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U.S. Department of Transportation
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RE: Docket No. FHWA-2013-0054
Docket RIN2125-AF54
Comments on MAP-21 Notice of Proposed Rulemaking for the Performance Management Measure: Assessing Performance of the National Highway System, Freight Movement on the Interstate System, and the Congestion Mitigation and Air Quality Improvement Program

To Whom It May Concern:

The California Department of Transportation, with the support of the California Air Resources Board, respectfully submits the enclosed comments on the MAP-21 Notice of Proposed Rulemaking for the Performance Management Measure: Assessing Performance of the National Highway System, Freight Movement on the Interstate System, and the Congestion Mitigation and Air Quality Improvement Program.

Sincerely,

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Enclosure:
Comments on MAP-21 Notice of Proposed Rulemaking for the Performance Management Measure: Assessing Performance of the National Highway System, Freight Movement on the Interstate System, and the Congestion Mitigation and Air Quality Improvement Program

Comments by the California Department of Transportation and the California Air Resources Board on the Federal Highway Administration's Notice of Proposed Rulemaking on the National Performance Management Measures; Assessing Performance of the National Highway System, Freight Movement on the Interstate System, and Congestion Mitigation and Air Quality Improvement Program

August 19, 2016

Overarching Comments

In California, the focus of measuring system performance and evaluating transportation impacts is trending toward vehicle miles traveled (VMT). Because the proposed federal measures and goals are mainly focused on time reliability and congestion, some system assessments may be in conflict with our state evaluations and direction. For passenger travel, the California Department of Transportation (Caltrans) and the California Air Resources Board (ARB) would prefer to see the Federal Highway Administration (FHWA) consider measurements that would encourage State Departments of Transportation (State DOTs) to increase person throughput rather than relying on existing vehicle-oriented metrics.

Caltrans and ARB urge FHWA to take this important step, comporting with statute, toward addressing climate pollutants from transportation. MAP-21 requires the United States Department of Transportation (U.S. DOT) to establish performance measures for States to use to assess traffic congestion and "...on-road mobile source emissions." 23 U.S.C. §150(c)(5). Carbon Dioxide (CO_2) and other greenhouse gases (GHGs), such as hydrofluorocarbons, should be considered "emissions" from these mobile sources. National fuel efficiency standards include CO_2 and other GHGs among the significant mobile source emissions. See, e.g., 75 FR 25324 (May 10, 2010). A CO_2 performance measure can be considered supporting the purpose of the Congestion Mitigation and Air Quality Improvement (CMAQ) program given that GHG reductions associated with reduced vehicle miles traveled typically also reduce the other criteria pollutants for which this Notice of Proposed Rulemaking (NPRM) is establishing performance metrics. Setting such a GHG performance metric also supports MAP-21's national goal of environmental sustainability by serving to "enhance the performance of the transportation system while protecting and enhancing the natural environment." 23 U.S.C. §150(b)(6).

Using the proposed methods to assess highway system performance is resource intense. Federal funding should be provided to support training as well as other required activities such as developing new analysis tools, internal and external coordination efforts, and data analysis. Additional time is also needed to assess trends and develop baselines.

Subpart E—National Performance Management Measures to Assess Performance of the National Highway System

The two proposed measures to assess performance of the Interstate are (1) Percent of the Interstate System providing for Reliable Travel and (2) Percent of the Interstate System where peak hour travel times meet expectations. The two proposed measures to assess performance of the non-Interstate National Highway System (NHS) are (1) Percent of the non-Interstate NHS

providing for Reliable Travel and (2) Percent of the non-Interstate NHS where peak hour travel times meet expectations.
As written, the metrics for assessing NHS performance focus on delay and vehicle throughput, which was more suitable in the past when the major focus for the NHS was construction and expansion. Today, the focus for the NHS should be on maintenance and effective operation. Given cost, right-of-way, and other limits on new highway construction, many urbanized regions are addressing congestion through intelligent transportation systems, congestion pricing, and investment in other modes in the corridor. An exclusive focus on vehicle travel times and speeds tends to drive system expansion, which can have adverse impacts when compared with other alternatives that are supported by other metrics such as VMT. Travel time-based measures should be averaged among modes in order to ensure they are not strictly auto-centric.

