For the costs of a	Use the principles in—
Private non-profit organization other than an (1) institution of higher education, (2) hospital, or (3) organization named in 2 CFR part 230, Appendix C, as not subject to that circular.	2 CFR part 230.
Institutions of higher education	2 CFR part 220.
Hospitals	45 CFR part 74, Appendix E, "Principles for Determining Costs Applicable to Research and Development under Grants and Contracts with Hospitals."
For-profit organizations other than a hospital, commercial organization or a non-profit organization listed in 2 CFR part 230, Appendix C, as not subject to that part.	48 CFR part 31, Contract Cost Principles and Procedures, or uniform cost accounting standards that comply with cost principles acceptable to the Federal agency.

[FR Doc. E8–8789 Filed 5–1–08; 8:45 am]
BILLING CODE 4910–9X–P

DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

49 CFR Parts 531 and 533

[Docket No. NHTSA–2008–0069]

Passenger Car Average Fuel Economy Standards—Model Years 2008–2020 and 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 analyzing the proposed passenger car and light truck corporate average fuel economy (CAFE) standards as required by the Energy Policy and Conservation Act, as amended by the Energy Independence and Security Act (EISA) of 2007, Pub. L. 110–140. This proposal is discussed in a companion notice published today.

DATES: Comments must be received on or before July 1, 2008.

ADDRESSES: You may submit comments [identified by Docket No. NHTSA–2008–0069] 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 a.m. and 5 p.m. 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: For non-legal issues, call Ken Katz, Lead Engineer, Fuel Economy Division, Office of International Policy, Fuel Economy and Consumer Programs, at (202) 366–0846, facsimile (202) 493–2290, electronic mail *ken.katz@dot.gov*. For legal issues, call Rebecca Schade, Office of the Chief Counsel, at (202) 366–2992.

SUPPLEMENTARY INFORMATION:

I. Introduction

In December 1975, during the aftermath of the energy crisis created by the oil embargo of 1973–74, Congress enacted the Energy Policy and Conservation Act (EPCA). The Act established an automotive fuel economy regulatory program by adding Title V, "Improving Automotive Efficiency," to the Motor Vehicle Information and Cost Saving Act. Title V has been amended from time to time and codified without substantive change as Chapter 329 of Title 49 of the United States Code. Chapter 329 provides for the issuance of average fuel economy standards for passenger automobiles (passenger cars) and automobiles that are not passenger automobiles (light trucks).

Section 32902(a) of Chapter 329 states that the Secretary of Transportation shall prescribe by regulation corporate average fuel economy (CAFE) standards for passenger cars for each model year. That section also states that "[e]ach standard shall be the maximum feasible average fuel economy level that the Secretary decides the manufacturers can achieve in that model year." The Secretary has delegated the authority to implement the automotive fuel economy program to the Administrator of NHTSA. 49 CFR 1.50(f). Section 32902(f) provides that, in determining the maximum feasible average fuel economy level, we shall consider four criteria: Technological feasibility, economic practicability, the effect of other motor vehicle standards of the Government on fuel economy, and the need of the United States to conserve energy.

Congress enacted the Energy Independence and Security Act of 2007 (EISA) on December 18, 2007, which further amends Chapter 329 of Title 49. EISA made a number of important changes to EPCA, including:

- Replacing the old statutory default standard of 27.5 mpg for passenger automobiles with a mandate to establish passenger automobile and light truck standards, beginning with model year (MY) 2011, set sufficiently high to ensure that the average fuel economy of the combined industry wide fleet of all new passenger automobiles and light trucks sold in the United States during MY 2020 is at least 35 mpg.
- Limiting to five the number of years for which standards can be established in a single rulemaking.
- Mandating the reforming of CAFE standards for passenger cars by requiring that all CAFE standards be based on one or more vehicle attributes,

thus ensuring that the improvements in fuel economy do not come at the expense of safety.

• Requiring that for each model year, beginning with MY 2011, the domestic passenger cars of each manufacturer of those cars must achieve a measured average fuel economy that is not less than 92 percent of the average fuel economy of the combined fleet of domestic and non-domestic passenger cars sold in the United States in that model year.

• Providing greater flexibility for automobile manufacturers by (a) increasing from three to five the number of years that a manufacturer can carry forward the compliance credits it earns for exceeding CAFE standards, (b) allowing a manufacturer to transfer the credits it has earned from one class of automobiles to another, and (c) authorizing the trading of credits between manufacturers.

To assist the agency in analyzing the proposed CAFE standards, NHTSA has included a number of questions, found in an appendix to this notice, directed primarily toward vehicle manufacturers. In a companion document, which is being published today in the **Federal Register**, NHTSA is proposing passenger car and light truck average fuel economy standards for MYs 2011–2015. To facilitate our analysis, we are seeking detailed comments relative to the requests found in the appendices of this document. The appendices request information from manufacturers regarding their product plans—including data about engines and transmissions—from MY 2008 through MY 2020 for passenger cars and light trucks and the assumptions underlying those plans. Regarding light trucks, the agency is asking manufacturers to update the information it provided previously regarding MYs 2008 through 2011 product plans and to provide information regarding future product plans for MYs 2012 to 2020. The appendices also ask manufacturers to assist the agency with its estimates of the future vehicle population and the fuel economy improvement attributed to technologies.

To facilitate comments and to 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 preferred format for data submittal, and can be found on the Volpe National Transportation Systems Center (Volpe Center) Web site at: *ftp://ftpserver.volpe.dot.gov/pub/CAFE/templates/* or can be requested from Ken Katz at *ken.katz@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 also include sample tables that manufacturers may refer to when submitting their data to the agency.

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 two copies, from which you have deleted the claimed confidential business information, to Docket Management at the address given above under **ADDRESSES**. 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 timeframe of the upcoming rulemaking, we will be very limited in our ability to consider comments filed after the comment closing date. If Docket Management receives a comment 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: 15 U.S.C. 2007; delegation of authority at 49 CFR 1.50.

Issued on: April 22, 2008.

Stephen R. Kratzke,

Associate Administrator for Rulemaking.

Appendix A

I. Definitions

As used in these appendices—

1. ''Automobile,'' ''fuel economy,'' ''manufacturer,'' and ''model year,'' 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. ''Cargo-carrying volume,'' ''gross vehicle weight rating'' (GVWR), and ''passenger-carrying volume'' are used as defined in 49 CFR 523.2.

3. ''Basic engine'' has the meaning given in 40 CFR 600.002–93(a)(21). When identifying a basic engine, respondent should provide the following information:

(i) Engine displacement (in liters). If the engine has variable displacement (*i.e.*, cylinder deactivation) the respondent should provide both the minimum and maximum engine displacement.

(ii) Number of cylinders or rotors.

(iii) Number of valves per cylinder.

(iv) Cylinder configuration (V, in–line, etc.).

(v) Other engine characteristics, abbreviated as follows:

A—Atkinson cycle
AM—Atkinson/Miller cycle
D—Diesel cycle
M—Miller cycle
O—Otto cycle
OA—Otto/Atkinson cycle
V—V–shaped
I—Inline
R—Rotary
DI—Direct injection
IDI—Indirect injection
MPFI—Multipoint fuel injection
PFI—Port fuel injection
SEFI—Sequential electronic fuel injection
SIDI—Stoichiometric spark ignition direct injection
TBI—Throttle body fuel injection
NA—Naturally aspirated
T—Turbocharged
S—Supercharged
FFS—Feedback fuel system
2S—Two-stroke engines
C—Camless
OHV—Overhead valve
SOHC—Single overhead camshaft
DOHC—Dual overhead camshafts
VVT—Variable valve timing
ICP—Intake cam phasing
CCP—Coupled cam phasing
DCP—Dual cam phasing
VVLT—Variable valve lift and timing
VVLTD—Discrete variable valve lift and timing
VVLTC—Coupled variable valve lift and timing
VCT—Variable cam timing
CYDA—Cylinder deactivation
IVT—Intake valve throttling
CVA—Camless valve actuation
VCR—Variable compression ratio
LBFB—lean burn-fast burn combustion
E—Exhaust continuous phasing
EIE—Equal continuous intake and exhaust phasing
IIE—Independent continuous intake and exhaust
CV—Continuously variable valve lift
F—Fixed valve lift
SVI—Stepped variable intake with 2 or more fixed profiles

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

5. ''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.

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

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. ''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.

11. ''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.

12. ''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.

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

14. ''Redesign'' means any change, or combination of changes, including powertrain 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.

15. ''Refresh'' means any change, or combination of changes, including powertrain 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.

