Note: The pre-publication version of the notice of proposed rulemaking is the reference for the page numbers in this summary. If the link provided is no longer active, please contact MEMA staff for a PDF copy. This summary is not meant to be comprehensive, and input and corrections are most welcome.

<https://www.nhtsa.gov/sites/nhtsa.gov/files/2023-07/CAFE-2027-2032-HDPUV-2030-2035-NPRM-web-version.pdf>

Quick take: this proposal is aware of, but not rigidly aligned with, the EPA LD/MD emissions proposed rule from earlier this year. NHTSA notes its authority and mission are slightly different than EPA and they cannot consider BEV efficiency standards, only ICE. The EPA proposal was also in active development so the two proposals were moving targets, and further coordination is necessary and intended. Unlike EPA, NHTSA does not have a strict BEV mandate from the President, so they do not have the same approach or scope in the CAFE rule. In this proposal, NHTSA focuses on tailpipe emissions almost entirely but does count BEV use and purchasing into its analyses, in part because a BEV purchase logically offsets an ICE vehicle purchase. Electricity generation emissions for BEV charging *are* included in the NHTSA pollution analyses, in notable contrast to the EPA NPRM which considers BEV as purely zero-emissions to own/operate. NHTSA make several assumptions and run many what-if analyses regarding consumer purchasing habits, since a 60MPG ICE could be costly and push a consumer to opt for BEV. Regarding cost, NHTSA explore several options available to MFRs with respect to conformance, running the gamut from massive production of BEV to gain credits for unimproved or partially improved ICE models, buying/trading credits from other MFRs, or simply paying the civil penalty and passing the costs along. Whether manufacturers will invest in improving ICE designs to continue their full compliance, or to some lesser extent, is unclear (to all of us). NHTSA explores these options. NHTSA explores multiple alternatives, all of which raise performance by a fixed percentage year by year. For Light Trucks, NHTSA perceives greater efficiency gains as possible sooner, due to less efficiency investments in the recent past. Therefore, NHTSA proposes higher year-by-year efficiency improvement requirements.

The regulations will apply to MYs 2027-2032 light-duty cars and trucks and to MYs 2030-2035 heavy-duty pickup trucks and vans (HDPUV).

From NHTSA’s website:

“As one of the range of options on which the agency is taking public comment, the preferred alternative in NHTSA’s proposal includes a 2% per year improvement in fuel efficiency for passenger cars, and a 4% per year improvement for light trucks, beginning in model year 2027 and ramping up through model year 2032, potentially reaching an average fleet fuel economy of 58 miles per gallon by 2032.

It also includes a 10% improvement per year for commercial pickup trucks and work vans (with gross vehicle weight ratings of more than 8,500 pounds and less than 14,001 pounds) beginning in model year 2030 and ramping up through model year 2035.”

As of this original draft, the draft impact analyses and technical support documents for the rule are unavailable, as the docket is not officially open (i.e. pre-publication conditions). Once the docket is open, supporting materials will become available, and we will begin digging into them to go deeper into the data and assumptions.

Highlights:

* PG1: “NHTSA currently projects that the proposed standards would require an industry fleet-wide average for passenger cars and light trucks of roughly 58 miles per gallon (mpg) in MY 2032 and an industry fleet-wide average for HDPUVs of roughly 2.6 gallons per 100 miles in MY 2038.”
* PG12: “This proposal responds to NHTSA’s statutory obligation to set CAFE and HDPUV standards at the maximum feasible level that the agency determines vehicle manufacturers can achieve in each MY, in order to improve energy conservation.”
* PG18: “The proposed CAFE standards remain vehicle-footprint-based, like the current CAFE standards in effect since MY 2011, and the proposed HDPUV standards remain work-factor-based, like the HDPUV standards established in the 2011 “Phase 1” rulemaking and continued to be used in 2016 “Phase 2” rulemaking.”
* PG30: “NHTSA coordinated with EPA in developing our proposal to avoid inconsistencies and produce requirements that are consistent with NHTSA’s statutory authority.”
* PG30: “First, NHTSA’s proposal, consistent with its statutory authority and mandate under EPCA/EISA, focuses on improving vehicle fuel economy and not directly on reducing vehicle emissions – though reduced emissions are a follow-on effect of improved fuel economy.”
* PG30: “Second, the biggest difference between the two proposals is due to EPCA/EISA’s statutory prohibition against NHTSA considering the fuel economy of dedicated alternative fueled vehicles, including BEVs, and including the full fuel economy of dual-fueled alternative fueled vehicles in determining the maximum feasible fuel economy level that manufacturers can achieve for passenger cars and light trucks, even though manufacturers may use BEVs and dual-fueled alternative fuel vehicles (AFV) to comply with CAFE standards.”
* PG30: “This constraint means that not only are NHTSA’s stringency rates of increase different from EPA’s but also the shapes of our standards are different based upon the different scopes.”
* PG31: “Recognizing that the agencies are implementing statutory mandates to set maximum feasible fuel economy standards and to address dangerous air pollution, and that both standards affect the same fleet of vehicles, we seek comment on how best to optimize the effectiveness of NHTSA’s standards consistent with the statutory factors.”
* PG33: “Specifically, for passenger cars and light trucks, NHTSA is required to consider four statutory factors – 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.”
* PG33: “For HDPUVs, NHTSA is required to consider three statutory factors – whether standards are appropriate, cost-effective, and technologically reasonable – to determine whether the standards it adopts are maximum feasible.”
* PG507: ‘In 2035, emissions of NOX, PM2.5, and SO2 increase under the CAFE and HDPUV FE alternative combinations compared to the No-Action Alternatives, while emissions of CO and VOCs decrease.”
* PG532: ‘Alternative PC2LT4 would require strong hybrids to increase by 8 percentage points by MY 2032, would decrease advanced engines by a similar amount, and would increase advanced MR by 19 percentage points.”
* PG534: “Alternative PC2LT4 would require strong hybrids to increase by 18 percentage points by MY 2032, would increase PHEVs580 by 13 percentage points, would decrease advanced engines by 25 percentage points, and would increase advanced MR by 38 percentage points.”
* PG564: “That said, NHTSA acknowledges the statute-driven cognitive dissonance, and NHTSA’s task in approaching the determination of maximum feasible standards is the same as ever, to evaluate potential future CAFE stringencies in light of statutory constraints.”
* PG603: “Starting in MY 2023, the penalty, as adjusted for inflation by law, is $16 for each tenth of a mpg that a manufacturer’s average fuel economy falls short of the standard multiplied by the total volume of those vehicles in the affected fleet (i.e., import passenger vehicles, domestic passenger vehicles, or light trucks), manufactured for that MY.”
* PG613: “NHTSA is proposing to remove AC and OC FCIVs (Fuel Consumption Improvement Value) for BEVs, which manufacturers can use to comply with CAFE standards, because the FCIVs represent energy savings for vehicles with ICEs.”
* PG616: “NHTSA is proposing to eliminate both the 5-cycle pathway and the alternative pathway for off-cycle FCIVs for LDVs starting in MY 2027. NHTSA is proposing this change because we do not believe that the benefit to manufacturers is significant enough to justify that the programs require a significant amount of time and resources to be committed to reviewing and approving requests.”
* PG618: “NHTSA is also requesting comment on eliminating OC FCIVs for BEVs if NHTSA does not eliminate OC FCIVs for all HDPUVs.”

Standout and “seeks comment” items:

* PG 12: “This proposal responds to NHTSA’s statutory obligation to set CAFE and HDPUV standards at the maximum feasible level that the agency determines vehicle manufacturers can achieve in each MY, in order to improve energy conservation.”
* PG14: “Specifically, NHTSA considered four regulatory alternatives for passenger cars and light trucks, as well as the No-Action Alternative. Each alternative is labeled for the type of vehicle and the rate of increase in fuel economy stringency, for example, PC1LT3 represents a 1 percent increase in Passenger Car standards and a 3 percent increase in Light Truck standards. We include three regulatory alternatives for HDPUVs, each representing different possible rates of year-over-year increase in the stringency of new fuel economy and fuel efficiency standards, as well as the No-Action Alternative.”





* PG16: “NHTSA is proposing standards that rise at a more rapid rate for light trucks than for passenger cars. As explained in more detail below, the agency believes that there is more room to improve the fuel economy of light trucks, in a cost-effective way, and that the benefits of requiring more improvement from light trucks will be significant given their high usage and the fact that they make up an ever-larger percentage of the overall fleet.”
* PG17: “NHTSA requests comment on the full range of standards encompassed between the No Action Alternative and Alternative PC6LT8 for MYs 2027-2032 Passenger Cars, as well as comments on the range of standards encompassed for light trucks, and on the full range of standards encompassed between the No-Action Alternative and Alternative HDPUV14 for MYs 2030-2035 HDPUVs.”
* PG17-18: “NHTSA expressly asks for comment on combinations of standards that may not be explicitly identified in this proposal, including standards between the No-Action Alternative and PC1/LT3, as well as between PC3/LT5 and PC6/LT8. NHTSA also notes that passenger car and light truck stringency may move independently of one another, and that rates of increase may vary by model year.”
* PG18: “The footprint of a vehicle is the area calculated by multiplying the wheelbase times the track width, essentially the rectangular area of a vehicle measured from tire to tire where the tires hit the ground. The work factor (WF) of a vehicle is a unit established to measure payload, towing capability, and whether or not a vehicle has four-wheel drive.”
* PG18: “NHTSA underscores that the equations and coefficients defining the curves are the CAFE and HDPUV standards, and not the mpg and gallon/100-mile estimates that the agency currently estimates could result from manufacturers complying with the proposed curves.”
* PG21-22: “NHTSA is also proposing new minimum domestic passenger car CAFE standards (MDPCS) for MYs 2027-2032 as required by the Energy Policy and Conservation Act of 1975 (EPCA), as amended by the EISA, and applied to vehicles defined as manufactured in the United States.
* PG22: “NHTSA retains the 1.9 percent offset first used in the 2020 final rule, reflecting prior differences between passenger car footprints originally forecast by the agency and passenger car footprints as they occurred in the real world, such that the minimum domestic passenger car standard is as shown in the table below. NHTSA requests comment on this approach.”
* PG22-23: “NHTSA notes both that real-world fuel economy is generally 20-30 percent lower than the estimated required CAFE level stated above, and also that the actual CAFE standards are the footprint target curves for passenger cars and light trucks. This last note is important, because it means that the ultimate fleet-wide levels will vary depending on the mix of vehicles that industry produces for sale in those MYs.”



* PG24: “Manufacturers with more traditional fleets do not over-comply at such high levels in our analysis, and our analysis considers the compliance paths for both manufacturer groups.”
* PG24: “The agency’s overall assessment is that the light truck standards are maximum feasible even though they may be challenging for some individual companies to achieve.”
* PG24: “For HDPUVs, NHTSA currently projects that the standards would require, on an average industry fleet-wide basis for the HDPUV fleet, roughly 2.638 gallons per 100 miles17 in MY 2035.”
* PG25: “Thus, since May 2022, NHTSA has updated technologies considered in our analysis (removing technologies which are already universal or nearly so and technologies which are exiting the fleet, adding certain advanced engine technologies); updated macroeconomic input assumptions, as with each round of rulemaking analysis; improved user control of various input parameters; updated our approach to modeling manufacturers’ expected compliance with states’ Zero Emission Vehicle (ZEV) programs; accounted for potential changes to DOE’s Petroleum Equivalency Factor (PEF), which is proposed to be changed, for the baseline assumptions; expanded accounting for Federal incentives such as Inflation Reduction Act programs; expanded procedures for estimating new vehicle sales and fleet shares; updated inputs for projecting aggregate light-duty Vehicle Miles Traveled (VMT); and added various output values and options.”
* PG25-26: “NHTSA tentatively concludes, as we explain in more detail below, that Alternative PC2LT4 is the maximum feasible alternative that manufacturers can achieve for MYs 2027-2034 passenger cars and light trucks, based on a variety of reasons.”
* PG26: “Moreover, although the vehicle fleet is undergoing a significant transformation now and in the coming years, for reasons other than the CAFE standards, NHTSA believes that a significant percentage of the on-road (and new) vehicle fleet may remain propelled by internal combustion engines (ICEs) through 2032. NHTSA believes that the alternative we are proposing will encourage manufacturers producing those ICE vehicles during the standard-setting time frame to achieve significant fuel economy, improve energy security, and reduce harmful pollution by a large amount.”
* PG26: “Alternative PC2LT4 comes at a cost we believe the market can bear without creating consumer acceptance or sales issues, appears to be much more achievable, and will still result in consumer net benefits on average.”
* PG27: “For HDPUVs, NHTSA tentatively concludes, as explained in more detail below, that Alternative HDPUV10 is the maximum feasible alternative that manufacturers can achieve for MYs 2030-2035 HDPUVs.”
* PG28: “In addition, the power sector emissions modeling reflected in this analysis does not incorporate the most up-to-date data on the future evolution of the power sector, and the emission projections are higher than analyses using more recent data indicate is likely to be the case.”
* PG30-31: “Additionally, NHTSA has considered and accounted for manufacturers’ expected compliance with California’s Advanced Clean Cars (ACC) and Advanced Clean Trucks (ACT) regulations in our analysis, as part of the analytical baseline. We find that manufacturers will comply with ZEV requirements in California and a number of other states in the absence of CAFE standards, and accounting for that expected compliance allows us to present a more realistic picture of the state of fuel economy even in the absence of changes to the CAFE standards.”
* PG39: “It is also worth emphasizing that, although NHTSA is prohibited from considering the availability of certain flexibilities in making our determination about the levels of CAFE standards that would be maximum feasible, manufacturers have a variety of flexibilities available to aid their compliance. Section VI of this preamble summarizes these flexibilities. NHTSA is proposing changes to some of these flexibilities as shown in Table I-14 and Table I-15.”
* PG40: “Proposed changes to 49 CFR 531.6 and 533.6 to eliminate AC efficiency FCIVs for BEVs starting in MY 2027.”
* PG40: “Proposing changes to 49 CFR 531.6 and 533.6 to eliminate off-cycle menu FCIVs for BEVs and to eliminate the 5- cycle and alternative approvals starting in MY 2027. PHEVs retain benefits. Proposing a 60-day response deadline for requests for information regarding off cycle requests for MY 2025-2026.”
* PG40: “Proposed technical amendments to accurately reflect changes contemplated by 2016 final rule establishing requirements for Phase 2. The multiplier for advanced technology credits ends after MY 2027.”
* PG40: “Proposed changes to eliminate innovative and off-cycle technology credits for heavy-duty pickup trucks and vans.”
* PG.40: “Proposed technical amendment to reflect, as intended in the 2016 Phase 2 rule that advanced technology credits may not be transferred across averaging sets for Phase 2 and beyond.”
* PG43: “The basic design of the CAFE Model is as follows: The system first estimates how vehicle manufacturers might respond to a given regulatory scenario, and from that potential compliance solution, the system estimates what impact that response will have on fuel consumption, emissions, safety impacts, and economic externalities.”
* PG47: “To prepare for analysis supporting this proposal, DOT has refined and expanded the CAFE Model through ongoing development. Examples of such changes, some informed by past external comment, made since 2022 include59:
	+ Addition of HDPUV, and associated required updates across entire model
	+ Updated technologies considered in the analysis
		- Addition of HCRE, HCRD and updated diesel technology models
		- Removal of EFR, DSLIAD, manual transmissions, AT6L2, EPS, IACC, LDB, SAX, and some P2 combinations61
	+ User control of additional input parameters
	+ Updated modeling approach to manufacturers’ expected compliance with states’ ZEV programs
	+ Expanded accounting for Federal incentives, such as the IRA
	+ Expanded procedures for estimating new vehicle sales and fleet shares
	+ VMT coefficient updates”
* PG48: “As explained, NHTSA’s analysis reflects a number of statutory and regulatory requirements applicable to CAFE/HDPUV and EPA GHG standard-setting. As stated previously, NHTSA will coordinate with EPA to optimize the effectiveness of NHTSA’s standards while minimizing compliance costs, informed by public comments from all stakeholders and consistent with the statutory factors. NHTSA seeks input to help inform these objectives.”
* PG51: “The CAFE Model does not allow civil penalty payment as an option for EPA’s GHG standards or NHTSA’s HDPUV standards.”
* PG 52: “The CAFE Model does account for dedicated and dual-fueled AFVs when simulating manufacturers’ potential responses to EPA’s GHG standards because the Clean Air Act (CAA), under which the EPA derives its authority to set GHG standards for motor vehicles, contains no restrictions in using AFVs for compliance.”
* PG53: “The CAFE Model can simulate manufacturers’ compliance with state level ZEV mandates applicable in California and “Section 177” states.”
* PG57: “NHTSA has also updated estimates of manufacturers’ compliance credit “holdings,” updated fuel price projections to reflect the U.S. EIA’s 2022 Annual Energy Outlook (AEO), updated projections of GDP and related macroeconomic measures, and updated projections of future highway travel.”
* PG57: “Even still, the estimates NHTSA is now using are not able to fully quantify and monetize a number of important categories of climate damages; because of those omitted damages and other methodological limits, DOT believes its values for SC-GHG are conservative underestimates.”
* PG59: “Using the functions, each manufacturer thus will have a CAFE average standard for each year that is almost certainly unique to each of its fleets, based on the footprint and production volumes of the vehicle models produced by that manufacturer.”
* PG59: “Although a manufacturer’s fleet average standard could be estimated throughout the MY based on the projected production volume of its vehicle fleet (and are estimated as part of EPA’s certification process), the standards with which the manufacturer must comply are determined by its final model year (FMY) production figures.”