Further, using travel time reliability as a metric does not indicate whether or not congestion improvement has taken place, only that the status quo has been maintained (e.g., since reliability is determined by variability, a facility that is severely congested throughout an entire day would score as "reliable"). Congestion-based metrics should instead measure how human mobility and goods movement in a corridor are balanced across parallel facilities and all modes of transportation and means of conveyance. It would be far more useful if traffic volumes were included in the data set and it was possible to calculate the average daily vehicle hours of delay (DVHD).

Ideally, in light of the growing national concern over GHG emissions from the transportation sector, the performance measures outlined in the NRPM would focus less on delay and more on accessibility and trip-generation based metrics. These types of measures may encourage greater consideration of non-auto travel modes like transit, carpooling, vanpooling, walking, and bicycling measures. Caltrans would prefer to see the focus shift from moving more vehicles along the highway to moving more people along the highway. This comment was also brought up by other stakeholders, as indicated on page 23813 of the Federal Register notice. Even though FHWA acknowledges that is difficult to establish person throughput as a national performance measure due to the limitation of available vehicle occupancy data, FHWA should still consider measurements that would encourage State DOTs to increase person throughput rather than relying on existing vehicle-oriented metrics.

Overall, Caltrans would like to see more flexibility in the metrics used to assess the performance of the Interstate and non-Interstate NHS. In order to maintain flexibility, states should be allowed to select the measures that are best suited to their needs. States should be allowed to demonstrate how they are achieving federal congestion and air quality targets through their individual strategies that balance a mix of transportation investments and influence over more travel-efficient regional growth patterns. Additionally, State DOT and Metropolitan Planning Organization (MPO) choices of measures should demonstrate the effects of transportation investments on economic growth, efficient land use, environment, and community quality of life, and should support the development of wider choices for addressing congestion.

The biggest challenge in these rules will be developing an analytical system to perform the prescribed measurements. Caltrans currently has an application which is used to assess highway performance in areas with highway detection, as well as purchased sensor data (Caltrans

Performance Measurement System, or Caltrans PeMS), which is used in all areas with detection in order to provide a large series of analyses.

Integration of the National Performance Management Research Data Set (NPMRDS) into Caltrans PeMS will be a significant and costly challenge and will require development of analysis tools, along with tools to process the data.

Since FHWA is requiring the same reports of all states using the same data set, Caltrans recommends that they license or develop an analysis tool for all State DOTs and MPOs to use in order to facilitate reporting without requiring all states to either modify their existing analysis tools or develop their own. In addition to economies of scale benefits, this recommendation would also help avoid potential for error due to minor differences in methodologies.

The reporting timelines for this rule will be very difficult to achieve if states are left to develop their own analysis tools. California will not have any tools in place by October 2016 to provide the initial analysis on the performance metrics, and it will be difficult to set targets until Caltrans has a functional tool and has been able to analyze both current and past data to establish trend information.

- While the proposed measures do establish a metric of performance, they do nothing to address the severity of performance issues in heavily congested areas, only assessing what percentage of the system falls short of a threshold that has been established. California focuses heavily on the amount of user delay and VMT, which are not part of the calculations for system performance in this NPRM.

- The metrics look at percentages of the entire system, and are so general that they would not give a very good picture of California and its regions, which vary significantly in performance.

- Caltrans does not have a comment on the 1.5 ratio. However, it is recommended that the use of the measures be limited to urban areas, where the vast majority of operational issues are located.

- California currently calculates travel time reliability metrics based on segment lengths which represent typical user trips, and are five (5) miles and longer. Segment lengths of one-half mile, even in urban areas, break the system down into pieces which are too small. It is recommend that minimum segment lengths be a mile or longer.

- While it is possible to calculate the proposed metrics, they are far too general to show significant progress in a state as large as California. If the NPRM were to break the measurements into state-defined corridors of significance, smaller regions, or individual routes, the data would be more applicable to California. This recommendation would also be useful for addressing specific freight bottlenecks in the system that may not be revealed in a general calculation of performance.

