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Hearing Title: Midterm Review and an Update on the Corporate Average Fuel Economy Program and Greenhouse Gas Emissions Standards for Motor Vehicles

Joint Hearing of Subcommittee on Commerce, Manufacturing, and Trade and the Subcommittee on Energy and Power, U.S. House of Representatives

Date: Thursday, September 22, 2016

My name is John D. Graham. I am Dean of the School of Public and Environmental Affairs (SPEA) at Indiana University (IU) where I also teach public policy analysis and conduct research on regulatory reform issues. From 2001 to 2006, I served as Administrator of the Office of Information and Regulatory Affairs (OIRA) at the White House Office of Management and Budget (OMB). In that capacity, I chaired the federal interagency task force that rejuvenated the Corporate Average Fuel Economy (CAFE) Program. CAFE regulations of the auto sector had been subject to a congressional freeze for almost a decade, starting in 1996.

At the direction of President George W. Bush, I helped develop a plan that raised the light truck CAFE standards for model years 2005-2011 and reformed the program to set standards based on vehicle size (measured as vehicle footprint). The "footprint" reform was designed primarily to minimize any potential adverse safety effects of CAFE (Graham, 2008), but that same reform seems to have built stronger industry acceptance of the program, possibly by spreading the compliance costs of the program more evenly across vehicle manufacturers. After I left the White House in 2006, President Bush worked with the Congress to develop a more comprehensive legislative reform of the CAFE program (Graham, 2010, 176-179), and that law is now being implemented by President Obama and his team at the Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA). President Bush's unexpected role as champion of CAFE is explored in my 2010 book (Graham, 2010, Chapter 6, 163-193), *Bush on the Home Front: Domestic Policy Triumphs and Setbacks* (Indiana University Press, 2010).

If Congress were to enact an economy-wide fee on greenhouse gas emissions, the EPA, NHTSA,

and California regulations we are discussing today might not be necessary. But, in the absence of an appropriate greenhouse gas fee or an equivalent rise in the federal gasoline tax, I support the retention and refinement of federal performance standards for fuel economy and/or greenhouse gases. I am also pleased that the Obama administration is devoting substantial resources to the "midterm review" of the model year 2022-2025 federal standards. In my new book (Graham, 2016) on President Obama's domestic policies, *Obama on the Home Front: Domestic Policy Triumphs and Setbacks* (Indiana University Press, 2016), I argue that President Obama's automotive policies -- though less publicized than the Affordable Care Act -- are among his most significant achievements.

The draft Technical Assessment Report (TAR) (EPA/DOT/CARB, 2016), which is one of the most complex and detailed regulatory documents I have ever read, is now available for public comment and will inform U.S. and California regulators during the next presidential administration. I would like to praise the efforts of the career civil servants and contractors who participated in the production of the draft TAR. It is far from a perfect document but it contains a massive amount of detailed engineering and economic information, and merits careful consideration by stakeholders, regulators, and legislators. Frankly, I wish the federal government would reconsider their recent decision against an extended period of public comment on this crucial document. Given the immense complexity of the draft TAR and the near-term demands on my time, I will not be able to comment on it.

With financial support from the Alliance of Automobile Manufacturers, a team of us at IU-SPEA are now exploring the cumulative macroeconomic effects of several regulatory programs:

NHTSA's Corporate Average Fuel Economy standards, EPA's greenhouse gas standards, California's greenhouse gas standards, and California's Zero-Emission Vehicle (ZEV) requirements. All of these programs impact the automotive industry, from vehicle manufacturers and their suppliers to car dealers and consumers. We issued a preliminary report earlier this year (Carley et al, 2016), which is now publicly available for comment, and we intend to issue our final report early next year. The testimony I shall offer today, while it draws insights from our preliminary report, represents my views alone. The opinions I express should not be attributed to the Alliance, SPEA, IU or my co-authors.

In my testimony today, I would like to focus on a crucial issue that has not yet received adequate attention in the mid-term review: the unexplored interaction of the California ZEV program with the EPA and NHTSA programs. Let me emphasize that I am not referring to the California GHG standards, which the Obama administration and California have artfully subsumed within the EPA and NHTSA programs -- at least temporarily. I am referring to the California ZEV requirements for model years 2018-2025, requirements that were established in early 2012 and are now under a separate review at the California Air Resources Board (CARB) (CARB, 2016). CARB has a strong track record in technology-forcing regulation, and historically has rivaled EPA as a producer of effective emissions-control regulations (Carley et al, 2011).

1. What Is the California ZEV Program?

Under California law, a ZEV has zero emissions of pollutants from the tailpipe during motor vehicle operation. Plug-in electric vehicles such as the Nissan Leaf and the Tesla Model S are

ZEVs. A plug-in hybrid electric vehicle (PHEV), such as the Chevrolet Volt, is considered a "transitional" ZEV (TZEV) under California law: it is powered by the combination of gasoline and electricity and therefore has some residual tailpipe emissions. The implication of the word "transitional" is that CARB is allowing PHEVs only for a limited period of time, which signals to automakers the need to invest resources in BEVs and/or FCVs, or what CARB calls "pure ZEVs" (CARB, 2016). A key question for CARB is how PHEVs should be handled in future compliance credit formulas, since some studies suggest PHEVs are actually more cost-effective investments for society than BEVs (Michalek et al, 2011).