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

17. ''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.

18. ''Test Weight'' is used as defined in 40 CFR 86.082–2.

19. ''Track Width'' means the lateral distance between the centerlines of the base tires at ground, including the camber angle.

20. ''Transmission class'' is used as defined in 40 CFR 600.002–93(a)(22). When identifying a transmission class, respondent also must indicate whether the type of transmission is equipped with a lockup torque converter (LUTC), a split torque converter (STC), and/or a wide gear ratio range (WR) and specify the number of forward gears or whether the transmission is a continuously variable design (CVT). If the transmission is of a hybrid type, that should also be indicated. Other descriptive information may also be added, as needed.

21. ''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.

22. ''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.

23. ''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 Data

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

1. Identify all passenger car models currently offered for sale in MY 2008 whose production you project discontinuing before MY 2010 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 which respondent projects it will cease to offer for sale in passenger cars before MY 2010, and identify the last model year in which each will be offered.

3. For each model year 2008–2020, list all projected car 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 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. Number—a unique number assigned to each model.

2. Manufacturer—manufacturer abbreviation (e.g., TOY).

3. Model—name of model (e.g., Camry).

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

5. Fuel Economy—measured in miles per gallon; weighted (FTP + highway) fuel economy.

6. Actual FE (FFVs)—measured in miles per gallon; for flexible fuel vehicles, fuel economy when vehicle is operated on gasoline only.

7. Energy Consumption [1]—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.

A. System irreversibility governed by the Second Law of Thermodynamics.

B. Heat lost to the exhaust and coolant streams.

C. 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).

D. 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).

E. 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).

F. 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).

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

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

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

8. Engine Code—unique number assigned to each engine.

A. Manufacturer—manufacturer abbreviation (e.g., GMC, FMC, HON).

B. Name—name of engine.

C. Configuration–classified as V = V4, V6, V8, V10 or V12; I = inline; R = rotary.

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

E. Engine's country of origin.

F. 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).

G. Cycle—combustion cycle of engine. Classified as A = Atkinson, AM = Atkinson/Miller, D = Diesel, M = Miller, O = Otto, OA = Otto/Atkinson.

H. Air/Fuel Ratio—the weighted (FTP + highway) air/fuel ratio (mass): A number generally around 14.7.

I. Fuel System—mechanism that delivers fuel to engine. Classified as DI = direct injection, IDI = indirect injection, MPFI = multipoint fuel injection, PFI = port fuel injection, SEFI = sequential electronic fuel injection, SIDI = Stoichiometric spark ignition direct injection, TBI = throttle body fuel injection.

J. Aspiration—based on breathing or induction process of engine (as per SAE Automotive Dictionary). Classified as NA = naturally aspirated, S = supercharged, T = turbocharged, TT = twin turbocharged.

K. Valvetrain Design—describes 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 C = camless, DOHC = dual overhead cam, OHV = overhead valve, SOHC = single overhead cam.

L. Valve Actuation/Timing—based on valve opening and closing points in the operating cycle (as per SAE J604). Classified as CC = continuously controlled, EIE = equal continuous intake and exhaust phasing, E = exhaust continuous phasing, F = fixed, IIE = independent continuous intake and exhaust phasing, or other designation, VCT = variable cam timing, VVTE = variable valve timing, exhaust, ICP = intake cam phasing, CCP = coupled cam phasing, DCP = dual cam phasing.

M. Valve Lift—describes the manner in which the valve is raised during combustion (as per SAE Automotive Dictionary). Classified as CV = continuously variable (throttled), F = fixed, SVI = stepped variable intake with 2 or more fixed profiles, VVLTD = discrete variable valve lift and timing, VVLTC = coupled variable valve lift and timing.

N. Cylinders—the number of engine cylinders. An integer equaling 3, 4, 5, 6, 8, 10 or 12.

O. Valves/Cylinder—the number of valves per cylinder. An integer from 2 through 5.

P. Deactivation—weighted (FTP + highway) aggregate degree of deactivation. For example, enter 0.25 for deactivation of half the cylinders over half the drive cycle, and enter 0 for no valve deactivation.

Q. Displacement—total volume displaced by a piston in a single stroke, measured in liters, also commonly referred to as engine size.

R. Compression Ratio (min)—typically a number around 8; for fixed CR engines, should be identical to maximum CR.

S. Compression Ratio (max)—a number between 8 and 1420; for fixed CR engines, should be identical to minimum CR.

T. Horsepower—the maximum power of the engine combined with the associated engine speed when horsepower is maximum, measured as horsepower per revolutions per minute (hp @ rpm).

U. Torque—the maximum torque of the engine, measured as ft-lb.

9. Transmission Code—an integer; unique number assigned to each transmission.

A. Manufacturer—manufacturer abbreviation (e.g., GMC, FMC, HON).

B. Name—name of transmission.

C. Country of origin—where the transmission is manufactured.

D. Type—type of transmission. Classified as C = clutch, CVT1 = belt or chain CVT, CVT2 = other CVT, T = torque converter.

E. Number of Forward Gears—integer indicating number of forward gears (or blank or ''CVT'' for CVT).

F. Control—classified as A = automatic, M = manual; automatic shift manual transmission (ASMT) would be coded as Type = C, Control = A.

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

10. Origin—classification (under CAFE program) as domestic or import, listed as D = domestic, I = import.

b. Sales—Actual and Projected U.S. Production for MY 2008 to MY 2020 Inclusive, Measured in Number of Vehicles

c. Vehicle Information

1. Style—classified as Sedan; Coupe; Hatchback; Wagon; or Convertible.

2. Class—classified as Two-Seater Car; Mini-Compact Car; Subcompact Car; Compact Car; Midsize Car; Large Car; Small Station Wagon; Midsize Station Wagon; or Large Station Wagon.

3. Structure—classified as either Ladder or Unibody.

4. Drive—classified as A = all-wheel drive; F = front-wheel drive; R = rear-wheel-drive; 4 = 4-wheel drive.

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

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

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

8. Wheelbase—measured to the nearest tenth of an inch; as defined above.

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

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

11. Footprint—as defined above.

12. 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).

[1] 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.

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

14. GVWR—Gross Vehicle Weight Rating; as defined per 49 CFR 523.2 measured in pounds.

15. Towing Capacity (Standard)—measured in pounds.

16. Towing Capacity (Maximum)—measured in pounds.

17. Payload—measured in pounds.

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

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

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

21. Enclosed Volume—measured in cubic feet.

22. 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.

23. Cargo Volume Index—defined per Table 28 of SAE J1100 (Sept. 2005).

24. Luggage Capacity—measured in cubic feet; defined per SAE J1100, V1 (Sept. 2005).

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

26. Number of Standard Rows of Seating—number of rows of seats that each vehicle comes standardly equipped with; provided in integer form, e.g. 1,2,3,4, or 5.

27. Frontal Area—a measure of the wind profile of the vehicle, typically calculated as the height times width of a vehicle body, e.g. 35 square feet.

28. 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.

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

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

31. Electrical System Voltage—measured in volts, e.g., 12 volt, 42 volts 2005).

d. MSRP—Measured in Dollars (2008); Actual and Projected Average MSRP (Sales-Weighted, Including Options) for MY 2008 to MY 2020 Inclusive

e. Hybridization

1. Type of hybridization of the vehicle, if any—classified as E = electric, H = hydraulic.

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

3. Energy storage capacity—measured in MJ.

4. Battery type—Classified as NiMH = Nickel Metal Hydride; Li-ion = Lithium Ion.

5. Percentage of breaking energy recovered and stored over the FTP and HFET (weighted 55/45) recovered and stored.

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

f. Planning and Assembly

1. US/Canadian/Mexican Content—measured as a percentage; overall percentage, by value, that originated in U.S., Canada and Mexico.

2. Final Assembly City.

3. Final Assembly State/Province (if applicable).

4. Final Assembly Country.

5. Predecessor—number and name of model upon which current model is based, if any.

6. Last Freshening—model year.

7. Next Freshening—model year.

8. Last Redesign—model year; where redesign means any change, including powertrain changes, 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.

