DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

49 CFR Parts 531 and 533

[Docket No. NHTSA-2009-0042]

Passenger Car Average Fuel Economy Standards--Model Years 2008-2020

Light Truck Average Fuel Economy Standards--Model Years 2008-2020

Request for Product Plan Information

AGENCY: National Highway Traffic Safety Administration (NHTSA), Department of Transportation (DOT)

ACTION: Request for Comments.

SUMMARY: The purpose of this request for comments is to acquire new and updated information regarding vehicle manufacturers' future product plans to assist the agency in assessing what corporate average fuel economy (CAFE) standards should be established for model years 2012 through 2016 passenger cars and light trucks. The establishment of those standards is required by the Energy Policy and Conservation Act, as amended by the Energy Independence and Security Act (EISA) of 2007, P.L. 110-140.

DATES: Comments must be received on or before **[insert date 60 days after publication in the Federal Register].**

ADDRESSES: You may submit comments [identified by Docket No. NHTSA-2009-0042] by any of the following methods:

- Federal eRulemaking Portal: Go to http://www.regulations.gov. Follow the online instructions for submitting comments.

• Mail: Docket Management Facility, U.S. Department of Transportation, 1200 New Jersey Avenue, SE, West Building Ground Floor, Room W12-140, Washington, DC 20590.

• Hand Delivery or Courier: West Building Ground Floor, Room W12-140, 1200 New Jersey Avenue, SE, between 9 am and 5 pm ET, Monday through Friday, except Federal holidays. Telephone: 1-800-647-5527.

• Fax: 202-493-2251

Instructions: All submissions must include the agency name and docket number for this proposed collection of information. Note that all comments received will be posted without change to http://www.regulations.gov, including any personal information provided. Please see the Privacy Act heading below.

Privacy Act: Anyone is able to search the electronic form of all comments received into any of our dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.). You may review DOT's complete Privacy Act Statement in the Federal Register published on April 11, 2000 (65 FR 19477-78) or you may visit http://www.dot.gov/privacy.html.

Docket: For access to the docket to read background documents or comments received, go to http://www.regulations.gov and follow the online instructions, or visit the Docket Management Facility at the street address listed above.

FOR FURTHER INFORMATION CONTACT: Mr. Peter Feather, Fuel Economy Division Chief, Office of International Policy, Fuel economy and Consumer Programs, at (202) 366-0846, facsimile (202) 493-2290, electronic mail peter.feather@dot.gov. For legal issues, call Ms. Rebecca Yoon, Office of the Chief Counsel, at (202) 366-2992.

SUPPLEMENTARY INFORMATION:

I. Introduction

NHTSA has been issuing Corporate Average Fuel Economy (CAFE) standards since the late 1970's under the Energy Policy and Conservation Act (EPCA). The CAFE program conserves petroleum, a non-renewable energy source, saves consumers money, and promotes energy independence and security by reducing dependence on foreign oil. It also reduces carbon dioxide (CO_2) emissions from the tailpipes of new motor vehicles and thus climate change.

The Energy Independence and Security Act (EISA) amended EPCA by mandating that model year (MY) 2011-2020 standards be set to ensure that the industry-wide average of all new passenger cars and light trucks, combined, is at least 35 miles per gallon (mpg) by MY 2020. This is a minimum requirement, as NHTSA must set standards at the maximum feasible level in each model year. NHTSA will determine, based on all of the relevant circumstances, whether that calls for establishing standards that reach the 35 mpg goal earlier than MY 2020.

EISA also mandated that the CAFE standards be based on one or more vehicle attribute. For example, size-based (*i.e.*, size-indexed) standards assign higher fuel economy targets to smaller vehicles and lower ones to larger vehicles. The fleet wide average fuel economy that a particular manufacturer must achieve depends on the size mix of its fleet. This approach ensures that all manufacturers will be required to incorporate fuel-saving technologies across a broad range of their passenger car and light truck fleets.

NHTSA proposed in April 2008 to begin implementing EISA by establishing CAFE standards for MYs 2011-2015. In a January 26, 2009 memorandum, the President requested NHTSA to divide its rulemaking into two parts. First, he requested that the agency issue a final rule adopting CAFE standards for MY 2011 only, and do so by March 30, 2009 in order to comply with EPCA, which requires that a final rule establishing fuel economy standards for a model year be adopted at least 18 months before the beginning of the model year (49 U.S.C. § 32902(a)). The agency is working to issue a final rule for MY 2011 in accordance with that schedule.

Second, the President requested that NHTSA establish standards for MY 2012 and later after considering the appropriate legal factors, the comments filed in response to the May 2008 proposal, the relevant technological and scientific considerations, and, to the extent feasible, a forthcoming report by the National Academy of Sciences, mandated under section 107 of EISA, assessing the costs and effectiveness of existing and potential automotive technologies that can practicably used to improve fuel economy.[1]

To assist the agency in analyzing potential CAFE standards for MYs 2012 through 2016, NHTSA is requesting updated future product plans from vehicle manufacturers, as well as production data through the recent past, including data about engines and transmissions for MY 2008 through MY 2020 passenger cars and light trucks and the assumptions underlying those plans. NHTSA requests information for MYs 2008-2020 to aid NHTSA in developing a realistic forecast of the MY 2012-2016 vehicle market. Information regarding earlier model years may help the agency to better account for cumulative effects such as volume- and time-based reductions in costs, and also may help to reveal product mix and technology application trends during model years for which the agency is currently receiving actual CAFE compliance data. Information regarding later model years helps the agency gain a better understanding of how manufacturers' plans through MY 2016 relate to their longer-term expectations regarding EISA

[1] A copy of the President's memorandum is available at http://www.whitehouse.gov/the_press_office/The_Energy_Independence_and_Security_Act_of_2007/ (last accessed Feb. 13, 2009).

requirements, market trends, and prospects for more advanced technologies (such as HCCI engines, and plug-in hybrid, electric, and fuel cell vehicles, among others). NHTSA will also consider information from model years before and after MYs 2012-2016 when reviewing manufacturers' planned schedules for redesigning and freshening their products, in order to examine how manufacturers anticipate tying technology introduction to product design schedules. In addition, the agency is requesting information regarding manufacturers' estimates of the future vehicle population, and fuel economy improvements and incremental costs attributed to technologies reflected in those plans. The request for information is detailed in appendices to this notice. NHTSA has also included a number of questions directed primarily toward vehicle manufacturers. They can be found in Appendix A to this notice. Answers to those questions will assist the agency in its analysis.

Given the importance that responses to this request for comment may have in NHTSA's upcoming CAFE rulemaking, either as part of the basis for the proposed standards or as an independent check on them, NHTSA intends to review carefully and critically all data provided by commenters. It is crucial that commenters fully respond to each question, particularly by providing information regarding the basis for technology costs and effectiveness estimates. Additionally, the agency notes that, in connection with recent deliberations regarding federal assistance to the industry, some manufacturers submitted short business plans to Congress in December 2008[2] and restructuring plans to the Treasury Department in February 2009,[3] and that some statements in these plans suggest that manufacturers' product plans may have changed

[2] Links to these business plans may be found at http://financialservices.house.gov/autostabilization.html (last accessed February 13, 2008).

[3] Chrysler's submission to the Treasury Department is *available at* http://www.treasury.gov/initiatives/eesa/agreements/auto-reports/ChryslerRestructuringPlan.pdf (last accessed Feb. 19, 2009), and GM's submission to the Treasury Department is *available at* http://www.treasury.gov/initiatives/eesa/agreements/auto-reports/GMRestructuringPlan.pdf (last accessed Feb. 19, 2009).

considerably since NHTSA last received detailed confidential product plans in July 2008. In light of these statements, and in light of the current uncertainty surrounding the auto industry, NHTSA will closely review the product plans submitted in response to today's request. We will carefully assess any significant apparent discrepancies between submitted product plans and manufacturers' public statements.

To facilitate the submission of comments and to help ensure the conformity of data received regarding manufacturers' product plans from MY 2008 through MY 2020, NHTSA has developed spreadsheet templates for manufacturers' use. The uniformity provided by these spreadsheets is intended to aid and expedite our review, integration, and analysis of the information provided. These templates are the agency's strongly preferred format for data submittal, and can be found on the Volpe National Transportation Systems Center (Volpe Center) website at ftp://ftpserver.volpe.dot.gov/pub/CAFE/templates/ or can be requested from Mr. Peter Feather at peter.feather@dot.gov. The templates include an automated tool (*i.e.*, a macro) that performs some auditing to identify missing or potentially erroneous entries. The appendices to this document also include sample tables that manufacturers may refer to when submitting their data to the agency.

