Comments on
CAFE Compliance and Effect Modeling System Documentation

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The CAFE compliance and effect model developed by the Volpe Center for NHTSA could serve as a useful tool to automatically evaluate costs and benefits of potential CAFE requirements for light-duty vehicles. The automation of the CAFE evaluation process will enable users to simulate in an interactive way effects of potential ways of meeting a new CAFE requirement by manufacturers.

General Comments

1. As to be the case for any other computer models, the results of the CAFE model, in terms of costs and benefits of potential CAFE requirements, rely heavily on input parameters in the model. As of now, key technical input parameters in the model are from the 2002 NAS study. Though comprehensive, the NAS study has its limitations. For example, hybrid electric vehicles were not addressed in that study. In addition to the NAS study, a study sponsored by the NESCAF has evaluated technological potentials and costs of various vehicle technologies for California's GHG emission regulations. The results from that study may serve as a valuable supplement to the 2002 NAS study for the CAFE model.

   Besides relying on results of completed studies, NHTSA needs to make efforts to address costs and technological potentials of additional fuel efficiency improving vehicle technologies. Such efforts need to be made periodically to reflect emerging technologies. The efforts should engage manufacturers and other agencies.

2. The CAFE model is supposed to predict benefits and costs of potential future CAFE requirements. The demo version of the model contains historical data for some of the key parameters (such as available vehicle models and their sales). It was not explained how such data for future years would be obtained for simulations of future years.

3. p.6, Lines 17-18. "…detailed confidential product plans provided by some manufacturers with "synthesized forecasts of other manufacturers' offerings." Usually, manufacturers treat such information highly confidential. If such information is provided to NHTSA on a voluntary basis and only by some manufacturers, I wonder how NHTSA ensures the reliability and completeness of such information.

4. p.7, Lines 1-7. The CAFE model relies on EPA's Mobile model for generating vehicle operation-related emissions. EPA's LDV Tier 2 emission regulation specifies seven bins among which a manufacturer can select for emission compliance by given vehicle models, as long as the fleet average NOx emission standard of 0.07 g/mi. is met by the manufacturer. To accurately estimate changes in criteria pollutant emissions, NHTSA needs to know which individual models will meet which bin standards so that emission changes can be simulated from the changes in vehicle model mixes caused by meeting CAFE standards. It appears that this is not the approach that is taken in the current version of the CAFE model. In fact, later in the report, it is shown that vehicle operation emissions are estimated for passenger cars and a few LDT classes without getting into the level of individual bins. This is troublesome, especially if hybrids and AFV technologies are to be considered for meeting CAFE standards by manufacturers. Experience in the past several years indicates that manufacturers may certify advanced technology vehicles to lower bins. It seems necessary that bin-specific emissions need to be estimated with Mobile and decisions need to be made on which vehicle technologies (or ideally which vehicle models) will meet which Tier 2 bins so that changes in criteria pollutant emissions can be accurately simulated.

5. Default Mobile simulations generate calendar year specific emissions for existing on-road vehicle fleets. Simulation of emission effects of meeting CAFE requirements by the CAFE model seems to require emissions for a given model-year vehicle type over its entire lifetime, which can be generated with Mobile. This approach may need to be used in the CAFE model.

6. Though hybrid technologies are included in the CAFE model, it is not clear how hybrids are to be simulated in the model. In particular, are they going to be simulated at subsystem levels (such as powertrain, engine, motor, battery, etc.), or at an aggregate level (such as mild and full hybrids)? Ideally, hybrids may be simulated at the subsystem levels so that effects of hybrid component technologies can be analyzed. But this may require use of some detailed vehicle models such as PSAT and ADVISOR.

7. The current version of the CAFE model is designed with intensive data requirements. Users seem to be regulatory agencies such as NHTSA and EPA who may have access to such detailed data. If the model is also to be used by others who have less access to detailed data, some compromise between accuracy of simulations and intensiveness of data requirements may have to be made.

