DATE: May 16, 2016

TO: Nicole Dolney, Chief of the Transportation Planning Branch, California Air Resources Board (ARB)

FROM: Tahoe Regional Planning Agency (TRPA) and Tahoe Metropolitan Planning Organization (TMPO)

RE: Methodology for estimating greenhouse gas emissions reductions from the Sustainable Communities Strategy for the Lake Tahoe Region

Overview

This memorandum describes the draft methodology for calculating greenhouse gas emissions per capita for the Lake Tahoe Region. This information is provided in accordance with California’s Senate Bill 375 (SB 375), the Sustainable Communities and Climate Protection Act of 2008. The methodology utilizes three tools or components:

- Lake Tahoe’s Activity-Based Transportation Model
- The Trip Reduction Impact Analysis (TRIA) Tool, a post-processor spreadsheet model
- Calculation of the share of vehicle miles traveled (VMT) attributable to the California portion of the Lake Tahoe Region; and modeling greenhouse gas estimates using ARB’s EMFAC2014 model

Background

Since the development of the bi-state Tahoe Regional Planning Compact (Public Law 96-551) in 1969, planning efforts in the Lake Tahoe Basin have engaged citizens in creating a vision for the future of Tahoe that will balance preservation of its natural beauty with its economic viability. A significant part of this vision is a reduction in dependence on automobiles as the primary means of transportation, in order to reduce the impacts on the environment and on the built form.
Recently, mitigation of climate change impacts has emerged as a high priority for all communities in California. SB 375 requires regional metropolitan planning organizations (MPOs) to focus regional land use and transportation policies to reduce greenhouse gas emissions (GHG) in order to meet targets established by the California Air Resources Board. SB 375 calls for each MPO to develop a Sustainable Communities Strategy (SCS) with its Regional Transportation Plan, identifying how regional GHG will be reduced to meet the regional targets.

**Tahoe Regional Planning Agency (TRPA) and TMPO Planning Responsibilities**

TRPA operates under the authority of the bi-state Tahoe Regional Planning Compact (Public Law 96-551) between the states of California and Nevada and is required to regulate transportation and land use. TRPA also serves as the Tahoe Metropolitan Planning Organization (TMPO) for the Basin and in this role is responsible for development of the region’s long-range transportation plan to meet state and federal requirements. Because of these requirements, TRPA is involved in several on-going planning processes related to transportation, land use, and the environment, including:

- Achieving the Environmental Thresholds of the bi-state Compact;
- Regularly updating the TRPA Regional Plan;
- Regularly updating the Regional Transportation Plan (RTP) (per California and federal law);
- Updating the region’s Sustainable Communities Strategy (SCS) under California state law, as part of the update of the Regional Transportation Plan.

As the primary authority regulating land use in the Lake Tahoe Basin, TRPA is responsible for developing a land use plan that, when integrated with transportation and housing strategies, supports the goals of SB 375. The Sustainable Communities Strategy must rely on the transportation strategies of the RTP and the land use strategies of the Regional Plan to meet the Lake Tahoe GHG targets. In 2012 the Regional Plan underwent a major update, incorporating new land use strategies to help meet regional greenhouse gas targets.

**Updates since the 2012 Regional Transportation Plan**

In the 2016 RTP/SCS, called *Linking Tahoe*, the TMPO will use the same land use assumptions that it used in the 2012 RTP/SCS, and anticipates building upon the transportation strategies that were presented in that plan.

As part of the development of the 2012 Regional Plan Update and the 2012 RTP/SCS, the TRPA and the TMPO considered and evaluated five different land use strategies. In December of 2012, the TRPA Governing Board approved Alternative 3, the “Low Development, Highly
Incentivized Redevelopment” scenario. In developing the 2016 RTP/SCS, the TMPO determined that the land use regulations that were in place as of December 31, 2014, were the appropriate regulations to use as the land use component of the strategy. The Alternative 3 land use strategies approved in December of 2012 were still wholly in place with no modifications that would affect the SCS as of December 31, 2014. Although the land use strategies themselves have not changed since the 2012 analysis, the TRPA and TMPO have made some improvements to the modeling, and will be better able to model forecasted transfers of commercial floor area and tourist accommodation units in the 2016 RTP/SCS.