In addition, NHTSA would like to note that we will share the information submitted in response to this notice with the Environmental Protection Agency (EPA). This sharing will facilitate our consideration of the appropriate factors to be used in establishing fuel economy standards for MY 2012 and beyond. We will ensure that confidential information that is shared is protected from disclosure in accordance with NHTSA's practices in this area.

II. Submission of Comments

How Do I Prepare and Submit Comments?

Comments should be submitted using the spreadsheet template described above. Please include the docket number of this document in your comments. Please submit two copies of your comments, including the attachments, to Docket Management at the address given above under ADDRESSES. Comments may also be submitted to the docket electronically by logging onto http://www.regulations.gov. Click on "How to Use This Site" and then "User Tips" to obtain instructions for filing the document electronically.

How Can I Be Sure That My Comments Were Received?

If you wish Docket Management to notify you upon its receipt of your comments, enclose a self-addressed, stamped postcard in the envelope containing your comments. Upon receiving your comments, Docket Management will return the postcard by mail.

How Do I Submit Confidential Business Information?

If you wish to submit any information under a claim of confidentiality, you should submit three copies of your complete submission, including the information you claim to be confidential business information, to the Chief Counsel, NHTSA, at the address given above under FOR FURTHER INFORMATION CONTACT. In addition, you should submit a copy from which you have deleted the claimed confidential business information to the docket. When you send a comment containing information claimed to be confidential business information, you should include a cover letter setting forth the information specified in our confidential business information regulation. (49 CFR Part 512.)

Will the Agency Consider Late Comments?

We will consider all comments that Docket Management receives before the close of business on the comment closing date indicated above under DATES. Due to the time frame of the upcoming rulemaking, we will be very limited in our ability to consider comments filed after the comment closing date. If a comment is received too late for us to consider it in developing a final rule, we will consider that comment as an informal suggestion for future rulemaking action.

How Can I Read the Comments Submitted by Other People?

You may read the comments received by Docket Management at the address given above under ADDRESSES. The hours of the Docket are indicated above in the same location. You may also see the comments on the Internet. To read the comments on the Internet, take the following steps:

1) Go to http://www.regulations.gov.

2) On that page, in the field marked “search,” type in the docket number provided at the top of this document.

3) The next page will contain results for that docket number; it may help you to sort by “Date Posted: Oldest to Recent.”

4) On the results page, click on the desired comments. You may download the comments. However, since the comments are imaged documents, instead of word processing documents, the downloaded comments may not be word searchable.

Please note that even after the comment closing date, we will continue to file relevant information in the Docket as it becomes available. Accordingly, we recommend that you periodically check the Docket for new material.

Anyone is able to search the electronic form of all comments received into any of our dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.). You may review DOT's complete Privacy Act Statement in the **Federal Register** published on April 11, 2000 (Volume 65, Number 70; Pages 19477-78) or you may visit http://www.dot.gov/privacy.html.

Authority: 49 U.S.C. 32902; delegation of authority at 49 CFR 1.50.

Issued on:

Stephen R. Kratzke
Associate Administrator for
Rulemaking

APPENDIX A

I. Definitions

As used in these appendices--

1. "Automobile," "fuel economy," "manufacturer," and "model year (MY)," have the meaning given them in Section 32901 of Chapter 329 of Title 49 of the United States Code, 49 U.S.C. 32901.

2. "Basic engine" has the meaning given in 40 CFR 600.002-93(a)(21).

3. "Cargo-carrying volume," "gross vehicle weight rating" (GVWR), and "passenger-carrying volume" are used as defined in 49 CFR 523.2.

4. "CARB" means California Air Resource Board.

5. "Domestically manufactured" is used as defined in Section 32904(b)(2) of Chapter 329, 49 U.S.C. 32904(b)(2).

6. "Footprint" means the product of average track width (measured in inches and rounded to the nearest tenth of an inch) times wheelbase (measured in inches and rounded to the nearest tenth of an inch) divided by 144 and then rounded to the nearest tenth of a square foot as described in 49 CFR Part 523.2.

7. "Light truck" means an automobile of the type described in 49 CFR Part 523.3 and 523.5.

8. A "model" of passenger car is a line, such as the Chevrolet Impala, Ford Fusion, Honda Accord, etc., which exists within a manufacturer's fleet.

9. "Model Type" is used as defined in 40 CFR 600.002-93(a)(19).

10. "MY" means model year.

11. "Passenger car" means an automobile of the type described in 49 CFR Part 523.3 and 523.4.

12. “Percent fuel economy improvements” means that percentage which corresponds to the amount by which respondent could improve the fuel economy of vehicles in a given model or class through the application of a specified technology, averaged over all vehicles of that model or in that class which feasibly could use the technology. Projections of percent fuel economy improvement should be based on the assumption of maximum efforts by respondent to achieve the highest possible fuel economy increase through the application of the technology. The baseline for determination of percent fuel economy improvement is the level of technology and vehicle performance with respect to acceleration and gradeability for respondent's 2008 model year passenger cars or light trucks in the equivalent class.

13. “Percent production implementation rate” means that percentage which corresponds to the maximum number of passenger cars or light trucks of a specified class, which could feasibly employ a given type of technology if respondent made maximum efforts to apply the technology by a specified model year.

14. “Production percentage” means the percent of respondent's passenger cars or light trucks of a specified model projected to be manufactured in a specified model year.

15. “Project” or “projection” refers to the best estimates made by respondent, whether or not based on less than certain information.

16. “Redesign” means any change, or combination of changes, to a vehicle that would change its weight by 50 pounds or more or change its frontal area or aerodynamic drag coefficient by 2 percent or the implementation of new engine or transmission.

17. “Refresh” means any change, or combination of changes, to a vehicle that would change its weight by less than 50 pounds and would not change its frontal area or aerodynamic drag coefficient.

18. “Relating to” means constituting, defining, containing, explaining, embodying, reflecting, identifying, stating, referring to, dealing with, or in any way pertaining to.

19. “Respondent” means each manufacturer (including all its divisions) providing answers to the questions set forth in this appendix, and its officers, employees, agents or servants.

20. “RPE” means retail price equivalent.

21. “Test Weight” is used as defined in 40 CFR 86.082-2.

22. “Track Width” means the lateral distance between the centerlines of the base tires at ground, including the camber angle.

23. “Truckline” means the name assigned by the Environmental Protection Agency to a different group of vehicles within a make or car division in accordance with that agency's 2001 model year pickup, van (cargo vans and passenger vans are considered separate truck lines), and special purpose vehicle criteria.

24. “Variants of existing engines” means versions of an existing basic engine that differ from that engine in terms of displacement, method of aspiration, induction system or that weigh at least 25 pounds more or less than that engine.

25. “Wheelbase” means the longitudinal distance between front and rear wheel centerlines.

II. Assumptions

All assumptions concerning emission standards, damageability regulations, safety standards, etc., should be listed and described in detail by the respondent.

III. Specifications – Passenger Car and Light Truck Data

Go to ftp://ftpserver.volpe.dot.gov/pub/CAFE/templates/ for spreadsheet templates.

1. Identify all passenger car and light truck models offered for sale in MY 2008 whose production respondent projects discontinuing before MY 2011 and identify the last model year in which each will be offered.

2. Identify all basic engines offered by respondent in MY 2008 passenger cars and light trucks which respondent projects it will cease to offer for sale in passenger cars before MY 2011, and identify the last model year in which each will be offered.

3. For each model year 2008-2020, list all known or projected car and truck lines and provide the information specified below for each model type. Model types that are essentially identical except for their nameplates (*e.g.*, Ford Fusion/Mercury Milan) may be combined into one item. Engines having the same displacement but belonging to different engine families are to be grouped separately. Within the fleet, the vehicles are to be sorted first by car or truck line, second by basic engine, and third by transmission type. For each model type, a specific indexed engine and transmission are to be identified. As applicable, an indexed predecessor model type is also to be identified. Spreadsheet templates can be found at ftp://ftpserver.volpe.dot.gov/pub/CAFE/templates/. These templates include codes and definitions for the data that the agency is seeking, including, but not limited to the following:

A. General Information

1. Vehicle Number – a unique number assigned to each model
2. Manufacturer – manufacturer's name (*e.g.*, Toyota)
3. Model – name of model (*e.g.*, Camry)

4. Nameplate – vehicle nameplate (*e.g.*, Camry Solara)

5. Primary Fuel – classified as CNG = compressed natural gas; D = diesel; E = electricity; E-85 = ethanol; E100 = neat ethanol; G = gasoline; H = hydrogen; LNG = liquefied natural gas; LPG = propane; M85 = methanol; M100 = neat methanol

6. Fuel Economy on Primary Fuel – measured in miles per gallon; laboratory fuel economy (weighted FTP+highway GEG, exclusive of any calculation under 49 U.S.C. 32905)