- With regard to data, section 490.103 requirements prevent Caltrans from using our extensive highway detection system in urban areas because it does not cover the entire state highway system or NHS. We would suggest that this rule be relaxed to enable Caltrans to use a far more accurate system of sensors to report on performance in urban areas.

Subpart F—National Performance Management Measures to Assess Freight Movement on the Interstate System

The two proposed measures to assess freight movement on the Interstate System are (1) Percent of the Interstate System Mileage providing for Reliable Truck Travel Time, and (2) Percent of the Interstate System Mileage Uncongested.

- The FHWA website lists one of the national goals of this NPRM as "Freight movement and economic vitality - To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development." The two proposed metric do not capture the essence of this goal, as they are limited to interstate freight movement only. Because the Interstate system does not capture many critical freight highways and surface streets, the metrics should encompass the proposed National Highway Freight Network instead. Caltrans suggests that the U.S. DOT propose metrics to measure 1) accessibility and connectivity to key freight origins and destinations, and 2) intermodal interconnectivity, to help address Fixing America's Surface Transportation Act freight provisions. In future the entire multimodal freight system should be covered by the proposed metrics.

- The two proposed metrics are too general to provide a good assessment or clear picture of statewide freight system performance, especially in large states with extensive rural mileage. Therefore, it is difficult to comprehend how the metrics will succeed in signifying progress toward national goal achievement.

- The rulemaking will require an intense commitment of resources to accomplish. Federal funding should be provided to support training as well as other required activities such as integrating existing performance measurement systems with the NPMRDS, developing new analysis tools, internal and external coordination efforts, and data analysis. To ensure consistency and reduce inefficiencies of each state integrating and developing their own analytical tools to be compliant, it is recommend that the U.S. DOT provide State DOTs and MPOs user-friendly tools and programs to more easily generate the required measures, and to allow the flexibility to use the tools for assessing other levels of performance.

- If the goal is to determine system reliability and congestion performance, it would be more efficient to focus resources on peak periods of freight travel and/or areas with congestion or bottlenecks, not on 24/7 data collection and analysis. Similar to considering peak periods, it would also be efficient to evaluate peak seasonal performance rather than annual averages for freight facilities serving agricultural regions.

- If the NPRM were to break the roadway measurements into state-defined corridors of significance, smaller regions, or individual routes instead of one-half mile to ten-mile segments, then the data would be more applicable for California.

- Caltrans is uncertain how well the NPMRDS data reflect freight movements of independent truckers and activity, especially near the California border with Mexico.

- The U.S. DOT should provide best practices and/or a set of negotiating guidelines to use if disagreements occur when determining mutual roadway segments and/or targets.

- Standard speed and reliability thresholds for passenger and freight differ even though vehicles are traveling along the same stretch of roadway. For example, with different goals set for passengers and freight, how will the variances in speed along the same roadway be reconciled? Since calculations for speed and reliability are required for both, it would be more efficient to make calculations using the same thresholds. That being said, having one fixed travel speed as a standard will not account for differences in terrain such as mountainous or costal geography and/or weather events that would influence travel speed.

- System performance and freight reliability percentiles for autos and trucks differ, which infers that although both cars and trucks are traveling along the same interstate, the system for cars would be considered reliable at the 80th percentile, but truck travel would not be considered reliable unless they are at the 95th percentile. This different percentile for autos and trucks is a potential source of conflict; that being said, having a higher reliability threshold for freight may make sense for highlighting issues for freight investment purposes.

- Caltrans currently uses a 35 mile per hour (mph) threshold standard to reflect uncongested speed, which differs from the proposed 50 mph threshold freight standard. Determining how this change would affect system performance, especially in dense urban areas, will require further examination.

- The NPRM indicates that the initial performance report is due October 1, 2016. If the final rule comes out in September 2016, more time is needed to allow State DOTs and MPOs to integrate our system with the NPMRDS, determine reporting segments in coordination with MPOs, establish baselines and meaningful targets, and report on progress toward target performance by the deadline.

- As part of Governor Brown's Executive Order (EO) B-32-15, Caltrans and ARB are working with other state agencies to develop a California Sustainable Freight Action Plan, which contains a freight sustainability metric. This proposed metric, with freight-associated gross domestic product and carbon dioxide emission equivalent components, aims to reduce GHG emissions by relating the value of freight sector goods and services to the amount of carbon it produces.