* PG63: “Again, while NHTSA is not required by statute to set HDPUV standards that are attribute-based and that are described by a mathematical function, NHTSA continues to believe that doing so is reasonable and appropriate for this segment of vehicles, consistent with prior HDPUV standard-setting rulemakings.”
* PG64: “NHTSA proposes to continue using the work-based attribute and gradually increasing stringency (which for HDPUVs means that standards appear to decline, as compared to passenger car and light truck standards where increasing stringency means that standards appear to increase.”
* PG67: “This chapter also discusses the policy and approach in selecting the specific mathematical functions. NHTSA refers readers to the Draft TSD for a full discussion of these topics and seeks comment on that discussion.”
* PG67: “When we say, “compliance simulation” throughout this rule, we mean the CAFE Model’s simulation of how vehicle manufacturers could comply with different levels of CAFE standards by adding fuel-economy-improving technology to an existing fleet of vehicles.”
* PG70: “When we say, “engineering judgment” throughout this rule, we are referring to decisions made by a team of engineers and analysts. This judgment is based on their experience working in the automotive industry and other relevant fields, and assessment of all the data sources described above. Most importantly, we use engineering judgment to assess how best to represent vehicle manufacturer’s potential responses to different levels of CAFE standards within the boundaries of our modeling tools, as “a model is meant to simplify reality in order to make it tractable.””
* PG71: “We begin the compliance analysis by defining the range of fuel economy improving technologies that the CAFE Model could add to a manufacturer’s vehicles in the United States market.”
* PG71: “Note that while EPCA/EISA constrains our ability to consider the possibility that manufacturers would comply with CAFE standards by implementing some electrification technologies when making decisions about the level of CAFE standards that is maximum feasible, there are several reasons why we must accurately model the range of available electrification technologies.”
* PG72: “However, selecting representative technology definitions for our analysis will ensure that, on balance, we capture a reasonable level of costs and benefits that would result from any manufacturer applying the technology.”
* PG73: “Our technology options also reflect an increase in diversity for hybridization and electrification options, though we utilize these options in a manner that is consistent with statutory constraints. In addition to better representing the current fleet, this reflects consistent feedback from vehicle manufacturers who have told us that they will reduce investment in ICEs while increasing investment in hybrid and plug-in BEV options.”
* PG74: “As with past analyses, we did not include technologies unlikely to be feasible in the rulemaking timeframe, engines technologies designed for markets other than the United States market that are required to use unique gasoline,88 or technologies where there were not appropriate data available for the range of vehicles that we model in the analysis (i.e. technologies that are still in the research and development phase but are not ready for mass market production).”
* PG74: “The HDPUV options also reflect more electrification and hybridization options in that real world fleet. However, the HDPUV technology options are also less diverse than the LD technology options, for several reasons.”
* PG75: “Note, however, that for both the LD and HDPUV analyses, the CAFE Model does not dictate or predict the technologies manufacturers must use to comply; rather, the CAFE Model outlines a technology pathway that manufacturers could use to meet the standards cost-effectively.”
* PG76: “Table II-1 and Table II-2 below list most of the technologies that we used for the LD and HDPUV analyses. Each technology has a name that loosely corresponds to its real-world technology equivalent. We abbreviate the name to a short easy signifier for the CAFE Model to read.”
* PG79: “We then organize the groups into pathways. The pathways instruct the CAFE Model how and in what order to apply technology. In other words, the pathways define technologies that are mutually exclusive (i.e., that cannot be applied at the same time), and define the direction in which vehicles can advance as the model evaluates which technologies to apply. Figure II-6 shows the LD and HDPUV technology pathways used in this analysis. In general, the paths are tied to ease of implementation of additional technology and how closely related the technologies are.”
* PG81: “Grouping technologies on pathways also tells the model how to evaluate technologies; continuing this example, a vehicle can only have one engine, so if a vehicle has one of the Turbo engines the model will evaluate which more advanced Turbo technology to apply.”
* PG81: “Then, the arrows between technologies instruct the model on the order in which to evaluate technologies on a pathway. This ensures that a vehicle that uses a more fuel-efficient technology cannot downgrade to a less efficient option or that a vehicle would switch to technology that was significantly technically different.”
* PG82: “We also consider two categories of technology that we could not simulate as part of the CAFE Model’s technology pathways. “Off-cycle” and air conditioning (AC) efficiency technologies improve vehicle fuel economy, but the benefit of those technologies cannot be captured using the fuel economy test methods that we must use under EPCA/EISA.”
* PG82: “Instead of including off-cycle and AC efficiency technologies in the technology pathways, we include the improvement as a defined benefit that gets applied to a manufacturer’s entire fleet instead of to individual vehicles. The defined benefit that each manufacturer receives in the analysis for using off-cycle and AC efficiency technology on their vehicles is located in the Market Data Input file.”
* PG83: “The Market Data Input file’s “Vehicles” tab (or worksheet) houses one of the most significant compilations of technology inputs and assumptions in the analysis, which is a characterization of a baseline fleet of vehicles to which the CAFE Model adds fuel-economy-improving technology. We call this fleet the “baseline fleet” or the “analysis fleet.” The baseline fleet includes a number of inputs necessary for the model to add fuel economy improving technology to each vehicle for the compliance analysis and to calculate the resulting impacts for the effects analysis.”
* PG85: “While it would certainly be easier to aggregate vehicles by model, ensuring that we capture model variants with different fuel economy values improves the accuracy of our analysis and the potential that our estimated costs and benefits from different levels of standards are appropriate.”
* PG86: “In addition, we include columns indicating if a vehicle is a “ZEV Candidate,” which means that the vehicle could be made into a zero emissions vehicle (ZEV) at its first redesign opportunity in order to simulate a manufacturer’s compliance with California’s ACC, ACC II, or ACT program, which is discussed further below.”
* PG86: “We also set product design cycles, which are the years when the CAFE Model can apply different technologies to vehicles. Manufacturers often introduce fuel saving technologies at a “redesign” of their product or adopt technologies at “refreshes” in between product redesigns.”
* PG87-88: “The CAFE Model includes procedures to consider the direct labor impacts of manufacturers’ response to CAFE regulations, considering the assembly location of vehicles, engines, and transmissions, the percent U.S. content (that reflects percent U.S. and Canada content), and the dealership employment associated with new vehicle sales.”
* PG90: “For this analysis, we assume that all manufacturers are willing to pay fines in MYs 2022-2026, and that in MY 2027 and beyond, only the manufacturers that have historically paid fines would continue to pay fines. We seek comment on these fine payment preference assumptions.”
* PG90: “The payback period represents an assumption that consumers are willing to buy vehicles with more fuel economy technology because the fuel economy technology will save them money on gas in the long run. For the past several CAFE Model analyses we have assumed that in the absence of CAFE or other regulatory standards, manufacturers would apply technology that “pays for itself” – by saving the consumer money on fuel – in 2.5 years.”
* PG91: “We also designate in the Market Data Input file the percentage of each manufacturer’s sales that must meet CAA Section 177 requirements in certain states.”
* PG91: “Finally, we include estimated CAFE compliance credit banks for each manufacturer in several years through 2021, which is the year before the compliance simulation begins. The CAFE Model does not explicitly simulate credit trading between and among vehicle manufacturers, but we estimate how manufacturers might use compliance credits in early MYs.”
* PG92: “We considered that using a baseline fleet year that has been impacted by these transitory shocks may not represent trends in future years; however, on balance, we believe that updating to using the most complete set of available fleet data provides the most accurate baseline for the CAFE Model to calculate compliance and effects of different levels of future fuel economy standards.”
* PG95: “We simulate a vehicle model’s behavior over the “two-cycle” tests that are used to measure vehicle fuel economy.”
* PG96: “Measuring every vehicle’s fuel economy values using the same test cycles (and in the real world, using sophisticated test and measurement equipment including dynamometers, carefully controlled environmental conditions, and precise procedures) ensures that the fuel economy certification results are repeatable for each vehicle model, and comparable among all of the different vehicle models.”
* PG98: “Measuring every vehicle’s fuel economy values using the same test cycles (and in the real world, using sophisticated test and measurement equipment including dynamometers, carefully controlled environmental conditions, and precise procedures) ensures that the fuel economy certification results are repeatable for each vehicle model, and comparable among all of the different vehicle models.”
* PG98: “Rather, ANL builds a discrete number of vehicle models that are representative of large portions of vehicles in the real world. We refer to the vehicle model’s type and performance level as the vehicle’s “technology class.” By assigning each vehicle in the Market Data Input file a “technology class,” we can connect it to the Autonomie effectiveness estimate that best represents how effective the technology would be on the vehicle, taking into account vehicle characteristics like type and performance metrics.”
* PG99: “We use a two-step process that involves two algorithms to give vehicles a “fit score” that determines which vehicles best fit into each technology class. At the first step we determine the vehicle’s size, and at the second step we determine the vehicle’s performance level.”
* PG100: “Again, depending on the technology, when two technologies are added to the vehicle together, they may not result in an additive fuel economy improvement. This is an important concept to understand because in Section II.D, below, we present technology effectiveness estimates for every single combination of technology that could be applied to a vehicle.”
* PG101: “This is because there are complex interactions between all fuel economy improving technologies. We model these individual technologies and groups of technologies to reduce the uncertainty and improve the accuracy of the CAFE Model outputs.”
* PG104: “Engine modeling is used to generate engine fuel map models that define the fuel consumption rate for an engine equipped with specific technologies when operating over a variety of engine load and engine speed conditions. Some performance metrics we capture in engine modeling include power, torque, airflow, volumetric efficiency, fuel consumption, turbocharger performance and matching, pumping losses, and more.”
* PG105: “The engine map models are developed by creating a base, or root, engine map and then modifying that root map, incrementally, to isolate the effects of the added technologies. The LD engine maps, developed by IAV using their GT-Power modeling tool and the HDPUV engine maps, developed by SwRI using their GT-Power modeling tool, are based on real-world engine designs. One important feature of both the LD and HDPUV engine maps is that they were both developed using a knock model.”
* PG106: “ANL then assigns “reference” technologies to each vehicle model. The reference technologies are the technologies on the first step of each CAFE Model technology pathway, and they closely (but do not exactly) correlate to the technology abbreviations that we use in the CAFE Model.”
* PG107: “The four performance metrics that we use in the Autonomie modeling for light duty vehicles are low-speed acceleration (the time required to accelerate from 0-60 mph), high-speed passing acceleration (the time required to accelerate from 50-80 mph), gradeability (the ability of the vehicle to maintain constant 65 mph speed on a six percent upgrade), and towing capacity for light duty pickup trucks.”
* PG108: “For HDPUVs, Autonomie examines sustainable maximum speed at 6 percent grade, start/launch capability on grade, and maximum sustainable grade at highway cruising speed, before examining towing capability to look for the maximum possible vehicle weight over 40 mph in gradeability.”
* PG109: “Every time a vehicle model in Autonomie adopts a new technology, the vehicle weight is updated to reflect the weight of the new technology.”
* PG110: “In the Autonomie modeling, when a new vehicle adopts fuel saving technologies that are inherited, the engine is not resized (i.e., the properties from the reference vehicle are used directly). While this may result in a small change in vehicle performance, manufacturers have repeatedly and consistently told us that the high costs for redesign and the increased manufacturing complexity that would result from resizing engines for small technology changes preclude them from doing so.”
* PG111: “We have determined that our rules about performance neutrality and technology inheritance result in a fleet that is essentially performance neutral.”
* PG113: “We condense the million or so datapoints from Autonomie into three datasets used in the CAFE Model. These three datasets include (1) the fuel economy value (converted into “fuel consumption”, which is the inverse of fuel economy; fuel economy is mpg and fuel consumption is gallons per mile) that each modeled vehicle achieved while driving the test cycles, for every technology combination in every technology class; (2) the fuel economy value for PHEVs driving those test cycles, when those vehicles drive on gasoline-only in order to comply with statutory constraints; and (3) optimized battery costs for each vehicle that adopts some sort of electrified powertrain (this is discussed in more detail below).”
* PG115: “In sum, we use Autonomie to generate physics-based full vehicle modeling and simulation technology effectiveness estimates.”
* PG116: “We estimate present and future costs for fuel-saving technologies based on a vehicle’s technology class and engine size.”
* PG118: “For emerging technologies, we use the best information available at the time of the analysis and will continue to update cost assumptions for any future analysis.”
* PG118: “To estimate total consumer costs (i.e., both direct and indirect costs), we multiply a technology’s DMCs by an indirect cost factor to represent the average price for fuel-saving technologies at retail. The factor that we use is the RPE, and it is the most commonly used to estimate indirect costs of producing a motor vehicle.”
* PG119: “The RPE averages 1.5 across the lifetime of technologies of all ages, with a lower average in earlier years of a technology’s life, and, because of LEs on direct costs, a higher average in later years.”
* PG123: “In general, we consider most base and basic engine and transmission technologies to be mature technologies that will not experience any additional improvements in design or manufacturing.”
* PG124: “We expect the cost to decrease as production volumes increase, manufacturing processes are improved, and economies of scale are achieved. We also assigned advanced engine technologies that are based on a singular preceding technology to the same learning curve as that preceding technology.”
* PG124: “Lastly, we estimate that the learning curves for road load technologies, with the exception of the most advanced MR level (which decreases at a fairly steep rate through MY 2040, as discussed further below and in Chapter 3.4 of the Draft TSD), will decrease through MY 2036 and then remain flat.”
* PG124: “We use the same cost learning rates for both LD and HDPUV technologies.”
* PG125: “Our battery pack learning curves recognize that there are many factors that could potentially lower battery pack costs over time outside of the cost reductions due to improvements in manufacturing processes due to knowledge gained through experience in production.”
* PG125: “For the purposes of today’s analysis, we incorporate two other government actions into our analysis: state ZEV requirements and federal tax credits.”
* PG127: “NHTSA models manufacturers’ compliance with these programs because accounting for technology improvements that manufacturers would make even in the absence of CAFE standards allows NHTSA to gain a more accurate understanding of the effects of the proposed rulemaking.”
* PG128: “At the time of our analysis, sixteen states in addition to California either formally signed on to the ACC II standards or were in the process of adopting them.153 Although a few states are adopting these requirements in future MYs, we include every state that officially committed to adopting the requirements by the start of December 2022 (regardless of MY start date),154 which was the time of analysis, as being part of the unified ACC II states group for ease of modeling.”
* PG129: “As other states are currently considering adopting ACT standards; we plan to update this number in the final rule analysis if those states formally adopt it.”
* PG129: “For the purposes of CAFE analysis, we include only those states that have formally adopted the ACT in our modeling as “ACT states”. States that have signed the MOU but not formally adopted the ACT program are referred to as “MOU states” and are not included in CAFE modeling.”
* PG130: “We focused on BEVs as ZEV conversions, rather than PHEVs or FCEVs, because, as for 2026-2035, manufacturers cannot earn more than 20% of their ZEV credits through PHEV sales.”
* PG130: “In addition, although FCEVs can earn the same number of credits as BEVs, we chose to focus on BEV technology pathways since FCEVs are generally less cost effective than BEVs and most manufacturers have not been producing them at high volumes.”
* PG130: “Credit targets in the ACT program (referred to as deficits) are calculated by multiplying sales by percentage requirement and weight class multiplier. Each HDPUV full ZEV in the 2b/3 class earns 0.8 credits and each NZEV (called PHEVs in the CAFE Model) earns 0.75 credits.”
* PG131: “We assumed that new registrations data best approximate new sales given the data options. For MY 2021 vehicles in the latest NVPP, the ACC II State group makes up approximately 38% of the total LD sales in the United States. The ACT state groups comprise approximately 19% of the new Class 2b and 3 vehicle market in the U.S.161 We based the volumes used for the ZEV credit target calculation on each manufacturer’s future assumed market share in ACC II and ACT states. We made this assumption after examining three past years of market share data and determining that the geographic distribution of manufacturers’ market shares remained fairly constant. We welcome comment on the assumptions described in this paragraph.”
* PG132: “We then multiply the resulting national sales volume predictions by manufacturer by each manufacturer’s total market share in the ACC II or ACT states to capture the appropriate volumes in the ZEV credits calculation. Required credits by manufacturer, per year, are determined within the CAFE Model by multiplying the ACC II state volumes by CARB’s ZEV credit percentage requirement for each program respectively.”
* PG133: “Although PHEVs are all ZEV candidates, we do not duplicate those rows as we focus the CAFE Model’s simulation of the ACC II and ACT programs on BEVs. However, any PHEVs already in the analysis fleet or made by the model will still receive the appropriate ZEV credits.”
* PG134: “When identifying ZEV candidates, we assign each candidate as either a BEV1 or a BEV2 based on their price, market segment, and other vehicle attributes.”
* PG134-135: “We did not assume compliance with ZEV requirements through banking of credits when simulating the program in the CAFE Model and focus instead on simulating manufacturer’s compliance fully through the production of new ZEVs.”
* PG135: “Based on guidance from CARB and assessment of CARB’s responses to manufacturer comments, we expect impacts of banked credit provisions on overall volumes to be small.”
* PG135: “NHTSA models two of the IRA provisions in this analysis. The first is the Advanced Manufacturing Production Tax Credit (AMPC).”
* PG135: “The second provision modeled is the Clean Vehicle Tax Credit (CVC), which provides up to $7,500 toward the purchase of clean vehicles with critical minerals and battery components manufactured in North America.”
* PG136: “The credits are currently in effect and are scheduled to sunset by 2032. Since the CAFE Model forecasts by model years, and MYs typically are released in the preceding CYs, NHTSA applies the credits to MYs 2024-2033 in the analysis for both LDVs and HDPUVs.”
* PG136: “The agency assumes that manufacturers’ shares of both credits will offset part of the cost to supply models that are eligible for the credits—PHEVs, BEVs, and FCVs. The subsidies reduce the costs of eligible vehicles and increase their attractiveness to buyers (however, in the LD fleet, the tax credits do not alter the penetration rate of BEVs in the regulatory alternatives).”
* PG137: “NHTSA recognizes that manufacturers may be unable to comply immediately with the CVC’s domestic component and critical mineral sourcing requirements, and that domestic production may ramp-up over the coming years. To reflect this ramp-up, the model phases-in the tax credit.”
* PG137: “Instead, we make the simplifying assumption for modeling purposes that all PHEVs, BEVs, and FCEVs produced sold during the time frame that tax credits are offered will be eligible for those credits subject to the MSRP restrictions discussed above.”
* PG138: “To account for these limitations, we assume that the average credit value for the CVC across all PHEV, BEV, and FCEV sales in a given year will never reach its full $7,500 value for all vehicles, and instead assume a maximum average credit value of $5,000.”
* PG138: “We seek comment on our methodology for modeling the CVC and AMPC. The agency has also included several sensitivity cases testing different passthrough amounts and maximum credit values. If commenters believe the agency should be modeling additional components of either of the tax credits, the agency requests commenters identify both potential data sources and methodologies.”
* PG139: “At the time NHTSA was developing its approach to modeling the IRA tax credits and coordinating with EPA, the Treasury Department had yet to release its guidance on the Commercial Credit and NHTSA was uncertain if vehicles leased to consumers would qualify for the credit or how the incremental value of commercial clean vehicles would be calculated.”
* PG139-140: “To the extent that our modeling of the CVC misses vehicles that may qualify for a higher credit through the Commercial Credit, our decision to not model the Commercial Credit may understate the impacts of the IRA.”
* PG140: “NHTSA is considering incorporating EPA’s revised approach for modeling the CVC and Commercial Credit jointly for the final rule to account for the guidance issued by the Treasury Department. Under this approach, NHTSA could retain the same basic mechanisms employed to model the CVC but would modify the phase-in and maximum average credit to account for the possibility that the Commercial Credit is available and offers a higher tax benefit than the CVC. NHTSA seeks comment on whether it should adopt this approach, and, if so, specifically requests commenters help identify what would be an appropriate maximum average credit, phase-in schedule, and elasticity share between producers and consumers for this approach.”
* PG140: “Finally, the Qualifying Advanced Energy Project credit (48C) provides manufacturers an amount equal to 30 percent of the qualified investment, including building or retooling plants for BEVs, PHEVs, or FCEVs.181 The agency excluded this tax credit for several reasons.”
* PG141: “For the sake of simplicity, we assume that manufacturers will chose the AMPC over the Qualified Advanced Energy Project credit. We also do not model other federal programs that incentivize the production or purchase of clean vehicles and their infrastructure, such as the IRA § 50142 Advanced Technology Vehicle Manufacturing Loan Program, IRA § 50143 Domestic Manufacturing Conversion Grants, IRA § 70002 USPS Clean Fleets, or IRA § 13404 Alternative Fuel Vehicle Refueling Property Credit.”
* PG142: “We seek comment on our decision to exclude these credits. Excluding these credits may overstate the projected cost to consumers of certain vehicles. If commenters feel that we should include any of these credits in the final rule, the agency requests commenters address the limitations noted above and provide data sources to assist with modeling the credit.”
* PG143: “The CAFE Model first determines whether any technology should be “inherited” from an engine, transmission, or platform that currently uses the technology to a vehicle that is due for a refresh or redesign…The model then again evaluates whether the manufacturer’s fleet complies with its CAFE standard. If it does not, the model begins the process of evaluating what from our universe of technologies could be applied to the manufacturer’s vehicles.”

