GHG EMISSIONS ESTIMATE APPROACH FOR INFRASTRUCTURE STUDIES

GHG emissions for a roadway capacity expansion project can be estimated more than one way and the method may affect the direction and magnitude of the result as well as the level of accuracy.

1. VMT by itself can be used to estimate GHG emissions by assuming an average fuel mileage rate. Typically, the US fleet average of about 22 miles per gallon is used. Since one gallon of gas generates about 24 pounds of CO2 equivalent, many estimates just use a ratio of 1 mile = about 1 pound of CO2 equivalent. VMT can be estimated using a travel demand model (macro/meso-level) or through a traffic operations micro-simulation model (micro-level). Since this approach is coarse at best, it is typically used for macro level estimates. The simulation model has other outputs as noted in method 4 below to provide more accurate GHG estimates.

2. VMT and speed can be used together to estimate GHG emissions since CO2 emission factors are sensitive to speed. For this method, a travel demand model can be used to forecast VMT in 5 mph speed increments. This input can be used with the California EMFAC model, an emissions factor model, to provide a more refined estimate of GHG emissions. While this method is more refined than the first method, it should still be considered a macro level estimate because it doesn't fully capture vehicle performance or traffic flow efficiency in the network, which is important for GHG emissions as explained in method 4.

3. Vehicle hours of delay (VHD) may be another option according to the FHWA policy options evaluation tool (POET). This model estimates that every hour of delay reduced results in 0.68 gallons of fuel saved. This is a macro level estimate that also doesn't fully account for vehicle performance or traffic flow efficiency changes. We do not recommend this method given its limited documentation the significant variation between hours of delay at different speeds and under different operating conditions.

4. Fuel consumption is the final and potentially the most accurate option depending on the model uses. In traffic operations micro-simulation models, fuel consumption is calculated from individual vehicle performance across the network. Since simulation models track each individual vehicle, the models can be used to calculate fuel consumption that considers how often the vehicle stops, starts, accelerates, decelerates, etc. To a limited degree, these models also consider the type of vehicle and its performance (i.e., passenger car versus truck). This is a preferred method for infrastructure projects since it provides a more complete understanding of potential GHG emissions. For example, using method 1 or 2 guarantees higher VMT levels when expanding a congested roadway because of increases in demand (see notes below about induced travel effects). However, if the traffic in the corridor is now traveling in stable flow conditions versus congested breakdown flow conditions, the vehicles will reduce their fuel consumption resulting in less GHG emissions. The key question is over what time period does fuel consumption decline before rising again due to long-term induced travel effects that lead to more vehicle travel.

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Some key issues to consider...

- GHG emissions analysis is typically report for annualized conditions. Travel demand models are often calibrated only to weekday conditions. Weekend day and holiday travel can vary significantly from weekday conditions and should be accounted for in the estimate. PeMS data in California can provided a basis for weekend versus weekday travel.

- Traffic operations micro-simulation models like VISSIM or PARAMICS are usually only set up for peak periods so they often won't provide a complete picture of all GHG emissions. However, reasonable judgments can be made about the non-peak period hours between alternatives if congested conditions are limited to the peak period. Under these conditions, the macro level estimates of vehicle travel may be sufficient for non-peak periods.

- Method 1 and 2 have traditionally been used, but now that greater focus on GHG emissions and impacts is occurring, more projects may need to rely on Method 4 (or some type of hybrid between 1/2 and 4) if higher levels of accuracy and defensibility are desired.

- This area of practice is evolving quickly and better data and models will likely be available in the near future that are more sensitive to individual vehicle performance and traffic flow efficiency.

Example project (I-80/Eureka Road Interchange)...

This project included the widening of Eureka Road and modifications to the I-80 eastbound diagonal on-ramp from Eureka Road. Signal modifications and ramp metering are also components of the project. All four methods described above were tested on this project to help the City of Roseville, CA, Caltrans District 3, and Caltrans Headquarters understand the implications of different methodologies.

GHG Emissions Estimate Method	GHG Emissions (1,2)	Project Impact
Method 1 – VMT	1,760 lbs	YES
Method 2 – VMT by Speed bin and EMFAC	- 60 lbs	NO
Method 3 – VHD	NA	NA
Method 4 – Microsimulation (VISSIM)	-171 lbs	NO
Notes: (1) Difference between project and no project under design year conditions. (2) CO2 Equivalent Not Applied		