Subpart G – National Performance Management Measures for Assessing the Congestion Mitigation and Air Quality Improvement Program – Traffic Congestion

The proposed measure to assess traffic congestion is Annual Hours of Excessive Delay per Capita.

- California Governor Jerry Brown signed Senate Bill (SB) 743 (Steinberg, 2013), which creates a process to change the way that transportation impacts are analyzed under the California Environmental Quality Act (CEQA). One legislative intent of SB 743 is to "more appropriately balance the needs of congestion management with statewide goals related to infill development, promotion of public health through active transportation, and reduction of GHG emissions." Another legislative intent is to "Ensure that the environmental impacts of traffic, such as noise, air pollution, and safety concerns continue to be properly addressed and mitigated through CEQA."

- Specifically, SB 743 requires the Governor's Office of Planning and Research (OPR) to amend the CEQA Guidelines to provide an alternative to Level of Service (LOS) for evaluating transportation impacts. Vehicle Miles Traveled is the alternative criteria for determining a project's significant impact. Once the CEQA Guidelines are amended to include the alternative criteria, auto delay will no longer be considered a significant impact under CEQA. The law will apply statewide after a two-year opt-in period. Transportation impacts related to air quality, noise and safety must still be analyzed under CEQA where appropriate.

- Caltrans Transportation Analysis Guide/Transportation Impact Study Guide (TAG/TISG) implements SB 743's direction in transportation analysis for projects on the State Highway System (SHS) as well as our review of local development projects' impact the SHS. The TAG/TISG will address performance measures, thresholds, induced demand, and other topics in addition to safety.

- The potential exists for FHWA's performance measures to be contained with the state's operational goals. Ultimately, Caltrans must meet federal performance measure requirements as well as state performance measure requirements that emerge from the TAG/TISG process.

Subpart H—National Performance Management Measures for Assessing the Congestion Mitigation and Air Quality Improvement Program—On-Road Mobile Source Emissions

The proposed measure to assess on-road mobile source emissions is Total Tons of Emissions Reduced from CMAQ Projects for Applicable Criteria Pollutants and Precursors.

- The Environmental Protection Agency (EPA) lowered the ozone standard in 2015, but have yet to designate the new nonattainment areas resulting from the change in the standard. There will likely be an increase in the number of isolated rural areas that will be nonattainment for ozone, which will affect the workloads of many State DOTs to differing degrees. If new isolated rural areas in California are added, there will be an

incremental workload increase for Caltrans in order to carry out the calculations in Subpart H.

This is simply one example demonstrating that the NPRM works in tandem with the Clean Air Act's implementing regulations, including the National Ambient Air Quality Standards (NAAQS), which continue to be made more stringent: as the NAAQS become more stringent over time, the workload for State DOTs and MPOs to comply with this NPRM will also increase over time. State DOTs and MPOs need to recognize the future increased workload for air quality compliance and performance measurement in order to prepare accordingly.

- With regard to section 490.809 data requirements, "For those projects that do not include a quantified emissions reduction [...] the CMAQ guidance allows for a qualitative assessment. This option is still allowed, but those projects will not be considered for the purposes of implementing the on-road mobile source emissions measure." It is understandable for the NPRM to propose that projects with a qualitative assessment would not be part of a quantified summation of total emissions reductions, for ease of calculation. However, this would disregard the contribution of those projects in reducing emissions. Reasons for qualitative assessments could simply be a result of lack of data and/or insufficient capacity to perform a quantitative assessment. Leaving these projects out will under-count total emissions reductions.

Consideration of a Greenhouse Gas Emission Measure

Caltrans and ARB support the inclusion of metrics to track GHG emissions. California has aggressive GHG reduction targets that apply to all State agencies, including Caltrans. In 2006, AB 32 established a statewide emission reduction target of 20% from a 1990 baseline by 2020, and EO B-30-15 (2015) sets an 80% reduction target for 2050. Accordingly, Caltrans and all California MPOs have created a set of tools and methods for measuring and reporting GHG emissions associated with the transportation system. These ten years of experience have given California a thorough understanding of the benefits and challenges of measuring and reducing GHGs from transportation. In reviewing the NPRM, Caltrans and ARB concentrated on proposing a measure and methods that capture the most significant emissions while creating consistency across all states. While California has invested heavily in developing the tools and methods to measure and model GHGs and policies that can reduce their emissions, Caltrans and ARB acknowledge that many states have not yet addressed this issue and will need guidance and time to develop this expertise.