Equation II-6: CAFÉ Model Effective Cost Calculation



* PG145: “The total fuel savings calculation is slightly more complicated. Broadly, when considering total fuel savings from switching from one technology to another, the CAFE Model must calculate the total fuel cost for the vehicle before application of a technology and subtract the total fuel cost for the vehicle after calculation of that technology.”
* PG145: “This equation also includes an assumption that consumers are likely to buy vehicles with fuel economy improving technology that pays for itself within 2.5 years, or 30 months.”
* PG146: “The CAFE Model accounts explicitly for each MY because manufacturers actually “carry forward” most technologies between MYs, tending to concentrate the application of new technology to vehicle redesigns or mid-cycle “freshenings,” and design cycles vary widely among manufacturers and specific products. Comments by manufacturers and model peer reviewers strongly support explicit year-by-year simulation.”
* PG148: “We consider engines together (for purposes of coding, discussed in Section II.C.2 above, and for SKIP application) if the engines share a common cylinder count and configuration, displacement, valvetrain, and fuel type, or if the engines only differed slightly in compression ratio (CR), horsepower, and displacement.”
* PG149: “The restrictions will be reflected in the usage of a SKIP of engine technology that the manufacturing line would not accommodate.”
* PG149: “SKIPs also relate to instances of stranded capital when manufacturers amortize research, development, and tooling expenses over many years, especially for engines and transmissions.”
* PG150: “We will monitor these trends to assess the role of stranded capital moving forward.”
* PG150: “Finally, we ensure that our analysis is performance neutral because the goal is to capture the costs and benefits of vehicle manufacturers adding fuel economy improving technology because of CAFE standards, and not to inappropriately capture costs and benefits for changing other vehicle attributes that may have a monetary value associated with them.”
* PG153: “These model logical structures and inputs act together to produce estimates of ways each manufacturer could potentially shift to new fuel-saving technologies over time, reflecting some measure of protection against rates of change not reflected in, for example, technology cost inputs. This does not mean that every modeled solution would necessarily be economically practicable. Using technology adoption features like phase-in caps and phase-in start years is one mechanism that can be used so that the analysis better represents the potential costs and benefits of technology application in the rulemaking timeframe.”
* PG154-155: “These guiding principles are as follows:
	+ Technologies will have complementary or non-complementary interactions with the full vehicle technology system.
	+ The effectiveness of a technology depends on the type of vehicle the technology is being applied to.
	+ The cost and effectiveness values for each technology should be reasonably representative of what can be achieved across the entire industry.
	+ The baseline for cost and effectiveness values must be identified before assuming that a cost or effectiveness value could be employed for any individual technology.”
* PG157: “For the LD analysis we show two sets of technology effectiveness charts for each technology type, titled “Unconstrained” and “Standard Setting.””
* PG157: “The standard setting values are used during the standard setting years being assessed in this analysis, and the unconstrained values are used for all other years.”
* PG158: “The paths are intended to be representative of the range of potential performance levels for each engine technology. In general, the paths are tied to ease of implementation of additional technology and how closely related the technologies are.”
* PG160: “For technologies on the HDPUV Engine Paths, we revisited work done for the HDPUV analysis in the Phase 2 rulemaking. We have updated our HDPUV Engine Paths based on that work, the availability of technology in the HDPUV baseline fleet, and technologies we believe will be available in the rulemaking timeframe.”
* PG161: “That said, we believe that the range of technologies between the HDPUV Engine Paths and Electrification/Hybrid/Electrics Path presents a reasonable representation of powertrain options available for HDPUVs now and in the rulemaking time frame.”
* PG161: “We begin defining engine technology options by defining potential engine configurations: dual over-head camshaft (DOHC) engines have two camshafts per cylinder head (one operating the intake valves and one operating the exhaust valves), single over-head camshaft (SOHC) engines have a single camshaft, and over-head valve (OHV) engines also have a single camshaft located inside of the engine (south of the valves rather than over-head) connected to a rocker arm that actuates the valves.”
* PG162: “For the LD analysis, VVL, SGDI, and DEAC can be applied to an engine individually or in combination with each other, and for the HDPUV analysis, SGDI and DEAC can be applied individually or in combination.”
* PG162: “The advanced engine technologies represent the application of alternate combustion cycles, various applications of forced induction technologies, or advances in cylinder deactivation.”
* PG164: “As discussed above, we pair turbocharging with engine downsizing, meaning that the turbocharged downsized engines in our analysis improve vehicle fuel economy by using less fuel to power the smaller engine while maintaining vehicle performance.”
* PG164: “The way that each individual manufacturer implements a modified Atkinson cycle will be unique, as each manufacturer must balance not only fuel efficiency considerations, but emissions, on-board diagnostics, and safety considerations that includes the vehicle being able to operate responsively to the driver’s demand.”
* PG165: “When we say, “lower power density issues,” this translates to a low torque density, meaning that the engine cannot create the torque required at necessary speeds to meet load demands.”
* PG166: “Instead, a manufacturer could significantly increase an engine’s displacement (i.e., size) to overcome those low power density issues, or could add an electric motor and battery pack to provide the engine with more power, but a far more effective pathway would be to apply a different type of engine technology, like a downsized, turbocharged engine.”
* PG166-167: “Any time more engine torque is required the application of this technology becomes less effective and more limited. For these reasons, to maintain a performance-neutral analysis, and as discussed further below, we limit non-hybrid and non-plug-in-hybrid HCR engine application to certain categories of vehicles.”
* PG167: “For this analysis, our HCR Engine Path includes three technology options: (1) a baseline Atkinson-enabled engine (HCR) with VVT and SGDI, (2) an Atkinson enabled engine with cooled exhaust gas recirculation (HCRE), and finally, (3) the Atkinson enabled engine with DEAC (HCRD).”
* PG168: “The Miller cycle is another alternative combustion cycle that uses an extended expansion stroke, similar to the Atkinson cycle, to improve fuel efficiency. Miller cycle-enabled engines have a similar trade-off in power density as Atkinson engines; the lower power density requires a larger volume engine in comparison to an Otto cycle-based turbocharged system for similar applications.”
* PG168: “In our analysis, the baseline Miller cycle-enabled engine includes the application of variable turbo geometry technology (VTG), or what is also known as a variable-geometry turbocharger.”
* PG168: “The second level of VTG Engine technology in our analysis (VTGE) is an advanced Miller cycle-enabled system that includes the application of at least a 40V-based electronic boost system.”
* PG169: “We included two levels of diesel engine technology in both the LD and HDPUV analyses: the baseline diesel engine technology (ADSL) is a turbocharged diesel engine, and the more advanced diesel engine (DSLI) adds DEAC to the ADSL engine technology. The diesel engine maps are new for this analysis. The LD diesel engine maps and HD van engine maps are based on a modern 3.0L turbo-diesel engine, and the HDPUV pickup truck engine maps are based on a larger 6.7L turbo-diesel engine”
* PG170: “As with the last analyses, CNG engines are included as a baseline-only technology and are not applied to any vehicle that did not already include a CNG engine”
* PG170: “Within each manufacturer’s fleet, we develop and assign unique engine codes based on configuration, technologies applied, displacement, CR, and power output. While the process for engine assignments is the same between the LD and HDPUV analyses, engine codes are not shared between the two fleets, and engine technologies are not shared between the fleets, for the reasons discussed above. We also assign engine technology classes, which are codes that identify engine architecture (e.g., how many cylinders the engine has, whether it is a DOHC or SOHC, and so on) to accurately account for engine costs in the analysis.”
* PG170: “When we consider how to best fit each of those 300 engines to our 40 engine technologies and engine map models, we use specific technical elements contained in manufacturer publications, press releases, vehicle benchmarking studies, technical publications, manufacturer’s specification sheets, and occasionally CBI (like the specific technologies, displacement, CR, and power mentioned above), and engineering judgment.”
* PG171: “Importantly, we never assign engine technologies based on one factor alone; we use data and engineering judgment to assign complex real-world engines to their corresponding engine technologies in the analysis. We believe that our initial characterization of the fleet’s engine technologies reasonably captures the current state of the market while maintaining a reasonable amount of analytical complexity.”
* PG172: “Besides technology path logic, which applies to all manufacturers and technologies, we place additional constraints on the adoption of VCR and HCR technologies.”
* PG172: “Because of these issues, we limited adoption of the VCR engine technology to original equipment manufacturers (OEMs) that have already employed the technology and their partners. We do not believe any other manufacturers will invest to develop and market this technology in their fleet in the rulemaking time frame.”
* PG172-175: “HCR engines are subject to three limitations.
	+ First, we do not allow vehicles with 405 or more horsepower, and (to simulate parts sharing) vehicles that share engines with vehicles with 405 or more horsepower, to adopt HCR engines due to their prescribed power needs being more demanding and likely not supported by the lower power density found in HCR-based engines.
	+ Secondly, to maintain a performance-neutral analysis,217 we exclude pickup trucks and (to simulate parts sharing) 218 vehicles that share engines with pickup trucks from receiving HCR engines that are not accompanied by an electrified powertrain.”
	+ Finally, we restrict HCR engine application for some manufacturers that are heavily performance-focused and have demonstrated a significant commitment to power dense technologies such as turbocharged downsizing.”
* PG176: “We develop the engine map models to be representative of the performance achievable across industry for a given technology, and they are not intended to represent the performance of a single manufacturer’s specific engine.”
* PG179: “Note that we never apply absolute BSFC levels from the engine maps to any vehicle model or configuration for the rulemaking analysis. We only use the absolute fuel economy values from the full vehicle Autonomie simulations to determine incremental effectiveness for switching from one technology to another technology.”
* PG180: “Some advanced engine technologies have values that indicate low effectiveness. We determined the low effectiveness resulted from the application of advanced engines to existing P2 architectures. This effect is expected and illustrates the importance of using the full vehicle modeling to capture interactions between technologies, and capture instances of both complimentary technologies and non-complimentary technologies.”
* PG180-181: “This reduces the advantage of adding advanced engine technologies, which also improve fuel economy, by broadening the range of speed and load conditions for the engine to operate at high efficiency. This redundancy in fuel savings mechanism results in a lower effectiveness when the technologies are added to each other.”
* PG184: “The engine costs in our analysis are the product of engine DMCs, RPE, the LE, and updating to a consistent dollar year.”
* PG185: “All engine technology costs start with a base engine cost, and then additional technology costs are based on cylinder and bank count and configuration; the DMC for each engine technology is a function of unit cost times either the number of cylinders or number of banks, based on how the technology is applied to the system.”
* PG185: “We only model automatic transmissions in both the LD and HDPUV analyses. The four subcategories of automatic transmissions that we model in the LD analysis include traditional automatic transmissions (AT), dual clutch transmissions (DCT), continuously variable transmissions (CVT and eCVT), and direct drive (DD) transmissions.233 We also include high efficiency gearbox (HEG) technology improvements as options to the transmission technologies (designated as L2 or L3 in our analysis to indicate level of technology improvement).”
* PG186: “Due to the trending decline of manual transmissions and their current low production volumes, we have removed manual transmissions from this analysis.”
* PG186: “We only model ATs in the HDPUV analysis because, except for DD transmissions that are only included as part of an electrified drivetrain, all HDPUV fleet baseline vehicles use ATs.”
* PG186: “The HDPUV automatic transmissions work in the same way as the LD ATs and are labeled the same, but they are sized and mapped, in the Autonomie effectiveness modeling,236 to account for the additional work, durability, and payload these vehicles are designed to conduct.”
* PG188: “Just like manufacturers share transmissions in multiple vehicles, the CAFE Model will treat transmissions as “shared” if they share a transmission code and transmission technologies will be adopted together.”
* PG188: “While identifying an ATs gear count is fairly easy, identifying HEG levels for ATs and CVTs is more difficult. We reviewed the age of the transmission design, relative performance versus previous designs, and technologies incorporated to assign an HEG level.”
* PG188: “We assigned vehicles in either the LD or HDPUV analyses fleets with a fully electric powertrain a DD transmission. We assigned any vehicle in the LD analysis fleet with a power-split hybrid (SHEVPS) powertrain an electronic continuously variable transmission (eCVT). Finally, we assigned the limited number of manual transmissions in the LD fleet as DCTs, as we did not model manual transmissions in Autonomie for this analysis.”
* PG189: “Technology pathways are designed to prevent “branch hopping” – changes in transmission type that would correspond to significant changes in transmission architecture – for vehicles that are relatively advanced on a given pathway.”
* PG189: “We also prevent “branch hopping” as a proxy for stranded capital, which is discussed in more detail in Section II.C and Chapter 2.5 of the Draft TSD.”
* PG189: “For the LD analysis, the automatic transmission path precludes adoption of other transmission types once a platform progresses past an AT8. We use this restriction to avoid the significant level of stranded capital loss that could result from adopting a completely different transmission type shortly after adopting an advanced transmission, which would occur if a different transmission type were adopted after AT8 in the rulemaking timeframe.”
* PG190: “Due to the limitations of current CVTs, discussed in Draft TSD Chapter 3.2, this analysis restricts the application of CVT technology on LDVs with greater than 300 lb.-ft of engine torque.”
* PG190: “This restriction aligns with CVT application in the baseline fleet, in that CVTs are only witnessed on vehicles with under 280 lb.-ft of torque.238 Additionally, this restriction is used to avoid stranded capital.”
* PG190: “DCTs are not a selectable technology for the HDPUV analysis.”
* PG191: “These transmission maps are developed to represent the gear counts and span, shift and torque converter lockup logic, and efficiencies that can be seen in the fleet, along with upcoming technology improvements, all while balancing key attributes such as drivability, fuel economy, and performance neutrality.”
* PG192: “The DD and eCVT transmissions do not have standalone effectiveness values because those technologies are only implemented as part of electrified powertrains.”
* PG196: “We seek comment on our approach to estimating all transmission costs, but in particular on HDPUV transmission costs for this analysis, in addition to any publicly available data from manufacturers or reports on the cost of HDPUV transmissions.”
* PG196: “We implement these restrictions in the CAFE Model by using fuel economy values that assume “charge sustaining” (gasoline-only) PHEV operation,244 and by restricting technologies that convert a vehicle to a BEV or a FCEV from being applied during “standard-setting” years.”
* PG196-197: “In brief: we must consider the existing fleet fuel economy level in calculating the maximum feasible fuel economy level that manufacturers can achieve in future years. Accurately calculating the pre-existing fleet fuel economy level is crucial because it marks the starting point for determining what further efficiency gains will be feasible during the rulemaking timeframe.”
* PG197: “Specifically, we assume that in the absence of CAFE and HDPUV FE standards, manufacturers will produce certain BEVs to comply with California’s ACCs and ACT program.”
* PG197-198: “To accurately capture the costs and benefits of vehicles subject to the standards in future years, the CAFE Model projects compliance through MY 2050. Outside of standard-setting years, we model the extent to which manufacturers could produce electrified vehicles, in order to improve the accuracy and realism of our analysis in situations where statute does not prevent us from doing so. Finally, we do consider the effects of electrified vehicle adoption in the CAFE Model under a “real-world” scenario where we lift EPCA/EISA’s restrictions on our decision-making.”
* PG198: “That said, PHEVs, BEVs, and FCEVs only represent a portion of the electrified technologies that we include in the analysis.”
* PG199: “Or, put another way, “[a] disadvantage of the power split architecture is that when towing or driving under other real-world conditions, performance is not optimum.” In contrast, “[o]ne of the main reasons for using parallel hybrid architecture is to enable towing and meet maximum vehicle speed targets.” This is an important distinction to comprehend to understand why we allow certain types of vehicles to adopt P2 powertrains and not SHEVPS powertrains, and to understand why we include only P2 architectures in the HDPUV analysis.”
* PG200: “The analysis includes PHEVs with an AER of 20 and 50 miles to encompass the range of PHEV AER in the market today. BEVs have an all-electric powertrain and use only batteries for the source of propulsion energy. BEVs with ranges of 200 to more than 350 miles are used in the analysis. Finally, FCEVs are another form of electrified vehicle that have a fully electric powertrain that uses a fuel cell system to convert hydrogen fuel into electrical energy.”’
* PG201: “Readers familiar with previous LD CAFE analyses will notice that we have increased the number of engine options available for strong hybrid-electric vehicles and plug-in hybrid-electric vehicles.”
* PG201: “In addition, we now refer to the BEV options as BEV1, 2, 3, and 4, rather than by their range assignments as in the previous analysis, to accommodate using the same model code for the LD and HDPUV analyses.”
* PG202: “In the CAFE Model, HDPUVs only have one strong hybrid engine/powertrain option, and one PHEV option.”
* PG202: “We do not allow engine downsizing in this setup in so that when the battery storage system is depleted, the vehicle is still able to operate. We picked the P2 strong hybrid architecture for HDPUV PHEVs because although there are currently no PHEV HDPUVs in the market to base a technology choice, we believe that the P2 strong hybrid architecture would more likely be picked than other architecture options.”
* PG203: “We only include one HDPUV PHEV option as there are no PHEVs in the baseline HDPUV fleet, and there are no announcements from major manufacturers that indicate this a pathway that they will pursue in the short term.”
* PG203: “More specifically, there would be a larger fuel economy benefit the more the vehicle could rely on its electric operation, with partial help from the ICE; examples of duty cycles where this would be the case include short delivery applications or construction trucks that drive between work sites in the same city. Accordingly, we do think that PHEVs can be a technology option for adoption in the rulemaking timeframe.”
* PG203: “We seek comment on the range of HDPUV electrification path technologies.”
* PG205: “We assigned electrification technologies to vehicles in the baseline LD and HDPUV fleets using manufacturer-submitted CAFE compliance information, publicly available technical specifications, marketing brochures, articles from reputable media outlets, and data from Wards Intelligence.”
* PG206: “Like the other technology pathways, as the CAFE Model adopts electrification technologies for vehicles, more advanced levels of hybridization or electrification technologies will supersede all prior levels, while certain technologies within each level are mutually exclusive.”
* PG207: “In other words, when the model applies one of these technologies, the others are immediately disabled from future application. However, all vehicles on the strong hybrid pathways can still advance to one or more of the plug-in technologies, when applicable in the modeling scenario (i.e., allowed in the model).”
* PG207-208: “We also think that 8-speed transmissions are representative of the transmissions that will continue to be used in these hybrid vehicles, as we anticipate manufacturers will continue to use these “off the shelf” transmissions based on availability and ease of incorporation in the powertrain.”
* PG208: “In the real world, performance vehicles with certain powertrain configurations cannot adopt the technologies listed above and maintain vehicle performance without redesigning the entire powertrain.”
* PG208: “No SKIP logic applies to P2s because we believe that this type of electrified powertrain is sufficient to meet all of the performance requirements for all types of vehicles>”
* PG209: “LD PHEV adoption is limited only by technology path logic; however, in the HDPUV analysis, PHEV technology is not available in the model until MY 2025 for HD vans and MY 2027 for HD pickups.”
* PG210: “However, in response to CAFE standards, PHEVs increase in all three cases by 1.5 percent. This results in functionally no difference in total SCs, total social benefits, and accordingly net social benefits from varying the HDPUV PHEV availability year, in addition to functionally no difference in gasoline consumption, CO2 emissions, and other economic and environmental parameters. We seek comment on this assumption, and any other information available from manufacturers or other stakeholders on the potential that original equipment manufacturers will implement PHEV technology prior to MY 2025 for HD vans, and prior to MY 2027 for HD pickups.”
* PG211: “Together, the phase-in cap and start year determine the maximum penetration rate for a given technology in a given year; the maximum penetration rate equals the phase-in cap times the number of years elapsed since the phase-in start year.”



