Updating Transportation Impacts Analysis in the CEQA Guidelines

Preliminary Discussion Draft of Updates to the CEQA Guidelines Implementing Senate Bill 743 (Steinberg, 2013)

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Appendix F

Available Models for Estimating Vehicle Miles Traveled

Overview

Our ability to anticipate the transportation outcomes of land use development has increased greatly in recent years. Research undertaken by academics, consulting firms, and public agencies provide the basis for estimating future vehicle travel, and advances in computing power have allowed more sophisticated application of that research.

Models range in complexity and sensitivity to factors that can influence vehicle miles traveled, or VMT. Simpler tools make assumptions, but are easier to implement. More complex models consider more variables, but are not always necessary or feasible. Models generally fall into one of two categories:

Sketch models use statistical characterizations of land use projects and transportation networks to estimate project VMT. For example, a sketch model might characterize the transportation network using statistics like intersections per square mile and number of transit stops per day within a half mile, rather than actually containing a detailed representation of the network itself. They range in sophistication from simple spreadsheet tools, which often require a smaller number of inputs and are therefore easier to use but sensitive to fewer variables, to complex software packages. A number of sketch models can be downloaded free of charge.

Three sketch models commonly used in California include:

- Urban Emissions Model (URBEMIS) - *California Air Resources Board*
- California Emissions Estimator Model (CalEEMod) – *California Air Pollution Control Officers' Association*
- EPA Mixed-Use Development Model (MXD) - *U.S. EPA*

Travel demand models represent links and nodes in the transportation network explicitly rather than statistically. As a result, they generally require more data, maintenance, and run time than sketch models. Because of their greater complexity, and because their use is typically required for various statutory functions (e.g. determining air quality conformity), travel demand models are maintained by all MPOs and RTPAs, and also by some cities and counties. For this reason, a regional travel demand model already exists in most locations and can be used to develop estimates of VMT. Because they represent the transportation network explicitly, travel demand models are required when analyzing the VMT impacts of transportation projects.

Travel demand models can supply inputs for sketch models, particularly trip lengths; a single travel demand model run can supply these inputs for sketch model runs throughout the region. Travel

demand models can also be used to develop maps depicting VMT generation across the model's geography, providing a quick method for estimating VMT of a project in a certain location.

Catalog of Models

This section catalogs many of the models that generate estimates of VMT. Some were primarily designed to estimate project VMT, while others calculate VMT primarily in order to estimate GHG emissions and/or other outcomes. Please note, this inventory of possible models should not be construed as an endorsement of any particular model.

Name: VMT+

Developer: Fehr and Peers

Year: 2013

Accessibility: Free, only web browser and Internet access required

Description: This free website functions like a spreadsheet tool, estimating weekly VMT and GHG by the size and type of land uses developed. The calculation is based on trip generation. ITE data are provided as a default for "Average Western US City" and for four California metropolitan areas. All default data (including trip generation, average trip length, and internal trip rates) can be replaced with project specific information. This tool is useful for development projects or land use plans of various sizes.

URL: http://www.fehrandpeers.com/vmt

Name: RapidFire

Developer: Calthorpe Associates

Year: 2011

Accessibility: Paid, spreadsheet software (e.g. Microsoft Excel) required

Description: This spreadsheet tool can estimate VMT and GHG, among many other factors, and is appropriate for a neighborhood and larger scale development. RapidFire, as deployed during the Plan Bay Area project in the San Francisco Bay Area, applies a user-friendly web interface to allow the public to explore the VMT and GHG outcomes of their development preferences.

URL: http://www.calthorpe.com/scenario_modeling_tools

Documentation:
http://www.calthorpe.com/files/Rapid%20Fire%20V%202.0%20Tech%20Summary_0.pdf

Name: Transportation Emissions Guidebook and Calculator

Developer: Center for Clean Air Policy

Year: 2007

Accessibility: Free, spreadsheet software (e.g. Microsoft Excel) required

Description: This spreadsheet tool uses a trip generation model to estimate neighborhood VMT and GHG, and then estimates the impact of 19 mitigation strategies. Required inputs include present day mode share, trip generation rates, and average trip length. This model is unique among those listed here in that it includes school siting as a potential VMT mitigation strategy.