7. Secondary Fuel – classified as CNG = compressed natural gas; D = diesel; E = electricity; E-85 = ethanol; E100 = neat ethanol; G = gasoline; H = hydrogen; LNG = liquefied natural gas; LPG = propane; M85 = methanol; M100 = neat methanol

8. Fuel Economy on Secondary Fuel – measured in miles per gallon; laboratory fuel economy (weighted FTP+highway GEG, exclusive of any calculation under 49 U.S.C. 32905)

9. Tertiary Fuel – classified as CNG = compressed natural gas; D = diesel; E = electricity; E-85 = ethanol; E100 = neat ethanol; G = gasoline; H = hydrogen; LNG = liquefied natural gas; LPG = propane; M85 = methanol; M100 = neat methanol

10. Fuel Economy on Tertiary Fuel – measured in miles per gallon; laboratory fuel economy (weighted FTP+highway GEG, exclusive of any calculation under 49 U.S.C. 32905)

11. CAFE Fuel Economy – measured in miles per gallon; laboratory fuel economy (weighted FTP+highway GEG, inclusive of any calculation under 49 U.S.C. 32905)

12. Engine Code – unique number assigned to each engine

A. Manufacturer – manufacturer's name (*e.g.*, General Motors, Ford, Toyota, Honda)

B. Name – name of engine

C. Configuration – classified as V = V-shaped; I = inline; R = rotary, H = horizontally opposed (boxer)

D. Primary Fuel – classified as CNG = compressed natural gas, D = diesel, E85 = ethanol, E100 = neat ethanol, G = gasoline, H = hydrogen, LNG = liquefied natural gas, LPG = propane, M85 = methanol, M100 = neat methanol

E. Secondary Fuel – classified as CNG = compressed natural gas, D = diesel, E85 = ethanol, E100 = neat ethanol, G = gasoline, H = hydrogen, LNG = liquefied natural gas, LPG = propane, M85 = methanol, M100 = neat methanol

F. Country of Origin – name of country where engine is manufactured

G. Engine Oil Viscosity – typical values as text include 0W20, 5W20, etc.; ratio between the applied shear stress and the rate of shear, which measures the resistance of flow of the engine oil (as per SAE Glossary of Automotive Terms)

H. Cycle – combustion cycle of engine: classified as A = Atkinson, AM = Atkinson/Miller, D = Diesel, M = Miller, O = Otto, OA = Otto/Atkinson

I. Air/Fuel Ratio – the weighted (FTP + highway) air/fuel ratio (mass); a number generally around 14.7

J. Fuel Delivery System – mechanism that delivers fuel to engine: classified as SGDI = stoichiometric gasoline direct injection; LBGDI = lean-burn gasoline direct injection; SFI = sequential fuel injection; MPFI = multipoint fuel injection;

TBI = throttle body fuel injection; CRDI = common rail direct injection (diesel); UDI = unit injector direct injection (diesel)

K. Aspiration – breathing or induction process of engine (as per SAE Automotive Dictionary); classified as NA = naturally aspirated, S = supercharged, T = turbocharged, T2 = twin turbocharged, T4 = quad-turbocharged, ST = supercharged and turbocharged

L. Valvetrain Design – design of the total mechanism from camshaft to valve of an engine that actuates the lifting and closing of a valve (as per SAE Glossary of Automotive Terms): classified as CVA = camless valve actuation, DOHC = dual overhead cam, OHV = overhead valve, SOHC = single overhead cam

M. Valve Actuation/Timing – valve opening and closing points in the operating cycle (as per SAE J604): classified as F = fixed, ICP = intake cam phasing, CCP = coupled cam phasing, DCP = dual cam phasing

N. Valve Lift – describes the manner in which the valve is raised during combustion (as per SAE Automotive Dictionary): classified as F = fixed, DVVL = discrete variable valve lift, CVVL = continuously variable valve lift

O. Cylinders – the number of engine cylinders: an integer equaling 3, 4, 5, 6, 8, 10 or 12

P. Valves/Cylinder – the number of valves per cylinder: an integer from 2 through 5

Q. Deactivation – presence of cylinder deactivation mechanism: classified as Y = cylinder deactivation applied; N = cylinder deactivation not applied

R. Displacement – total volume displaced by a piston in a single stroke multiplied by the number of cylinders; measured in liters

S. Compression Ratio (min) – typically a number between 8 and 11 (for fixed CR engines, should be identical to maximum CR)

T. Compression Ratio (max) – typically a number between 8 and 20 (for fixed CR engines, should be identical to minimum CR)

U. Max. Horsepower – the maximum power of the engine, measured as horsepower

V. Max. Horsepower RPM – rpm at which maximum horsepower is achieved

W. Max. Torque – the maximum torque of the engine, measured as lb-ft.

X. Max Torque RPM – rpm at which maximum torque is achieved

13. Transmission Code – unique number assigned to each transmission

A. Manufacturer – manufacturer's name (*e.g.*, General Motors, Ford, Toyota, Honda)

B. Name – name of transmission

C. Country of origin - where the transmission is manufactured

D. Type – type of transmission: classified as M = manual, A = automatic (torque converter), AMT = automated manual transmission (single clutch w/ torque interrupt), DCT = dual clutch transmission, CVT1 = belt or chain CVT, CVT2 = other CVT (*e.g.*, toroidal), HEVT = hybrid/electric vehicle transmission (for a BISG or CISG type hybrid please define the actual transmission used, not HEVT)

E. Clutch Type – type of clutch used in AMT or DCT type transmission: D = dry, W = wet

F. Number of Forward Gears – classified as an integer indicating the number of forward gears; "CVT" for a CVT type transmission; or "n/a" for an electric vehicle

G. Logic – indicates aggressivity of automatic shifting: classified as A = aggressive, C = conventional U.S. Provide rationale for selection in the transmission notes column.

14. Origin – classification (under CAFE program) as domestic or import: D = domestic, I = import

B. Production

1. Production – actual and projected US production for MY 2008 to MY 2020 inclusive, measured in number of vehicles

2. Percent of Production Regulated by CARB Standards – percent of production volume that will be regulated under CARB's AB 1493 for MY 2008 to MY 2020 inclusive

C. MSRP – measured in dollars (2009); actual and projected average MSRP (sales-weighted, including options) for MY 2008 to MY 2020 inclusive

D. Vehicle Information

1. Subclass – for technology application purposes only and should not be confused with vehicle classification for regulatory purposes: classified as Subcompact, Subcompact Performance, Compact, Compact Performance, Midsize, Midsize Performance, Large, Large Performance, Minivan, Small LT, Midsize LT, Large LT; where LT = SUV/Pickup/Van; use tables below, with example vehicles, to place vehicles into most appropriate subclass

Subclass	**Example vehicles**
Subcompact	Chevy Aveo, Honda Civic

Subcompact Performance	Mazda Miata, Saturn Sky
Compact	Chevy Cobalt, Nissan Sentra and Altima
Compact Performance	Audi S4 Quattro, Mazda RX8
Midsize	Chevy Camaro (V6), Toyota Camry, Honda Accord, Hyundai Azera
Midsize Performance	Chevy Corvette, Ford Mustang (V8), Nissan G37 Coupe
Large	Audi A8, Cadillac CTS and DTS
Large Performance	Bentley Arnage, Daimler CL600

Subclass	**Example vehicles**
Minivans	Dodge Caravan, Toyota Sienna
Small SUV/Pickup/Van	Ford Escape & Ranger, Nissan Rogue,
Midsize SUV/Pickup/Van	Chevy Colorado, Jeep Wrangler 4-door, Volvo XC70, Toyota Tacoma
Large SUV/Pickup/Van	Chevy Silverado, Ford Econoline, Toyota Sequoia

2. Style – classified as Convertible, Coupe, Hatchback, Sedan, Minivan, Pickup, Sport Utility, Van, Wagon

3. Light Truck Indicator – an integer; a unique number(s) assigned to each vehicle which represents the design feature(s) that classify it as a light truck. classified as:

(0) The vehicle neither has off-road design features (defined under 49 CFR § 523.5(b) and described by numbers 1 and 2 below) nor has functional characteristics (defined under 49 CFR § 523.5(a) and described by numbers 3 through 7 below) that would allow it to be properly classified as a light truck, thus the vehicle is properly classified as a passenger car.

> An automobile capable of off-highway operation, as indicated by the fact that it:

(1) (i) Has 4-wheel drive; or

(ii) Is rated at more than 6,000 pounds gross vehicle weight; and

(2) Has at least four of the following characteristics calculated when the automobile is at

curb weight, on a level surface, with the front wheels parallel to the automobile's longitudinal centerline, and the tires inflated to the manufacturer's recommended pressure—

(i) Approach angle of not less than 28 degrees.

(ii) Breakover angle of not less than 14 degrees.

(iii) Departure angle of not less than 20 degrees.

(iv) Running clearance of not less than 20 centimeters.