The TMPO anticipates making some updates to the estimated VMT and greenhouse gas reductions associated with the transportation strategies. The updates will include a review of recent research and incorporation of new findings into the reduction estimates, and incorporation of new strategies, pending public and board input. In particular the TMPO anticipates inclusion of new transit strategies, as new strategies are currently being developed through updates to short- and long-range transit plans.

The Transportation Vision for Lake Tahoe

Through an extensive public planning process to update the TRPA’s Regional Plan in 2012, the TRPA developed a transportation vision statement, which is reflected in the 2012 Regional Transportation Plan, Mobility 2035:

An innovative multimodal transportation system is in place that gives priority to viable alternatives to the private automobile, appeals to users, and serves mobility needs, while improving the environmental and socioeconomic health of the Region.

While on-going public feedback gathered since 2012 supports this vision, formal public outreach processes planned for the spring and summer of 2016 will continue to vet and test this vision. Needed modifications will be incorporated into the 2016 RTP.

A central goal of the Regional Transportation Plan update is to develop the necessary transportation projects, policies, and programs that complement the land use strategies called for in the Regional Plan, and that achieve the vision while meeting regional threshold and greenhouse gas emission targets. The sections below describe the TRPA’s methodology for estimating the greenhouse gas impacts of the 2016 Sustainable Communities Strategy.

Component 1: The Lake Tahoe Transportation Model

The Lake Tahoe Transportation Model is the primary tool used to calculate the VMT and GHG impacts of the existing and planned land use pattern, the existing and proposed street network, and the basic transit network. Progressively sophisticated versions of the transportation model
have been in use in the Lake Tahoe Region since 1981, when the first model was used to develop an environmental threshold goal for VMT for the region. The TRPA now uses an activity-based model, which is described in more detail below. As part of the RTP update the TRPA used outside peer review to validate the model. The memo describing the results of this model validation is included as Attachment A.

The TRPA invests in updates to the travel-forecasting model on an on-going basis. In 2005, the TRPA updated its model from a 3-step trip-based model developed in the 1980’s, to an activity-based model that uses the TransCAD platform. The TransCAD activity-based model introduced several improvements over the previous model, including the ability to associate non-home-based trips with their producing household and associated socio-demographic variables. Another strength of Tahoe’s activity-based model is the ability of a “traveler” represented within the model to make trip substitution decisions along the trip chain, by eliminating a trip or changing the destination or time that a trip begins. Each “decision” is encapsulated within a separate sub-model and therefore a modeled household is able to dynamically adjust its trip choices. In a trip-based model (like the TRPA’s old model), if a traveler is faced with congestion during mode choice, then the traveler’s only choice is to change modes. In the activity-based model, that same traveler could choose to leave at a different time period for a work trip, or choose a different destination for a discretionary trip.

The 2005 resident and visitor sub-models were based on a resident and visitor survey conducted in 2005. The results of the survey provided the necessary information about resident, seasonal resident, and visitor travel characteristics in order to develop the submodels to create realistic trip patterns for these groups. The 2005 surveys, however, did not provide sufficient information about the number of external workers traveling into and out of the region, the entry/exit point into the region for day visitors, or the number of visitors in the region at any one time. In 2010, the TRPA received a grant from the Strategic Growth Council to conduct a license plate survey that was followed up by a web-based travel survey of vehicle drivers entering and exiting the Region. The goal of the survey was to obtain the total number of vehicles entering the Region and to determine the travel purpose of each vehicle. This data was used to validate and update the existing assumptions about proportions of residents, visitors, external workers, and through travelers. Based on the new license plate survey, adjustments were made to the trip and tour purposes at the seven external stations around the Basin.

The Tahoe model consists of an activity-based resident model and an activity-based visitor model. Because the number of resident households, employment locations, person activities, and the resident/visitor mix are potentially very different in the region during the summer versus the winter, socio-economic data has been developed for the two seasons. Thus, the user may choose to model an average summer weekday or an average winter weekday. Both the SB 375 targets for the Tahoe Region and the Region’s Vehicle Miles Traveled Threshold are based on the average summer weekday model.
For the SCS analysis, the Tahoe model will utilize the land-use scenario approved in the Regional Plan in 2012. Once the model run is complete, the resulting trip table is used as an input to the remaining two components of the GHG analysis. Due to the model update described above, the 2005 base year inputs will be re-run using the most recent version of the model, so that the greenhouse gas targets, which are based on the 2005 base year, will be comparable with the new 2020 and 2035 greenhouse gas estimates.