Measuring GHG emissions associated with state-owned transportation networks requires tools that accurately capture and model volumes, speed, load, and types of vehicles traveling on the highway system. These input data are often created through a combination of state/national travel surveys, travel demand models, and emissions models. On-road vehicle monitors (e.g., loop detectors, Bluetooth readers, GPS) are used to calibrate and verify travel demand model outputs. Each of these tools require state-specific information and modeling, and uncertainty must be quantified and minimized at each step. Many states do not currently have detailed state travel surveys, travel demand models, nor robust on-road vehicle monitors. All of these tools

require significant investment and technical expertise to establish and calibrate. Therefore, Caltrans and ARB recommend that FHWA prioritize the development of nationally consistent methods for creating state-specific household travel surveys, travel demand modeling, and on-road vehicle monitoring within this rulemaking. This will help standardize the states' emission measurement and allow FHWA to establish performance-based targets and policies during the next iteration of rulemaking.

1. Should the measure address all on-road mobile sources or should it focus only on a particular vehicle type (e.g., light-duty vehicles)?

   The measure should address all on-road mobile sources. It is also important that fuel efficiency standards continue to be mandated by vehicle type.

2. Should the measure be normalized by changes in population, economic activity, or other factors (e.g., per capita or per unit of gross state product)?

   Both total emissions (mass) and emissions per capita are necessary.

   Absolute total tons of CO_2 should be used because normalized numbers can hide a growth in total emissions. Per capita emissions should be derived from the total because they are more relatable to the public, and could contextualize challenges states face due to population increases.

3. Should the measure be limited to emissions coming from the tailpipe, or should it consider emissions generated upstream in the life cycle of the vehicle operations (e.g., emissions from the extraction/refining of petroleum products and the emissions from power plants to provide power for electric vehicles)?

   In the short term, this measure should be limited to emissions coming from the tailpipe because incorporating emissions from upstream sources is more complicated, and not necessary for transportation agencies to begin the planning process to meet GHG reduction targets. Additionally, transportation agencies are not equipped to calculate GHG emissions from the electricity sector. Data for tailpipe emissions are also more readily available than upstream emissions since refineries' and power plants' products are not made exclusively for transportation/vehicle use.

   As state's data and modeling capabilities increase, zero emission vehicles (electric and hydrogen electric) penetrate the market, and renewable fuels increase in volume, the measure will need to include upstream emissions in order to capture transportation's entire contribution to national emissions. FHWA should begin creating guidelines to incorporate upstream emissions since this effort will require more time, data, resources, and interagency collaboration. Although the electricity sector will be primarily responsible for reducing the emissions associated with electric and hydrogen vehicles, incorporating a full well-to-wheel perspective will help transportation agencies plan how vehicle technology, fuels, and the transportation system can work in concert to meet targets.

4. Should the measure include non-road sources, such as construction and maintenance activities associated with Title 23 projects?

   Only on-road sources should be included at this time as it will cover the vast majority of GHG emissions from the transportation sector.

5. Should CO_2 emissions performance be estimated based on gasoline and diesel fuel sales, system use (vehicle miles traveled), or other surrogates?

   In the short-term, before states develop sophisticated travel demand models, fuel sales data should be used to assess CO_2 emissions. States should be allowed to use separate methodology if approved by FHWA as equivalent or superior.

   Ultimately, for the transportation sector, CO_2 emissions performance should be based on speed-stratified, VMT based travel demand models, and emissions models such as EMFAC from ARB or U.S. EPA's MOBILE. U.S. EPA's MOVES model should also be considered although it is based on Vehicle Specific Power. No single surrogate can accurately represent CO_2 emissions since the emissions are dependent on multiple variables including travel time, speed, and vehicle load.