9. Next Redesign—model year.

10. Employment Hours Per Vehicle—number of hours of U.S. labor applied per vehicle produced.

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

4. Does respondent project introducing any variants of existing basic engines or any new basic engines, other than those mentioned in your response to Question 3, in its passenger car fleets in MYs 2008–2020? If so, for each basic engine or variant indicate:

a. The projected year of introduction,

b. Type (e.g., spark ignition, direct injection diesel, 2-cycle, alternative fuel use),

c. Displacement (If engine has variable displacement, please provide the minimum and maximum displacement),

d. Type of induction system (e.g., fuel injection with turbocharger, naturally aspirated),

e. Cylinder configuration (e.g., V–8, V–6, I–4),

f. Number of valves per cylinder (e.g., 2, 3, 4),

g. Valvetrain design (e.g., overhead valve, overhead camshaft),

h. Valve technology (e.g., variable valve timing, variable valve lift and timing, intake valve throttling, camless valve actuation, etc.),

i. Horsepower and torque ratings,

j. Models in which engines are to be used, giving the introduction model year for each model if different from ''a,'' above.

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, 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 of the model years 2008–2020, and for each passenger car model projected to be manufactured by respondent (if answers differ for the various models), provide the requested information on new technology applications for each of items ''6a'' through ''6r'' listed below:

(i) Description of the nature of the technological improvement;

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

(iii) The basis for your answer to 6(ii), (e.g., data from dynamometer tests conducted by respondent, engineering analysis, computer simulation, reports of test by others);

(iv) The percent production implementation rate and the reasons limiting the implementation rate;

(v) A description of the 2008 baseline technologies and the 2008 implementation rate; and

(vi) The reasons for differing answers you provide to items (ii) and (iv) for different models in each model year. Include as a part of your answer to 6(ii) and 6(iv) a tabular presentation, a sample portion of which is shown in Table III–A.

a. Improved automatic transmissions. Projections of percent fuel economy improvements should include benefits of lock-up or bypassed torque converters, electronic control of shift points and torque converter lock-up, and other measures which should be described.

b. Improved manual transmissions. Projections of percent of fuel economy improvement should include the benefits of increasing mechanical efficiency, using improved transmission lubricants, and other measures (specify).

c. Overdrive transmissions. If not covered in ''a'' or ''b'' above, project the percentage of fuel economy improvement attributable to overdrive transmissions (integral or auxiliary gear boxes), two-speed axles, or other similar devices intended to increase the range of available gear ratios. Describe the devices to be used and the application by model, engine, axle ratio, etc.

d. Use of engine crankcase lubricants of lower viscosity or with additives to improve friction characteristics or accelerate engine break-in, or otherwise improved lubricants to lower engine friction horsepower. When describing the 2008 baseline, specify the viscosity of and any fuel economy-improving additives used in the factory-fill lubricants.

e. Reduction of engine parasitic losses through improvement of engine-driven accessories or accessory drives. Typical engine-driven accessories include water pump, cooling fan, alternator, power steering pump, air conditioning compressor, and vacuum pump.

f. Reduction of tire rolling losses, through changes in inflation pressure, use of materials or constructions with less hysteresis, geometry changes (e.g., reduced aspect ratio), reduction in sidewall and tread deflection, and other methods. When describing the 2008 baseline, include a description of the tire types used and the percent usage rate of each type.

g. Reduction in other driveline losses, including losses in the non-powered wheels, the differential assembly, wheel bearings, universal joints, brake drag losses, use of improved lubricants in the differential and wheel bearing, and optimizing suspension geometry (e.g., to minimize tire scrubbing loss).

h. Reduction of aerodynamic drag.

i. Turbocharging or supercharging.

j. Improvements in the efficiency of 4-cycle spark ignition engines including (1) increased compression ratio; (2) leaner air-to-fuel ratio; (3) revised combustion chamber configuration; (4) fuel injection; (5) electronic fuel metering; (6) interactive electronic control of engine operating parameters (spark advance, exhaust gas recirculation, air-to-fuel ratio); (8) variable valve timing or valve lift; (9) multiple valves per cylinder; (10) cylinder deactivation; (11) friction reduction by means such as low tension piston rings and roller cam followers; (12) higher temperature operation; and (13) other methods (specify).

k. Direct injection gasoline engines, with and without turbocharging/supercharging.

l. Naturally aspirated diesel engines, with direct or indirect fuel injection.

m. Turbocharged or supercharged diesel engines with direct or indirect fuel injection.

n. Stratified-charge reciprocating or rotary engines, with direct or indirect fuel injection.

o. Two cycle spark ignition engines.

p. Use of hybrid drivetrains.

q. Use of fuel cells; provide a thorough description of the fuel cell technology employed, including fuel type and power output.

r. Other technologies for improving fuel economy or efficiency.

7. For each model of respondent's passenger car fleet projected to be manufactured in each of MYs 2008–2020, describe the methods used to achieve reductions in average test weight. For each specified model year and model, describe the extent to which each of the following methods for reducing vehicle weight will be used. Separate listings are to be used for 4x2 passenger cars and 4x4 passenger cars.

a. Substitution of materials.

b. ''Downsizing'' of existing vehicle design to reduce weight while maintaining interior roominess and comfort for passengers, and utility, *i.e.*, the same or approximately the same, payload and cargo volume, using the same basic body configuration and driveline layout as current counterparts.

c. Use of new vehicle body configuration concepts, which provides reduced weight for approximately the same payload and cargo volume.

8. Indicate any MY 2008–2020 passenger car 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. For each new or redesigned vehicle identified in response to Question 3 and each new engine or fuel economy improvement identified in your response to Questions 3, 4, 5, and 6, provide your best estimate of the following, in terms of constant 2008 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.

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.

10. Please provide respondent's actual and projected U.S. passenger car sales, 4x2 and 4x4, 0–8,500 lbs. GVWR for each model year from 2008 through 2020, inclusive. Please subdivide the data into the following vehicle categories:

i. Two-Seater Car (e.g., Chevrolet Corvette, Honda S2000, Porsche Boxster)

ii. Mini-Compact Car (e.g., Audi TT, Mitsubishi Eclipse, Mini Cooper)

iii. Compact Car (e.g., Ford Focus, VW Golf, Kia Rio)

iv. Midsize Car (e.g., Chevrolet Malibu, Honda Accord, Toyota Camry)

v. Large Car (e.g., Ford Crown Victoria, Cadillac DTS, Mercedes Maybach)

vi. Small Station Wagon (e.g., BMW 325 Sport Wagon, Subaru Impreza Wagon, Pontiac Vibe/Toyota Matrix)

vii. Midsize Station Wagon (e.g., Saab 9–5 Wagon, Volvo V70 Wagon, Jaguar X-Type Wagon)

viii. Large Station Wagon (e.g., Mercedes E-Class Wagon, Dodge Magnum, BMW 530 XiT Wagon)

See Table III–B for a sample format.

11. Please provide your estimates of projected *total industry* U.S. passenger car sales for each model year from 2008 through 2020, inclusive. Please subdivide the data into 4x2 and 4x4 sales and into the vehicle categories listed in the sample format in Table III–C.

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

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

14. 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.

Note: The parenthetical numbers in Table III–A refer to the items in Section III, Specifications.

TABLE III–A.—SAMPLE TECHNOLOGY IMPROVEMENTS

Technological improvement	Baseline technology	Percent fuel economy improvement, %	Basis for improvement estimate	Models on which technology is applied	Production share of model with technological improvement				
					2008	2009	2010	2011	2012
(6a.) Improved Auto Trans.:									
A5	....	4.0	....	....	20	35	50	60	80
A6	....	4.5	....	....	15	20	30	40	55
A7	....	5.0	....	....	0	0	15	25	35
(6b) Improved Manual Trans.:									
M5	....	1.0	....	....	12	15	20	25	32
M6	....	0.7	....	....	0	0	0	8	10

TABLE III–B.—SAMPLE ACTUAL AND PROJECTED U.S. PASSENGER CAR SALES

Amalgamated Motors Passenger Car Sales Projections						
Model line	Model year					
	2008	2009	2010	2011	2012	2013
Two-Seater	43,500					
Mini-Compact	209,340					
Subcompact	120,000					
Compact	60,000					
Midsize	20,000					
Large	29,310					
Small Station Wagon	54,196					
Midsize Station Wagon	38,900					
Large Station Wagon	24,000					
Total	599,246					

TABLE III–C.—SAMPLE TOTAL U.S. PASSENGER CAR SALES

Model type	2008	2009	2010	2011	2012	2013
Two-Seater						
Mini-Compact						
Subcompact						
Compact						
Midsize						
Large						
Small Station Wagon						
Midsize Station Wagon						
Large Station Wagon						
Total						

IV. Specifications—Light Truck Data

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

1. Identify all light truck models currently offered for sale in MY 2008 whose production you project discontinuing before MY 2010 and identify the last model year in which each will be offered.