Specific Comments

p.3, lines 3-4. Even though it is stated that the model will allow for an uncertainty analysis to generate the potential range of outcomes, I did not see this feature in the current version. Is this a task that the next version of the model will address?

p.4, Table 1. It is noted that AFVs are not included in the CAFE model. Yet there are more than four million ethanol FFVs which have been produced by automakers and which earned CAFE credits. To effectively model CAFE credits of FFVs and other vehicle technologies and their impacts on overall CAFE compliance (and furthermore the potential effects on reduction of US transportation oil use), it seems necessary to include AFVs in the model.

p.5, Lines 24-26. Although Mobile is currently used for estimating vehicle emissions, EPA has been working on developing a new generation of vehicle emission model (called MOVES). MOVES will be very different from Mobile in terms of architecture and results. NHTSA needs to pay attention to this EPA effort so that MOVES can be used for the CAFE model as soon as EPA makes it official.

p.5, Lines 35-38. If AFVs are to be included in a future version of the CAFE model, it seems desirable that some of the features in the TAFV model that was developed at Oak Ridge National Laboratory could be incorporated in the CAFE model.

p.5. In discussion of available models, the PSAT model is missing. The PSAT model was developed at Argonne to simulate fuel economy of different vehicle technologies under different driving conditions and for different vehicle performance requirements. It is required for use by the USCAR and DOE's FreedomCar program to simulate advanced vehicle technologies for the partnership between USCAR and DOE.

p.6, Line 12. The term "nonpassenger automobile" is used frequently in this report. Please give some examples of nonpassenger automobiles.

p.10, Lines 20-22. Are the vehicle classes used in the CAFE model consistent with the classes in EPA's annual fuel economy trend reports? It is critical to maintain some consistency so that EPA-collected fuel economy information can be used in the CAFE model.

p.11, Table 3 and Line 13. Many readers may not be familiar with the three technology paths specified in the 2002 NAS study. Please explain the three paths in the report.

p.16, Lines 25-27 and Footnote 16. It seems that the CAFE model calculates private cost savings of increased fuel economy from consumers' point of view. On the other hand, the model considers social benefits in dollars from reductions in emissions and imported oil. How does the model reconcile the two types of monetary benefits eventually?

p.20, Line 23. I did not see equations 1.6, 1.7, and 1.8.

p.20, Footnote 31. Discussion is needed on whether emissions should be discounted or not.

p.25, Lines 6-8. "the increase in vehicle use that results from improving their fuel economy via the rebound effect will raise emissions of these pollutants." This statement is not true for tailpipe SOx emissions and evaporative VOC emissions. The reductions for these two emission sources that result from fuel use reduction could far exceed the potential increase in them from the rebound effect.

p.25, Equation 1.27. Please note that g is fuel consumption in gallons. Also, please note that fuel-specific carbon content for gasoline may vary over time because gasoline mix (conventional vs. reformulated) may change over time.

p.26, Equation 1.29. $r \cdot c_r$ needs to be separated for feedstock and fuel stages for gasoline and diesel because domestic production shares are so different for petroleum (feedstock) and fuels (i.e., gasoline and diesel).

p.26. When other fuels such as ethanol and CNG are to be included in a new version of the CAFE model, emissions of producing these fuels will need to be included in the new version.

p.27, Equations 1.31 and 1.32. It seems the minus sign should be plus sign.

p.27, Lines 14-16. Mobile generates emissions for general vehicle classes such as passenger cars, LDT1, LDT2, etc. It does not generate emissions for the vehicle classes contained in the CAFE model (cars, small SUV, large SUV, small truck, large truck, etc.). Furthermore, in order to accurately predict emission changes from vehicle model mix changes caused by CAFE compliance, vehicle model-specific emissions may need to be generated (see a previous comment).

p.27, Footnote 39. For emissions with the U.S. context, the CAFE model may need to separate foreign and domestic emissions so that foreign carbon emissions may not be included in CAFE modeling.