* PG212: “Many manufacturers have told us that the portion of consumers willing to accept a vehicle with the lowest modeled range is small, with manufacturers targeting range values above BEV1 range.”
* PG213: “For higher BEV ranges (such as that for BEV2 for both LD and HDPUVs), phase-in caps are intended to conservatively reflect potential challenges in the scalability of BEV manufacturing and implementing BEV technology on many vehicle configurations, including larger vehicles.”
* PG213: “We seek comment on the BEV phase-in caps for the LD and HDPUV analyses. Remember when submitting comments that BEV phase-in caps are a tool that we use in the model to allow the model to build higher-range BEVs (when the modeling scenario allows, as in outside of standard-setting years), because if we did not, the model would only build BEV1s, as they are the most cost-effective BEV technology.”
* PG214: “The phase-in cap for FCEVs is assigned based on existing market share as well as historical trends in FCEV production for LD and HDPUV. FCEV production share in the past five years has been extremely low and the lack of fueling infrastructure remains a limiting factor – we set the phase-in cap accordingly.”
* PG215: “Specifically, ANL scales the efficiency maps, specific to powertrain type, to have total system peak efficiencies ranging from 96-98 percent– such that their peak efficiency value corresponds to the latest state-of-the-art technologies, opposed to retaining dated system efficiencies (90-93 percent).”
* PG216: “However, for regulatory test cycles related to fuel economy, the electrical load is repeatable because the fuel economy regulations control for these factors.”
* PG216: “However, for this analysis, we use a fixed (by vehicle technology class and powertrain type), constant power draw to represent the effect of these accessory loads on the powertrain on the 2- cycle test. We intend and expect that fixed accessory load values will, on average, have similar impacts on effectiveness as found on actual manufacturers’ systems.”
* PG217: “The Autonomie simulations use a series of resizing algorithms that contain “loops,” such as the acceleration performance loop (0-60 mph), which automatically adjusts the size of certain powertrain components until a criterion, like the 0-60 mph acceleration time, is met.”
* PG218: “To establish the effectiveness of the technology packages, Autonomie simulates the vehicles’ performance on compliance test cycles.”
* PG219: “The range of effectiveness for the electrification technologies in this analysis is a result of the interactions between the components listed above and how the modeled vehicle operates on its respective test cycle. This range of values will result in some modeled effectiveness values being close to real-world measured values, and some modeled values that will depart from measured values, depending on the level of similarity between the modeled hardware configuration and the real-world hardware and software configurations.”
* PG224: “We estimate base year battery pack costs for most electrification technologies using BatPaC, which is an ANL model designed to calculate the cost of EV battery packs.”
* PG224: “Instead, ANL staff builds “lookup tables” with BatPaC that provide battery pack manufacturing costs, battery pack weights, and battery pack cell capacities for vehicles with varying power requirements modeled in our large-scale simulation runs.”
* PG224: “Two BatPaC assumptions are of note when generating base year battery costs: (1) battery cell chemistry and (2) battery plant production volume.”
* PG225: “We used NMC622-G 312 for all other electrified vehicle technology initial battery pack cost calculations.”
* PG226: “We recognize there is ongoing research and development with battery cathode chemistries that may have the potential to reduce costs and increase battery capacity. In particular, we are aware of a recent shift by manufacturers to transition to lithium iron phosphate (LFP) chemistry-based battery packs as prices for materials used in battery cells fluctuate (see additional discussion below); however, we believe that based on available data, NMC622 is more representative for our MY 2022 base year battery costs than LFP, and any additional cost reductions from manufacturers switching to LFP chemistry-based battery packs in years beyond 2022 are accounted for through LEs.”
* PG227: “As discussed above, the battery chemistry we use is intended to reasonably represent what is used in U.S. battery manufacturing in MY 2022, the DMC base year for our BatPaC calculations.”
* PG227: “However, in BatPaC, a battery plant is assumed to manufacture and assemble a specific battery pack design, and all cost estimates are based on one single battery plant manufacturing only that specific battery pack.”
* PG230: “We believe it was reasonable to consider U.S. sales for purposes of this calculation rather than global sales based on the best available data we had at the time of modeling and based on our understanding of how manufacturers design BEVs for particular markets. 324 That said, we are interested in comments from manufacturers and other stakeholders on how vehicle and battery manufacturers take advantage of design overlap across markets to maintain cost reduction progress in battery technology.”
* PG231: “To the extent that manufacturers’ costs are based more closely on global volumes of battery packs produced, our base year battery pack production volume assumption could potentially be conservative; however, as discussed further below, our base year MY 2022 battery pack costs fall well within the range of reasonable estimates based on 2023 data. Again, we seek comment on this approach and the resulting base year cost estimates.”
* PG231: “From our base year BatPaC cost estimates, that vehicle might have a battery pack that costs around $123/kWh. Note that the total cost of a battery pack goes up the higher the power/energy requirements, however the cost per kWh goes down. This represents the cost of hardware that is needed in all battery packs but is deferred across more kW/kWh in larger packs, which reduces the per kW/kWh cost.”
* PG233: “For this analysis, our method of estimating future battery costs has three fundamental components: 1) an estimate of MY 2022 battery pack costs (i.e., our base year costs generated in the BatPaC 5.0 model to estimate battery pack costs for specific vehicles, depending on factors such as pack size and power requirements, discussed above), and 2) future learning rates through 2050, and 3) the effect of changes in the cost of key minerals on battery pack costs, which are discussed below.”
* PG234: “Recognizing that battery pack costs for future years are inherently uncertain, we sought comment on our learning rates and also provided cost estimates from other sources against which to compare our estimates. Our conclusion after considering comments and publicly available information was that our estimates of how battery pack costs could reduce over time fell reasonably within the estimates of potential future battery pack cost estimates from other sources.”
* PG238: “For this analysis, instead of relying on our previous methodology of using the BatPaC model to estimate volume-based cost reductions for battery packs, we extracted estimated learning rates from the Mauler et al. study discussed above. Our learning rates are based on the year-over-year cost decreases shown in the Mauler et al. study; however, we modified the learning rate in two ways, discussed in turn.”
* PG238: “First, we began Mauler’s 2030-2035 estimated learning rate in MY 2022, as it better aligns with our MY 2022 BatPaC-based base year cost estimates and is reflected in the most recent BNEF survey data.”
* PG238-239: “Second, to reflect the combination of fluctuating mineral costs and an increase in demand, we hold the battery pack cost learning curve constant between MYs 2022 and 2025. This is a conservative assumption that is also employed by EPA in their proposal for light duty vehicles and medium duty vehicles beginning in MY 2027 at Section IV.C.2 and Draft Regulatory Impact Analysis Section 2.5.2.1.3.”
* PG239: “The assumption reflects increased lithium costs since 2020 that are not expected to decline appreciably to circa 2020 levels until additional capacity (mining, materials processing, and cell production) comes on-line, although prices have already fallen from 2022 highs at the time of writing.”
* PG239: “We seek comment on this representation of mineral costs in the learning curve, and any other feedback relevant to incorporating these considerations into our modeling framework.”
* PG239-240: “We believe that during the rulemaking time frame, based on on-going research and discussions with stakeholders, the industry will continue to employ lithium-ion NMC as the predominant battery cell chemistry for the near-term but will transition more fully to advanced high-nickel battery chemistries like NMC811 or less-costly cell chemistries like LFP-G during the middle or end of the decade – i.e., during the rulemaking timeframe.”
* PG241: “One important point that these sensitivity case results emphasize is that because of NHTSA’s inability to consider manufacturers building EVs in response to CAFE standards during standard-setting years (i.e., MYs 2027-2032 for this proposal), net SCs and benefits do not change significantly between battery cost sensitivity cases, and similarly would not change significantly if much lower battery costs were used.”
* PG243: “Because of the way in which EPA has thus parameterized its battery cost, which is dependent on cumulative volume production in a given policy scenario, a direct comparison to the NHTSA cost sensitivities shown in Figure II-27 is not straightforward. The cost/kWh of several different pack sizes, as implemented in the EPA analysis supporting the recent EPA proposal, are shown in Figure 30.”
* PG244: “The costs developed by EPA as depicted in Figure II-27 above show the potential to reach significantly lower levels than most of the costs in NHTSA’s battery sensitivity cases of Figure II-26, depending on the volume production associated with a given policy scenario and year.”
* PG245: “NHTSA requests comment on the possibility of implementing for its final rule analysis EPA’s cumulative volume-based learning approach, and on the methodology outlined in EPA’s DRIA that EPA used to generate and validate the cumulative GWh battery pack production based battery pack costs.”
* PG245: “Recognizing that there is no way to validate costs for years that have not yet happened, we seek comment in particular from vehicle and battery manufacturers on any additional data they can submit (preferably publicly) to further the conversation about battery pack costs in the later part of this decade through the early 2030s.”
* PG245: “In addition, we seek comment on all aspects of our methodology for modeling base year and future year battery pack costs, and welcome data or other information that could inform our approach for the final rulemaking. We specifically seek comment on how the performance metrics may change in response to shifts in chemistries used in vehicle models driven by global policies affecting battery supply chain development, total global production and associated learning rates, and related sensitivity analyses.”
* PG246: “For all electrified vehicle powertrain types, we group non-battery electrification components into four major categories: electric motors (or e-motors), power electronics (generally including the DC-DC converter, inverter, and power distribution module), charging components (charger, charging cable, and high voltage cables), and thermal management system(s).”
* PG246: “Although each manufacturer’s ETDS and power electronics vary between the same electrified vehicle types and between different electrified vehicle types, we consider the ETDS for this analysis to be comprised of the e-motor and inverter, power electronics, and thermal system.”
* PG247: “As a result, HDPUVs and LDVs share the same non-battery electrification DMCs.”
* PG248: “In summary, we calculate total electrified powertrain costs by summing individual component costs, which ensures that all technologies in an electrified powertrain appropriately contribute to the total system cost. We combine the costs associated with the ICE (if applicable) and transmission, non-battery electrification components like the electric machine, and battery pack to create a full-system cost.”
* PG250: “We include three road load reducing technology paths in this analysis: the MR Path, Aerodynamic Improvements (AERO) Path, and ROLL Path. For all three vehicle technologies, we assign baseline fleet technologies and identify adoption features based on the vehicle’s body style.”
* PG250: “The LD fleet body styles we include in the analysis are convertible, coupe, sedan, hatchback, wagon, SUV, pickup, minivan, and van. The HDPUV fleet body styles include chassis cab, cutaway, fleet SUV, work truck, and work van.”
* PG251: “MR is a relatively cost-effective means of improving fuel economy, and vehicle manufacturers are expected to apply various MR technologies to meet fuel economy standards.”
* PG252: “For the LD fleet portion of this analysis, we considered five levels of MR technology (MR1-MR5) that include increasing amounts of advanced materials and MR techniques applied to the vehicle’s glider.”
* PG252: “We considered two levels of MR (MR1 – MR2) and a baseline (MR0) for the HDPUV fleet.”
* PG253: “We have been improving on the LD regression analysis since the 2016 Draft Technical Assessment Report (TAR) and continue to find that it reasonably estimates MR technology levels of vehicles in the analysis fleet. We developed a similar regression for the HDPUV fleet for this analysis using the factors described above and other applicable HDPUV attributes and found that it similarly appropriately assigns baseline MR technology levels.”
* PG254: “As the model applies technologies, it will “level up” all variants on a platform to the highest level of MR technology on the platform.”
* PG254: “The CAFE Model will not apply MR5 technology to platforms representing high volume sales, like a Chevrolet Traverse, for example, where hundreds of thousands of units are sold per year. We use this particular adoption feature and the 80,000-unit threshold in particular, to model several relevant considerations.”
* PG255: “There are no other adoption features for MR in the LD analysis, and no adoption features for MR in the HDPUV analysis.”
* PG260: “Put another way, for a given vehicle platform, a baseline mass is assigned using the aforementioned regression model. The amount of mass to reach each of the five levels of MR is calculated by the CAFE Model based on this baseline number and then multiplied by the dollar per pound saved figure for each of the five MR levels.”
* PG260: “However, this figure increases steeply going from MR4 to MR5 because the technology cost to realize the associated mass savings level is an order of magnitude larger.”
* PG260: “For the HDPUV analysis, there is also a significant cost increase from MR1 to MR2.”
* PG261: “Manufacturers may employ both passive and active aerodynamic technologies to improve aerodynamic drag values.”
* PG262: “There are four levels of aerodynamic improvement (over the baseline AERO0) available in the LD analysis (AERO5, AERO10, AERO15, AERO20), and two levels of improvements available for the HDPUV analysis (AERO10, AERO20).”
* PG262: “Each AERO level associates with 5, 10, 15, or 20 percent aerodynamic drag improvement values over a baseline computed for each vehicle body style. These levels, or bins, respectively correspond to the level of aerodynamic drag reduction over the baseline, e.g., “AERO5” corresponds to the 5 percent aerodynamic drag improvement value over the baseline, and so on.”
* PG263: “This analysis considers both frontal area and body style as unchangeable utility factors affecting aerodynamic forces; therefore, the analysis assumes all reduction in aerodynamic drag forces come from improvement in the drag coefficient. Then we used drag coefficients for each vehicle in the baseline fleet to establish a baseline aerodynamic technology level for each vehicle. We compared the vehicle’s drag coefficient to the calculated drag coefficient by body style mentioned above, to assign baseline levels of aerodynamic drag reduction technology.”
* PG264: “Therefore, manufacturers may have limited ability to improve aerodynamic drag coefficients for high performance vehicles with ICEs without reducing horsepower.”
* PG264: “BEVs are therefore more likely to achieve higher AERO levels, so the horsepower threshold is set high enough that it does not restrict AERO15 and AERO20 application.”
* PG265: “We use the change in fuel consumption values between entire technology keys, and not the individual technology effectiveness values. Using the change between whole technology keys captures the complementary or non-complementary interactions among technologies,”
* PG268: “For LD AERO improvements, the cost to achieve AERO5 is relatively low, as manufacturers can make most of the improvements through body styling changes. The cost to achieve AERO10 is higher than AERO5, due to the addition of several passive aerodynamic technologies, and consecutively the cost to achieve AERO15 and AERO20 are much higher than AERO10 due to use of both passive and active aerodynamic technologies.”
* PG268: “Because of this similarity, and unlike other technology areas that are required to handle higher loads or greater wear, aerodynamics technologies can be almost directly ported between fleets. As a result, there is no difference in technology cost between LD and HDPUV fleets for this analysis.”
* PG269: “We received no additional comments from stakeholders regarding the costs established in the 2018 PRIA during the MY 2024-2026 standards analysis and continued to use the established costs for this analysis.”
* PG270: “We use three levels of low rolling resistance tire technology for LDVs and two levels for HDPUVs. Each level of low rolling resistance tire technology reduces rolling resistance by 10 percent from an industry-average baseline rolling resistance coefficient (RRC) value of 0.009.”
* PG271: “We have been using ROLL10 and ROLL20 in the last several CAFE Model analyses. New for this analysis is ROLL30 for the LD fleet. In past rulemakings, we did not consider ROLL30 due to lack of widespread commercial adoption of ROLL30 tires in the fleet within the rulemaking timeframe, despite commenters’ argument on availability of the technology on current vehicle models and possibility that there would be additional tire improvements over the next decade.”
* PG271: “With increasing use of ROLL30 application by OEMs, and material selection making it possible to design low rolling resistance independent of tire wet grip (discussed in detail in Chapter 3.6 of the Draft TSD), we now consider ROLL30 as a viable future technology during this rulemaking period.”
* PG272: “However, we did not consider ROLL30 for the HDPUV fleet, for several reasons. We do not believe that HDPUV manufacturers will use ROLL30 tires because of the significant added cost for the technology while they would see more fuel efficiency benefits from powertrain improvements.”
* PG272: “We believe that HDPUV manufacturers will still move through ROLL10 and ROLL20 technology in the rulemaking timeframe. That said, we welcome any data or feedback from stakeholders showing a pathway to ROLL30 (i.e., vehicles that can achieve a RRC value of 0.0063) for HDPUVs.”
* PG273: “Like the aerodynamic technology improvements discussed above, we applied ROLL technology adoption features based on vehicle horsepower and body style. All vehicles in the LD and HDPUV fleets that have below 350hp can adopt all levels of ROLL technology.”
* PG276: “In the absence of ROLL30 DMCs from tire manufacturers, vehicle manufacturers, or studies, to develop the DMC for ROLL30 we extrapolated the DMCs for ROLL10 and ROLL20. We seek comment on this approach, and if we receive updated information from tire or vehicle manufacturers, or other studies, we will update it for future analyses.”
* PG277: “Off-cycle and AC efficiency technologies can provide fuel economy benefits in real world vehicle operation, but the traditional 2-cycle test procedures (i.e., FTP and HFET) used to measure fuel economy cannot fully capture those benefits.”
* PG277: “Vehicle manufacturers have the option to generate credits for off-cycle technologies and improved AC systems under the EPA’s CO2 program and receive a fuel consumption improvement value (FCIV) equal to the value of the benefit not captured on the 2-cycle test under NHTSA’s CAFE program. The FCIV is not a “credit” in the NHTSA CAFE program – unlike, for example, the statutory overcompliance credits prescribed in 49 U.S.C. 32903 – but FCIVs increase the reported fuel economy of a manufacturer’s fleet, which is used to determine compliance.”