Validation of the Updated Transportation Model and Forecast Year Assumptions

Whenever updates are made to the transportation model, TRPA conducts a model validation process to ensure that the model is accurately predicting travel patterns and that the model is sensitive to changes in land use. TRPA conducted a test of the model in 2015 in preparation for the development of the SCS forecasts and found that the model met the static and dynamic validation criteria recommended in the Caltrans 2010 RTP Guidelines (see Attachment A). In addition, TRPA verified model input assumptions for the 2020 and 2035 forecast years through a variety of means, including:

- Comparing model factors that influence growth in overnight and day visitors to California and Nevada demographer population forecasts from surrounding counties and counties that serve as a major source of tourists to the Region;
- Comparing model factors that influence growth in overnight and day visitors to the recent “Bay to Tahoe Basin Recreation and Tourism Rural Roadway Impact Study” completed by El Dorado County in October 2014;
- Vetting visitor growth assumptions with representatives from the tourism industry at Lake Tahoe;
- Comparing 2035 TRPA model forecast volumes on Basin entry roads with forecast volumes from Sacramento Area Council of Governments (SACOG), Carson Area Metropolitan Planning Organization (CAMPO), Washoe Regional Transportation Commission (Washoe RTC), and Placer County (Table 1).
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Component 2: Off-Model Reductions

The TRPA maintains a Trip Reduction Impact Analysis (TRIA) spreadsheet tool to evaluate the trip and VMT reduction impacts of various transportation policies and programs under consideration as part of the Sustainable Communities effort. While the TransCAD model is robust, it cannot capture more nuanced strategies that can have a significant effect on travel demand such as parking policies, traveler information systems, new transit operations, or construction of new bike trails and sidewalks. The purpose of the TRIA is to provide planning-level, order-of-magnitude, comparative estimates of the quantitative impacts on auto trips, vehicle miles traveled and greenhouse gas emissions of the continuation of existing policies and programs compared to the impacts of implementing new policies and programs in the areas of transit service expansion, bicycling and walking, and transportation demand management.

TRIA Methodology

As noted above, the TRIA provides a way to make comparisons between different policy alternatives and their ultimate effect on greenhouse gas emissions. Using the tool allows the TRPA to develop a package of policies tailored to the Tahoe area that will help the Region meet the greenhouse gas emissions reduction targets set by the California Air Resources Board under California’s Senate Bill 375.

As far as possible, the TRIA will use estimates based on current conditions in the Tahoe Basin, or existing forecasts developed locally, particularly in the case of new transit services and new active transportation facilities such as bike trails and sidewalks. For policies or projects for which there are no local studies the impacts will be estimated based on a review of the available literature and studies of places where these policies have already been implemented. Where
research shows that a policy might vary in effectiveness the more conservative approach will be chosen, so as not to overstate the trip and VMT reduction potential.

The TRIA is built around the main modes of transportation and analysis of how the land use plan and transportation strategies and policies proposed in the Regional Transportation Plan will impact these modes. The main categories considered in the model are:

- Bicycling and walking
- Public transit, including new technologies
- Transportation Demand Management measures
- Parking policy changes

The model is structured in such a way as to estimate the potential growth for each mode, for example the potential for new transit riders who were previously vehicle riders, and to take this growth as reductions in vehicle trips.

**Analysis by Mode**

*Bike and Pedestrian Facilities*


*Transit Services and Facilities*

The transit portion of the trip and VMT reductions will be based on ridership projections from the most recent short- and long-range transit systems plans. Potential investments under consideration include additional frequency on both the North Shores and South Shores, free fares, and improved traveler experience through deployment of advanced technologies such universal fare payment systems, seamless transfers, and improved traveler information. To the extent feasible, ridership projections will be increased over time to correlate with increases in population or visitor growth. Other services may include new inter-regional transit to population centers outside of the Region, and cross-lake waterborne ferry service.

