Incentive Program Capital Projects, including the Lemon Grove Main Street Promenade which will provide pedestrian enhancements to integrate planned mixed-use development at an existing light rail station

San Diego Forward: The Regional Plan Work Plan

On February 22, 2013, the SANDAG Board of Directors reviewed the work program for the Regional Plan. The work program provides the overall framework and schedule to develop and adopt the Regional Plan in 2015. Highlights of the work plan include the following activities:

- Engage in public outreach and involvement

- Establish the Regional Plan vision, goals, and policy objectives

- Prepare the 2050 Regional Growth Forecast update (Series 13)

- Refine and develop policy areas

- Incorporate recommendations from more detailed planning studies

- Develop Sustainable Community Strategies (SCS) and Alternative Planning Strategy (if needed)

- Update revenue and cost projections for projects, programs, and services

- Update regional arterial system (as needed)

- Update airport multimodal and rail planning

- Update transportation project evaluation criteria

- Update performance measures for the Regional Plan

- Develop financially unconstrained multimodal transportation scenario

- Develop revenue constrained alternative transportation scenarios and select preferred scenario

- Perform air quality conformity analysis

- Produce draft Regional Plan

- Prepare draft EIR

- Address feedback from public comment period

- Adopt final Regional Plan and certify final EIR

- Air quality conformity determination by United States Department of Transportation

- Air Resources Board (ARB) determination on the adopted SCS

Public Involvement Plan

The Public Involvement Plan (PIP) is intended to support the development of the Regional Plan, creating a variety of opportunities for individuals, organizations, agencies, and other stakeholders to provide meaningful input. The PIP was created based on input obtained throughout the fall of 2012 from the SANDAG Board of Directors, Policy Advisory Committees, working groups, surveys, and a public workshop held in October 2012. The PIP was drafted using the guidelines provided by the agency's overall Public Participation Plan, which sets the foundation for specific public outreach approaches. The PIP describes efforts that SANDAG will undertake to secure input on: developing sustainability and land use goals; priorities for transportation projects, programs, and services; transportation networks; infrastructure recommendations; funding alternatives; policies and programs; performance measures; GHG emissions targets; and other related issues.

Implementation of this PIP will accomplish the following:

- Provide a road map to ensure that all interested stakeholders are given the chance to participate in the process

- Reach beyond traditional methods to encourage participation from a wide variety of members of the public

- Communicate the importance of the plan and the opportunities to participate in the process

- Educate the public about SANDAG and its role in the region

- Establish the new Regional Plan as a critical policy document helping to balance our future housing, jobs, land use, transportation, health, social equity, economic, and environmental sustainability needs

This PIP is intended to be a living document. Because of the fluid nature of public participation, this plan may be updated at major milestones and adjusted in response to issues and circumstances that arise throughout the planning process.

Series 13: 2050 Regional Growth Forecast

The Series 13 Regional Growth Forecast serves as the foundation for the Regional Plan and other planning documents (e.g., water, general plans) across the region. SANDAG denotes forecasts by a sequential series number. The forecast under development is known as the Series 13: 2050 Regional Growth Forecast. The forecast used in the 2050 RTP/SCS, adopted in October 2011, was the Series 12: 2050 Regional Growth Forecast.

The regional forecast is developed by SANDAG with input from expert demographers, economists, developers, planners, and natural resource managers. These experts review economic and

demographic assumptions about fertility, migration, inflation, and other indicators. In addition to the traditional expert panel review SANDAG conducts, SANDAG also has reviewed the forecast with key stakeholders across the region, including transportation, land use, and economic development advocates.

SANDAG uses its Demographic and Economic Forecasting Model (DEFM) to develop the regional forecast. The DEFM was first developed to support the Series 4 forecast in the late 1970's. The DEFM uses a standard cohort-survival modeling technique along with econometric tools to estimate future growth. The DEFM has a proven track record of accuracy; since Series 4 (1977), on average, it has been within 4 percent of observed population growth.