* PG278: “We only calculate and apply FCIVs at a manufacturer’s fleet level, and the improvement is based on the volume of the manufacturer’s fleet that contains qualifying technologies.”
* PG278: “We currently do not model AC efficiency and off-cycle technologies in the CAFE Model like we model other vehicle technologies, for several reasons. Each time we add a technology option to the CAFE Model’s technology pathways we increase the number of Autonomie simulations by approximately a hundred thousand. This means that to add just five AC efficiency and five off-cycle technology options would double our Autonomie simulations to around two million total simulations.”
* PG278: “However, starting with MY 2023, manufacturers are required to submit AC efficiency and off-cycle technology data to NHTSA in the new CAFE Projections Reporting Template for PMY, MMY and supplementary reports. Once we begin evaluating manufacturer submissions in the CAFE Projections Reporting Template we may reconsider in future analyses how off-cycle and AC efficiency technologies are evaluated in the analysis.”
* PG279: “Instead, the CAFE Model applies predetermined AC efficiency and off-cycle benefits to each manufacturer’s fleet after the CAFE Model applies traditional technology pathway options. The CAFE Model attempts to apply pathway technologies and AC efficiency and off-cycle technologies in a way that both minimizes cost and allows the manufacturer to meet a given level of CAFE standard without over or under complying.”
* PG279: “The predetermined benefits that the CAFE Model applies for AC efficiency and off-cycle technologies are based on EPA’s 2022 Trends Report and CBI compliance data from vehicle manufacturers.”
* PG279: “New for this analysis, we also developed a methodology for considering BEV AC efficiency and off-cycle technology application.”
* PG279: “We calculated the maximum off cycle benefit that the model could apply for each manufacturer and each MY based on off-cycle technologies that could be applied to BEVs and the percentage of BEVs in each manufacturer’s fleet. Note that we do not include PHEVs in this calculation, because they still use a conventional engine and transmission.”
* PG280: “We generated costs for these technologies on a dollars per gram of CO2 per mile ($ per g/mi) basis, as AC efficiency and off-cycle technology benefits are applied in the CAFE Model on a gram per mile basis (as in the regulations). Like the last CAFE analysis, we used data from EPA’s Proposed Determination TSD and the 2012 Joint NHTSA/EPA TSD, updated to 2018$ with an indirect cost markup and relatively flat learning rate applied. We did not have time to update these costs to 2021$, but will do so for the final rule, and we expect the impact to be minimal.”
* PG281: “The next few subsections walk through how the analysis models how consumers respond to changes to vehicles implemented by manufacturers to respond to the CAFE and HDPUV FE standards. NHTSA seeks comment on the following discussion.”
* PG281: “The analysis presented along with today’s proposal employs fuel price forecasts developed by the EIA’s NEMS.”
* PG282: “The analysis also uses IHS Markit Global Insight forecasts of U.S. population, GDP, total number of households, and disposable personal income.”
* PG283: “Increased fuel economy offers vehicle owners savings through reduced fuel expenditures throughout the lifetime of a vehicle. If buyers fully value the savings in fuel costs that result from driving (and potentially re-selling) vehicles with higher fuel economy and manufacturers supply all improvements in fuel economy that buyers demand, market-determined levels of fuel economy would reflect both the cost of improving it and the private benefits from doing so. In that case, regulations on fuel economy would only be necessary to reflect environmental or other benefits other than to buyers themselves.”
* PG283: “But if consumers instead undervalue future fuel savings or are otherwise unable to purchase their optimal levels of fuel economy due to market failures, they will underinvest in fuel economy and manufacturers would spend too little on fuel-saving technology (or deploy its energy-saving benefits to improve vehicles’ other attributes). In that case, more stringent fuel economy standards could lead manufacturers to adopt improvements in fuel economy that not only reduce external costs from producing and consuming fuel to appropriate levels but also improve consumer welfare.”
* PG284: “Recent econometric research is divided between studies concluding that consumers value most or all of the potential savings in fuel costs from driving higher-mpg vehicles, and those concluding that consumers significantly undervalue expected fuel savings.”
* PG284: “Manufacturers have repeatedly informed the agency that consumers only value between 2 to 3 years-worth of fuel savings when making purchasing decisions.”
* PG286-287: “. Because preferences can be context dependent, some consumers may view the decision whether to buy a model offering increased fuel economy in a market without increasing fuel economy standards as a risky choice, because their return from the purchase will vary with their future travel activity and gasoline prices. In contrast, if the fuel economies of most new vehicles are increasing in response to higher standards, they may view the relative risk/reward of purchasing a vehicle with higher fuel economy more favorably.”
* PG287: “The analysis assumes that potential buyers value only the undiscounted savings in fuel costs from purchasing a higher-mpg model they expect to realize over the first 30 months (i.e., 2.5 years) they own it. NHTSA feels that 30 months is supported by the totality of present literature and is consistent with manufacturer assumptions about consumer demand.”
* PG287: “NHTSA seeks comment on whether 30 months of undiscounted fuel savings is an appropriate measure for the analysis of consumer willingness to pay for fuel economy”
* PG288: “Given this constraint, NHTSA believes that using the same payback period for the HDPUV fleet as for the LD fleet made sense.”
* PG289: “Several commenters on previous regulatory actions and peer reviewers of the CAFE Model encouraged consideration of the potential impact of fuel efficiency standards on new vehicle prices and sales, the changes to compliance strategies that those shifts could necessitate, and the downstream impact on vehicle retirement rates.”
* PG289-290: “Particularly given the broad uncertainty discussed in Chapter 4.2 of the Draft TSD, NHTSA seeks comment on the discussion below and the associated discussions in the TSD, on the internal structure of the sales and scrappage modules, and whether and how to change the sales and scrappage analyses for the final rule.”
* PG290: “As such, the sales response model currently contains three parts: a nominal forecast that provides the level of sales in the baseline (based upon macroeconomic inputs, exclusively), a price elasticity that creates sales differences relative to that No-Action alternative in each year, and a fleet share model that produces differences in the passenger car and light truck market share in each alternative.”
* PG291: “NHTSA’s projection oscillates by MY at the beginning of the analysis before settling on a constant trend in the 2030s. This result seems consistent with the continued response to the pandemic and to supply chain challenges. NHTSA’s projections for most MYs fall between AEO 2021 and 2022 forecasts, which were run as sensitivity cases. NHTSA will continue to monitor macroeconomic data and new vehicle sales and update its baseline forecast as appropriate.”
* PG291: “The baseline HDPUV fleet is modeled differently. NHTSA considered using a statistical model drawn from the LD specification to project new HDPUV sales but reasoned that the mix of HDPUV buyers and vehicles was sufficiently different that an alternative approach was required. Due to a lack of historical and future data on the changing customer base in the HDPUV market (e.g., the composition of commercial and personal users) and uncertainty around vehicle classification at the LDV and HDPUV margin, NHTSA chose to rely on an exogenous forecast path from the AEO to project sales.”
* PG292: “NHTSA seeks comment on this approach, and whether it should implement an approach similar to how NHTSA models LDV sales.”
* PG292: “The central analysis in this proposal simulates multiple programs simultaneously (CAFE and HDPUV FE final standards, EPA final GHG standards, ZEV, and the California Framework Agreement), and the regulatory cost includes both technology costs and civil penalties paid for non-compliance (with CAFE standards) in a MY. We also subtract any IRA tax credits that a vehicle may qualify for from the regulatory costs.”
* PGS292-293: “The price to which the elasticity is applied this analysis represents the residual price change between scenarios after accounting for 2.5 years’ worth of fuel savings to the new vehicle buyer.”
* PG293: “The price elasticity is also specified as an input, and for this analysis the agency assumes an elastic response of -0.4—meaning that a five percent increase in the average price of a new vehicle produces a two percent decrease in total sales…. NHTSA seeks comment on this assumption and has included several sensitivity cases testing alternative values.”
* PG294: “For today’s proposal, NHTSA has revised its approach to modeling the DFS. The baseline fleet share projection is derived from the agency’s own compliance data for the 2022 fleet, and the 2022 AEO projections for later MYs.”
* PG294: “The fleet is distributed across two different body-types: “cars” and “light trucks.” While there are specific definitions of “passenger cars” and “light trucks” that determine a vehicle’s regulatory class, the distinction used in this phase of the analysis is more simplistic. All body-styles that are commonly considered a car—sedans, coupes, convertibles, hatchbacks, and station wagons—are defined as “cars” for the purpose of determining fleet share. Everything else—SUVs, smaller SUVs (crossovers), vans, and pickup trucks—are defined as “light trucks”—even though they may not be treated as such for compliance purposes.”
* PG295: “This approach implicitly assumes that manufacturers are currently pricing individual vehicle models within market segments in a way that maximizes their profit. Without more information about each OEM’s true cost of production and operation, fixed and variables costs, and both desired and achievable profit margins on individual vehicle models, there is no basis to assume that strategic shifts within a manufacturer’s portfolio will occur in response to standards.”
* PG295: “Similar to the second component of the sales module, the DFS then applies an elasticity to the change in price between alternatives and the No-Action Alternative to determine the change in fleet share. NHTSA uses the net regulatory cost differential (costs minus fuel savings) in a logistic model to capture the changes in fleet share between passenger cars and light trucks, with a price coefficient of -0.000042.”
* PG296: “NHTSA seeks comment on how it is modeling the DFS in this proposal, and more specifically seeks input to the elasticity NHTSA is using.”
* PG296: “In prior rules, NHTSA has speculated that the rise in light-truck market share may be attributable to the increased utility that light-trucks provide their operators, and as the fuel economy between the different body-styles diminished, light-trucks have become an even more attractive option. As explained in a docket memo, NHTSA has been unable to create a comprehensive model that includes the variables in NEMS, price, and fuel economy that behaves appropriately. NHTSA is considering applying an elasticity to the changes in fuel economy directly to capture this change in utility. NHTSA seeks comment on whether this alternative approach is appropriate.”
* PG297: “While scrappage decisions are made at the household level, NHTSA is unaware of sufficient household data to sufficiently capture scrappage at that level. Instead, NHTSA uses aggregate data measures that capture broader market trends.”
* PG298: “The most predictive element of vehicle scrappage is “engineering scrappage.” This source of scrappage is largely determined by the age of a vehicle and the durability of a specific MY vintage. NHTSA uses proprietary vehicle registration data from IHS/Polk to estimate vehicle age and durability. Other factors include fuel economy and new vehicle prices. For historical data on new vehicle transaction prices, NHTSA uses National Automobile Dealers Association (NADA) Data.”
* PG299: “NHTSA uses fixed effects to capture potential changes in durability across MYs, and to ensure that vehicles approaching the end of their life are scrapped in the analysis, NHTSA applies a decay function to vehicles after they reach age 30.”
* PG299: “For this proposal, NHTSA modeled the retirement of HDPUVs similarly to pick-up trucks.”
* PG300: “In addition to the variables included in the scrappage model, NHTSA considered several other variables that likely either directly or indirectly influence scrappage in the real world, including maintenance and repair costs, the value of scrapped metal, vehicle characteristics, the quantity of new vehicles purchased, higher interest rates, and unemployment. These variables were excluded from the model either because of a lack of underlying data or modeling constraints.”
* PG300: “NHTSA seeks comments on its approach to modeling scrappage.”
* PG301: “It is NHTSA’s perspective that the total demand for VMT should not vary excessively across alternatives.”
* PG301: “NHTSA seeks comment on whether non-rebound VMT should be constrained across the LD fleet, or if it would be more appropriate to model VMT changing with fleet size.”
* PG301: “NHTSA seeks comment on whether it should continue to constrain aggregate, non-rebound VMT across alternatives. NHTSA is considering removing the constraint on VMT.”
* PG302: “NHTSA created “mileage accumulation schedules” using IHS-Polk odometer data to construct mileage accumulation schedules as an initial estimate of how much a vehicle expected to drive at each age throughout its life. NHTSA uses simulated new vehicle sales, annual rates of retirement for used vehicles, and the mileage accumulation schedules to distribute VMT across the age distribution of registered vehicles in each CY to preserve the non-rebound VMT constraint.”
* PG302: “For the aforementioned reasons, we believe that the change in VMT that results from changes in fleet composition and size are reasonable. NHTSA seeks comment on this assumption, and alternatively asks commenters to identify an independent forecast of HDPUV VMT that may be used as a constraint.”
* PG303: “NHTSA conducted a review of the literature related to the fuel economy rebound effect, which is extensive and covers multiple decades and geographic regions. The totality of evidence, without categorically excluding studies on grounds that fail to meet certain criteria, and evaluating individual studies based on their particular strengths, suggests that a plausible range for the rebound effect is 10-50 percent.”
* PG304: “NHTSA selected a rebound effect of 10% for its analysis of both LD and HDPUV fleets because it was well-supported by the totality of the evidence. It is rarely possible to identify whether estimates of the rebound effect in academic literature apply specifically to household vehicles, LDVs, or another category, and different nations classify trucks included in NHTSA’s HDPUV category in varying ways, so NHTSA has assumed the same value for LDVs and HDPUVs.”
* PG304-305: “In order to calculate total VMT with rebound, the CAFE Model applies the price elasticity of VMT (taken from the FHWA forecasting model) to the full change in CPM and the initial VMT schedule but applies the (user defined) rebound parameter to the incremental percentage change in CPM between the non-rebound and full CPM calculations to the miles applied to each vehicle during the reallocation step that ensured adjusted non-rebound VMT matched the non-rebound VMT constraint.”
* PG306: “To assist with creating even more precise estimates of VMT, NHTSA requests comment on alternative approaches to simulate VMT demand.”
* PG306: “NHTSA uses the fuel economy and age and body-style VMT estimates to determine changes in fuel consumption. NHTSA divides the expected vehicle use by the anticipated mpg to calculate the gallons consumed by each simulated vehicle, and when aggregated, the total fuel consumed in each alternative.”
* PG307: “For transportation applications, upstream emissions are generated between the point of energy feedstock extraction to the vehicle’s fuel tank or energy storage system; in lifecycle analysis this is often referred to as well-to-tank emissions.”
* PG307: “Downstream emissions are primarily comprised of what is emitted through the vehicle’s exhaust but would also include other emissions generated during vehicle use and inactivity (called ‘soaking’), including hydrofluorocarbons leaked from AC systems.”
* PG308: “EFs measure the mass of each greenhouse or criteria pollutant emitted per vehicle-mile of travel, gallon of fuel consumed, or unit of fuel energy content.”
* PG308: “Simply stated, the rule’s upstream emission inventory is the product of the per-gallon EF and the corresponding number of gallons of gasoline or diesel, or amount of electricity, the vehicle consumes.”
* PG308-309: “Similarly, the downstream emission inventory is the product of the per-mile EF and the appropriate miles traveled estimate. The only exceptions are that tailpipe SOx and CO2 also use a per-gallon EF in the CAFE Model.”
* PG309: “EVs do not produce combustion-related emissions, 417 however, EV upstream electricity emissions are also accounted for in the CAFE Model inputs.”
* PG309: “Based on our assumption that any reduction in fuel consumption within the United States leads to an equal sized increase in gasoline exports, we currently do not project changes in upstream emissions resulting from feedstock extraction and fuel production outside the U.S.”
* PG310: “We seek comment on the most suitable methods for conducting this analysis, and on our underlying analysis and assumptions about the likely effects of changes in domestic gasoline consumption on U.S. gasoline imports and exports as well as the global supply and demand.”
* PG310: “We intend to employ updated estimates of power sector emissions in our final rule, which could be based on the latest available versions of AEO and GREET, and we seek comment on making these updates.”
* PG310-211: “We seek comment on these sensitivity cases and which national grid mix forecast may best represent the latest market conditions and policies, such as the Inflation Reduction Act. We also seek comments on other forecasts to consider, including EPA’s Integrated Planning Model for the post-IRA 2022 reference case for the final rulemaking, 419 and the methodology used to generate alternate forecasts.”
* PG312: "BTW will constitute a slight majority of PM2.5 emissions in 2020 and after. Similarly, for light trucks, BTW will become a majority of PM2.5 in 2035. In particular, brake wear from cars and light trucks will account for up to 40 percent of their PM2.5 inventories by 2050. Previous CAFE rulemakings have not modeled the indirect impacts to BTW emissions due to changes in fuel economy and VMT. This rule considers PM2.5 from the vehicle’s exhaust, brakes, and tires."
* PG312: “There is some evidence that average vehicle weight will differ by fuel type and powertrain, particularly EVs with extended-range battery packs, which are often heavier than a comparable gasoline- or diesel-powered vehicle. These weight increases due to useful life and reduces associated brake wear, but the additional mass from heavier batteries might increase BTW emissions overall.”
* PG315: “That said, we believe that the BPT approach provides a reasonable estimate of how different CAFE stringencies may impact public health. The BPT methodology and data sources are unchanged from the 2022 CAFE rule, and stakeholders generally agreed that estimates of the benefits of PM2.5 reductions were improved from prior analyses based on our emissions-related health impacts methodology updated for that rule.”
* PG316: “We are aware that EPA recently updated its estimated benefits for reducing PM2.5 from several sources,434 but those sources do not include mobile sources. After discussion with EPA staff, we retained the PM2.5 incidence per ton values from the last CAFE analysis for consistency with the current mobile source emissions estimates.”
* PG319: “NHTSA reports the costs and benefits of proposed standards for LDVs and HDPUVs separately. While the effects are largely the same for the two fleets our fuel economy and fuel efficiency programs are separate, and NHTSA makes independent determinations of the maximum feasible standards for each fleet.”
* PG320: “Fuel savings and most other benefits from tightening standards will be experienced directly by owners of vehicles that offer higher fuel economy and thus affect their future consumption opportunities, while benefits or costs that are experienced more widely throughout the economy will also primarily affect future consumption.”