2. Identify all basic engines offered by respondent in MY 2008 light trucks which respondent projects it will cease to offer for sale in light trucks before MY 2010, and identify the last model year in which each will be offered.

3. For each model year 2008–2020, list all projected light truck lines and provide the information specified below for each model type. Model types that are essentially identical except for their nameplates (e.g., Chrysler Town & Country/Dodge Caravan) 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 light 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. Number—a unique number assigned to each model.

2. Manufacturer—manufacturer abbreviation (e.g., GMC).

3. Model—name of model (e.g., Escalade).

4. Nameplate—vehicle nameplate (e.g., Escalade ESV).

5. Fuel Economy—measured in miles per gallon; weighted (FTP + highway) fuel economy.

6. Actual FE (FFVs)—measured in miles per gallon; for flexible fuel vehicles, fuel economy when vehicle is operated on gasoline only.

7. Energy Consumption [2]—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.

A. Systems irreversibility governed by the Second Law of Thermodynamics.

B. Heat lost to the exhaust and coolant streams.

C. 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).

D. 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).

[2] *See* supra note 2.

E. 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).

F. 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).

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

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

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

8. Engine Code—unique number assigned to each engine.

A. Manufacturer—manufacturer abbreviation (e.g., GMC, FMC, HON.)

B. Name—name of engine.

C. Configuration—classified as V = V4, V6, V8, V10 or V12; I = inline; R = rotary.

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

E. Engine's country of origin.

F. 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).

G. Cycle—combustion cycle of engine. Classified as A = Atkinson, AM = Atkinson/

Miller, D = Diesel, M = Miller, O = Otto, OA = Otto/Atkinson.

H. Air/Fuel Ratio—the weighted (FTP + highway) air/fuel ratio (mass): a number generally around 14.7.

I. Fuel System—mechanism that delivers fuel to engine. Classified as DI = direct injection, IDI = indirect injection, MPFI = multipoint fuel injection, PFI = port fuel injection, SEFI = sequential electronic fuel injection, SIDI = Stoichiometric spark ignition direct injection, TBI = throttle body fuel injection.

J. Aspiration—based on breathing or induction process of engine (as per SAE Automotive Dictionary). Classified as NA = naturally aspirated, S = supercharged, T = turbocharged, TT = twin turbocharged.

K. Valvetrain Design—describes 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 C = camless, DOHC = dual overhead cam, OHV = overhead valve, SOHC = single overhead cam.

L. Valve Actuation/Timing—based on valve opening and closing points in the operating cycle (as per SAE J604). Classified as CC=continuously controlled, EIE = equal continuous intake and exhaust phasing, E = exhaust continuous phasing, F = fixed, ICP = intake continuous phasing, IIE = independent continuous intake and exhaust phasing, or other designation, VCT = variable cam timing, VVTE = variable valve timing, exhaust, ICP = intake cam phasing, CCP = coupled cam phasing, DCP = dual cam phasing.

M. Valve Lift—describes the manner in which the valve is raised during combustion (as per SAE Automotive Dictionary). Classified as CV = continuously variable (throttled), F = fixed, SVI = stepped variable intake with 2 or more fixed profiles, or other designation, VVLTD = discrete variable valve lift and timing, VVLTC = coupled variable valve lift and timing.

N. Cylinders—the number of engine cylinders. An integer equaling 3, 4, 5, 6, 8, 10 or 12.

O. Valves/Cylinder—the number of valves per cylinder. An integer from 2 through 5.

P. Deactivation—weighted (FTP + highway) aggregate degree of deactivation. For example, enter 0.25 for deactivation of half the cylinders over half the drive cycle, and enter 0 for no valve deactivation.

Q. Displacement—total volume displaced by a piston in a single stroke, measured in liters, also commonly referred to as engine size.

R. Compression Ratio (min)—typically a number around 8; for fixed CR engines, should be identical to maximum CR.

S. Compression Ratio (max)—a number between 8 and 20; for fixed CR engines, should be identical to minimum CR.

T. Horsepower—the maximum power of the engine combined with the associated engine speed when horsepower is maximum, measured as horsepower per revolutions per minute (hp @ rpm).

U. Torque—the maximum torque of the engine, measured as ft-lb.

9. Transmission Code—an integer; unique number assigned to each transmission.

A. Manufacturer—manufacturer abbreviation (e.g., GMC, FMC, HON).

B. Name—name of transmission.

C. Country of origin—where the transmission is manufactured.

D. Type—type of transmission. Classified as C = clutch, CVT1 = belt or chain CVT, CVT2 = other CVT, T = torque converter.

E. Number of Forward Gears—integer indicating number of forward gears (or blank or ''CVT'' for CVT).

F. Control—classified as A = automatic, M = manual; automatic shift manual transmission (ASMT) would be coded as Type = C, Control = A.

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

10. Origin—classification (under CAFE program) as domestic or import, listed as D = domestic, I = import.

11. Light Truck Indicator—an integer; a unique number 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.

1. The vehicle has 4-wheel drive (includes all wheel drive) and has at least four of the following characteristics:

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

(ii) Breakover angle of not less that 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 are not less than 18 centimeters.

2. The vehicle is rated at more than 6000 lb gross vehicle weight (GVW), and has at least four of the following characteristics:

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

(ii) Breakover angle of not less that 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 are not less than 18 centimeters.

3. The vehicle transports more that 10 persons;

4. The vehicle provides temporary living quarters;

5. The vehicle transports property on an open bed;

6. The vehicle, in its standard version without reference to options (or ''delete'' options), provides greater cargo-carrying than passenger-carrying volume; or

7. The vehicle permits expanded use of the automobile for cargo-carrying purposes or other nonpassenger-carrying purposes through:

(i) For light trucks 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 light trucks 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.

b. Sales—Actual and Projected U.S. Production for MY 2008 to MY 2020 Inclusive, Measured in Number of Vehicles

c. Vehicle Information

1. Style—classified as Crossover; Pickup; Sport Utility; or Van.

2. Class—classified as Cargo Van; Crossover Vehicle; Large Pickup; Midsize Pickup; Minivan; Passenger Van; Small Pickup; Sport Utility Vehicle; or Sport Utility Truck.

3. Structure—classified as either Ladder or Unibody.

4. Drive—classified as A = all-wheel drive; F = front-wheel drive; R = rear-wheel-drive; 4 = 4-wheel drive.

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

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

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

8. Wheelbase—measured to the nearest tenth of an inch; as defined above.

9. Track Width (front)—measured in inches; defined per SAE J1100, W101–1 (Sept. 2005), and clarified above.

10. Track Width (rear)—measured in inches; defined per SAE J1100, W101–2 (Sept. 2005), and clarified above.

11. Footprint—wheelbase times average track width; measured in square feet, clarified above.

12. Running Clearance—measured in centimeters; defined per 49 CFR 523.2.

13. Front Axle Clearance—measured in centimeters; defined per 49 CFR 523.2.

14. Rear Axle Clearance—measured in centimeters; defined per 49 CFR 523.2.

15. Approach Angle—measured in degrees; defined per 49 CFR 523.2.

16. Breakover Angle—measured in degrees; defined per 49 CFR 523.2.

17. Departure Angle—measured in degrees; defined per 49 CFR 523.2.

18. 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).

19. Test Weight—weight of vehicle as tested, including the driver, operator (if

necessary), and all instrumentation (as per SAE J1263); measured in pounds.

20. GVWR—Gross Vehicle Weight Rating; as defined per 49 CFR 523.2 measured in pounds.

21. Towing Capacity (Standard)—measured in pounds.

22. Towing Capacity (Maximum)—measured in pounds.

23. Payload—measured in pounds.

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

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

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

27. Enclosed Volume—measured in cubic feet.

28. 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.

29. Cargo Volume Index—defined per Table 28 of SAE J1100 (Sept. 2005).

30. Luggage Capacity—measured in cubic feet; defined per SAE J1100, V1 (Sept. 2005).

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

32. Number of Standard Rows of Seating—number of rows of seats that each vehicle comes standardly equipped with; provided in integer form, e.g. 1, 2, 3, 4, or 5.

33. Frontal Area—a measure of the wind profile of the vehicle, typically calculated as the height times width of a vehicle body, e.g. 35 square feet.

34. 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.

35. 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.