The DEFM results will feed the sub-regional allocation models to develop city and neighborhood level forecasts. The Series 13 sub-regional forecast will use a new tool called PECAS. This model offers several enhancements beyond the sub-regional forecasting models used in prior forecasts by introducing economic conditions and return on investment calculations into the projections of development, redevelopment, and infill. In addition to new data sources, PECAS continues to rely upon the land use plans, policies, and zoning ordinances of the 18 cities, the County of San Diego, and other land use authorities. To ensure that local plans and policies are accurately reflected in the subregional forecast, the local jurisdictions and member agencies complete a review of its land use inputs (including general plans, planned land use, and housing capacity) via an online review tool.

Once the sub-regional forecast is complete, the detailed demographic forecast is produced. The Program for Age, Sex, and Ethnicity Forecast (PASEF) is a demographic model designed to forecast detailed demographic characteristics at a neighborhood level. PASEF projects population for 18 five-year age groups (0-4, 5-9,...,80-84, and 85+) broken down by gender and ethnicity for the region and smaller geographies.

A more detailed description of the land use forecasting models is included below in the *Modeling the Regional Plan* section of this report.

Evaluation Criteria and Performance Measure Development and Implementation

Project evaluation criteria is one element of a multistep process used to develop the revenue constrained multimodal transportation network for the Regional Plan. Evaluation criteria have been used in previous transportation plans including in the 2050 RTP/SCS. Project prioritization along with other factors such as funding availability, project readiness, and overall network connectivity are considered when developing the proposed transportation network alternatives.

In past transportation plans, SANDAG also has utilized performance measures to evaluate the performance of proposed revenue constrained transportation networks. The performance measures from the 2050 RTP/SCS included metrics to evaluate safety, multimodal mobility and reliability, goods movement, social equity, environmental impacts, and the relationship between land use and transportation. Performance measures are used to compare the proposed network alternatives and serve as a tool to select the preferred revenue constrained network scenario.

SANDAG is currently analyzing both the evaluation criteria and performance measures to incorporate best practices being used in the transportation planning field. Revisions for evaluation criteria are intended to simplify and standardize the criteria across different modal categories.

Performance measure revisions will assess the effectiveness of existing measures and consider new components including public health factors. Consultant assistance has been retained to research the best practices of other Metropolitan Planning Organizations (MPO) and various transportation research institutions and to develop refinements of the evaluation criteria and performance measures. The revised transportation project evaluation criteria and the updated performance measures will be presented to the SANDAG Board of Directors in fall 2013 for approval.

Land Use and Transportation Scenarios

The development of alternative land use and transportation scenarios, including the evaluation of potential pricing and parking strategies, is proposed to test strategies that could result in further reductions of GHG emissions beyond those forecasted in the 2050 RTP/SCS. The Series 13 sub-regional forecast will provide the baseline scenario against which alternative scenarios are compared.

Initial work on defining the scenario assumptions will begin in spring 2013, and scenario testing will begin in summer 2013. Through this planning process, various scenarios will be prepared, tested, and analyzed by early 2014, so results can inform the development of revenue-constrained transportation network scenarios.

A consultant team is assisting SANDAG in developing inputs and assumptions to assess the alternative land use and transportation scenarios. The scenarios will be measured against indicators, tested for performance, and refined throughout 2013. Sketch planning and travel demand models will be used in this planning effort.

Modeling the Regional Plan

SANDAG will use an integrated land use, economic, and transportation modeling system to estimate the GHG in the Regional Plan. Over the past five years, SANDAG has developed a new PECAS, Population Synthesizer (PopSyn), Activity-Based Model (ABM), Commercial Travel Model (CTM), and updated its Heavy-Duty Truck Model (HDTM).

The integrated system includes: (1) DEFM; (2) PECAS in conjunction with Urban Development Model (UDM); (3) detailed demographic forecast (PASEF and PopSyn); (4) the ABM and CTM; and (5) the latest Emission Factors (EMFAC) model from ARB (currently EMFAC 2011). Depending on model sensitivity to certain transportation policies, SANDAG will consider using off-model factors (or ARB defined Policies and Practices) as recommended by the Regional Targets Advisory Committee (RTAC). The Regional Plan model will have a base year of 2012.

The first model component, DEFM, is an econometric forecasting model with a demographic module. DEFM produces an annual forecast of the size and structure of the region's economy and a demographic forecast consistent with that future economy. For the economic forecast, DEFM relates historical changes in the region's economy to historical changes in the United States' economy using input-output and econometric methodologies. The demographic module uses a cohort survival model to forecast population by age, gender, and ethnicity. DEFM produces a wealth of data about the region's future economic and demographic characteristics. Among the more important elements are the size and composition of the population, employment by industry sector,

household and personal income, housing units by structure type, vacancy status and persons per household, labor force, and school enrollment.