(v) Front and rear axle clearances of not less than 18 centimeters each.

> An automobile designed to perform at least one of the following functions:

(3) Transport more than 10 persons;

(4) Provide temporary living quarters;

(5) Transport property on an open bed;

(6) Provide, as sold to the first retail purchaser, greater cargo-carrying than passenger-carrying volume, such as in a cargo van; if a vehicle is sold with a second-row seat, its cargo-carrying volume is determined with that seat installed, regardless of whether the manufacturer has described that seat as optional; or

(7) Permit expanded use of the automobile for cargo-carrying purposes or other nonpassenger-carrying purposes through:

(i) For non-passenger automobiles manufactured prior to model year 2012, the removal of seats by means installed for that purpose by the automobile's manufacturer or with simple tools, such as screwdrivers and wrenches, so as to create a flat, floor level, surface extending from the forwardmost point of installation of those seats to the rear of the automobile’s interior; or

(ii) For non-passenger automobiles manufactured in model year 2008 and beyond, for vehicles equipped with at least 3 rows of designated seating positions as standard equipment, permit expanded use of the automobile for cargo-carrying purposes or other nonpassenger-carrying purposes through the removal or stowing of foldable or pivoting seats so as to create a flat, leveled cargo surface extending from the forwardmost point of installation of those seats to the rear of the automobile's interior.

4. Structure – classified as either L = Ladder or U =Unibody

5. Drive – classified as A = all-wheel drive; F = front-wheel drive; R = rear-wheel-drive; 4 = 4-wheel drive[4]

6. Axle Ratio – ratio of the speed in revolutions per minute of the drive shaft to that of the drive wheels

7. Length – measured in inches; defined per SAE J1100, L103 (Sept. 2005)

8. Width – measured in inches; defined per SAE J1100, W116 (Sept. 2005)

9. Wheelbase – measured to the nearest tenth of an inch; defined per SAE J1100, L101 (Sept. 2005), and clarified above

10. Track Width (front) – measured to the nearest tenth of an inch; defined per SAE J1100, W101-1 (Sept. 2005), and clarified above

11. Track Width (rear) – measured to the nearest tenth of an inch; defined per SAE J1100, W101-2 (Sept. 2005), and clarified above

12. Footprint – the product of average track width (measured in inches and rounded to the nearest tenth of an inch) times wheelbase (measured in inches and rounded to the

[4] NHTSA considers "4-wheel drive" to refer only to vehicles that have selectable 2- and 4-wheel drive options, as opposed to all-wheel drive, which is not driver-selectable.

nearest tenth of an inch) divided by 144 and then rounded to the nearest tenth of a square foot; defined per 49 CFR 523.2.

13. Base Tire - the tire specified as standard equipment by a manufacturer on each vehicle configuration of a model type (*e.g.*, 275/40R17)

14. Running Clearance – measured in centimeters, defined per 49 CFR 523.2

15. Front Axle Clearance - measured in centimeters, defined per 49 CFR 523.2

16. Rear Axle Clearance - measured in centimeters, defined per 49 CFR 523.2

17. Approach Angle – measured in degrees, defined per 49 CFR 523.2

18. Breakover Angle - measured in degrees, defined per 49 CFR 523.2

19. Departure Angle - measured in degrees, defined per 49 CFR 523.2

20. Curb Weight – total weight of vehicle including batteries, lubricants, and other expendable supplies but excluding the driver, passengers, and other payloads, measured in pounds; per SAE J1100 (Sept. 2005)

21. Test Weight – weight of vehicle as tested, including the driver, operator (if necessary), and all instrumentation (as per SAE J1263), measured in pounds

22. GVWR – Gross Vehicle Weight Rating, as defined per 49 CFR 523.2 measured in pounds

23. Towing Capacity (Maximum) – measured in pounds

24. Payload – measured in pounds

25. Cargo volume behind the front row – measured in cubic feet, defined per Table 28 of SAE J1100 (Sept. 2005)

26. Cargo volume behind the second row – measured in cubic feet, defined per Table 28 of SAE J1100 (Sept. 2005)

27. Cargo volume behind the third row – measured in cubic feet, defined per Table 28 of SAE J1100 (Sept. 2005)

28. Enclosed Volume – measured in cubic feet

29. Passenger Volume – measured in cubic feet; the volume measured using SAE J1100 as per EPA Fuel Economy regulations (40 CFR 600.315-82, "Classes of Comparable Automobiles"). This is the number that manufacturers calculate and submit to EPA.

30. Cargo Volume Index – defined per Table 28 of SAE J1100 (Sept. 2005)

31. Luggage Capacity – measured in cubic feet, defined per SAE J1100, V1 (Sept. 2005)

32. Seating (max) – number of usable seat belts before folding and removal of seats (where accomplished without special tools), provided in integer form

33. Number of Standard Rows of Seating – number of rows of seats that each vehicle comes with as standard equipment provided in integer form (*e.g.*, 1, 2 ,3, 4, or 5)

34. Frontal Area – a measure of the wind profile of the vehicle, typically calculated as the height times width of a vehicle body, *e.g.*, 25 square feet.

35. Aerodynamic Drag Coefficient, C_d – a dimensionless coefficient that relates the motion resistance force created by the air drag over the entire surface of a moving vehicle to the force of dynamic air pressure acting only over the vehicle's frontal area, *e.g.*, 0.25.

36. Tire Rolling Resistance, C_{rr} – a dimensionless coefficient that relates the motion resistance force due to tire energy losses (*e.g.*, deflection, scrubbing, slip, and air drag) to a vehicle's weight, *e.g.*, 0.0012.

37. Fuel Capacity – measured in gallons of diesel fuel or gasoline; MJ (LHV) of other fuels (or chemical battery energy)

38. Electrical System Voltage – measured in volts, *e.g.*, 12 volt, 42 volts

2005)

39. Power Steering – H = hydraulic; E = electric; EH = electro-hydraulic

40. Percent of Production Volume Equipped with A/C

41. A/C Refrigerant Type – *e.g.*, HFC-134a, HFC-152a, CO_2

42. A/C Compressor Displacement – measured in cubic centimeters

43. A/C CARB credit – measured in grams per mile, g/mile CO_2 equivalent as reportable under California ARB's AB 1493 Regulation

44. N_2O Emission Rate – measured in grams per mile, as reportable under California ARB's AB 1493 Regulation

45. CH_4 Emission Rate – measured in grams per mile, as reportable under California ARB's AB 1493 Regulation

46. Estimated Total CARB Credits - measured in grams per mile, g/mile CO_2 equivalent as reportable under California ARB's AB 1493 Regulation

E. Hybridization/Electrification

1. Type of Hybrid/Electric vehicle - classified as MHEV = 12V micro hybrid, BISG = belt mounted integrated starter generator, CISG = crank mounted integrated starter generator, PSHEV = power-split hybrid, 2MHEV = 2-mode hybrid, PHEV = plug-in hybrid, EV = electric vehicle, H = hydraulic hybrid, P = pneumatic hybrid

2. Voltage (volts) or, for hydraulic hybrids, pressure (psi)

3. Energy storage capacity – measured in MJ

4. Electric Motor Power Rating – measured in hp or kW

5. Battery type – classified as NiMH = Nickel Metal Hydride; Li-ion = Lithium Ion

6. Battery Only Range (charge depleting PHEV) – measured in miles

7. Maximum Battery Only Speed – measured in miles per hour; maximum speed at which a HEV can still operate solely on battery power measured on a flat road using the vehicle's FTP weight and coefficients

8. Percentage of braking energy recovered and stored over weighted FTP + highway drive cycle

9. Percentage of maximum motive power provided by stored energy system

10. Electrified Accessories – list of electrified accessories: classified as WP = water (coolant) pump, OP = oil pump, AC = air conditioner compressor

F. Energy Consumption[5] – of total fuel energy (higher heating value) consumed over FTP and highway tests (each weighted as for items 5 and 6 above), shares attributable to the following loss mechanisms, such that the sum of the shares equals one

1. System irreversibility governed by the Second Law of Thermodynamics

2. Heat lost to the exhaust and coolant streams

3. Engine friction (*i.e.*, the part of mechanical efficiency lost to friction in such engine components as bearings and rods, as could be estimated from engine dynamometer test results)

4. Pumping losses (*i.e.*, the part of mechanical efficiency lost to work done on gases inside the cylinder, as could be estimated from engine dynamometer test results)

5. Accessory losses (*i.e.*, the part of fuel efficiency lost to work done by engine-driven accessories, as could be estimated from bench test results for the individual components)

[5] This information is sought in order to account for a given vehicle model's fuel economy as partitioned into nine energy loss mechanisms. The agency may use this information to estimate the extent to which a given technology reduces losses in each mechanism.