URL: http://www.ccap.org/safe/guidebook/guide_complete.html

Documentation:

http://www.ccap.org/guidebook/CCAP%20Transportation%20Guidebook%20(1).pdf

Name: Sketch7 VMT Spreadsheet Tool

Developer: UC Davis Institute of Transportation Studies

Year: 2012

Accessibility: Free, spreadsheet software (e.g. Microsoft Excel) required

Description: This Excel spreadsheet and online GIS application use elasticities for seven "D's" (density, diversity, distance, design, destination, demographics, and development scale) to compare site or neighborhood plans, and estimate the VMT and GHG produced by each.

URL: http://ultrans.its.ucdavis.edu/projects/improved-data-and-tools-integrated-land-use-transportation-planning-california

Documentation:
http://downloads.ice.ucdavis.edu/ultrans/statewidetools/Appendix_G_VMT_Spreadsheet_Tool.pdf

Name: COMMUTER

Developer: United States Environmental Protection Agency (U.S. EPA), Cambridge Systematics, Inc.

Year: 2011

Accessibility: Free, spreadsheet software (e.g. Microsoft Excel) required

Description: This spreadsheet tool estimates the impact on VMT and GHG of several common transportation demand management strategies, including pricing/subsidy, transit improvements, carpooling, and telecommute promotion. The model allows the user to provide baseline mode share, trip generation and length, and population as inputs, or alternately can provide defaults from MOBILE6.

URL: http://cfpub.epa.gov/crem/knowledge_base/crem_report.cfm?deid=74941

Documentation: http://www.epa.gov/otaq/stateresources/policy/transp/commuter/420b05017.pdf

Name: Envision Tomorrow

Developer: Fregonese Associates, U.S. Office of Housing and Urban Development (HUD)

Year: 2014 (version 3.4)

Accessibility: Free, spreadsheet software (e.g. Microsoft Excel) required

Description: This suite of linked spreadsheets allows users to "paint" changes to land use and transportation at the neighborhood or site level and model the resulting impacts on travel behavior. Inputs include employment characteristics, intersection counts, transit coverage, and assumed average vehicle speeds. The spreadsheets use trip generation rates to estimate VMT and GHG. Envision Tomorrow is distributed under a Creative Commons license, is free to use, and is open source.

URL: http://www.envisiontomorrow.org/site-level-travel-model

Documentation: http://www.envisiontomorrow.org/storage/user_manuals/20131029ENVISION%20TOMORROW%20PLUS_USER%20MANUAL_1st%20COMPLETE%20VERSION_updated_sm2.pdf

Name: Urban Emissions Model (URBEMIS)

Developer: California Air Resources Board (CARB)

Year: 2007

Accessibility: Free

The Urban Emissions Model (URBEMIS) was developed to model VMT and GHG from new development, and is appropriate for small and large site developments. The tool was developed with the support of California air districts, and is free to download and use. As it was designed with local data, URBEMIS is used across California, including in the San Joaquin Valley. It has faced and passed legal challenges. The model calculates impacts from many mitigation measures, including affordable housing, free transit passes, and transit availability, as well as decisions throughout the construction phase.

URL: http://www.urbemis.com

Documentation: http://www.urbemis.com/support/manual.html

Name: California Emissions Estimator Model (CalEEMod)

Developer: California Air Pollution Control Officers Association (CAPCOA)

Year: 2013

Accessibility: Free

Description: This user-friendly tool is appropriate for any size site development, and estimates VMT and GHG based on the size and land use(s) of the project. The model integrates with the California Air Pollution Control Officers Association (CAPCOA) Quantification of GHG Mitigation Measures.

URL: http://www.caleemod.com

Documentation: http://www.aqmd.gov/caleemod/user's-guide

Name: Smart Growth INDEX 2.0

Developer: United States Environmental Protection Agency (U.S. EPA), Criterion Planners/Engineers

Year: 2002

Accessibility: Free

Description: This tool requires users to upload a map of the project's surrounding neighborhood into a GIS system such as ESRI ArcMap. Inputs (shapefile format) include: land use, transportation, demographics, housing, and other community features. Once uploaded, users can configure and compare development scenarios, projecting 56 indicators that include VMT and GHG. Designed for stakeholder engagement, the tool can be set to rank the performance of multiple scenarios by community-defined metrics.