   A technical advisory committee with experts from each state should be convened to create guidance for states to establish transportation analysis tools (i.e., mobile source emissions models and travel demand models) that accurately capture CO_2 emissions based on vehicle operation. This committee should recommend a standard method and/or tool that all states can use, with the option to use comparable methods that exceed this standard by providing state-specific information.

6. Due to the nature of CO_2 emissions (e.g., geographic scope and cumulative effects) and their relationship to climate change effects across all parts of the country, should the measure apply to all States and MPOs? Is there any criteria that would limit the applicability to only a portion of the States or MPOs?

   The measure should apply to all states and be reported by the State DOTs. Highly populated urban areas produce more aggregate CO_2 emissions but also have more options for reducing emissions than less densely populated areas. Therefore, MPOs will play a critical role in modeling and reducing transportation CO_2 emissions and should be encouraged to participate in intra-state target-setting discussions.

7. Would a performance measure on CO_2 emissions help to improve transparency and to realign incentives such that State DOTs and MPOs are better positioned to meet national climate change goals?

   Yes. A CO_2 measure will also increase public accountability and encourage states to continuously reduce their transportation emissions.

Transportation should be responsible for its share of CO_2 reductions. FHWA should work with State DOTs to develop a national GHG reduction goal for transportation that aligns with the 21st Conference of the Parties of the United National Framework Convention on Climate Change (aka, "Paris Agreement"). States should use the CO_2 performance measure to drive decisions that help to meet, or exceed, national GHG reduction goals.

8. The target establishment framework proposed in this rulemaking requires that States and MPOs would establish 2 and 4 year targets that lead to longer term performance expectations documented in longer range plans. Is this framework appropriate for a CO_2 emissions measure? If not, what would be a more appropriate framework?

   A CO_2 emissions measure should have short-, mid- and long-term targets.

   Many infrastructure investments take years to plan, scope, design, and build, so it is unlikely that significant changes to statewide CO_2 emissions could be demonstrated using a 2-year target. Emission reductions for 4-year periods (e.g., 2020) may be small, but should show continued progress towards longer term goals. A 4-year short-term target would also align the CO_2 measure with other national system performance measure reporting to promote consideration of the CO_2 effects when making investment decisions.

   Major changes to the transportation system and system operations are needed to significantly reduce CO_2 emissions and avoid the most serious effects of climate change. This will be a long-term effort. Caltrans and ARB recommend that FHWA establish a national long range CO_2 performance target (e.g., 2050). States would then establish 20-year targets as part of their long-range transportation planning timeline, to ensure progress towards the national target. The hope is that alignment will help fit consideration of CO_2 emissions into the planning and project selection process.

9. Should short term targets be a reflection of improvements from a baseline (e.g., percent reduction in CO_2 emissions) or an absolute value?

   Short-term targets should be established after a method for measuring state emissions is agreed upon and implemented.

   FHWA should use a 2005 baseline. A 2005 baseline year is recommended to evaluate performance against the 2005 baseline year used for CO_2 reduction goals in the "Paris Agreement." In doing so, FHWA would show support for international climate change goals and provide leadership to guide the states.

   State emissions should be reported as total emissions, upon which both per capita and percent reductions will be calculated. Percent reductions will make the reductions relatable to the public, and per capita emission targets will allow for direct comparisons between states and account for fluctuations in population.

   Implementing strategies to meet GHGs reduction targets will require investment in new vehicle technology, low and zero carbon fuels (based on lifecycle), and planning and

development of projects that reduce VMT. As such, FHWA will need to work with states to create and identify resources and feasible strategies for funding these efforts.

10. What data sources and tools are readily available or are needed to track and report CO_2 emissions from on-road sources?

    California has advanced data and tools for reporting CO_2 emissions to meet the State's CO_2 reduction targets established by AB 32. California's annual statewide GHG emission inventory is an important tool for establishing historical emission trends and tracking California's progress in reducing GHGs. An updated emission inventory is published annually to include additional years and improved estimation methods.