Next, PECAS offers several improvements over more traditional spatial interaction "gravity" models. PECAS attempts to account for variation in the cost and quality of goods and services, as well as individual tastes and preferences. By integrating spatial characteristics (travel distances, land availability) and the economic system (prices, income), PECAS can evaluate a wider range of socio-economic impacts resulting from land use and transportation policies. PECAS is able to model the effects of land use and transportation policies on the wages, rents, productivity, and overall benefit to industrial and socio-economic groups.

PECAS has two component modules: the Activity Allocation (AA) Module and Space Development (SD) Module. The AA Module models the areas in which households and firms locate and who buys what from whom. Households located in one submarket interact with businesses throughout the region by both providing labor and purchasing goods and services. Businesses exchange their products with other businesses located throughout the region and use household labor as part of their production process. The SD Module models the actions of real estate developers who provide space (land use and floor space) in which households and firms can locate, responding to demand from households and businesses in AA for space in certain areas. These modules are run in one-year steps, with SD following AA. As a final step in the PECAS process, zonal control targets for housing and jobs are allocated to the parcel level with the UDM.

The third model component includes PASEF and the PopSyn. PASEF is a demographic model designed to forecast detailed demographic characteristics at a neighborhood level. The detailed demographic forecast comes directly from DEFM, but requires aggregating the single year of age detail into the five-year age groups used in PASEF, and an adjustment for special populations. The model projects population for 18 five-year age groups (0-4, 5-9,...,80-84, and 85+) broken down by gender and ethnicity for the region and smaller geographies. PASEF produces population controls used by the PopSyn.

The PopSyn generates a synthetic population for the region. This synthetic population represents the individual travelers that the ABM will simulate. For each simulation year, a full population is synthesized to match the forecasted socio-economic and housing characteristics of each part of the region at the zonal level. These forecasts, a key ABM input, come from the land use models described above. Synthesis works by replicating a sample of Census or American Community Survey Public Use Microdata Sample records (each containing complete household and individual characteristics) and placing them around the region in such a way that the forecasted characteristics of each zone are matched.

The fourth model component, the ABM, forecasts travel activity. The ABM simulates individual and household transportation decisions that compose their daily travel itinerary. People travel for activities such as work, school, shopping, healthcare, and recreation, and the ABM attempts to predict whether, where, when, and how this travel occurs. The ABM addresses both household-level and person-level travel choices including intra-household interactions between household members. It also offers sensitivity to demographic and socio-economic changes by the enhanced and flexible population synthesis procedures as well as by the fine level of model segmentation.

The ABM operates at fine temporal and spatial resolution: a half hour temporal resolution for the tour generation, mode choice, and trip generation. These 30-minute intervals are aggregated into five time-of-day periods for auto, transit, and non-motorized assignment. The ABM takes advantage of the Master Geographic Reference Area (MGRA) zone system, which is the most disaggregate zonal system currently in use in any travel demand model in the United States. The SANDAG current MGRA system consists of 23,000 zones (Series 13 version), which are roughly equivalent to Census block groups. To avoid computational burden, SANDAG relies on a 4,900 Transportation Analysis Zone (TAZ) system for the auto assignment step, but performs transit calculations at the more detailed MGRA level.

While the ABM addresses personal travel, the CTM addresses travel made in the region for non-personal reasons. Commercial travel is defined as heavy-duty truck trips with both origin and destination in San Diego County; professional service vehicle trips such as trips generated by plumbers, gardeners, and electricians; light-duty freight trips such as trips generated by trash trucks, light construction trucks, food delivery vehicle operators; postal and package couriers (such as FedEx and UPS); and at-work business trips generated by company employees.

The CTM is a disaggregate tour-based model used to forecast "local" intra-region commercial travel. The model starts with aggregate tour generation by industry type followed by disaggregate simulation of the tour attributes such as mode, purpose, exact start time, stop purposes, stop locations, and stop durations. The trip list produced by the CTM is transformed into trip tables by vehicle class for assignment with the ABM person trip tables. This model construct allows for more realistic commercial movements over trip-based models since commercial movements tend to have complex tours with a large number of stops.