* PG321: “Thus, we simply assume that manufacturers raise the prices of models whose fuel economy they elect to improve sufficiently to recover their increased costs for doing so. The technology costs are incurred by manufacturers and then passed onto consumers. While we include the effects of IRA tax credits in our modeling of consumer responses to the standards, the effect of the tax credit is an economic transfer where the costs to one party are exactly offset by benefits to another and have no impact on the net benefits of the proposal. NHTSA could include IRA tax credits as a reduction in the technology costs for manufacturers and purchasing prices in our cost-benefit accounting, tax credits are a transfer from the government to private parties, and as such have no net effect on the benefits or costs of the proposed rule.”
* PG322: “Consumers who forgo purchasing a new vehicle because of the increase in the price of new vehicles’ prices caused by more stringent standards will experience a decrease in welfare.”
* PG323: “NHTSA estimates the loss of sales surplus based on the change in quantity of vehicles projected to be sold, after adjusting for quality improvements attributable to higher fuel economy or fuel efficiency. For additional information about consumer sales surplus, see Chapter 6.1.2 of the Draft TSD. NHTSA seeks comment on our methodology for the consumer sales surplus.”
* PG323: “Some costs of purchasing and owning a new or used vehicle increase in proportion to its purchase price or market value. At the time of purchase, the price of the vehicle combined with the state-specific tax rate determine the sales tax paid. Throughout the lifetime of the vehicle, the residual value of the vehicle—which is determined by its initial purchase price, age, and accumulated usage—determine value-related registration fees and insurance premiums. The analysis assumes that the transaction price is a fixed share of the MSRP, which allows calculation of these factors as shares of MSRP. As the standards influence the price of vehicles, these ancillary costs will also increase.”
* PG323: “These costs are included in the consumer per-vehicle cost-benefit analysis but not in the societal cost-benefit analysis, because they are assumed to be transfers from consumers to government agencies or to reflect actuarially “fair” insurance premiums. We seek comment on this approach and our methodology for calculating these costs.”
* PG324: “However, as we noted in the 2022 final rule, the availability of vehicle financing offers a benefit to consumers by spreading out the costs of additional fuel economy technology over time. Thus, we no longer include financing as a cost to consumers. We seek comment on this assumption.”
* PG324: “Under this assumption, our estimates of fuel consumption from increasing the fuel economy or fuel efficiency of each individual model depend only on how much its fuel economy or efficiency is increased, and do not reflect whether its actual use differs from other models of the same body type.”
* PG324-325: “Expenditures on alternative fuels (E85 and electricity, primarily) are also included in the calculation of fuel expenditures, on which fuel savings are based. However, since alternative fuel technology is not applied to meet the proposed standards, the majority of the costs associated with operating alternative fuels net to zero. And while the included taxes net out of the social benefit cost analysis (as they are a transfer), consumers value each gallon saved at retail fuel prices including any additional fees or taxes they pay.”
* PG325: “While the analysis does not allow electrification to be chosen as a compliance pathway with the proposed standards for LDVs, it is still important to model recharging since excluding these costs would underestimate scenarios with additional BEVs, such as our sensitivity cases that examine lower battery costs.”
* PG326: “We seek comment on this methodology. In particular, we seek comment on whether increasing fuel economy for LDVs and fuel efficiency for HDPUVs should be expected to reduce the amount of refueling benefits. An alternative hypothesis NHTSA is considering is whether manufacturers maintain vehicle range by lowering tank size as vehicle efficiency improves without, therefore, reducing refueling time.”
* PG326: “Under each of the alternatives considered in this analysis, the fuel CPM of driving would decrease as a consequence of higher fuel economy and efficiency levels, thus increasing the number of miles that buyers of new cars, light trucks, and HDPUVs would drive as a consequence of the well-documented fuel economy rebound effect.”
* PG327: “The amount by which the benefit of this additional travel exceeds its economic costs measures the net benefits drivers and their passengers experience, usually referred to as increased consumer surplus.”
* PG327: “The benefit of additional mobility over and above its costs is measured by the change in consumers’ surplus, which NHTSA approximates as one-half of the change in fuel CPM times the increase in VMT due to the rebound effect. NHTSA seeks comment on both the assumption and methodology employed to capture the value of additional mobility.”
* PG327: “We do not estimate the consumers' surplus associated with the reallocated miles because there is no change in total non-rebound VMT and thus no change in consumers' surplus per consumer. Chapter 6.1.5 of the Draft TSD explains NHTSA’s methodology for calculating the benefits of reallocated miles. We seek comment on this assumption and methodology.”
* PG328: “To estimate the economic costs associated with changes in congestion and noise caused by increases in driving, NHTSA updated the estimates of per-mile congestion and noise costs from increased automobile and light truck use reported in FHWA’s 1997 Highway Cost Allocation Study to account for changes in travel activity and economic conditions since they were originally developed, as well as to express them in 2021 dollars for consistency with other economic inputs”
* PG329: “NHTSA specifically seeks comment on the congestion costs employed in this analysis, and whether and how to change them for the analysis for the final rule.”
* PG330: “NHTSA uses the SC-GHG interim values to estimate the climate benefits of decreased fuel consumption stemming from this proposal.”
* PG332: “NHTSA is mindful that our understanding of the SC-GHG is still evolving. In addition to participating in the IWG process, DOT continues to track developments in the economic and environmental sciences literature regarding the SC of GHG emissions, including research from Federal sources like the EPA.440 NHTSA seeks comment on whether an alternative approach should be considered for the final rule.”
* PG333: “Following this statement from OMB, and recognizing the need to balance welfare improvements to current and future generations, it would be inappropriate to apply an opportunity cost of capital rate to estimate SC-GHG.”
* PG335: “The agency’s analysis showing our primary non-GHG impacts at 3 and 7 percent alongside climate-related benefits discounted at each rate recommended by the IWG may be found in Chapter 8 of the PRIA for both LDVs and HDPUVs. For the sake of simplicity, most tables throughout today’s analysis pair both the 3 percent and the 7 percent discount rates for other costs and benefits with the SCs of GHGs discounted at a 3 percent rate. We believe that this approach provides policymakers with a range of costs and benefits associated with the rule using a reasonable range of discounting approaches and associated climate benefits, while also reporting that the 95th percentile value illustrates the potential for climate change to cause damages that are much higher than the “best guess” damage estimates.”
* PG335: “We seek comment on our choice to consider a broad range of discount rates for SC-GHGs, and we will consider modifying our approach to discounting SC-GHGs based on such comments and any updated guidance.”
* PG336: “We use the same EPA sources that provided health incidence values to determine which monetized health impacts per ton values to use as inputs in the CAFE Model. Like the estimates associated with health incidences per ton of criteria pollutant emissions, we used multiple EPA papers and conversations with EPA staff to appropriately account for monetized damages for each pollutant associated with the source sectors included in the CAFE Model and based our final estimates on the most up-to-date data. The various emission source sectors included in the EPA papers do not always correspond exactly to the emission source categories used in the CAFE Model. In those cases, we mapped multiple EPA sectors to a single source category and computed a weighted average of the health impact per ton values.”
* PG337: “It is important to note that the EPA sources cited frequently refer to these monetized health impacts per ton as “benefits per ton,” since they describe these estimates in terms of emissions avoided. In the CAFE Model input structure, these are generally referred to as monetized health impacts or damage costs associated with pollutants emitted (rather than avoided), unless the context states otherwise.”
* PG337: “In addition, the CAFE Model documentation contains more details of the model’s computation of monetized health impacts. We seek comment on this approach.”
* PG339: “For these reasons, lower U.S. spending on petroleum products that results from raising standards, reducing U.S. gasoline demand, and the downward pressure it places on global petroleum prices is not included among the economic benefits accounted for in the agency’s evaluation of this proposed rule. We seek comment on this assumption.”
* PG341: “NHTSA seeks comment on its accounting of energy security.”
* PG341-342: “Further, as manufacturers choose to produce more electrified vehicles, they will also become more susceptible to disruptions to critical mineral markets, which may make it harder for them to comply with CAFE standards if their voluntary compliance strategy relies on electrification rather than other technologies. NHTSA does not include costs or benefits related to these emerging energy security considerations in its analysis for this proposed rule but seeks comment on whether it is appropriate to include an estimate in the analysis and, if so, which data sources and methodologies it should employ.”
* PG343: “We seek comment on the practicability of expanding the scope of the proposal’s labor analysis for the final rule and whether the REMI model is appropriate.”
* PG344: “We seek comment on these assumptions, and whether there are any data sources or methodologies the agency could employ to dynamically model parts content across different regulatory alternatives. While the IRA tax credit eligibility is not dependent on our labor assumptions here, if NHTSA were able to dynamically model changes in parts content with enough confidence in its precision, NHTSA could potentially employ those results to dynamically model a portion of tax credit eligibility.”
* PG344-345: “However, NHTSA notes that due to statutory constraints on considering the fuel economy of BEVs and the full fuel economy of PHEVs in determining maximum feasible CAFE standards, any reduction in maintenance and repair costs due to electrification would have a limited impact on NHTSA’s analysis comparing alternatives. NHTSA seeks comment on methods for estimating these costs.”
* PG346: “NHTSA seeks comment on alternative methods for estimating the potential sacrifice in other vehicle attributes.”
* PG347: “We seek comment on this sensitivity analysis, and in particular, comments on market failures that are relevant to commercial operators and sources to help identify the market share of commercial operators.”
* PG348: “NHTSA believes the most recent analysis represents the best estimate of the impacts of MR that results in changes in mass disparities on crash fatalities, although it is important to note that these best estimates are not significantly different from zero and are not significant at the 5th confidence level. NHTSA seeks comments on its approach to estimating the effects of the standards on mass-safety.”
* PG350: “We believe that HDPUVs share many physical commonalities with light trucks and the incidence and crash severity are likely to be similar. As such, we concluded it was appropriate to use the light truck safety coefficients for HDPUVs. We seek comment on this assumption.”
* PG351: “NHTSA seeks comment on its safety assumptions and methodology, which is described in detail in Chapter 7 of the Draft TSD.”
* PG352: “MR in heavier vehicles is more beneficial to the occupants of lighter vehicles than it is harmful to the occupants of the heavier vehicles. MR in lighter vehicles is more harmful to the occupants of lighter vehicles than it is beneficial to the occupants of the heavier vehicles. To accurately capture the differing effect on lighter and heavier vehicles, NHTSA splits vehicles into lighter and heavier vehicle classifications in the analysis.”
* PG354: “NHTSA calculates the fatality risk of a vehicle based on the vehicle’s MY, age, and style, while controlling for factors that are independent of the intrinsic nature of the vehicle, such as behavioral characteristics. Using this same approach, NHTSA designed separate models for fatalities, non-fatal injuries, and property damaged vehicles. We seek comment on the fatality models in Chapter 7.1 of the Draft TSD.”
* PG355: “We seek comment on our general approach to modeling the impact of advance crash avoidance systems on safety and invite commenters to provide any additional empirical data and research that we can use to augment the analysis.”
* PG355: “As such, NHTSA believes a large portion of the safety risks associated with additional driving are offset by the benefits drivers gain from added driving. The level of risk internalized by drivers is uncertain. This analysis assumes that drivers of both HDPUV and LDVs internalize 90 percent of this risk, which mostly offsets the societal impact of any added fatalities from this voluntary consumer choice. Additional discussion of internalized risk is contained in Chapter 7.4 of the Draft TSD. NHTSA seeks comment on this assumption and asks commenters to provide any academic literature that may attempt to further illuminate this topic.”
* PG358: “One action alternative is less stringent than the Preferred Alternative for passenger cars and light trucks and two action alternatives are more stringent. The alternatives considered in this proposal for passenger cars and light trucks represent a reasonable range of possible agency actions.”
* PG358-359: “In a departure from recent CAFE rulemaking trends, we have applied different rates of increase to the passenger car and the light truck fleets. Rather than have both fleets increase their respective standards at the same rate, light truck standards will increase at a faster rate than passenger car standards. Each action alternative evaluated for this proposal has a passenger fleet rate-of-increase of fuel economy lower than the rate-of-increase of fuel economy for the light truck fleet.”
* PG359: “Because the CAFE statute prohibits us from considering BEVs and full PHEVs’ combined fuel economy, we believe manufacturers will find it difficult to improve fuel economy with ICE engine technologies beyond what we are proposing for passenger cars and maintain a reasonable cost.”
* PG360: “Our analysis shows that for light truck stringency increases, the value of fuel savings alone outweighs the increased regulatory cost. In short, there appears to be more room to improve the light truck fleet, and thus NHTSA has considered larger ongoing increases in stringency for this fleet compared to passenger cars, though still generally smaller increases than those finalized for MYs 2024-2026.”
* PG361: “Under each action alternative, the stringency changes at the same percentage rate in each MY in the rulemaking time frame. One action alternative is less stringent than the Preferred Alternative for HDPUVs, and one action alternative is more stringent. The alternatives considered in this proposal for HDPUVs represent a reasonable range of possible agency actions.”
* PG361: “NHTSA requests comment on the full range of standards encompassed between the No-Action Alternative and Alternative PC6LT8 for MYs 2027-2032 passenger cars and light trucks, including the possibility of setting standards in between the considered alternatives. NHTSA also requests comment on the full range of standards encompassed between the No-Action Alternative and Alternative HDPUV14 for MYs 2030-2035 HDPUVs, including the possibility of setting standards in between the considered alternatives.”
* PG362: “Foreseeably, NHTSA, EPA, and CARB will all be regulating simultaneously; manufacturers will be responding to those regulations as well as to foreseeable shifts in market demand during the rulemaking time frame (both due to cost/price changes for different types of vehicles over time, fuel price changes, and the recently-passed tax credits for BEVs and PHEVs).”
* PG371: “The No-Action Alternative also includes NHTSA’s estimates of ways that each manufacturer could introduce new PHEVs and BEVs in response to state ZEV mandates. To account for the ZEV programs, NHTSA has included the main provisions of the ACC II and ACT programs in the CAFE Model’s analysis of compliance pathways.”
* PG371-372: “The No-Action Alternative also includes NHTSA estimates of ways that manufacturers could take advantage of recently-passed tax credits for battery-based vehicle technologies. NHTSA explicitly models portions of two provisions of the IRA when simulating the behavior of manufacturers and consumers.”
* PG373: “NHTSA staff believe that manufacturers do at times improve fuel economy even in the absence of new standards, for several reasons.”
* PG375: “However, our compliance data show that at least some manufacturers do improve their fuel economy if fuel prices are high enough, even if they are not able to respond perfectly to fluctuations precisely when they happen. This highlights the importance of fuel price assumptions both in the analysis and in the real world on the future of fuel economy improvements.”
* PG376: “In addition to the No-Action Alternative, NHTSA has considered four “action” alternatives for passenger cars and light trucks, each of which is more stringent than the No Action Alternative during the rulemaking time frame.”
* PG376: “Alternative PC1LT3 would increase CAFE stringency by 1 percent per year, year over year, for MYs 2027-2032 passenger cars, and by 3 percent per year, year over year, for MYs 2027-2032 light trucks.”
* PG378: “Alternative PC2LT4 would increase CAFE stringency by 2 percent per year, year over year, for MYs 2027-2032 passenger cars, and by 4 percent per year, year over year, for MYs 2027-2032 light trucks.
* PG381: “Alternative PC3LT5 would increase CAFE stringency by 3 percent per year, year over year, for MYs 2027-2032 passenger cars, and by 5 percent per year, year over year, for MYs 2027-2032 light trucks.”
* PG384: “Alternative PC6LT8 would increase CAFE stringency by 6 percent per year, year over year, for MYs 2027-2032 passenger cars, and by 8 percent per year, year over year, for MYs 2027-2032 light trucks.”
* PG387: “While each of the Action Alternatives described below would establish increases in stringency from MY 2030 through MY 2035, NHTSA also requests comment on a scenario where these Action Alternatives would extend only through MY 2032, which coincides with the timeframe of the EPA proposed GHG standards for this vehicle segment.”
* PG388: “Alternative HDPUV4 would increase HDPUV standard stringency by 4 percent per year for MYs 2030-2035 HDPUVs. NHTSA included this alternative in order to evaluate a possible balancing of statutory factors in which cost-effectiveness outweighed all other factors.”
* PG390: “Alternative HDPUV10 would increase HDPUV standard stringency by 10 percent per year for MYs 2030-2035 HDPUVs.”
* PG392: “Alternative HDPUV14 would increase HDPUV standard stringency by 14 percent per year for MYs 2030-2035 HDPUVs.”
* PG394: “To estimate the potential effects of each of these alternatives, NHTSA has, as with all recent rulemakings, assumed that standards would continue unchanged after the last model year to be covered by proposed CAFE targets (in this case an augural MY, 2032).”
* PG396: “For this proposal, NHTSA estimates that manufacturers’ responses to standards defining each alternative could lead average fuel economy levels to increase through MY 2032, as shown in the following tables.”
* PG400: “The action alternatives show nearly the same BEV penetration rates as the No-Action Alternative, although in some cases there is a slight deviation, despite no new BEVs entering the fleet, due to rounding in some MYs where fewer vehicles are being sold in response to the proposed standards and altering fleet shares.”