    To quantify GHG emissions from on-road gasoline and diesel emissions, fuel reported from the California Board of Equalization (BOE) is combined with CO_2 emission rates per gallon of fuel. California's EMission FACtors model (EMFAC) is also used to apportion fuel sales data (for gasoline and distillate) among different categories of vehicles, and thus for calculating emissions for each of the classes of vehicles. EMFAC has a rigorous scientific foundation (i.e., tailpipe measurements) and multiple versions have been vetted through various stakeholder reviews. EMFAC also reflects the composition of vehicle types and technologies operating in California and specific fuel emission control technology. Apportioned fuel sales are then combined with a fuel specific CO_2 emission factors from USEPA (Mandatory Reporting of Greenhouse Gas Regulation, http://www.epa.gov/ghgreporting/) to derive the CO_2 inventory.

    This method could be applied readily to other states that maintain similar fuel sales data, which are also referenced in FHWA's Highway Statistics annual reports.

    Regarding data needs, vehicle load measurement may be an area of needed improvement. Some states will likely need more weigh stations and/or weigh-in-motion equipment to produce better data for their emissions estimates.

11. What tools are needed to help transportation agencies project future emissions and establish targets for a CO_2 emission measure?

    Forecasting can be done in a number of ways. The most simplistic method utilizes fuel sales projections from state or national sources (e.g., EIA Energy Outlook which provides a region-specific forecast). The forecast fuel consumption, coupled with future changes to the CO_2 fuel-based emission rates can be applied to the base inventory discussed above to estimate future CO_2 emissions.

    Targets for CO_2 reductions can be developed to reflect what level of CO_2 reduction is needed to curtail the impacts of climate change. According to climate scientists, the world will need to cut emissions by 80 percent from today's levels to stabilize the amount of carbon dioxide in the atmosphere and prevent the most severe effects of global climate change. This long range goal is reflected in California EO S-3-05 that requires an 80 percent reduction of GHGs from 1990 levels by 2050.

More complex methods of developing CO_2 projections involve development travel demand models that take more time to develop, but allow states to understand the impacts of their transportation system on emissions and develop transportation plans for reducing GHG emissions.

In addition to FHWA's existing guidance and tools, states that are new to measuring tailpipe CO_2 emissions based on system use will need Federal guidance for developing robust household travel surveys and/or expanding the National Household Travel Survey, state-of the practice travel demand models, and on-road vehicle monitoring. A probabilistic model may also help to quantify the margin of error within these tools and their application. Travel surveys and emissions models will need to be evaluated to ensure that electric vehicles and alternative fuel vehicles – including hydrogen, CNG, LNG, and biofuels – are accounted for in the measure. States also need a travel demand model that shows the synergistic relationship between transportation and land use in order to establish GHG reduction strategies and scenarios.

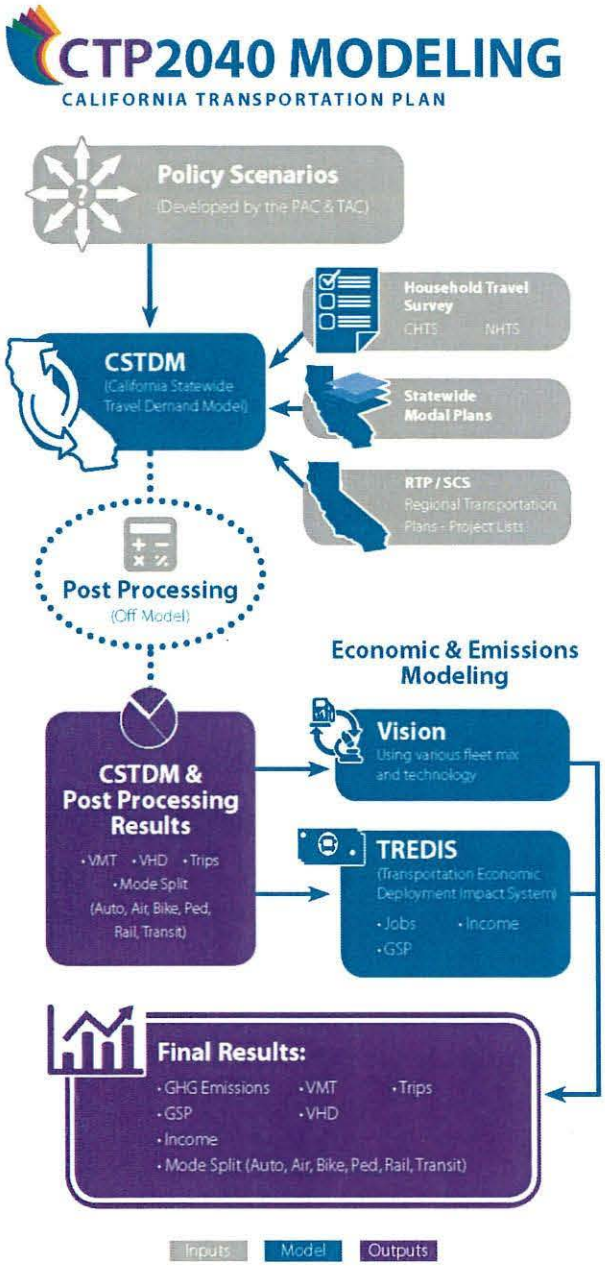
There are also scenario tools such as the Argonne National Laboratory (ANL) national Vision Model, and California's Vision model, which would allow states to evaluate vehicle technology, fuel and efficiency scenarios for meeting air quality and climate goals. Each of these tools can be modified to reflect individual state information, and can be used in conjunction with the travel demand models discussed above.