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

37. Electrical System Voltage—measured in volts, e.g., 12 volt, 42 volts 2005).

d. MSRP—Measured in Dollars (2008); Actual and Projected Average MSRP (Sales-Weighted, Including Options) for MY 2008 to MY 2020 Inclusive

e. Hybridization

1. Type of hybridization of the vehicle, if any—classified as E = electric, H = hydraulic.

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

3. Energy storage capacity—measured in MJ.

4. Battery type—Classified as NiMH = Nickel Metal Hydride; Li-ion = Lithium Ion.

5. Percentage of breaking energy recovered and stored over the FTP and HFET (weighted 55/45).

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

f. Planning and Assembly

1. U.S./Canadian/Mexican Content—measured as a percentage; overall percentage, by value, that originated in U.S., Canada and Mexico.

2. Final Assembly City.

3. Final Assembly State/Province (if applicable).

4. Final Assembly Country.

5. Predecessor—number and name of model upon which current model is based, if any.

6. Last Freshening—model year.

7. Next Freshening—model year.

8. Last Redesign—model year; where redesign means any change, including powertrain changes, 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.

9. Next Redesign—model year.

10. Employment Hours per Vehicle—number of hours of U.S. labor applied per vehicle produced.

g. The agency also requests that each manufacturer provide an estimate of its overall 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. Does respondent project introducing any variants of existing basic engines or any new basic engines, other than those mentioned in your response to Question 3, in its light truck fleets in MYs 2008–2020? If so, for each basic engine or variant indicate:

a. The projected year of introduction,

b. Type (e.g., spark ignition, direct injection diesel, 2-cycle, alternative fuel use),

c. Displacement (If engine has variable displacement, please provide the minimum and maximum displacement),

d. Type of induction system (e.g., fuel injection with turbocharger, naturally aspirated),

e. Cylinder configuration (e.g., V–8, V–6, I–4),

f. Number of valves per cylinder (e.g., 2, 3, 4),

g. Valvetrain design (e.g., overhead valve, overhead camshaft),

h. Valve technology (e.g., variable valve timing, variable valve lift and timing, intake valve throttling, camless valve actuation, etc.),

i. Horsepower and torque ratings,

j. Models in which engines are to be used, giving the introduction model year for each model if different from ''a,'' above.

5. Relative to MY 2008 levels, for MYs 2008–2020, please provide information, 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 of the model years 2008–2020, and for each light truck model projected to be manufactured by respondent (if answers differ for the various models), provide the requested information on new technology applications for each of items ''6a'' through ''6r'' listed below:

(i) description of the nature of the technological improvement;

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

(iii) the basis for your answer to 6(ii) (e.g., data from dynamometer tests conducted by respondent, engineering analysis, computer simulation, reports of test by others);

(iv) the percent production implementation rate and the reasons for limiting the implementation rate;

(v) a description of the 2008 baseline technologies and the 2008 implementation rate; and

(vi) the reasons for differing answers you provide to items (ii) and (iv) for different models in each model year. Include as a part of your answer to 6(ii) and 6(iv) a tabular presentation, a sample portion of which is shown in Table IV–A.

a. Improved automatic transmissions. Projections of percent fuel economy improvements should include benefits of lock-up or bypassed torque converters, electronic control of shift points and torque converter lock-up, and other measures which should be described.

b. Improved manual transmissions. Projections of percent of fuel economy improvement should include the benefits of increasing mechanical efficiency, using improved transmission lubricants, and other measures (specify).

c. Overdrive transmissions. If not covered in ''a'' or ''b'' above, project the percentage of fuel economy improvement attributable to overdrive transmissions (integral or auxiliary gear boxes), two-speed axles, or other similar devices intended to increase the range of available gear ratios. Describe the devices to be used and the application by model, engine, axle ratio, etc.

d. Use of engine crankcase lubricants of lower viscosity or with additives to improve friction characteristics or accelerate engine break-in, or otherwise improved lubricants to lower engine friction horsepower. When describing the 2008 baseline, specify the viscosity of and any fuel economy-improving additives used in the factory-fill lubricants.

e. Reduction of engine parasitic losses through improvement of engine-driven accessories or accessory drives. Typical engine-driven accessories include water pump, cooling fan, alternator, power steering pump, air conditioning compressor, and vacuum pump.

f. Reduction of tire rolling losses, through changes in inflation pressure, use of materials or constructions with less hysteresis, geometry changes (e.g., reduced aspect ratio), reduction in sidewall and tread deflection, and other methods. When describing the 2008 baseline, include a description of the tire types used and the percent usage rate of each type.

g. Reduction in other driveline losses, including losses in the non-powered wheels, the differential assembly, wheel bearings, universal joints, brake drag losses, use of improves lubricants in the differential and wheel bearing, and optimizing suspension geometry (e.g., to minimize tire scrubbing loss).

h. Reduction of aerodynamic drag.

i. Turbocharging or supercharging.

j. Improvements in the efficiency of 4-cycle spark ignition engines including (1) increased compression ratio; (2) leaner air-to-fuel ratio; (3) revised combustion chamber configuration; (4) fuel injection; (5) electronic fuel metering; (6) interactive electronic control of engine operating parameters (spark advance, exhaust gas recirculation, air-to-fuel ratio); (8) variable valve timing or valve lift; (9) multiple valves per cylinder; (10) cylinder deactivation; (11) friction reduction by means such as low tension piston rings and roller cam followers; (12) higher temperature operation; and (13) other methods (specify).

k. Direct injection gasoline engines, with and without turbocharging/supercharging.

l. Naturally aspirated diesel engines, with direct or indirect fuel injection.

m. Turbocharged or supercharged diesel engines with direct or indirect fuel injection.

n. Stratified-charge reciprocating or rotary engines, with direct or indirect fuel injection.

o. Two cycle spark ignition engines.

p. Use of hybrid drivetrains.

q. Use of fuel cells; provide a thorough description of the fuel cell technology employed, including fuel type and power output.

r. Other technologies for improving fuel economy or efficiency.

7. For each model of respondent's light truck fleet projected to be manufactured in each of MYs 2008–2020, describe the methods used to achieve reductions in average test weight. For each specified model year and model, describe the extent to which each of the following methods for reducing vehicle weight will be used. Separate listings are to be used for 4x2 light trucks and 4x4 light trucks.

a. Substitution of materials.

b. ''Downsizing'' of existing vehicle design to reduce weight while maintaining interior roominess and comfort for passengers, and utility, *i.e.*, the same or approximately the same, payload and cargo volume, using the same basic body configuration and driveline layout as current counterparts.

c. Use of new vehicle body configuration concepts, which provides reduced weight for approximately the same payload and cargo volume.

8. Indicate any MY 2008–2020 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. For each new or redesigned vehicle identified in response to Question 3 and each new engine or fuel economy improvement identified in your response to Questions 3, 4, 5, and 6, provide your best estimate of the following, in terms of constant 2008 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.

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.

10. Please provide respondent's actual and projected U.S. light truck sales, 4x2 and 4x4, 0–8,500 lbs. GVWR, and 8,501–10,000 lbs. GVWR for each model year from 2008 through 2020, inclusive. Please subdivide the data into the following vehicle categories:

i. Compact Pickup (e.g., Ford Ranger, Chevrolet Colorado, Nissan Frontier).

ii. Standard Pickup—Light (e.g., Ford F150, Chevrolet Silverado, Toyota Tundra).

iii. Standard Pickup—Heavy (e.g., Ford F250/350, Dodge Ram 2500/3500).

iv. Standard Cargo Van—Light (e.g., Chevrolet Savana, Ford E–150).

v. Standard Cargo Van—Heavy (e.g., Chevrolet G2500, Ford E–250/350, Dodge Sprinter).

vi. Compact Passenger Van/Minivan (e.g., Toyota Sienna, Dodge Caravan, Nissan Quest).

vii. Standard Passenger Van—Light (e.g., GMC Express, Ford E–150).

viii. Standard Passenger Van—Heavy (e.g., Ford E–250/350, Dodge Sprinter).

ix. Compact Sport Utility (e.g., Jeep Wrangler, Toyota RAV4).

x. Mid-size Sport Utility (e.g., Chevrolet Trailblazer, Ford Explorer, Toyota 4Runner).

xi. Full-size Sport Utility (e.g., Chevrolet Tahoe, Ford Expedition, Nissan Titan).

xii. Crossover Vehicle (e.g., Toyota RX 330, Nissan Murano, Acura MDX).

xiii. Sport Utility Truck (e.g., Cadillac Escalade EXT, Honda Ridgeline).

See Table IV–B for a sample format.

11. Please provide your estimates of projected *total industry* U.S. light truck sales for each model year from 2008 through 2020, inclusive. Please subdivide the data into 4x2 and 4x4 sales and into the vehicle categories listed in the sample format in Table IV–C.

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

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

14. 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.