* PG404: “NHTSA estimates that although projected fuel savings under the more stringent regulatory alternatives could tend to increase new vehicle sales, this tendency could be outweighed by the opposing response to higher prices, such that new vehicle sales could decline slightly under the more stringent alternatives.”
* PG405: “While these slight reductions in new vehicle sales tend to reduce projected automobile industry labor by small margins, NHTSA estimates that the cost increases could reflect an underlying increase in employment to produce additional fuel-saving technology, such that automobile industry labor could remain about the same under each of the four regulatory alternatives.”
* PG406: “Additionally, for purposes of calculating average fuel efficiency for HDPUVs, NHTSA considers EVs, fuel cell vehicles, and the proportion of electric operation of EVs and PHEVs that is derived from electricity that is generated from sources that are not onboard the vehicle to have a fuel efficiency value of 0 grams/mile.”
* PG407: “Manufacturers may bank credits from overcompliance in one year that may be used to cover shortfalls in up to five future MYs. Manufacturers may also carry forward credit deficits for up to three MYs. If a manufacturer is still unable to address the shortfall, NHTSA may assess civil penalties.”



* PG412: “In this accounting framework, the CAFE Model records costs and benefits for particular MYs in the LD fleet but also reports these measures over the lifetime of the vehicle and allows for the accounting of costs and benefits across calendar years.”
* PG413: “In the HDPUV FE analysis, where the proposed standard would continue until otherwise amended, we report only the costs and benefits across calendar years.”
* PG413: “. Manufacturers are directly regulated under the program and incur additional production costs when they apply technology to their vehicle offerings in order to improve their fuel economy. We assume that those costs are fully passed through to new car and truck buyers in the form of higher prices. We also assume that any civil penalties paid by manufacturers for failing to comply with their CAFE standards are passed through to new car and truck buyers and are included in the sales price.”
* PG413: “However, those civil penalties are paid to the U.S. Treasury, where they currently fund the general business of government. As such, they are a transfer from new vehicle buyers to all U.S. citizens, who then benefit from the additional federal revenue. While they are calculated in the analysis, and do influence consumer decisions in the marketplace, they do not directly contribute to the calculation of net benefits (and are omitted from the tables below).”
* PG413-414: “This analysis assumes that drivers of new vehicles internalize 90 percent of the risk associated with increased exposure to crashes when they engage in additional travel (as a consequence of the rebound effect).”
* PG414: “In addition to private benefits and costs—those borne by manufacturers, buyers, and owners of cars and light trucks—there are other benefits and costs from increasing CAFE standards that are borne more broadly throughout the economy or society, which NHTSA refers to as SCs.”
* PG415: “The associated benefits related to reduced health damages from criteria pollutants and the benefit of improved energy security are both significantly smaller than the associated change in GHG damages across alternatives.”
* PG415-416: “In the cases with the highest SCC-GHG DR (5%), net benefits are still positive in the lower stringent alternatives (PC1LT3 and PC2LT4) at a 3 percent social DR.”
* PG417: [HDPUV] “The choice of GHG DR also affects the resulting benefits and costs. As the tables show, net social benefits are positive for all alternatives, and are greatest when SC-GHG DRs of 2.5 or 3 percent are used.”
* PG419-420: “The size of the on-road fleet increases in later decades regardless of alternative, but the greatest on-road fleet size projection is seen in the baseline, with fleet sizes declining as the alternatives become increasingly more stringent.”
* PG420: “VMT increases occur in the two later decades, with the highest miles occurring from 2041-2050. Fuel consumption (measured in gallons or gasoline gallon equivalents) declines across both decades and alternatives as the alternatives become more stringent, as do GHG emissions.”
* PG421: “Gasoline consumption decreases over time, with the largest decreases occurring in more stringent alternatives. Electricity consumption increases over time, with the same pattern of Alternative PC6LT8 experiencing the highest magnitude of change.”
* PG422: “NHTSA estimates the GHGs attributable to the LD on-road fleet, from both vehicles and upstream energy sector processes (e.g., petroleum refining, fuel transportation and distribution, electricity generation). Figure IV-7, Figure IV-8, and Figure IV-9 present NHTSA’s estimate of how emissions from these three GHGs across all fuel types could evolve over the years. Note that these graphs include emissions from both downstream (powertrain and BTW) and upstream processes.”
* PG425: “Under each regulatory alternative, NHTSA projects a dramatic decline in annual emissions of NOX, and PM2.5 attributable to the LD on-road fleet between 2022 and 2050.”
* PG426: “On the other hand, as discussed in the PRIA Chapter 8.2 and Chapter 4 of the Draft EIS accompanying this notice, NHTSA projects that annual SO2 emissions attributable to the LD on road fleet could increase by 2050 in all of the alternatives, including the baseline, due to greater use of electricity for PHEVs and BEVs (See Figure IV-6). Differences between the action alternatives are modest. However, we also note that the adoption of actions that result in a cleaner electricity grid that reduces electricity generation emission rates below the projected levels underlying NHTSA’s analysis (discussed in the Draft TSD) could dramatically reduce SO2 emissions under all regulatory alternatives considered here.”
* PG431: “NHTSA estimates the same physical and environmental effects for HDPUVs as it does for LDVs, including: quantities of fuel and electricity consumption; tons of GHG emissions and criteria pollutants reduced; and health and safety impacts.”
* PG432: “Gasoline consumption decreases over time, with the largest decreases occurring in more stringent alternatives. Electricity consumption increases over time, with the same pattern of Alternative HDPUV14 experiencing the highest magnitude of change. In both charts, the differences in magnitudes across alternatives do not vary drastically.”
* PG436: “However, as for the LD analysis, we note that the adoption of actions that result in a cleaner electricity grid that reduces electricity generation emission rates below the projected levels underlying NHTSA’s analysis (discussed in the TSD) could dramatically reduce SO2 emissions under all regulatory alternatives considered here.”
* PG441: “For this reason, we do not interpret the sensitivity analysis as necessarily providing justification for alternative regulatory scenarios to be preferred. Rather, the analysis simply provides an indication of which assumptions are most critical, and the extent to which future deviations from central analysis assumptions could affect costs and benefits of the rule.”
* PG460: “EPCA, as amended by EISA, also requires another separate standard to be set for domestically manufactured513 passenger cars. Unlike the generally applicable standards for passenger cars and light trucks described above, the compliance obligation of the MDPCS is identical for all manufacturers.”
* PG463: “NHTSA is proposing to set separate standards for “spark ignition” (SI, or, gasoline-fueled) and “compression ignition” (CI, or, diesel-fueled) HDPUVs, consistent with the existing Phase 2 standards. Each class of vehicles has its own work-factor based target curve; alternative fueled vehicles are subject to the standard for CI vehicles and HEVs and PHEVs are subject to the standard for SI vehicles. We understand that EPA has proposed a single curve for all HDPUVs regardless of fuel type; NHTSA is not proposing to take this approach, for several reasons.”
* PG463: “And finally, NHTSA is more confident that, given the lead time concerns and the technologies anticipated to be required, retaining separate CI and SI curves will better balance NHTSA’s statutory factors for HDPUVs of cost-effectiveness and technological feasibility. We seek comment on this aspect of the proposal.”
* PG464: “As in previous rulemakings, NHTSA proposes to define the standards in the form of a constrained linear function that generally sets higher (more stringent) targets for smaller-footprint vehicles and lower (less stringent) targets for larger-footprint vehicles. As discussed above in Section II.B, NHTSA seeks comment on these aspects of the proposal.”
* PG464: “While NHTSA continues to believe that we do have authority to set such standards, we propose to address the concerns by setting light truck standards that increase at a more rapid rate, 4 percent year over year, than the 2-percent-per-year passenger car standards over the same timeframe. We believe that this will minimize regulatory complexity, as compared to creating entire new standards with which manufacturers would have to comply simultaneously, and it should achieve a similar aim of requiring the fleet that consumes more fuel – light trucks – to continue improving rather than backsliding. We seek comment on this approach.”
* PG465: “NHTSA proposes to continue to set work-factor based gallons-per-100-miles standards for HDPUVs for MYs 2027-2032.”
* PG466: “We seek comment on the value of presenting augural standards for MY 2032 as part of this action and including their presentation in the final rule. NHTSA notes that it also conducted a sensitivity analysis removing the augural year, MY 2032. The results of that sensitivity analysis showed slightly lower costs, benefits, and net benefits for each regulatory alternative, and no change in the relative ordering of net benefits amongst the alternatives.523 NHTSA tentatively concludes that the presentation of MY 2032 throughout these documents would not change our decision as to which alternative is maximum feasible.”
* PG467: “As a result, the standards previously set remain in effect indefinitely at the levels required in the last MY, until amended by a future rulemaking action.”
* PG468: “For this proposal, NHTSA has considered a wide range of technologies that improve fuel economy, while considering the need to account for which technologies have already been applied to which vehicle mode/configuration, as well as the need to estimate, realistically, the cost and fuel economy impacts of each technology as applied to different vehicle models/configurations.”
* PG470: “In evaluating economic practicability, NHTSA considers the uncertainty surrounding future market conditions and consumer demand for fuel economy alongside consumer demand for other vehicle attributes.”
* PG471: “While consumer acceptance of additional new vehicle cost associated with more stringent CAFE standards is uncertain, NHTSA still finds this metric useful for evaluating economic practicability.”
* PG473: “In many past CAFE rulemakings, NHTSA has said that it considers the adverse effects of other motor vehicle standards on fuel economy. It said so because, from the CAFE program’s earliest years535 until recently, compliance with these other types of standards has had a negative effect on fuel economy.”
* PG474: “here are differences between the two agencies’ programs that make NHTSA’s CAFE standards and EPA’s GHG standards not perfectly one-to-one (even besides the fact that EPA regulates other GHGs besides CO2, EPA’s CO2 standards also differ from NHTSA’s in a variety of ways, often because NHTSA is bound by statute to a certain aspect of CAFE regulation). NHTSA creates standards that meet our statutory obligations, including through considering EPA’s standards as other motor vehicle standards of the Government.
* PG475: “Because the EPA and NHTSA programs were developed in coordination, and stringency decisions were made in coordination, NHTSA has not incorporated EPA’s proposed CO2 standards for MYs 2027-2032 as part of the analytical baseline for this proposal’s main analysis. NHTSA recognizes that the proposed CAFE standards thus sit alongside EPA’s light-duty vehicle multipollutant emission standards that were proposed in April. NHTSA’s intention is to finalize regulations that achieve energy conservation per its statutory mandate and consistent with its statutory constraints, that work in harmony with EPA’s regulations addressing air pollution. NHTSA believes that these statutory mandates can be met while ensuring that manufacturers have the flexibility they need to achieve cost-effective compliance. Between proposed and final rules, NHTSA will continue to coordinate with EPA to optimize the effectiveness of NHTSA’s standards while minimizing compliance costs, informed by public comments from all stakeholders and consistent with the statutory factors.”
* PG475-476: “In so doing, we are not taking a position on whether or not these programs are preempted under EPCA, nor does NHTSA even have authority to make such determinations with the force of law. NHTSA is also not taking a position on whether these regulatory requirements are or are not other motor vehicle standards of the Government; in either event, it is still appropriate to include these requirements in the regulatory baseline because they are foreseeable legal obligations applying to the automakers during the rulemaking time frame and are therefore relevant to understanding the state of the world absent any further regulatory action by NHTSA.”
* PG478: “As the reliance on electricity grows in the LD fleet, NHTSA will continue to monitor the trends in electricity prices and their implications, if any, for CAFE standards.”
* PG483: “As a result, electrification contributes meaningfully to the decarbonization of the transportation sector, in addition to having additional environmental, health, and economic development benefits, although these benefits may not yet be equally distributed across society. They also present new environmental (and social) questions, like the consequences of upstream electricity production, minerals extraction for battery components, and ability to charge an EV.”
* PG487: “The effect of the prohibitions against considering these statutory flexibilities (like the compliance boosts for dedicated and dual-fueled alternative vehicles, and the use and availability of overcompliance credits) in setting the CAFE standards is that NHTSA cannot set standards that assume the use of these flexibilities in response to those standards – in effect, that NHTSA cannot set standards as stringent as NHTSA would if NHTSA could account for the availability of those flexibilities.”
* PG493: “NHTSA has further clarified that the consideration of technological feasibility “does not mean that the technology must be available or in use when a standard is proposed or issued.” Consistent with these previous interpretations, NHTSA believes that a technology does not necessarily need to be currently available or already in use for all regulated parties to be “technologically feasible” for these proposed standards, as long as it is reasonable to expect, based on the evidence before us, that the technology will be available in the MY in which the relevant standard takes effect.”
* PG503: “Relative to the CAFE No-Action Alternative, the modeling results suggest NOX, PM2.5, and SO2 emissions increases in 2035 get larger from Alternative PC1LT3 through Alternative PC6LT8 (the most stringent alternative in terms of estimated required mpg). The increases in NOX, PM2.5, and SO2 emissions reflect the projected increase in EV use in the later years, which would result in greater emissions from fossil-fueled power plants to generate the electricity for charging the EVs even as the electric grid that charges EVs gets progressively cleaner in later years.”
* PG504: “NOX emissions decrease under Alternatives PC1LT3 and PC2LT4 but increase under Alternatives PC3LT5 and PC6LT8, compared to the CAFE No-Action Alternative. SO2 emissions decrease under Alternative PC1LT3 but increase under Alternatives PC2LT4 through PC6LT8, and the increases get larger from Alternative PC2LT4 through Alternative PC6LT8.”
* PG504: “SO2 increases are largely due to higher upstream emissions associated with electricity use by greater numbers of electrified vehicles being produced in response to the standards.”
* PG505: “In 2050, emissions of NOX and SO2 increase under all HDPUV FE standard action alternatives compared to the HDPUV FE No-Action Alternative, and the increases get larger from Alternative HDPUV4 through Alternative HDPUV14.”
* PG507: “In 2035, emissions of NOX, PM2.5, and SO2 increase under the CAFE and HDPUV FE alternative combinations compared to the No-Action Alternatives, while emissions of CO and VOCs decrease.”
* PG508: ‘Under each CAFE and HDPUV FE alternative combination compared to the No-Action Alternatives, the largest relative increases in emissions among the criteria pollutants would occur for SO2, for which emissions would increase by as much as 15.2 percent under Alternatives PC6LT8 and HDPUV14 in 2035, compared to the No-Action Alternatives.”
* PG508: “Toxic air pollutant emissions across the CAFE and HDPUV FE alternative combinations remain the same or decrease in 2035 and 2050, relative to the No-Action Alternatives.”
* PG524: “NHTSA believes that a large percentage of the fleet will remain propelled by ICEs through 2032, despite the potential significant transformation being driven by reasons other than the CAFE standards.”
* PG525: “Although Alternatives PC3LT5 and PC6LT8 would conserve more energy and provide greater fuel savings benefits and carbon dioxide emissions reductions, NHTSA currently estimates that those alternatives may simply not be achievable for many manufacturers in the rulemaking time frame, particularly given NHTSA’s statutory restrictions on the technologies we may consider when determining maximum feasible standards.”
* PG526: “In contrast to Alternatives PC3LT5 and PC6LT8, Alternative PC2LT4 comes at a cost we believe the market can bear, appears to be much more achievable, and will still result in consumer net benefits on average. The proposed alternative also achieves large fuel savings benefits and significant reductions in carbon dioxide emissions. NHTSA tentatively concludes Alternative PC2LT4 is a better choice than PC3LT5 and PC6LT8 given these factors.”
* PG528: “However, both relative and absolute effects for NOX, PM2.5, and SOX under each regulatory alternative are quite small in the context of overall U.S. emissions of these pollutants, and even in the context of U.S. transportation sector emissions of these pollutants.”
* PG528 (Footnote 5780: “We note also that some of the increase in certain pollutants, notably SOX, results from estimated increases in electricity usage over time, as a result of greater electrification in the fleet, both in the baseline/No-Action Alternative and in the later years of the rulemaking analysis, 2040-2050. While 49 U.S.C. 32902(h) prohibits NHTSA from considering the fuel economy of BEVs and the electric-only-operation fuel economy of PHEVs during the rulemaking time frame, NHTSA believes it would be remiss to fail to account for the emissions consequences of the energy consumed to power those vehicles. Fuel economy and emissions consequences are actually different things for purposes of this proposal and analysis – fuel economy is simply an input to calculating manufacturer compliance positions, while emissions are estimated based on estimated on-road vehicle use. Emissions are affected by fuel economy, but they are not literally fuel economy.”
* PG530: “One important question would be how fast that consumer acceptance of advanced technologies grows, which is difficult to know in advance with much certainty. If consumer acceptance is outpaced by technological developments, it is possible that there could be sales impacts unforeseen by our analysis, and thus not accounted for in our decision-making.”
* PG531: “When excluding various forms of electrification, we believe that more stringent standards may not be technologically feasible. NHTSA seeks comment on this question. NHTSA also notes that whether or not such standards would be technologically feasible, they would likely not be economically practicable (and thus beyond maximum feasible).”
* PG532: ‘Alternative PC2LT4 would require strong hybrids to increase by 8 percentage points by MY 2032, would decrease advanced engines by a similar amount, and would increase advanced MR by 19 percentage points.”
* PG534: “Alternative PC2LT4 would require strong hybrids to increase by 18 percentage points by MY 2032, would increase PHEVs580 by 13 percentage points, would decrease advanced engines by 25 percentage points, and would increase advanced MR by 38 percentage points.”