Caltrans has utilized a suite of tools to measure and reduce CO_2. Further refinement of these tools is needed, but they are an example for other states to follow. These tools include:

a. the California Household Travel Survey
b. additional survey questions within the National Household Travel Survey
c. the California Statewide Travel Demand Model
d. ARB's Vision Model
e. EMFAC – a California-specific emissions model
f. Performance Measurement System (PeMS) – a network of 39,000 loop detectors

States need a model to show GHG benefits from tested scenarios. Currently Caltrans and ARB partner to run Caltrans' scenarios through ARB's Vision Model.

The graphic below shows the data sources and process used for calculating California's CO_2 emissions.



12. How long would it take for transportation agencies to implement such a measure?

The time needed to implement such a measure depends on the method chosen. The estimates below assume that a state has limited experience conducted an emissions measurement, and would need to both develop and/or refine their existing data sets and emissions modeling tools.

Fuel-Sales based reporting (1-2 years)

- Transportation fuel sales data are available with a 1-2 year time lag in some states and with 2-3 year lag from the Energy Information Administration (EIA). Where

fuel sales are used for reporting, the CO_2 performance measure should be based on the EIA dataset and provided to State DOTs by FHWA.

- Outreach from FHWA to state environmental agencies, private fuel wholesalers, and EIA is encouraged to support faster fuels sales data reporting at the state level.

On-Road GHG emissions Modeling and Calculation (2-3 years)

- Federal guidance could help standardize states' creation and use of travel demand models (like CSTDM) and emissions models (like MOVES and EMFAC).
- Ensure that emissions models (e.g., MOVES) incorporate electric and alternative-fuel vehicle types.

Travel Data Collection (3-4 years)

- Create and implement minimum standards for
  - Statewide travel surveys (3 years) – also could expand NHTS to provide more detailed, state-specific data
  - Vehicle monitoring methods (2 years)

Scenario modeling (5 years or more)

- Create land use-transportation models that can evaluate CO_2 reduction policies

States will need additional tools to determine their target and understand the probable efficacy of potential reduction strategies. FHWA is encouraged to work with State DOTs to develop guidance for each specific step in the target setting and reporting process.

13. Additionally, the FHWA requests data about the potential agency implementation costs and public benefits associated with establishing a CO_2 emissions measure.

    It is difficult to determine the costs associated with establishing a measure since they are dependent on the method selected for calculating emissions.

    Public benefits – CO_2 reductions from the nation's transportation system are crucial to reducing the threat of climate change. The Intergovernmental Panel on Climate Change concluded in its Fifth Assessment Report, issued in 2014, that "warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia" and that "continued emission of GHGs will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems." As such, the public's well-being, health, natural resources, economy and environment are at risk of serious damage if CO_2 emissions are not swiftly reduced.

    Establishing a nationally-consistent CO_2 measure will allow FHWA to transparently track the transportation system's contribution to climate change, and create data-based targets and strategies to reduce these emissions.