p.27, Lines 30-33. Again, petroleum and its fuels (gasoline and diesel) need to be separated for emission calculations (see an above comment).

p.28, Equation 1.34. $e_{i,k,MY,t}$ could be different among CAFE scenarios because of potential changes in vehicle model mixes caused by CAFE compliance.

p.28, SOx emissions can be calculated in a way similar to the calculation for CO2 emissions. That is, SOx emissions can be calculated by assuming all sulfur in a fuel is converted into SO2 emissions.

p.29, Lines 8-9. A better subtitle format is needed so that these two can be differentiated.

p.29, Line 21. "high prices result in losses in welfare or consumer surplus to buyers…" This effect may be tiny.

p.29, Lines 36-41. Please note here that a payback period of 5 years and a discount rate of 7% are used in the CAFE model.

p.29, Lines 45-46. "The rebound effect results in additional benefits to new vehicle buyers in the form of consumer surplus…" This effect could be tiny.

p.30, Lines 10-11. Use of one half of the product of the decline in fuel cost per mile driven in vehicle models with increased fuel economy and the resulting increase in the annual number of miles they are driven seems to be a very crude assumption.

p.30, Footnote 42. It appears that there is some evidence that this is the case.

p.31, Lines 13-14. "The pre-tax price per gallon is used in assessing the value of fuel savings to the economy as a whole." It is questionable to assume that the pre-tax price of a fuel reflect the social cost of the fuel.

p.32, Lines 25. "…although this influence appears to be limited." The recent oil price increases appear to show that even small increase in oil import by countries (such as China and India) could have a significant psychological and materialized impact on world oil price.

p.35, Lines 6-7. "using estimates of the value per ton of emissions of each pollutant that is eliminated." Dollar values of air pollutants could vary significantly among different US regions.

p.36, How about the concern that CAFE may result in less safe vehicles and resultant increased social costs?

p.B-3, Lines 8-11. I did not see that feature when I ran the CAFE model.

p.B-4. Help functions are needed to explain the three technology paths (see an above comment).

p.C-1. For the parameter group, I have the following comments. First, fuel properties seem to be from GREET1.5, which need to be revised with the most recent GREET version. Second, I wonder if the US imports 26.4% of its gasoline and diesel from other countries. I remember that gasoline and diesel imports are usually small for the US. Third, the crude import share in the model is questionable. Fourth, upstream emissions for fuels need to be updated with the new GREET version. Fifth, tailpipe SOx emissions can be calculated with sulfur content of gasoline and diesel (see a previous comment).

In general, the above parameters could be changed over time. Maybe time-series tables can be designed in the CAFE model for these parameters to address this issue.

p.C-2, Line 4 and Table C-2, I only saw year 2002 in the model.

p.C-11, Lines 18-19. "a 35% reduction in the rate of fuel consumption." This reduction seems to be volumetric based fuel consumption. It is better to refer to Btu-based fuel use reductions.

p.C-20, Table C-16, Lines 10-24. The data sources in the table and in the two paragraphs followed are contradicting with each other. Please clarify the actual data source used for vehicle age data.

p.C-21, Table C-17. Fuel properties need to be updated with the current GREET model.

p.C-22, Table C-18. Upstream emissions in GREET are in grams per million Btu in lower heating values for fuels. On the other hand, EIA uses higher heating values in its statistics. Please make Btu values consistent within the CAFE model when using data from different sources.

p.C-25, Lines 20-23. It is not a good reason that CO2 dollar values are not included because there is a wide range of dollar values per ton of CO2. The same can be said to dollar values for criteria pollutants. Yet, monetary values for criteria pollutant emissions are included in the model.

p.C-26, Table C-21. The unit for automobile and light truck ratios (expressed in double) seems not correct.

p.D-1, Footnote 76. It appears that the baseline scenario has a cost of $2 billion. Please clarify.

p.D-7, Table D-8 (and other similar tables). The values in all parentheses are supposed to mean negative values. Please change Excel cell format to reflect this.