Note: The parenthetical numbers in Tables IV–A refer to the items in Section IV, *Specifications*.

TABLE IV–A.—SAMPLE TECHNOLOGY IMPROVEMENTS

Technological improvement	Baseline technology	Percent fuel economy improvement, %	Basis for mprovement estimate	Models on which technology is applied	Production share of model with technological improvement				
					2010	2011	2012	2013	2014+
(6a.) Improved Auto Trans.:									
A5	....	4.0	....	....	20	35	50	60	80
A6	....	4.5	....	....	15	20	30	40	55
A7	....	5.0	....	....	0	0	15	25	35
(6b.) Improved Manual Trans.:									
M5	....	1.0	....	....	12	15	20	25	32
M6	....	0.7	....	....	0	0	0	8	10

TABLE IV–B.—SAMPLE ACTUAL AND PROJECTED U.S. LIGHT TRUCK SALES

Amalgamated Motors Light Truck Sales Projections

Model line	Model year					
	2010	2011	2012	2013	2014	2015+
Compact Pickup	43,500					
Standard Pickup—Light	209,340					
Standard Pickup—Heavy	120,000					
Standard Cargo Van—Light	20,000					
Standard Cargo Van—Heavy	29,310					
Compact Passenger Van/Minivan	54,196					
Standard Passenger Van—Light	38,900					
Standard Passenger Van—Heavy	24,000					
Compact Sport Utility	125,000					
Mid-size Sport Utility	221,000					
Full-size Sport Utility	165,000					
Crossover Vehicle	98,000					
Sport Utility Truck	10,000					
Total	1,158,246					

TABLE IV–C.—SAMPLE TOTAL U.S. LIGHT TRUCK SALES

Model type	2010	2011	2012	2013	2014	2015	2016+
Compact Pickup							
Standard Pickup—Light							
Standard Pickup—Heavy							
Standard Cargo Van—Light							
Standard Cargo Van—Heavy							
Compact Passenger Van/Minivan							
Standard Passenger Van—Light							
Standard Passenger Van—Heavy							
Compact Sport Utility							
Mid-size Sport Utility							
Full-size Sport Utility							
Crossover Vehicle							
Sport Utility Truck							
Total							

V. Technologies, Cost and Potential Fuel Economy Improvements

The agency requests that manufacturers and other interested parties separately describe any fuel economy-related technologies not listed in the tables below. For the technologies listed in the tables below and any additional technologies, the agency requests that each manufacturer and other interested parties provide estimates of the model year of availability of each technology. Because engineering, planning and financial constraints prohibit most technologies from being applied across an entire fleet of vehicles within a year, the agency requests information on possible constraints on the rates at which each technology can penetrate a manufacturer's fleet. The agency refers to these as ''phase-in caps.'' [3]

Also for the technologies listed in the tables below and any additional technologies, the agency requests estimates of the range of costs and fuel economy improvements of available fuel economy technologies. Estimates of energy loss reduction estimates should also be provided.

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.

Considering the appropriate sequencing of technologies, the estimates requested above should follow the format provided by Tables 1 through 6:

Table 1: The list of technologies, and estimates of the first model year in which each technology is expected to be available for significant commercial use.

Table 2: Estimates of highest incremental share of fleet to which a technology could be added in a single model year (''phase-in cap'' percentage) for individual technologies, if relevant.

Table 3: Estimates of the incremental cost and Retail Price Equivalent (in 2008 dollars) of each technology, assuming preceding technologies have already been applied and/or superseded. Costs should be described as manufacturer cost, supplier cost, or some other basis. Retail Price Equivalent multipliers should be provided for each technology. If cost reductions available through learning effects are anticipated, 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.[4]

Table 4: Estimates of the incremental fuel consumption reduction achieved by each technology, assuming preceding technologies

[3] 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 amount of the cap. Having done so, it applied other technologies in lieu of the ''capped'' technology.

[4] ''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 ''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 applied with a 25,000 unit threshold would reduce the applicable technology's incremental cost by up to 36 percent.

have already been applied and/or superseded.

Table 5: Estimates of the percentage by which each technology reduces energy losses attributable to each of nine energy loss mechanisms.

Table 6: Estimates of the amount by which the fuel consumption exceeds the value obtained by combining (through multiplication) fuel consumption reduction estimates shown in Table 2.[5]

The agency has included sample tables for manufacturers' use. Spreadsheet templates for these tables can be found at *ftp://ftpserver.volpe.dot.gov/pub/cafe/templates/*.

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[5] 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 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).

Table 1: List of Technologies and Year of Availability

Technologies	Year of Availability
Low friction lubricants – incremental to base engine	
Engine friction reduction – incremental to base engine	
Overhead Cam Branch	
VVT – intake cam phasing	
VVT – coupled cam phasing	
VVT – dual cam phasing	
Cylinder deactivation	
Discrete VVLT	
Continuous VVLT	
Overhead Valve Branch	
Cylinder deactivation	
VVT – coupled cam phasing	
Discrete VVLT	
Continuous VVLT (includes conversion to Overhead Cam)	
Camless valvetrain (electromagnetic)	
GDI – stoichiometric	
GDI – lean burn	
Gasoline HCCI dual-mode	
Turbocharging & Downsizing	
Diesel – Lean NOx trap	
Diesel – urea SCR	
Aggressive shift logic	
Early torque converter lockup	
5-speed automatic	
6-speed automatic	
6-speed AMT	
6-speed manual	
CVT	
Stop-Start with 42 volt system	
IMA/ISA/BSG (includes engine downsize)	
2-Mode hybrid electric vehicle	
Power-split hybrid electric vehicle (P-S HEV)	
Full-Series hydraulic hybrid	
Plug-in hybrid electric vehicle (PHEV)	
Full electric vehicle (EV)	
Improved high efficiency alternator & electrification of accessories (12 volt)	
Electric power steering (12 or 42 volt)	
Improved high efficiency alternator & electrification of accessories (42 volt)	
Aero drag reduction (20% on cars, 10% on trucks)	
Low rolling resistance tires (10%)	
Low drag brakes (ladder frame only)	
Secondary axle disconnect (unibody only)	
Front axle disconnect (ladder frame only)	
Weight reduction (1%) – above 5,000 lbs only	
Weight reduction (2%) – incremental to 1%	
Weight reduction (3%) – incremental to 2%	

Table 2: Phase-In Caps

Technology	Percent phase-in cap
Low Friction Lubricants	
Engine Friction Reduction	
Variable Valve Timing (ICP)	
Variable Valve Timing (CCP)	
Variable Valve Timing (DCP)	
Cylinder Deactivation	
Variable Valve Lift & Timing (CVVL)	
Variable Valve Lift & Timing (DVVL)	
Cylinder Deactivation on OHV	
Variable Valve Timing (CCP) on OHV	
Multivalve Overhead Cam with CVVL	
Variable Valve Lift & Timing (DVVL) on OHV	
Camless Valve Actuation	
Stoichiometric GDI	
Diesel following GDI-S (SIDI)	
Lean Burn GDI	
Turbocharging and Downsizing	
Diesel following Turbo D/S	
HCCI	
Diesel following HCCI	
5 Speed Automatic Transmission	
Aggressive Shift Logic	
Early Torque Converter Lockup	
6 Speed Automatic Transmission	
Automated Manual Transmission	
Continuously Variable Transmission	
6 Speed Manual	
Improved Accessories	
Electric Power Steering	
42-Volt Electrical System	
Low Rolling Resistance Tires	
Low Drag Brakes	
Secondary Axle Disconnect – Unibody	
Secondary Axle Disconnect - Ladder Frame	
Aero Drag Reduction	
Material Substitution (1%)	
Material Substitution (2%)	
Material Substitution (5%)	
ISG with Idle-Off	
IMA/ISAD/BSG Hybrid (includes engine downsizing)	
2-Mode Hybrid	
Power Split Hybrid	
Plug-in Hybrid	
Other technologies (please list)	