URL: http://www.epa.gov/smartgrowth/topics/sg_index.htm

Documentation: http://www.epa.gov/dced/pdf/4_Indicator_Dictionary_026.pdf

Name: Low-Carb Land

Developer: Sonoma Technology, Inc., Washington State Department of Transportation

Year: 2011

Accessibility: Paid

Description: This sketch-planning tool is intended primarily for site development in suburban and rural areas because it uses simple and high-level inputs, and doesn't account for the complexities of more centrally-located development. Users model a base case and one or more project scenarios. Aside from location, the other inputs are the "5 D's" commonly discussed in VMT mitigation: density, diversity, destination, distance and design. The tool incorporates prevailing VMT rates and elasticities for the area.

URL: http://www.sonomatech.com/project.cfm?uprojectid=672

Documentation: http://www.trpc.org/regionalplanning/transportation/Documents/Modeling/Low-Carb%20Land_TRB%20Presentation_2011.pdf

Name: CommunityViz

Developer: Placeways

Year: 2014 (version 4.4)

Accessibility: Paid, ESRI ArcGIS required

Description: CommunityViz, is a model designed to facilitate an engaging experience between planners and the public. Optional inputs include demographic data, transportation network characteristics, land use, water use, and jobs. Outputs include VMT and GHG. The user-friendly, interactive interface was designed to invite community members step up during public meetings, enter their own preferences, and then model and display the results in real-time, using with 3-D visualizations, charts, and maps.

URL: http://placeways.com/communityviz/

Documentation:
http://placeways.com/communityviz/resources/downloads/items/WhitePaperIndicators2011.pdf

Name: Transportation Impacts of Mobility Management Strategies (TRIMMS)

Developer: United States Environmental Protection Agency (U.S. EPA), Center for Urban Transportation Research, University of South Florida

Year: 2012

Accessibility: Free, spreadsheet software (e.g. Microsoft Excel) required

Description: Using constant elasticities of demand, TRIMMS predicts VMT and GHG changes brought about by the application of several mitigation strategies, including Smart Growth land use development, transit fare reduction, transit service enhancements, and parking pricing. TRIMMS also estimates GHG emissions.

URL: http://www.nctr.usf.edu/abstracts/abs77805.htm

Documentation: http://ntl.bts.gov/lib/43000/43600/43635/77932-final.pdf

Name: Emme

Developer: INRO (Canada)

Year: 2014 (version 4.1)

Accessibility: Paid

Description: Used in the United States and internationally, Emme is a desktop-based model that uses neighborhood-level household information to estimate the impacts of a variety of transportation policy and infrastructure decisions, including transit service, bicycle facilities, carpooling, and tolling. Emme is appropriate for neighborhood-level development and outputs VMT and GHG.

URL: http://www.inro.ca/en/products/emme/index.php

Name: I-PLACE3S

Developer: Parson Brinkerhoff, Freonese Calthorpe Associates

Year: 1996

Accessibility: Free, ESRI ArcGIS required

Description: I-PLACE3S was launched in 2002 as a web-based modeling tool commissioned by the California Energy Commission, and is appropriate for larger developments and plans. The model works by developing a comprehensive land use and transportation network for a base year, before estimating effects of the development on VMT and GHG, among other variables. I-PLACE3S has a user-friendly interface, and is currently being used in several cities across the United States.

URL: http://www.smartcommunities.ncat.org/articles/place3s.shtml

Documentation: http://www.smartcommunities.ncat.org/pdf/places.pdf

Name: Surface Transportation Efficiency Analysis System

Developer: Federal Highway Administration (FHWA), Cambridge Systematics, Inc.

Year: 1997

Accessibility: Free

Description: Though STEAM requires substantial base year data; it is well suited for exploring many VMT mitigation strategies in a sub-region or along a corridor. Inputs include baseline vehicle occupancy, trip length, and population as well as several elasticities. Outputs include VMT and GHG.