6. Transmission losses (*i.e.*, the part of driveline efficiency lost to friction in such transmission components as gears, bearings, and hydraulics, as could be estimated from chassis dynamometer test results)

7. Aerodynamic drag of the body, as could be estimated from coast-down test results

8. Rolling resistance in the tires, as could be estimated from coast-down test results

9. Work done on the vehicle itself, as could be estimated from the vehicle's inertia mass and the fuel economy driving cycles

G. Planning and Assembly

1. U.S. Content – overall percentage, by value, that originated in the U.S.

2. Canadian Content – overall percentage, by value, that originated in Canada

3. Mexican Content – overall percentage, by value, that originated in Mexico

4. Domestic Content - overall percentage, by value, that originated in the U.S, Canada and Mexico

5. Final Assembly City

6. Final Assembly State/Province (if applicable)

7. Final Assembly Country

8. Predecessor – number (or name) of model upon which current model is based, if any

9. Refresh Years – model years of most recent and future refreshes through the 2020 time period, *e.g.*, 2010, 2015, 2020

10. Redesign Years – model years of most recent and future redesigns through the 2020 time period, *e.g.*, 2007, 2012, 2017; where redesign means any change or combination of changes to a vehicle that would change its weight by 50 pounds or more or change its frontal area or aerodynamic drag coefficient by 2 percent or more.

11. Employment Hours Per Vehicle – number of hours of U.S. labor applied per vehicle produced

H. The agency also requests that each manufacturer provide an estimate of its overall passenger car CAFE and light truck CAFE for each model year. This estimate should be included as an entry in the spreadsheets that are submitted to the agency.

4. As applicable, please explain in detail the relationship between the business plans submitted to Congress in December 2008, the restructuring plans submitted to the Treasury Department in February 2009, and the product plans being submitted in response to this request.

5. Relative to MY 2008 levels, for MYs 2008-2020 please provide information, by carline and as an average effect on a manufacturer's entire passenger car fleet, and by truckline and as an average effect on a manufacturer's entire light truck fleet, on the weight and/or fuel economy impacts of the following standards or equipment:

A. Federal Motor Vehicle Safety Standard (FMVSS No. 208) Automatic Restraints

B. FMVSS No. 201 Occupant Protection in Interior Impact

C. Voluntary installation of safety equipment (*e.g.*, antilock brakes)

D. Environmental Protection Agency regulations

E. California Air Resources Board requirements

F. Other applicable motor vehicle regulations affecting fuel economy.

6. For each specific model year and model of respondent's passenger car and light truck fleets projected to implement one or more of the following and/or any other weight reduction methods:

A. Substitution of materials

B. "Downsizing" of existing vehicle design, systems or components

C. Use of new vehicle, structural, system or component designs

Please provide the following information:

(i) description of the method (*e.g.*, substituting an composite body panel for a steel panel);

(ii) the weight reduction, in pounds, averaged over the model;

(iii) the percent fuel economy improvement averaged over the model;

(iv) the basis for your answer to (iii) (*e.g.*, data from dynamometer tests conducted by respondent, engineering analysis, computer simulation, reports of test by others);

(v) the incremental RPE cost (in 2009 dollars), averaged over the model, associated with the method;

(vi) the percent production implementation rate and the reasons limiting the implementation rate.

7. For each specific model year and model of respondent's passenger car and light truck fleets projected to implement one or more of the following and/or any other aerodynamic drag reduction methods:

A. Revised exterior components (*e.g.*, front fascia or side view mirrors)

B. Addition of underbody panels

C. Vehicle design changes (*e.g.*, change in ride height or optimized cooling flow path)

Please provide the following information:

(i) description of the method/aerodynamic change;

(ii) the percent reduction of the aerodynamic drag coefficient (C_d) and the C_d prior to the reduction, averaged over the model;

(iii) the percent fuel economy improvement, averaged over the model;

(iv) the basis for your answer to (iii) (*e.g.*, data from dynamometer tests conducted by respondent, wind tunnel testing, engineering analysis, computer simulation, reports of test by others);

(v) the incremental RPE cost (in 2009 dollars), averaged over the model, associated with the method/change;

(vi) the percent production implementation rate and the reasons limiting the implementation rate.

8. Indicate any MY 2008-2020 passenger car and light truck model types that have higher average test weights than comparable MY 2007 model types. Describe the reasons for any weight increases (*e.g.*, increased option content, less use of premium materials) and provide supporting justification.

9. Please provide your estimates of projected <u>total industry</u> U.S. passenger car sales and light truck sales, separately, for each model year from 2008 through 2020, inclusive.

10. Please provide your company's assumptions for U.S. gasoline and diesel fuel prices during 2008 through 2020.

11. Please provide projected production capacity available for the North American market (at standard production rates) for each of your company's passenger carline and light truckline designations during MYs 2008-2020.

12. Please provide your estimate of production lead-time for new models, your expected model life in years, and the number of years over which tooling costs are amortized. Additionally, the agency is requesting that manufactures provide vehicle or design changes that characterize a freshening and those changes that characterize a redesign.

IV. Technologies, Cost and Potential Fuel Economy Improvements

Spreadsheet templates for the tables mentioned in the following section can be found at ftp://ftpserver.volpe.dot.gov/pub/cafe/templates/.

1. The agency requests that manufacturers, for each passenger car and light truck model projected to be manufactured by respondent between MY 2008-2020, provide the following information on new technology applications:

(i) description of the nature of the technological improvement; including the vehicle's baseline technology that the technology replaces (*e.g.*, 6-speed automatic transmission replacing a 4-speed automatic transmission);

(ii) the percent fuel economy improvement averaged over the model;

(iii) the basis for your answer to (ii) (*e.g.*, data from dynamometer tests conducted by respondent, engineering analysis, computer simulation, reports of test by others);

(iv) the incremental RPE cost (in 2009 dollars), averaged over the model, associated with implementing the new technology;

(v) the percent production implementation rate and the reasons limiting the implementation rate.

In regards to costs, the agency is requesting information on cost reductions available through learning effects that are anticipated, so information should be provided regarding what the learning effects are, when and at what production volumes they occur, and to what degrees such learning is expected to be available.[6] The agency is also asking that the RPE markup factor (used to determine the RPE cost estimates) is stated in the response.

2. Additionally, the agency requests that manufactures and other interested parties provide the same information, as requested above, for the technologies listed in the following tables and any other potential technologies that may be implemented to improve fuel economy. These potential technologies can be inserted into additional rows at the end of each table. Examples of other potential technologies could include, but are not limited to: Homogenous Charge Compression Ignition (HCCI), Electric Vehicle (EV), Fuel Cell Vehicle, Belt Mounted Integrated Starter Generator (BISG), and Crank Mounted Integrated Starter Generator (CISG) specific technologies. In an effort to standardize the information received the agency requests that if possible respondents fill in the following tables:

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[6] "Learning effects" describes the reduction in unit production costs as a function of accumulated production volume and small redesigns that reduce costs. Applying learning effects, or "learning curves," requires estimates of three parameters: (1) the initial production volume that must be reached before cost reductions begin to be realized (referred to as "threshold volume"); (2) the percent reduction in average unit cost that results from each successive doubling of cumulative production volume (usually referred to as the "learning rate"); and (3) the initial cost of the technology. The method applies this effect for up to two doublings of production volume. For example, a 20 percent learning rate discount applied with a 300,000 unit threshold would reduce the applicable technology's incremental cost by up to 36 percent.

Table IV-1 with estimates of the model year of availability for each technology listed and any other identified technology.

Table IV-2 with estimated phase-in rates[7] by year for each technology listed and any other additional technologies. Engineering, planning and financial constraints can prohibit many technologies from being applied across an entire fleet of vehicles within a single model year, so the agency requests information on possible constraints on the rates at which each technology can penetrate a manufacturer's fleet.

Tables IV-3a, b and IV-4a, b with estimates for incremental RPE costs (in 2009 dollars) and incremental fuel consumption reductions for each technology listed and any other additional technologies. These estimates, for the technologies already listed, should assume that the preceding technologies, as defined by the decision trees in Appendix B, have already been applied and/or will be superseded. The agency is requesting that respondents fill in incremental RPE costs and fuel consumption reductions estimates for all vehicle subclasses listed. If a respondent feels that the incremental RPE cost and fuel consumption reduction estimates are similar for different subclasses they may combine subclasses.

Table IV-5 with estimates for the percentage by which each technology reduces energy losses attributable to each of nine energy loss mechanisms.

Tables IV-6a, b with estimates for synergies[8] that can occur when multiple technologies are applied.

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[7] In NHTSA's 2006 rulemaking establishing CAFE standards for MY 2008-2011 light trucks, the agency considered phase-in caps by ceasing to add a given technology to a manufacturer's fleet in a specific model year once it has increased the corresponding penetration rate by at least the amount of the cap. Having done so, it applied other technologies in lieu of the "capped" technology.