An external HDTM addresses external to internal, internal to external, and external to external truck trips for San Diego County. The model is based on disaggregated Freight Analysis Framework forecast data. External trucks by commodity are allocated to TAZs based on employment types. Both the CTM and HDTM external model work on the same TAZ system as the ABM.

At the end of the modeling system is the EMFAC model, which takes vehicle miles traveled (VMT) by vehicle class and fuel type, and VMT speed distributions by vehicle class, post processed from the ABM/Commercial Vehicle Model, and calculates the GHG emissions for the SCS.

SANDAG strives to stay in the forefront of forecasting technology by subjecting its efforts to peer review and presenting the methodology at relevant meetings and conferences.

Active Transportation Enhancements

The Active Transportation Model component enhances the ABM to provide greater sensitivity and broader capabilities to address Active Transportation projects and policies and inform the SANDAG policy development and future decision-making. These enhancements include a complete representation of bike and pedestrian networks, and associated attributes such as facility type, distance, and grade; a new Bike-Route Choice Model; and revised and recalibrated trip and tour mode choices in ABM.

The first phase of the Active Transportation Model development is a seven-month project that is anticipated be completed in the second half of 2013. In this phase, a Bike-Route Choice Model will

be borrowed from San Francisco County and will be calibrated and validated with San Diego local bike count datasets. In cooperation with the County of San Diego and San Diego State University, SANDAG has installed 28 permanent bicycle count stations around the region to continuously monitor bicycle and pedestrian activity on key regional corridors.

A bike travel behavior survey will be conducted in future phases to estimate a San Diego Bike-Route Choice Model. With these enhancements, the integrated ABM and Active Transportation model can be used to assess the impact of bike and pedestrian investments on bike ridership and pedestrian volume changes, diversion of ridership on parallel facilities, mode share changes, VMT reductions, and GHG emission reductions. The Active Transportation Model will produce a set of non-motorized travel related Regional Transportation Plan (RTP) performance measures.

Emissions Modeling

The latest version of EMFAC (currently EMFAC 2011) will be used to calculate the GHG emissions for the Regional Plan based on the transportation model outputs. The transportation model post processes highway and transit assignment information to create EMFAC input files containing vehicle trips by vehicle class and fuel type, VMT by vehicle class and fuel type, and VMT speed distributions by vehicle class and hour. The current version of EMFAC projects the following GHG pollutants: carbon dioxide, carbon monoxide, nitrous oxides, total hydrocarbons, and methane.

Feedback in the Regional Travel Demand Model

A noteworthy feature of the forecasting process is the feedback of information from one model to another. For example, regionwide projections of economic activity from the DEFM are used in the AA Module of PECAS, and then AA Module results are used for the SD Module of PECAS. Similarly, data from AA are major inputs to the transportation model, and then transportation model data are used in subsequent AA calculations. A key feature of the modeling system is the central role that land use and transportation policies play in determining future travel patterns and the associated location of people, houses, and jobs.

Off-Model Techniques to Measure GHG

While the impacts of certain policy scenarios cannot be measured in the Travel Demand Model, SANDAG may use these policy scenarios to meet its GHG targets established by ARB. In these instances, SANDAG 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 RTP, SCS, and/or model documentation.

RTP Consistency with RTAC Target Setting Process

SANDAG anticipates using the methodology described in this report to calculate GHG emissions for the Regional Plan and its SCS as well as the current GHG target setting process as outlined by the RTAC and any subsequent updates by ARB. SANDAG may revise the methodology to be used in the regional plan in consultation with ARB if updated software (e.g., EMFAC 2013) or a more accurate methodology becomes available during the target-setting revision process.

Addressing GHG Emissions after 2035 in the Regional Plan

SANDAG will use the modeling methodology outlined in this document to calculate GHG emission for 2020 and 2035 for the SCS as required by California Government Code 65080. SANDAG will perform an analysis of GHG emissions through 2050. As the Regional Plan is being developed, SANDAG will work with the appropriate federal and state agencies to ensure its 2050 methodology is consistent with best practices and conforms to all applicable state and federal regulations.