URL: https://www.fhwa.dot.gov/steam/products.htm

Documentation: https://www.fhwa.dot.gov/steam/20manual.htm

Name: Urban Footprint

Developer: Calthorpe Associates

Year: 2012

Description: Developed for the Vision California process, this web-based tool allows users to estimate VMT and GHG at a large site or neighborhood scale. Urban Footprint also outputs land consumption, fiscal impact (household and government), household resource use, and public health. Within California, Urban Footprint is currently being used by the Sacramento Area Council of Governments (SACOG), San

Diego Association of Governments (SANDAG) and the Southern California Association of Governments (SCAG).

URL: http://www.calthorpe.com/scenario_modeling_tools

Documentation: http://www.calthorpe.com/files/UrbanFootprint%20Technical%20Summary%20-%20July%202012.pdf

Name: UrbanSim

Developer: Synthicity

Year: 2014 (ongoing open source improvements)

Accessibility: Free, ESRI ArcGIS required

Description: UrbanSim is an open-source transportation and land use scenario-planning tool, which can model VMT and GHG, among many other outcomes. The Metropolitan Transportation Commission (MTC) applied UrbanSim to forecast its Plan Bay Area outcomes. Modeling site and neighborhood development with UrbanSim is most feasible if the surrounding region already uses UrbanSim.

URL: http://www.urbansim.org/Main/UrbanSim

Documentation: https://github.com/synthicity/urbansim/wiki

Name: EPA Mixed-Use Development (MXD) Model

Developer: United States Environmental Protection Agency (U.S. EPA)

Year: 2007

Accessibility: Free, spreadsheet software and ESRI ArcGIS required

Description: The MXD Model is a spreadsheet tool designed to model VMT production from project sites and neighborhoods that apply Smart Growth principles. The model must integrate with a desktop GIS application, and for inputs, it requires household and employment characteristics, intersection density, and transit availability.

URL: http://www.epa.gov/smartgrowth/mxd_tripgeneration.html

Name: MXD+ / Plan+ / TDM+ Toolkit

Developer: Fehr and Peers

Year: 2013

Accessibility: Paid

Description: These proprietary tools build on the EPA MXD model, estimating VMT for site and neighborhood-scaled development. MXD+ adjusts trip generations rates downward for mixed use development. Plan+ introduces new land use mitigations (parking pricing, connection to transit, bicycle parking) to estimate further reductions. TDM+ models the effects of the CAPCOA Guideline mitigations.

URL: http://asap.fehrandpeers.com/tools/sustainable-development/plan

Name: CUTR_AVR

Developer: Federal Highway Administration (FHWA)

Year: 1999

Accessibility: Free

Description: The CUTR_AVR model is ideal for large office developments with 100 or more employees with innovative TDM programs. The model estimates the mode share and ridership effects of the TDM programs, which can be input into other models to estimate VMT and GHG. The model is based on a dataset including 7,000 employer TDM programs from three metropolitan areas in Arizona and California.

Information: http://www.fhwa.dot.gov/environment/air_quality/conformity/research/transportation_control_measures/emissions_analysis_techniques/descriptions_cutr_avr.cfm

Download: http://www3.cutr.usf.edu/tdm/registercutravr.htm

Documentation: http://www3.cutr.usf.edu/tdm/pdf/CUTRAVR.PDF

Name: National Energy Modeling System (NEMS): Transportation Sector Module (TSM)

Developer: United States Department of Energy (DOE) Energy Information Administration

Year: 2001

Accessibility: Free

Description: This model focuses exclusively on the impact of changes in the vehicle fleet on VMT and GHG. Input data includes the vehicle fleet (personal, transit, and freight), fuel prices, fuel economy, passenger miles, population, income, and changes in costs and income.

URL: http://www.eia.gov/bookshelf/models2002/tran.html

Documentation: http://www.eia.gov/FTPROOT/modeldoc/m0702001.pdf

Name: VMT Impact Tool

Developer: California Air Resources Board (CARB)

Year: 2014

Accessibility: Free, spreadsheet software (e.g. Microsoft Excel) required

Description: This spreadsheet tool calculates the effect of changes in seven factors on VMT: pricing, transit utilization, job access, activity mix, active mode share, road network connectivity, and mixing of uses.   It does not calculate absolute VMT quantities, but can be used to estimate the change in VMT that would result from policy changes. The results can be exported to GIS to visualize spatial relationships.

URL (Tool and Documentation): http://www.arb.ca.gov/research/single-project.php?row_id=64861