Where transit alternatives are obviously mutually exclusive, only the project with the highest projected ridership will be included. Otherwise, all proposed transit projects will be included and assumed not to affect the ridership of other services.
Transportation Demand Management (TDM) Measures

The TRIA will compare the effect of improving the compliance rate of existing TDM ordinances through improved enforcement or updating of policies. Compliance rates and trip reduction potential will be based on literature review and local mode share survey data.

Parking Management

Where available, the parking calculations used in the trip and VMT reduction estimates will be based on observed parking occupancy statistics and estimates of the total parking supply provided by existing studies, compared to the total parking supply estimated to be available after parking management strategies proposed in the RTP go into effect. Where occupancy and turnover data is not available, trip generation rates will be based on data from Trip Generation, 9th Edition1.

Cumulative Effect

While the effect of each policy or project type will be analyzed individually, the cumulative effect of these policies will also be estimated. The cumulative effect of the policies cannot simply be the sum of individual effects. The impact of some policies depends on the origin and destination – for example whether they affect trips that start in Tahoe but end outside the region, or if the entire trip takes place within the Tahoe Basin. Other policies may be mutually exclusive – i.e. the measures could not reasonably be implemented at the same time.

Where there are several reduction measures that are not mutually exclusive, the total cumulative reduction does not equal Measure A + Measure B. Once Measure A has been applied, the Measure B will then apply to a base that has already been reduced by the measure A. For example, if two trip reduction measures would each give a 10% trip reduction, the total cumulative reduction is not 20%. Rather, it would be equal to 100% - (90%*90%) = 19%.

Other Off-Model Reductions

Additional strategies to reduce greenhouse gas emissions, such as changes to the amount of vehicle miles traveled by electric vehicles, may be applied prior to finalizing greenhouse gas emissions estimates.

Component 3: Calculating VMT and Greenhouse Gas emissions

Because the Tahoe Transportation Model spans both California and Nevada in its region-wide VMT calculations, it is necessary to develop a methodology for splitting out the VMT attributable to the California portion of the Region. In addition, in accordance with the RTAC protocol for accounting for half of the VMT of all trips with an origin or destination outside the region, and

1 Trip Generation, 9th Edition, Institute of Transportation Engineers (2012)
none of the VMT for trips that cross through the region without stopping, additional post-processing of the transportation model results is necessary. This section explains how the TRIA is integrated into the model results, and how total VMT and GHG emissions for the California portion of the Region are calculated.

The TRPA developed an “accounting-based” approach to improve the accuracy of VMT estimates in the Tahoe Basin. As described below, this approach accounts for every vehicle trip in the TRPA model. By doing so, it does not have to rely on any interim assumptions, and produces accurate VMT estimates that can be readily reviewed/confirmed by others.

**VMT Calculation for the TRPA Travel Demand Model**

This section outlines the process the TRPA will undertake to calculate the California-side VMT for the 2005, 2020, and 2035 model years. As noted, VMT is estimated for a peak summer weekday.

**Step 1: Obtain Daily Trip Table**

The daily trip table is a large matrix displaying the total number of vehicle trips on a daily basis that travel from one particular traffic analysis zone (TAZ) to another. Trip tables also include the number of trips that remain internal to a particular TAZ and trips that have an origin or destination to an external gateway. Below is an illustration of TRPA’s trip table.

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**Step 2: Apply TRIA Adjustments**

The TRIA quantifies the trip reduction benefits of various transportation programs and policies that are part of the SCS. Since the traffic model is not capable of modeling changes in behavior due to these strategies (e.g., employer shuttles, parking management, subsidized transit, etc), it is necessary to model these behavior changes through ‘post-processing’ of the model results. TRPA will modify the daily trip table shown above by reducing trips in accordance with the percentages displayed in the TRIA in those TAZs where travel behavior would be affected by the SCS strategies.
Step 3: Estimate Distance of Trips

A distance-skim matrix is used to estimate the travel distance between all TAZs within a model. It is a matrix of identical size to a trip table, but whose contents are expressed as miles versus vehicle trips.

Step 4: Calculate Zone-to-Zone VMT

The TransCAD software program allows for matrix multiplication. The adjusted trip table from Step 2 is multiplied by the distance skim in Step 3 to yield a new matrix whose content is VMT (i.e., number of daily trips multiplied by distance) between all zones in the model.