[8] When two or more technologies are added to a particular vehicle model to improve its fuel efficiency, the resultant fuel consumption reduction may sometimes be higher or lower than the product of the individual effectiveness values for those items. This may occur because one or more technologies applied to the same vehicle partially address the same source or sources of engine or vehicle losses. Alternately, this effect may be seen when one technology shifts the engine operating points, and therefore increases or reduces the fuel consumption reduction

3. The agency also asks that manufacturers or other interested parties provide information on appropriate sequencing of technologies, so that accumulated cost and fuel consumption effects may be evaluated incrementally. As examples of possible technology sequences, "decision trees" are shown in Appendix B below.

4. For each new or redesigned vehicle identified in response to Question III-3 and each new engine or fuel economy improvement identified in your response to Questions IV-1 and IV-2 provide your best estimate of the following, in terms of constant 2009 dollars:

A. Total capital costs required to implement the new/redesigned model or improvement according to the implementation schedules specified in your response. Subdivide the capital costs into tooling, facilities, launch, and engineering costs.

B. The maximum production capacity, expressed in units of capacity per year, associated with the capital expenditure in (A) above. Specify the number of production shifts on which your response is based and define "maximum capacity" as used in your answer.

C. The actual capacity that is planned to be used each year for each new/redesigned model or fuel economy improvement.

D. The increase in variable costs per affected unit, based on the production volume specified in (B) above.

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achieved by another technology or set of technologies. The difference between the observed fuel consumption reduction associated with a set of technologies and the product of the individual effectiveness values in that set is sometimes referred to as a "synergy." Synergies may be positive (increased fuel consumption reduction compared to the product of the individual effects) or negative (decreased fuel consumption reduction).

E. The equivalent retail price increase per affected vehicle for each new/redesigned model or improvement. Provide an example describing methodology used to determine the equivalent retail price increase.

Table IV-1: List of Technologies and Year of Availability

TECHNOLOGY	Abrev.	Year of Availability
Low Friction Lubricants	LUB	
Engine Friction Reduction	EFR	
VVT - Coupled Cam Phasing (CCP) on SOHC	CCPS	
Discrete Variable Valve Lift (DVVL) on SOHC	DVVLS	
Cylinder Deactivation on SOHC	DEACS	
VVT - Intake Cam Phasing (ICP)	ICP	
VVT - Dual Cam Phasing (DCP)	DCP	
Discrete Variable Valve Lift (DVVL) on DOHC	DVVLD	
Continuously Variable Valve Lift (CVVL)	CVVL	
Cylinder Deactivation on DOHC	DEACD	
Cylinder Deactivation on OHV	DEACO	
VVT - Coupled Cam Phasing (CCP) on OHV	CCPO	
Discrete Variable Valve Lift (DVVL) on OHV	DVVLO	
Conversion to DOHC with DCP	CDOHC	
Stoichiometric Gasoline Direct Injection (GDI)	SGDI	
Combustion Restart	CBRST	
Turbocharging and Downsizing	TRBDS	
Exhaust Gas Recirculation (EGR) Boost	EGRB	
Conversion to Diesel following CBRST	DSLC	
Conversion to Diesel following TRBDS	DSLT	
Electric Power Steering	EPS	
Improved Accessories	IACC	
12V Micro-Hybrid	MHEV	
Higher Voltage/Improved Alternator	HVIA	
Integrated Starter Generator (Belt/Crank)	ISG	
6-Speed Manual/Improved Internals	6MAN	
Improved Auto. Trans. Controls/Externals	IATC	
Continuously Variable Transmission	CVT	
6/7/8-Speed Auto. Trans with Improved Internals	NAUTO	
Dual Clutch or Automated Manual Transmission	DCTAM	
Power Split Hybrid	PSHEV	
2-Mode Hybrid	2MHEV	
Plug-in Hybrid	PHEV	
Material Substitution (1%)	MS1	
Material Substitution (2%)	MS2	
Material Substitution (5%)	MS5	
Low Rolling Resistance Tires	ROLL	
Low Drag Brakes	LDB	
Secondary Axle Disconnect	SAX	
Aero Drag Reduction	AERO	

Table IV-2: Phase-In Caps

		Percent Phase-in Rate per Year												
TECHNOLOGY	Abrev.	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Low Friction Lubricants	LUB													
Engine Friction Reduction	EFR													
VVT - Coupled Cam Phasing (CCP) on SOHC	CCPS													
Discrete Variable Valve Lift (DVVL) on SOHC	DVVLS													
Cylinder Deactivation on SOHC	DEACS													
VVT - Intake Cam Phasing (ICP)	ICP													
VVT - Dual Cam Phasing (DCP)	DCP													
Discrete Variable Valve Lift (DVVL) on DOHC	DVVLD													
Continuously Variable Valve Lift (CVVL)	CVVL													
Cylinder Deactivation on DOHC	DEACD													
Cylinder Deactivation on OHV	DEACO													
VVT - Coupled Cam Phasing (CCP) on OHV	CCPO													
Discrete Variable Valve Lift (DVVL) on OHV	DVVLO													
Conversion to DOHC with DCP	CDOHC													
Stoichiometric Gasoline Direct Injection (GDI)	SGDI													
Combustion Restart	CBRST													
Turbocharging and Downsizing	TRBDS													
Exhaust Gas Recirculation (EGR) Boost	EGRB													
Conversion to Diesel following CBRST	DSLC													
Conversion to Diesel following TRBDS	DSLT													
Electric Power Steering	EPS													
Improved Accessories	IACC													
12V Micro-Hybrid	MHEV													
Higher Voltage/Improved Alternator	HVIA													
Integrated Starter Generator (Belt/Crank)	ISG													
6-Speed Manual/Improved Internals	6MAN													
Improved Auto. Trans. Controls/Externals	IATC													
Continuously Variable Transmission	CVT													
6/7/8-Speed Auto. Trans with Improved Internals	NAUTO													
Dual Clutch or Automated Manual Transmission	DCTAM													
Power Split Hybrid	PSHEV													
2-Mode Hybrid	2MHEV													
Plug-in Hybrid	PHEV													
Material Substitution (1%)	MS1													
Material Substitution (2%)	MS2													
Material Substitution (5%)	MS5													
Low Rolling Resistance Tires	ROLL													
Low Drag Brakes	LDB													
Secondary Axle Disconnect	SAX													
Aero Drag Reduction	AERO													

Table IV-3a: Technology Cost Estimates

VEHICLE TECHNOLOGY RETAIL PRICE EQUIVALENT INCREMENTAL COSTS PER VEHICLE ($) BY VEHICLE SUBCLASS							
		Subcompact	Performance Subcompact	Compact	Performance Compact	Midsize	Performance Midsize
TECHNOLOGY	Abrev.	Car	Car	Car	Car	Car	Car
Low Friction Lubricants	LUB						
Engine Friction Reduction	EFR						
VVT - Coupled Cam Phasing (CCP) on SOHC	CCPS						
Discrete Variable Valve Lift (DVVL) on SOHC	DVVLS						
Cylinder Deactivation on SOHC	DEACS						
VVT - Intake Cam Phasing (ICP)	ICP						
VVT - Dual Cam Phasing (DCP)	DCP						
Discrete Variable Valve Lift (DVVL) on DOHC	DVVLD						
Continuously Variable Valve Lift (CVVL)	CVVL						
Cylinder Deactivation on DOHC	DEACD						
Cylinder Deactivation on OHV	DEACO						
VVT - Coupled Cam Phasing (CCP) on OHV	CCPO						
Discrete Variable Valve Lift (DVVL) on OHV	DVVLO						
Conversion to DOHC with DCP	CDOHC						
Stoichiometric Gasoline Direct Injection (GDI)	SGDI						
Combustion Restart	CBRST						
Turbocharging and Downsizing	TRBDS						
Exhaust Gas Recirculation (EGR) Boost	EGRB						
Conversion to Diesel following CBRST	DSLC						
Conversion to Diesel following TRBDS	DSLT						
Electric Power Steering	EPS						
Improved Accessories	IACC						
12V Micro-Hybrid	MHEV						
Higher Voltage/Improved Alternator	HVIA						
Integrated Starter Generator (Belt/Crank)	ISG						
6-Speed Manual/Improved Internals	6MAN						
Improved Auto. Trans. Controls/Externals	IATC						
Continuously Variable Transmission	CVT						
6/7/8-Speed Auto. Trans with Improved Internals	NAUTO						
Dual Clutch or Automated Manual Transmission	DCTAM						
Power Split Hybrid	PSHEV						
2-Mode Hybrid	2MHEV						
Plug-in Hybrid	PHEV						
Material Substitution (1%)	MS1						
Material Substitution (2%)	MS2						
Material Substitution (5%)	MS5						
Low Rolling Resistance Tires	ROLL						
Low Drag Brakes	LDB						
Secondary Axle Disconnect	SAX						
Aero Drag Reduction	AERO						