Table 3: Technology Cost Estimates

Technologies	Vehicle Technology Incremental Retail Price Equivalent per Vehicle ($) by Vehicle Class									
	Subcompact Car	Compact Car	Midsize Car	Large Car	Small Pickup	Small SUV	Minivan	Midsize SUV	Large Pickup	Large SUV
Low friction lubricants – incremental to base engine										
Engine friction reduction – incremental to base engine										
Overhead Cam Branch										
VVT – intake cam phasing										
VVT – coupled cam phasing										
VVT – dual cam phasing										
Cylinder deactivation										
Discrete VVLT										
Continuous VVLT										
Overhead Valve Branch										
Cylinder deactivation										
VVT – coupled cam phasing										
Discrete VVLT										
Continuous VVLT (includes conversion to Overhead Cam)										
Camless valvetrain (electromagnetic)										
GDI – stoichiometric										
GDI – lean burn										
Gasoline HCCI dual-mode										
Turbocharging & downsizing										
Diesel – Lean NOx trap										
Diesel – urea SCR										
Aggressive shift logic										
Early torque converter lockup										
5-speed automatic										
6-speed automatic										
6-speed AMT										
6-speed manual										
CVT										
Stop-Start with 42 volt system										
IMA/ISA/BSG (includes engine downsize)										
2-Mode hybrid electric vehicle										
Power-split hybrid electric vehicle (P-S HEV)										
Full-Series hydraulic hybrid										
Plug-in hybrid electric vehicle (PHEV)										
Full electric vehicle (EV)										
Improved high efficiency alternator & electrification of accessories (12 volt)										
Electric power steering (12 or 42 volt)										
Improved high efficiency alternator & electrification of accessories (42 volt)										
Aero drag reduction (20% on cars, 10% on trucks)										
Low rolling resistance tires (10%)										
Low drag brakes (ladder frame only)										
Secondary axle disconnect (unibody only)										
Front axle disconnect (ladder frame only)										
Weight reduction (1%) – above 5,000 lbs only										
Weight reduction (2%) – incremental to 1%										
Weight reduction (3%) – incremental to 2%										

Table 4: Technology Effectiveness Estimates

Technologies	Vehicle Technology Incremental Fuel Consumption Reduction (%) by Vehicle Class									
	Subcompact Car	Compact Car	Midsize Car	Large Car	Small Pickup	Small SUV	Minivan	Midsize SUV	Large Pickup	Large SUV
Low friction lubricants – incremental to base engine										
Engine friction reduction – incremental to base engine										
Overhead Cam Branch										
VVT – intake cam phasing										
VVT – coupled cam phasing										
VVT – dual cam phasing										
Cylinder deactivation										
Discrete VVLT										
Continuous VVLT										
Overhead Valve Branch										
Cylinder deactivation										
VVT – coupled cam phasing										
Discrete VVLT										
Continuous VVLT (includes conversion to Overhead Cam)										
Camless valvetrain (electromagnetic)										
GDI – stoichiometric										
GDI – lean burn										
Gasoline HCCI dual-mode										
Turbocharging & Downsizing										
Diesel – Lean NOx trap										
Diesel – urea SCR										
Aggressive shift logic										
Early torque converter lockup										
5-speed automatic										
6-speed automatic										
6-speed AMT										
6-speed manual										
CVT										
Stop-Start with 42 volt system										
IMA/ISA/BSG (includes engine downsize)										
2-Mode hybrid electric vehicle										
Power-split hybrid electric vehicle (P-S HEV)										
Full-Series hydraulic hybrid										
Plug-in hybrid electric vehicle (PHEV)										
Full electric vehicle (EV)										
Improved high efficiency alternator & electrification of accessories (12 volt)										
Electric power steering (12 or 42 volt)										
Improved high efficiency alternator & electrification of accessories (42 volt)										
Aero drag reduction (20% on cars, 10% on trucks)										
Low rolling resistance tires (10%)										
Low drag brakes (ladder frame only)										
Secondary axle disconnect (unibody only)										
Front axle disconnect (ladder frame only)										
Weight reduction (1%) – above 5,000 lbs only										
Weight reduction (2%) – incremental to 1%										
Weight reduction (3%) – incremental to 2%										

Table 5: Energy Loss Mechanism Estimates

Technologies	Reduction (%) of Energy Losses, by Loss Mechanism								
	System Irreversibility	Heat Lost to Exhaust and Coolant	Engine Friction	Pumping Losses	Accessory Losses	Transmission Losses	Aerodynamic Losses	Tire Rolling Losses	Work on Vehicle
Low friction lubricants – incremental to base engine									
Engine friction reduction – incremental to base engine									
Overhead Cam Branch									
VVT – intake cam phasing									
VVT – coupled cam phasing									
VVT – dual cam phasing									
Cylinder deactivation									
Discrete VVLT									
Continuous VVLT									
Overhead Valve Branch									
Cylinder deactivation									
VVT – coupled cam phasing									
Discrete VVLT									
Continuous VVLT (includes conversion to Overhead Cam)									
Camless valvetrain (electromagnetic)									
GDI – stoichiometric									
GDI – lean burn									
Gasoline HCCI dual-mode									
Turbocharging & Downsizing									
Diesel – Lean NOx trap									
Diesel – urea SCR									
Aggressive shift logic									
Early torque converter lockup									
5-speed automatic									
6-speed automatic									
6-speed AMT									
6-speed manual									
CVT									
Stop-Start with 42 volt system									
IMA/ISA/BSG (includes engine downsize)									
2-Mode hybrid electric vehicle									
Power-split hybrid electric vehicle (P-S HEV)									
Full-Series hydraulic hybrid									
Plug-in hybrid electric vehicle (PHEV)									
Full electric vehicle (EV)									
Improved high efficiency alternator & electrification of accessories (12 volt)									
Electric power steering (12 or 42 volt)									
Improved high efficiency alternator & electrification of accessories (42 volt)									
Aero drag reduction (20% on cars, 10% on trucks)									
Low rolling resistance tires (10%)									
Low drag brakes (ladder frame only)									
Secondary axle disconnect (unibody only)									
Front axle disconnect (ladder frame only)									
Weight reduction (1%) – above 5,000 lbs only									
Weight reduction (2%) – incremental to 1%									
Weight reduction (3%) – incremental to 2%									

Table 6: Technology Synergy Estimates

Synergies		Synergy values by Vehicle Class Vehicle classes must be in the same order and the same names as the preceding worksheets. Positive values are [positive] synergies, negative values are dissynergies. Blank cells are assumed to be zero. The units for all numbers are assumed to be percents (%)									
Technology A	Technology B	SUV-Small	SUV-Mid	SUV-Large	Minivan	Pickup-Small	Pickup-Large	Sub com-pact	Com-pact	Midsize	Large
VVTI	5SP	-0.50	-0.50	-0.50	-0.50	-0.50	-0.50	-0.50	-0.50	-0.50	-0.50