Step 5: Aggregate Zones into California and Nevada Sides

To show achievement of the greenhouse gas targets associated with SB 375, VMT must be calculated for the California side only. The TRPA model contains 289 TAZs, of which 184 represent land uses on the California side of the Tahoe Basin and 105 represent land uses on the Nevada side of the Tahoe Basin and external gateways. The California and Nevada zones are identified so that Step 6 can be conducted.

Step 6: Apply RTAC’s VMT Calculation Methodology

The Regional Targets Advisory Committee (RTAC) established under SB 375 recommends the following accounting of various trip types for VMT purposes:

- Include 100% of internal-internal (I-I) trips
- Exclude external-external (X-X) trips
- Count 50% of internal-external (I-X) and external-internal (X-I) trips

Since the SB 375 evaluation is for the California side of the Tahoe Basin, I-I trips are those that begin and end in this area. An example of an I-X trip is a trip from Meyers, CA to Incline Village, NV, or a trip from Sacramento to Tahoe City, CA. An example of an X-X trip is a trip from Echo Summit, CA to Incline Village, NV, or a trip from Placerville, CA to Carson City, NV.

The zone-to-zone VMT matrix from Step 4 was manipulated based on the aggregation of zones in Step 5 and the above VMT calculation methodology.

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3 TMPO has decided to count 100% of the modeled VMT for I-X and X-I trips with one trip end in the California side of the Basin and the other trip end to a California point outside the Tahoe Basin, as the transportation model provides trip lengths only to the borders of the TMPO Region. For I-X and X-I trips occurring between the California portion of the Tahoe Basin and the Nevada portion of the Tahoe Basin, or external Nevada point, the TMPO will count 50% of the VMT, in recognition that not all of this VMT is attributable to the California side.
The results of this six-step process yield the VMT for the California side of the Tahoe Basin using the RTAC-recommended calculation method.

**Greenhouse Gas Emission Estimation**

The California Air Resources Board requires MPOs to use the Emissions Factors (EMFAC) model to calculate greenhouse gas emissions associated with the SCS. In 2015 ARB released a memo entitled “Methodology to Calculate CO2 Adjustment to EMFAC Output for SB 375 Target Demonstrations.” The methodology states:

“In 2010, ARB established regional SB 375 greenhouse gas (GHG) targets in the form of a percent reduction per capita from 2005 for passenger vehicles using the ARB Emission Factor model, EMFAC 2007. EMFAC is a California-specific computer model that calculates weekday emissions of air pollutants from all on-road motor vehicles including passenger cars, trucks, and buses. ARB updates the EMFAC model periodically to reflect the latest planning assumptions (such as vehicle fleet mix) and emissions estimation data and methods. Since the time when targets were set using EMFAC2007, ARB has released two subsequent versions, EMFAC2011 and EMFAC2014.”

The memo continues:

“As MPOs estimate GHG emissions reductions from subsequent RTP/SCSs, they will use the latest approved version of EMFAC, but using a different model will influence their estimates and their ability to achieve SB 375 targets. The goal of this methodology is to hold each MPO to the same level of stringency in achieving their SB 375 targets regardless of the version of EMFAC used for its second RTP/SCS.”

The methodology describes a process for neutralizing the changes in fleet average emission rates between the version of EMFAC used for the first SCS and the version used for the second SCS. The methodology adjusts for the small benefit or disbenefit resulting from the use of a different version of EMFAC by applying an adjustment when quantifying the percent reduction in per capita CO2 emissions using the newest version of EMFAC.

After calculating the VMT attributable to the California side of the Tahoe Basin in accordance with RTAC procedures, the TRPA will use this VMT as an input to EMFAC2014 model to estimate GHG emissions. The resulting GHG emissions are then divided by the 2005, 2020, and 2035 residential populations to obtain GHG emissions per capita. Since the TRPA used EMFAC2011 to calculate GHG emissions in its first SCS, the TRPA will apply ARB’s
methodology for neutralizing the difference between EMFAC models in order to ensure that resultant estimates are comparable to the targets set for the Region.

**Attachments:**
- A. Validation of TRPA Base Year (2014) Travel Demand Model