Table IV-3b: Technology Cost Estimates

VEHICLE TECHNOLOGY RETAIL PRICE EQUIVALENT INCREMENTAL COSTS PER VEHICLE ($) BY VEHICLE SUBCLASS							
		Large	Performance Large	Minivan	Small	Midsize	Large
TECHNOLOGY	Abrev.	Car	Car	LT	LT	LT	LT
Low Friction Lubricants	LUB						
Engine Friction Reduction	EFR						
VVT - Coupled Cam Phasing (CCP) on SOHC	CCPS						
Discrete Variable Valve Lift (DVVL) on SOHC	DVVLS						
Cylinder Deactivation on SOHC	DEACS						
VVT - Intake Cam Phasing (ICP)	ICP						
VVT - Dual Cam Phasing (DCP)	DCP						
Discrete Variable Valve Lift (DVVL) on DOHC	DVVLD						
Continuously Variable Valve Lift (CVVL)	CVVL						
Cylinder Deactivation on DOHC	DEACD						
Cylinder Deactivation on OHV	DEACO						
VVT - Coupled Cam Phasing (CCP) on OHV	CCPO						
Discrete Variable Valve Lift (DVVL) on OHV	DVVLO						
Conversion to DOHC with DCP	CDOHC						
Stoichiometric Gasoline Direct Injection (GDI)	SGDI						
Combustion Restart	CBRST						
Turbocharging and Downsizing	TRBDS						
Exhaust Gas Recirculation (EGR) Boost	EGRB						
Conversion to Diesel following CBRST	DSLC						
Conversion to Diesel following TRBDS	DSLT						
Electric Power Steering	EPS						
Improved Accessories	IACC						
12V Micro-Hybrid	MHEV						
Higher Voltage/Improved Alternator	HVIA						
Integrated Starter Generator (Belt/Crank)	ISG						
6-Speed Manual/Improved Internals	6MAN						
Improved Auto. Trans. Controls/Externals	IATC						
Continuously Variable Transmission	CVT						
6/7/8-Speed Auto. Trans with Improved Internals	NAUTO						
Dual Clutch or Automated Manual Transmission	DCTAM						
Power Split Hybrid	PSHEV						
2-Mode Hybrid	2MHEV						
Plug-in Hybrid	PHEV						
Material Substitution (1%)	MS1						
Material Substitution (2%)	MS2						
Material Substitution (5%)	MS5						
Low Rolling Resistance Tires	ROLL						
Low Drag Brakes	LDB						
Secondary Axle Disconnect	SAX						
Aero Drag Reduction	AERO						

Table IV-4a: Technology Effectiveness Estimates

VEHICLE TECHNOLOGY INCREMENTAL FUEL CONSUMPTION REDUCTION (-%) BY VEHICLE SUBCLASS							
		Subcompact	Performance Subcompact	Compact	Performance Compact	Midsize	Performance Midsize
TECHNOLOGY	Abrev.	Car	Car	Car	Car	Car	Car
Low Friction Lubricants	LUB						
Engine Friction Reduction	EFR						
VVT - Coupled Cam Phasing (CCP) on SOHC	CCPS						
Discrete Variable Valve Lift (DVVL) on SOHC	DVVLS						
Cylinder Deactivation on SOHC	DEACS						
VVT - Intake Cam Phasing (ICP)	ICP						
VVT - Dual Cam Phasing (DCP)	DCP						
Discrete Variable Valve Lift (DVVL) on DOHC	DVVLD						
Continuously Variable Valve Lift (CVVL)	CVVL						
Cylinder Deactivation on DOHC	DEACD						
Cylinder Deactivation on OHV	DEACO						
VVT - Coupled Cam Phasing (CCP) on OHV	CCPO						
Discrete Variable Valve Lift (DVVL) on OHV	DVVLO						
Conversion to DOHC with DCP	CDOHC						
Stoichiometric Gasoline Direct Injection (GDI)	SGDI						
Combustion Restart	CBRST						
Turbocharging and Downsizing	TRBDS						
Exhaust Gas Recirculation (EGR) Boost	EGRB						
Conversion to Diesel following CBRST	DSLC						
Conversion to Diesel following TRBDS	DSLT						
Electric Power Steering	EPS						
Improved Accessories	IACC						
12V Micro-Hybrid	MHEV						
Higher Voltage/Improved Alternator	HVIA						
Integrated Starter Generator (Belt/Crank)	ISG						
6-Speed Manual/Improved Internals	6MAN						
Improved Auto. Trans. Controls/Externals	IATC						
Continuously Variable Transmission	CVT						
6/7/8-Speed Auto. Trans with Improved Internals	NAUTO						
Dual Clutch or Automated Manual Transmission	DCTAM						
Power Split Hybrid	PSHEV						
2-Mode Hybrid	2MHEV						
Plug-in Hybrid	PHEV						
Material Substitution (1%)	MS1						
Material Substitution (2%)	MS2						
Material Substitution (5%)	MS5						
Low Rolling Resistance Tires	ROLL						
Low Drag Brakes	LDB						
Secondary Axle Disconnect	SAX						
Aero Drag Reduction	AERO						

Table IV-4b: Technology Effectiveness Estimates

VEHICLE TECHNOLOGY INCREMENTAL FUEL CONSUMPTION REDUCTION (-%) BY VEHICLE SUBCLASS							
		Large	Performance Large	Minivan	Small	Midsize	Large
TECHNOLOGY	Abrev.	Car	Car	LT	LT	LT	LT
Low Friction Lubricants	LUB						
Engine Friction Reduction	EFR						
VVT - Coupled Cam Phasing (CCP) on SOHC	CCPS						
Discrete Variable Valve Lift (DVVL) on SOHC	DVVLS						
Cylinder Deactivation on SOHC	DEACS						
VVT - Intake Cam Phasing (ICP)	ICP						
VVT - Dual Cam Phasing (DCP)	DCP						
Discrete Variable Valve Lift (DVVL) on DOHC	DVVLD						
Continuously Variable Valve Lift (CVVL)	CVVL						
Cylinder Deactivation on DOHC	DEACD						
Cylinder Deactivation on OHV	DEACO						
VVT - Coupled Cam Phasing (CCP) on OHV	CCPO						
Discrete Variable Valve Lift (DVVL) on OHV	DVVLO						
Conversion to DOHC with DCP	CDOHC						
Stoichiometric Gasoline Direct Injection (GDI)	SGDI						
Combustion Restart	CBRST						
Turbocharging and Downsizing	TRBDS						
Exhaust Gas Recirculation (EGR) Boost	EGRB						
Conversion to Diesel following CBRST	DSLC						
Conversion to Diesel following TRBDS	DSLT						
Electric Power Steering	EPS						
Improved Accessories	IACC						
12V Micro-Hybrid	MHEV						
Higher Voltage/Improved Alternator	HVIA						
Integrated Starter Generator (Belt/Crank)	ISG						
6-Speed Manual/Improved Internals	6MAN						
Improved Auto. Trans. Controls/Externals	IATC						
Continuously Variable Transmission	CVT						
6/7/8-Speed Auto. Trans with Improved Internals	NAUTO						
Dual Clutch or Automated Manual Transmission	DCTAM						
Power Split Hybrid	PSHEV						
2-Mode Hybrid	2MHEV						
Plug-in Hybrid	PHEV						
Material Substitution (1%)	MS1						
Material Substitution (2%)	MS2						
Material Substitution (5%)	MS5						
Low Rolling Resistance Tires	ROLL						
Low Drag Brakes	LDB						
Secondary Axle Disconnect	SAX						
Aero Drag Reduction	AERO						