* PG535: “The effects of this baseline application of technology are not attributable to this action, and NHTSA has therefore excluded these from our estimates of the incremental technology application, benefits, and costs that could result from each action alternative considered here.”
* PG540: “It should be clear from the tables above that results vary by manufacturer, by year, and by fleet. NHTSA typically considers average results for a metric like per-vehicle cost, in part because NHTSA has typically approached economic practicability as a question for the industry as a whole, such that standards can still be maximum feasible even if they are harder for some manufacturers than others.”
* PG541: “Looking at average costs, with $1,205 for passenger cars and $1,795 for light trucks by MY 2032, PC3LT5 may be more likely to be economically feasible. However, average results may be increasingly somewhat misleading as manufacturers transition their fleets to the BEVs whose fuel economy NHTSA is prohibited from considering when setting the standards. This is because fuel economy in the fleet has historically been more of a normal distribution (i.e., a bell curve), and with more and more BEVs, it becomes more of a bimodal distribution (i.e., a two-peak curve). Attempting to average a bimodal distribution does not necessarily give a clear picture of what non-BEV-specialized manufacturers are capable of doing, and regardless, NHTSA is directed not to consider BEV fuel economy. Thus, in this proposal, NHTSA believes it is appropriate to examine individual manufacturer results more closely.”
* PG544: “For some companies that NHTSA judges willing to pay civil penalties in lieu of compliance, usually based on past history of penalty payment, NHTSA assumes that they will do so as soon as it becomes more cost-effective to pay penalties rather than add technology. For other companies whom NHTSA judges unwilling to pay civil penalties, if they have converted all vehicles available to be redesigned in a given MY to SHEV or PHEV and still cannot meet the required standard, then NHTSA does not assume that these companies will break redesign or refresh cycles to convert even more (of the remaining ICE) vehicles to SHEV or PHEV. In these instances, a manufacturer would be “in shortfall” in NHTSA’s analysis.”
* PG544: “Shortfall rates can also be informative for determining economic practicability, because if manufacturers simply are not achieving the required levels, then that suggests that manufacturers have generally judged it more cost-effective not to comply by adding technology. Moreover, the standards would not be accomplishing what they set out to accomplish, which would mean that the standards are not meeting the need of the U.S. to conserve energy as originally expected.”
* PG547: “For passenger cars, the industry average again obscures more serious shortfall trends among individual manufacturers… Given all of the data examined, NHTSA believes that PC2LT4 may represent the upper limit of economic practicability during the rulemaking time frame.”
* PG547-548: ‘While we estimate that the per-vehicle costs and technology penetration rates of Alternative PC2LT4 are reasonable, and while our analysis suggests that it maximizes net benefits in the rulemaking time frame given our statutory restrictions, we note that it produces a slight decline in new vehicle sales (less than 1 percent through MY 2032) as compared to the No-Action Alternative, as a consequence of the higher retail prices that result from additional technology application.”
* PG548: “On the one hand, when fewer vehicles are sold, manufacturers require fewer labor hours to satisfy demand, but on the other hand, development and deployment of new fuel-economy-improving technologies increase demand for labor.”
* PG550: “Looking simply at the effects for consumers, our analysis suggests that there is no action alternative (again, in the context of the standard-setting analysis) in which private benefits will outweigh private costs for passenger cars, although PC1LT3 and PC2LT4 are the most beneficial, relatively speaking. For light trucks, all of the action alternatives appear net beneficial for consumers, with PC2LT4 and PC6LT8 being the most beneficial.”
* PG561: “NHTSA is statutorily prohibited from considering the fuel economy of BEVs in determining maximum feasible stringency but notes in passing that the case changing the value of DOE’s PEF reduces net benefits somewhat, although not significantly, and that changing assumptions about the value of electrification tax credits that reach consumers reduces net benefits significantly.”
* PG562: “Finally, as discussed in Section IV.A, NHTSA accounts for the effects of other motor vehicle standards of the Government in its balancing, often through their incorporation into our regulatory baseline… Regardless of which agency’s standards are binding given a manufacturer’s chosen compliance path, manufacturers will choose a path that complies with both standards, and in doing so, will still be able to build a single fleet of vehicles – even if it is not exactly the fleet that the manufacturer might have preferred to build. This remains the case with this proposal.”
* PG562: “NHTSA does not believe that it is a reasonable interpretation of Congress’ direction to set “maximum feasible” standards, as some commenters might prefer, at the fuel economy level at which no manufacturer need ever apply any additional technology or spend any additional dollar beyond what EPA’s standards, with their many flexibilities, would require.”
* PG563: “If NHTSA could not account for the ACC2 program, and could not be informed about the baseline effects, then NHTSA could overestimate the availability of vehicles that can be improved to meet potential new CAFE standards, and thus end up setting a fuel economy standard that requires an infeasible level of improvement. Moreover, as the “No ZEV” sensitivity case shows, the effect of including the ACC2 program in the baseline is simply to decrease costs and benefits attributable to potential future CAFE standards.”
* PG566: “CAFE standards can still help industry complete that journey, and as such, based on all of the information contained in this record, NHTSA tentatively concludes that PC2LT4 represents the maximum feasible standards for passenger cars and light trucks in the MYs 2027 to 2032 time frame. We seek comment on this tentative conclusion and all aspects of this discussion.”
* PG566: “NHTSA’s distinct statutory authority for setting HDPUV standards, expanding BEV technologies are part of NHTSA’s standard setting consideration.”
* PG567: “NHTSA is aware that some historic Light truck applications now being offered as BEVs may be heavy enough to fall outside the Light Truck segment and into the HDPUV segment,594 but NHTSA expects manufacturers to find strategies to return them to the CAFE Light Truck fleet in the coming years… However, until these technologies materialize, NHTSA assumes in its analysis there will continue to be ‘spill-over’ of vehicles that exist as edge cases.”
* PG575: “As discussed earlier, the HDPUV fleet is a smaller fleet compared to passenger cars and light trucks, and so for a manufacturer to meet standards that are more or less stringent, they must transition a relatively larger portion of that smaller fleet to new technologies. Thus, under many comparisons, HDPUV10 appears the most cost-effective; under others, HDPUV4 appears the most cost-effective.”
* PG578: “NHTSA also recognizes that these baseline technology penetration rates result from our assumptions about battery costs and available tax credits, among other things.”
* PG581: “Again, it is clear that a great deal of technology application is expected in response to the baseline, as evidenced by the fact that technology penetration rates for most manufacturers do not change between alternatives.”
* PG581-582: “Additionally, NHTSA is allowed to consider banked overcompliance for the HDPUV fleet, as well as the full fuel efficiency of AFVs like BEVs and PHEVs. Combined with the fact that BEVs and the electric operation of PHEVs are granted 0 gal/100 miles fuel consumption for compliance purposes, our analysis shows that even with one redesign we see large improvements in the fleet even at low volumes. Based on the information before us, NHTSA cannot conclude that technological feasibility is necessarily a barrier to choosing any of regulatory alternatives considered in this proposal.”
* PG588: “We are seeking comment on the assignment of 0 gal/100 miles value for HDPUV BEV compliance. Any change to this value would change the appearance of overcompliance in NHTSA’s analysis, and this is another potential reason to be conservative in our proposal.”
* PG588: “or these reasons, NHTSA is proposing HDPUV10 for MYs 2030-2035 HDPUVs. We seek comment on this tentative conclusion, on the feasibility of HDPUV10 in light of the regulatory analysis, and on all aspects of this discussion, including whether and how standards more closely aligned with EPA’s standards for these vehicles would be appropriate and maximum feasible for NHTSA to adopt for the model years subject to this rulemaking.”
* PG592: “As mentioned above, there are three primary components to NHTSA’s compliance program: (1) determining compliance; (2) using flexibilities and incentives; and (3) paying civil penalties for shortfalls.”
* PG594: “Proposed changes to 49 CFR 531.6 and 533.6 to eliminate AC efficiency FCIVs for BEVs starting in MY 2027.”
* PG594: “Proposing changes to 49 CFR 531.6 and 533.6 to eliminate off-cycle menu FCIVs for BEVs and to eliminate the 5- cycle and alternative approvals starting in MY 2027. PHEVs retain benefits. Proposing a 60-day response deadline for requests for information regarding off cycle requests for MY 2025-2026.”
* PG596: “At the end of each MY NHTSA confirms whether a manufacturer's fleet average performance for each of its fleets of LDVs exceeds the applicable target-based fleet standard. NHTSA makes its ultimate determination of a manufacturer’s CAFE compliance obligation based on official reported and verified CAFE data received from EPA.”
* PG597-598: “If a manufacturer’s fleet fails to meet a fuel economy standard, NHTSA will provide written notification to the manufacturer that it has not met the standard. The manufacturer will be required to confirm the shortfall and must either submit a plan indicating how to allocate existing credits, or if it does not have sufficient credits available in that fleet, how it will address the shortfall either by earning, transferring and/or acquiring credits or by paying the appropriate civil penalty. The manufacturer must submit a plan or payment within 60 days of receiving agency notification. Credit allocation plans received from the manufacturer will be reviewed and approved by NHTSA. NHTSA will approve a credit allocation plan unless it finds the proposed credits are unavailable or that it is unlikely that the plan will result in the manufacturer earning sufficient credits to offset the shortfall.”
* PG598: “Two general types of flexibilities that exist for the CAFE program include (1) FCIVs that can be used to increase CAFE values; and (2) credit flexibilities. To provide context for the changes NHTSA is proposing, a discussion of two types of FCIVs is provided below. These credits are for the addition of technologies that improve air/conditioning efficiency (AC FCIVs) and other “off-cycle” technologies that reduce fuel consumption that are not accounted for in the 2-cycle testing (OC FCIVs). NHTSA is not proposing any changes to credit flexibilities.”
* PG599: “Manufacturers can improve the efficiency of AC systems through redesigned and refined AC system components and controls. These improvements, however, are not measurable or recognized using 2-cycle test procedures because the AC is turned off during the CAFE compliance 2-cycle testing. Any AC system efficiency improvements that reduce load on the engine and improve fuel economy, therefore, cannot be accounted for in those tests.”
* PG600: “If a vehicle has more than one thermal load improvement technology, the improvement values are added together, but subject to a cap of 3.0 grams/mile for cars and 4.3 grams/mile for trucks. Manufacturers seeking FCIVs beyond the regulated caps may request the added benefit for AC technology under the off-cycle program.”
* PG601: “For determining FCIV benefits, EPA and NHTSA created three compliance pathways for the off-cycle program: (1) menu technologies, (2) 2 to 5-Cycle Testing, and (3) an alternative approval methodology. Manufacturers may generate off-cycle credits or improvements through the EPA and NHTSA approved menu pathway without agency approval.”
* PG601: “For off-cycle technologies both on and off the pre-defined technology list, EPA allows manufacturers to use 5-cycle testing to demonstrate off-cycle improvements.”
* PG603: “Starting in MY 2023, the penalty, as adjusted for inflation by law, is $16 for each tenth of a mpg that a manufacturer’s average fuel economy falls short of the standard multiplied by the total volume of those vehicles in the affected fleet (i.e., import passenger vehicles, domestic passenger vehicles, or light trucks), manufactured for that MY.”
* PG603: “A person that violates Section 32911(a) of title 49 is liable to the United States Government for a civil penalty of not more than $49,534 for each violation. A separate violation occurs for each day the violation continues. These penalties apply in cases in which NHTSA finds a violation outside of not meeting CAFE standards, such as those that may occur due to violating information request or reporting requirements as specified by Congress or codified in NHTSA’s regulations.”
* PG606: “Proposed technical amendments to accurately reflect changes contemplated by 2016 final rule establishing requirements for Phase 2. The multiplier for advanced technology credits ends after MY 2027.”
* PG606: “Proposed changes to eliminate innovative and off-cycle technology credits for heavy-duty pickup trucks and vans.”
* PG607: “: Proposed technical amendment to reflect, as intended in the 2016 Phase 2 rule that advanced technology credits may not be transferred across averaging sets for Phase 2 and beyond.”
* PG609-610: “Compliance with the fleet average standards is determined using 2-cycle test procedures. However, manufacturers may also earn credits for the addition of technologies that result in real-world fuel improvements that are not accounted for in the 2-cycle testing. If the fleet average performance exceeds the standard, the manufacturer complies for the MY. If the manufacturer’s fleet does not meet the standard, the manufacturer may address the shortfall by using a credit flexibility equal to the credit shortage in the averaging set. The averaging set balance is equal to the balance of earned credits in the account plus any credits that are traded into or out of the averaging set during the MY.”
* PG610: “Manufacturers may improve fleet averages by (1) earning fuel consumption incentive benefits and by (2) transferring or trading in credits that were earned through overcompliance with the standards. First, as mentioned above, manufacturers may earn credits associated with fuel efficiencies that are not accounted for in the 2-cycle testing. Second, manufacturers may transfer credits into like fleets (i.e., averaging sets) from other manufacturers through trades.”
* PG610: “Unlike the LDV program, there is no AC credit program for HDPUVs. Currently, these vehicles may only earn fuel consumption improvement credits through an off-cycle program, which may include earning credits for AC efficiency improvements. In order to receive these credits, manufacturers must submit a request to EPA and NHTSA with data supporting that the technology will result in measurable, demonstrable, and verifiable real-world CO2 emission reductions and fuel savings.”
* PG611: “Manufacturers may transfer in credits from past (carry-forward credits) MYs of the same averaging set. Manufacturers may also trade in credits earned by another manufacturer, as long as the credits are traded into the same averaging set/fleet type. Manufacturers may not transfer credits between LD CAFE fleets and HD fleets. Likewise, a manufacturer cannot trade in credits from another manufacturer’s LD fleet to cover shortfalls in their HD fleets.”
* PG612-613: “Therefore, NHTSA’s maximum civil penalty for a manufacturer would be calculated as the: Aggregate Maximum Civil Penalty for a Non-Compliant Regulatory Category = (CAA Limit) × (production volume within the regulatory category). This approach applies for all HD vehicles including pickup trucks and vans as well as engines regulated under NHTSA’s fuel consumption programs.”
* PG613: “Beginning in MY 2027, NHTSA proposes to eliminate eligibility to gain FCIVs for any vehicles that do not have IC engines. Thus, BEVs would no longer be eligible for these credits after MY 2026. NHTSA believes that eliminating AC and OC FCIVs is appropriate because BEVs are currently generating credits in a program designed to provide credits based on reductions in emissions and fuel consumption of IC engine vehicles.”
* PG614: “Therefore, NHTSA is proposing to end off-cycle and AC efficiency FCIVs for LDVs with no IC engine beginning in MY 2027. NHTSA is seeking comments on this proposal.”
* PG614: “Additionally, in light of its proposal to eliminate FCIVs for BEVs, NHTSA is seeking comment on whether it should propose adjusting FCIVs for PHEVs based on utility factor for the portion only operated by IC engine.”
* PG614: “NHTSA is requesting comment on whether it should propose reducing FCIVs for PHEVs proportional to the estimated percentage of VMT that the vehicles would be operated as EVs.”
* PG616: ‘Therefore, NHTSA is requesting comment on whether it should phase out FCIVs for off-cycle technologies for ICE vehicles. Alternatively, NHTSA is requesting comment on whether it should propose new values for off-cycle technologies that are more representative of the real-world fuel savings provided by these technologies, and if so, how NHTSA should calculate the appropriate values for these technologies.”
* PG616: “NHTSA is proposing to eliminate both the 5-cycle pathway and the alternative pathway for off-cycle FCIVs for LDVs starting in MY 2027. NHTSA is proposing this change because we do not believe that the benefit to manufacturers is significant enough to justify that the programs require a significant amount of time and resources to be committed to reviewing and approving requests.”
* PG616: ‘Therefore, NHTSA proposes to eliminate 5-cycle pathway, starting in MY 2027 for earning off-cycle fuel economy improvements. NHTSA is seeking comments on this proposal.”
* PG618: “Therefore, NHTSA proposes to eliminate the alternative approval process for earning off-cycle fuel economy improvements starting in MY 2027. NHTSA is seeking comments on this proposal.”
* PG618: “NHTSA is also requesting comment on eliminating OC FCIVs for BEVs if NHTSA does not eliminate OC FCIVs for all HDPUVs.”
* PG618: “For MY 2025 and MY 2026, NHTSA is proposing to create a time limit to respond to requests for information regarding request for OC petitions for LDVs… NHTSA proposes to create a deadline of 60 days for responding to requests for additional information regarding OC petitions.”
* PG620: “NHTSA is now correcting the regulations to clarify that for Phase 2, advanced technology credits may be increased by the corresponding multiplier through MY 2027.”
* PG620: “In the interim and until the proposed technical amendment is implemented, there is no multiplier for advanced technology credits for Phase 2. However, NHTSA will permit manufacturers to use the larger multipliers with the condition that if they choose to do so, they will not be permitted to transfer the increased advanced technology credits across averaging sets.”
* PG621-622: “Specifically, NHTSA is proposing to make the following technical amendments:
	+ Change references to Section 502 of the Motor Vehicle Information and Cost Savings Act to the appropriate codified provision (i.e., 49 U.S.C. 32901 or 32902) in 49 CFR 531.1, 531.4, 533.1, 533.4, 535.4, 537.3, and 537.4.
	+ Amend § 531.4 to include a definition for “domestically manufactured passenger automobile” which references 49 U.S.C. 32904(b)(3) and 40 CFR 600.511-08.
	+ Amend § 531.5 to correct a cross reference to the provision containing NHTSA’s standards for low-volume motor vehicles (found in 49 CFR 531.5(e)) and to include references to the provision as appropriate.
	+ Amend § 535.4 to correct a typographical error to change “Alterers” to “Alterer.”
	+ Amend § 535.7(b)(2) to correct a cross-reference to the EPA provision’s provision regarding fuel consumption values for advanced technologies. f. Amend § 537.2 to correct a typographical error. g. Amend § 537.3 to end the reporting requirements in (c)(7)(iii) end after MY 2027 to coincide with the sunset date for FCIVs for advanced full-size pickup trucks.””