Appendix B. Technology Decision Trees

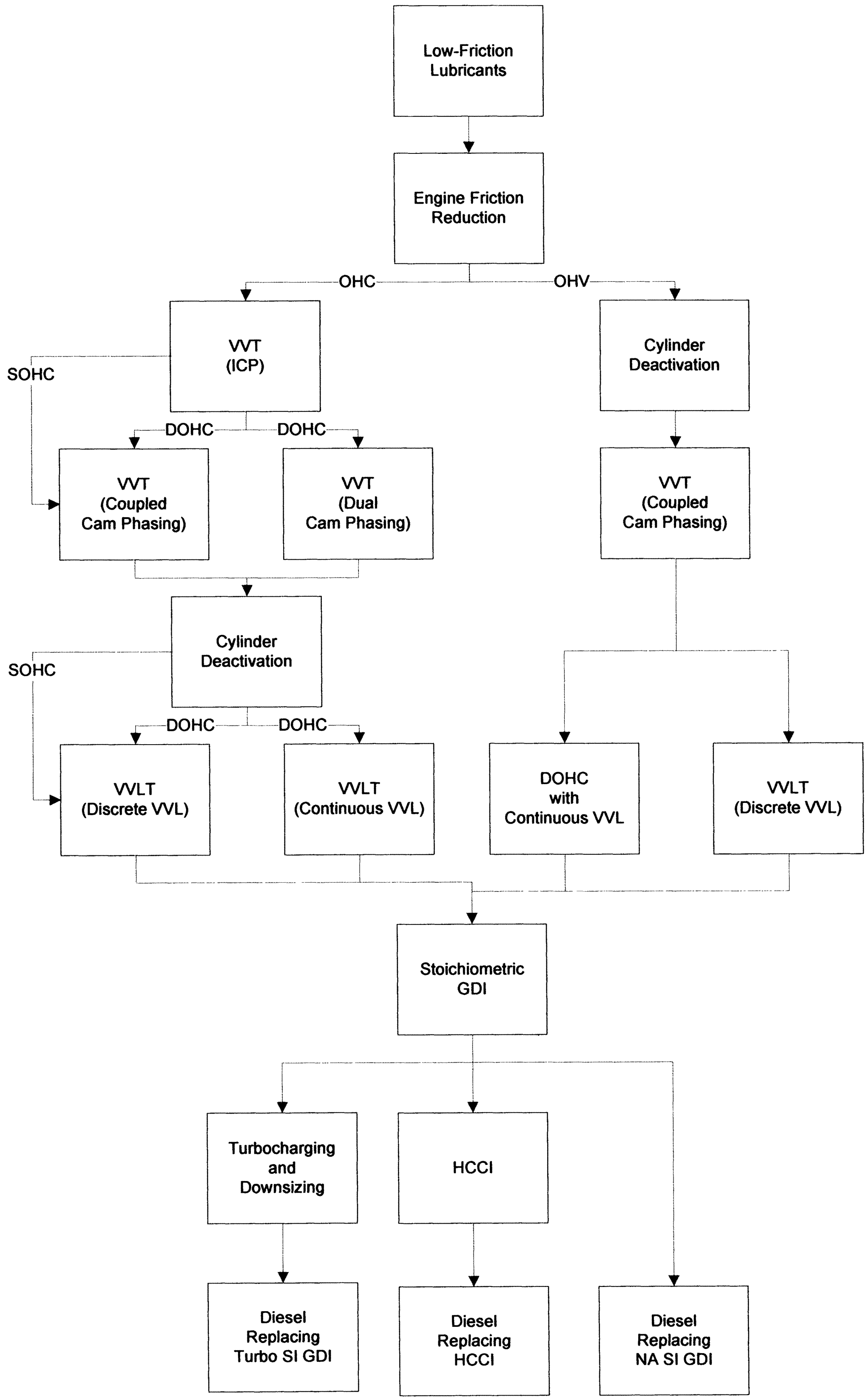

Figure 1. Engine Technology Decision Trees

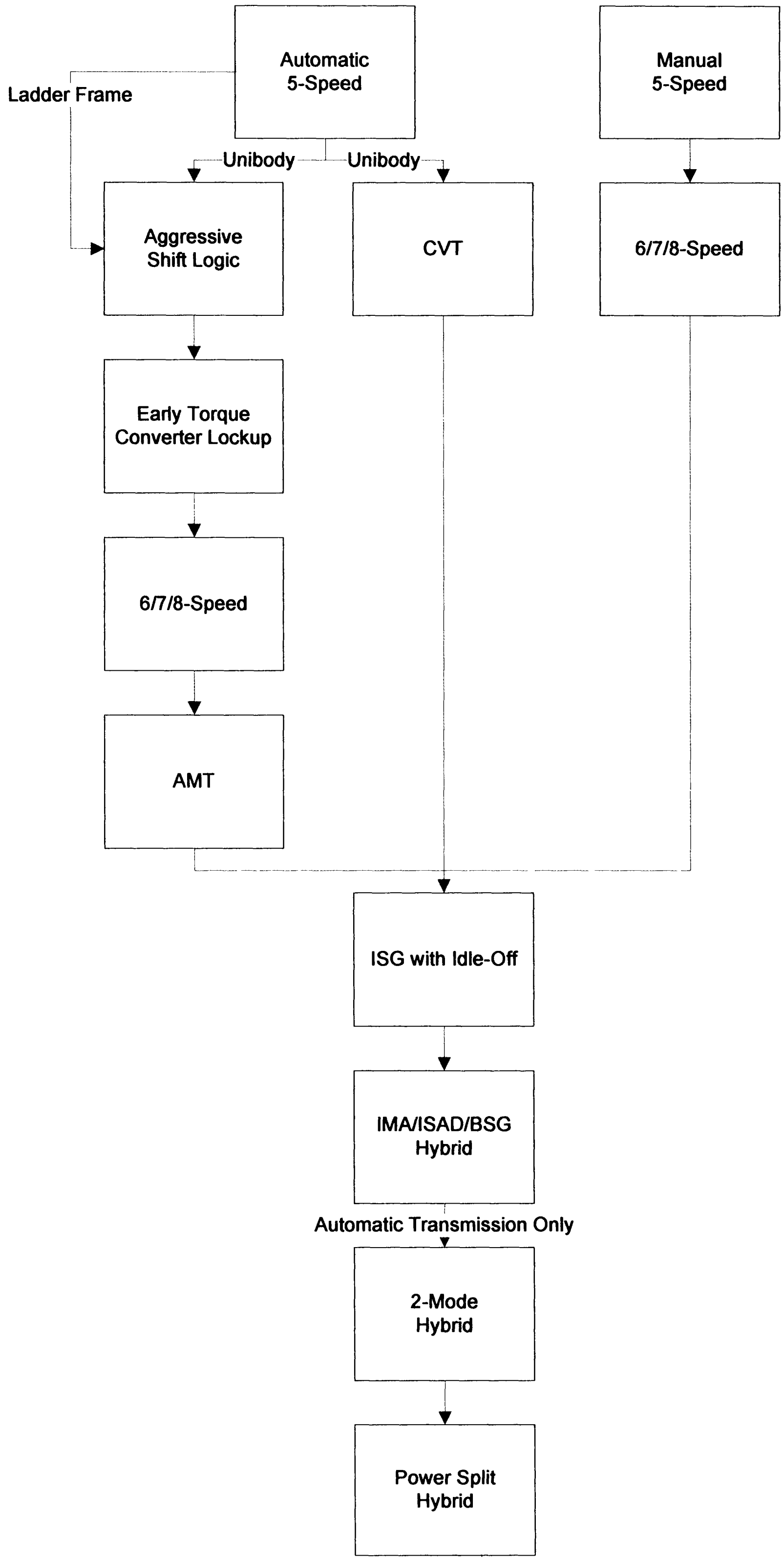

Figure 2. Transmission Technology Decision Trees

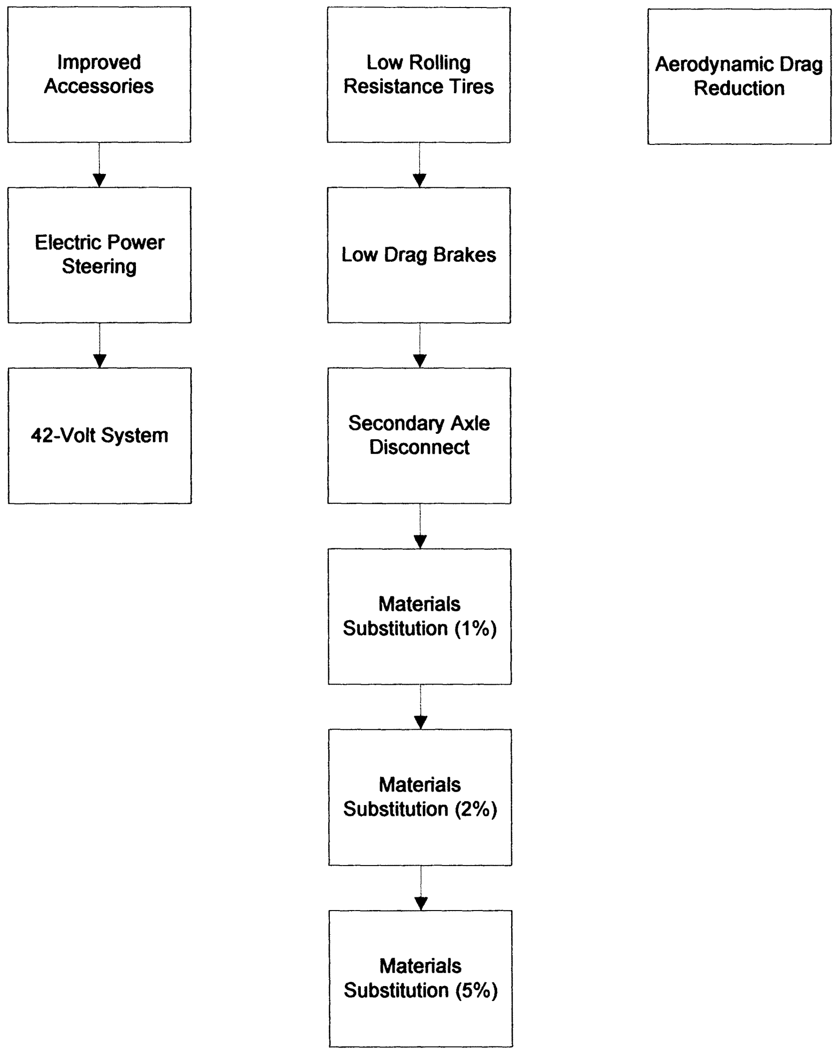

Figure 3. Decision Trees for Other Technologies

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