Table IV-5: Energy Loss Mechanism Estimates

Percent Reduction of Energy Losses, by Loss Mechanism										
TECHNOLOGY	Abrev.	System Irreversibility	Exhaust and Coolant Heat Loss	Engine Friction	Pumping Losses	Accessory Losses	Transmission Loses	Aerodynamic Drag	Tire Rolling Resistance	Vehicle Work
Low Friction Lubricants	LUB									
Engine Friction Reduction	EFR									
VVT - Coupled Cam Phasing (CCP) on SOHC	CCPS									
Discrete Variable Valve Lift (DVVL) on SOHC	DVVLS									
Cylinder Deactivation on SOHC	DEACS									
VVT - Intake Cam Phasing (ICP)	ICP									
VVT - Dual Cam Phasing (DCP)	DCP									
Discrete Variable Valve Lift (DVVL) on DOHC	DVVLD									
Continuously Variable Valve Lift (CVVL)	CVVL									
Cylinder Deactivation on DOHC	DEACD									
Cylinder Deactivation on OHV	DEACO									
VVT - Coupled Cam Phasing (CCP) on OHV	CCPO									
Discrete Variable Valve Lift (DVVL) on OHV	DVVLO									
Conversion to DOHC with DCP	CDOHC									
Stoichiometric Gasoline Direct Injection (GDI)	SGDI									
Combustion Restart	CBRST									
Turbocharging and Downsizing	TRBDS									
Exhaust Gas Recirculation (EGR) Boost	EGRB									
Conversion to Diesel following CBRST	DSLC									
Conversion to Diesel following TRBDS	DSLT									
Electric Power Steering	EPS									
Improved Accessories	IACC									
12V Micro-Hybrid	MHEV									
Higher Voltage/Improved Alternator	HVIA									
Integrated Starter Generator (Belt/Crank)	ISG									
6-Speed Manual/Improved Internals	6MAN									
Improved Auto. Trans. Controls/Externals	IATC									
Continuously Variable Transmission	CVT									
6/7/8-Speed Auto. Trans with Improved Internals	NAUTO									
Dual Clutch or Automated Manual Transmission	DCTAM									
Power Split Hybrid	PSHEV									
2-Mode Hybrid	2MHEV									
Plug-in Hybrid	PHEV									
Material Substitution (1%)	MS1									
Material Substitution (2%)	MS2									
Material Substitution (5%)	MS5									
Low Rolling Resistance Tires	ROLL									
Low Drag Brakes	LDB									
Secondary Axle Disconnect	SAX									
Aero Drag Reduction	AERO									

Table IV-6a: Technology Synergy Estimates

Synergies		Fuel Consumption Improvement Synergy values by Subclass Positive values are [positive] synergies, negative values are dissynergies.					
Technology A	Technology B	Subcompact PC	Subcompact Perf. PC	Compact PC	Compact Perf. PC	Midsize PC	Midsize Perf. PC
ICP	CVT						

Table IV-6b: Technology Synergy Estimates

Synergies		Fuel Consumption Improvement Synergy values by Subclass Positive values are [positive] synergies, negative values are dissynergies.					
Technology A	**Technology B**	**Large PC**	**Large Perf. PC**	**Minivan LT**	**Small LT**	**Midsize LT**	**Large LT**
ICP	CVT						

Appendix B. Technology Decision Trees

Figure 1. Engine Technology Decision Trees

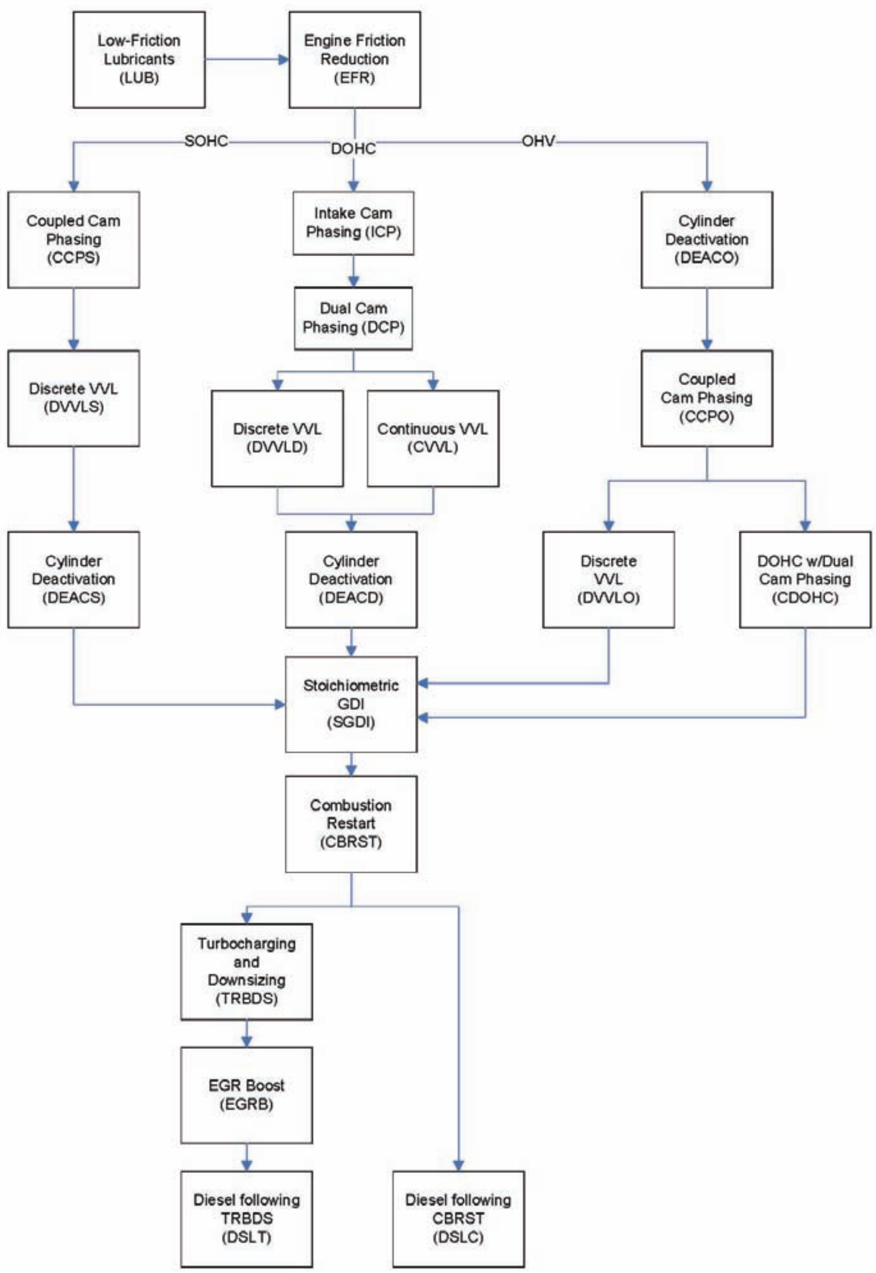

Figure 2. Transmission Technology Decision Trees

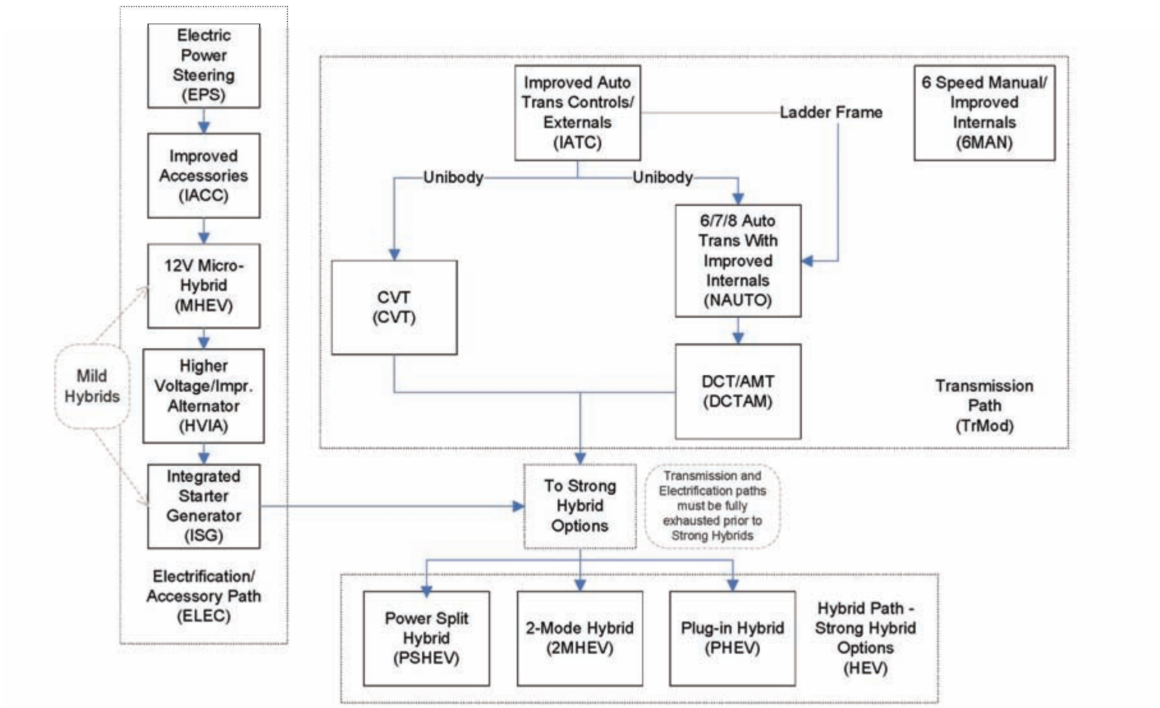

Figure 3. Decision Trees for Other Technologies