The ZEV program was authorized in the 1990 Clean Air Act Amendments as a tool to help California achieve compliance with EPA's health-based standards for ozone, particulate matter, and other local air pollutants. Replacing gasoline vehicles with ZEVs was seen as a tool to help southern California and other smog-ridden cities accelerate their progress toward clean-air attainment. The 2023 and 2032 EPA compliance deadlines for ozone nonattainment in the South Coast and San Joaquin regions of California may require significant use of PEVs by motorists (EEE Inc., 2014, 27). Thus, the ZEV program was not originally seen as a greenhouse gas (GHG) program to address global climate change.

Following a 2008 public hearing where the climate rationale for ZEV was first advanced, CARB reengineered the ZEV program as part of California's ambitious efforts to slash GHG emissions from the state's economy (CARB, 2012). In 2012 CARB set a goal of 100% ZEV sales in the State by 2040-2050 to help combat global climate change (CARB, 2012). In 2016 CARB refined those goals with a target of 40% ZEV penetration by 2030 and 100% by 2050 (CARB,

2016).

Basically, the ZEV program requires that any vehicle manufacturer doing significant business in California must distribute for sale a certain number of ZEVs that corresponds to a specified number of ZEV credits. CARB has published a schedule of how many ZEV credits are earned by vehicles of different design. If a manufacturer does not earn those credits, they must purchase them from another manufacturer, pay fines, and/or an enforcement action can be taken against the company (which could mean that the company's ability to sell vehicles in California may be jeopardized).

As a practical matter, CARB believes that vehicle manufacturers will comply with the ZEV requirements primarily by offering a mix of plug-in battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (CARB, 2011). BEVs and PHEVs, together, are generally referred to as plug-in electric vehicles (PEVs). Some manufacturers, such as Toyota, may instead offer hydrogen fuel-cell vehicles (FCVs), and the State of California is taking steps to create a limited hydrogen refueling infrastructure. Conventional hybrid-electric vehicles (without a plug-in feature), such as the Toyota Prius, are no longer eligible for compliance credits under the ZEV program.

In 2012 EPA awarded CARB the necessary waiver under the Clean Air Act to implement the ZEV program (EPA, 2012). However, EPA did not support its waiver decision with any cost-benefit analysis, perhaps in part because Congress in 1990 did not compel such an analysis for waiver decisions. In 2011 CARB released a cost-benefit analysis to support the ZEV

requirements (CARB, 2011) but that analysis was prepared from California's perspective (i.e., it did not address benefits and costs in other states or other regions of the country), and the CARB analysis would not likely have passed muster had it been reviewed by OMB analysts under OMB Circular A-4. For a more detailed critique of CARB's cost-benefit analysis of the ZEV program, see my 2012 House testimony prepared for the Judiciary Committee's Subcommittee on Courts, Commercial and Administrative Law (Graham, 2012).

For the automotive industry, the California ZEV program may become a much larger regulatory challenge than the NHTSA and EPA requirements for fuel economy and greenhouse gas control. Although the estimated costs of producing a ZEV appear to be declining rapidly due to advances in technology and production processes (Carley et al, 2016), a ZEV remains quite expensive to produce (i.e., the cost premium can be more than $10,000 per vehicle) compared to a gasoline-powered vehicle (National Research Council, 2015a). ZEVs also require construction of new infrastructure for motorists to recharge the batteries or refuel their hydrogen tank. Despite these challenges, CARB projected in 2012 that the ZEV regulation would result in about 15.4% of new vehicles sold in California in 2025 being BEVs, PHEVs or FCVs (CARB, 2012). More recently, CARB updated the 2025 penetration rate to 18% (CARB, 2016, Table 15, 166).

Some automakers have amassed a large supply of unused ZEV credits from earlier years when CARB awarded credits for conventional hybrids such as the Toyota Prius. Other automakers have relatively few unused credits and face challenging near-term compliance obligations in California. The ZEV program is structured so that start-up makers of PEVs (e.g., Tesla and other PEV start-up companies) can earn ZEV credits and sell them to other automakers who need them. The selling of ZEV credits appears to be a significant feature of Tesla's business model,

and Tesla executives have publicly advocated that CARB should enact even more stringent ZEV requirements in the near future (Edelstein, 2015; Knittel, 2014). A recent study commissioned by the Natural Resources Defense Council is also recommending that the ZEV program be made more stringent than it is today, in part because Tesla's potential commercial success could take other automakers off the hook to produce PEVs (Shulock, 2016).

2. How Have Nine Other States Joined the California ZEV Program?

The Clean Air Act amendments of 1990 do not allow each of the 50 states to enact their own vehicle emission standards. However, individual states are allowed to copy California standards if they prefer them to EPA standards. Opt-in states -- sometimes called "ZEV states" or "Section 177 states" -- are not required to prepare a cost-benefit analysis to support their decision to join the ZEV program; nor are they required to invest in the infrastructure -- or enact other complementary policies (e.g., state consumer tax credits or HOV lane access for ZEVs) -- that would help dealers sell ZEVs to consumers in large quantities. Some states are doing a much better job than others in helping automakers and dealers prepare for the ZEV requirements (Lutsey et al, 2015; Clark-Sutton et al., 2016) and a recent report from the National Research Council (2015a) advances a variety of solutions to overcome the many barriers to commercialization of PEVs.

Nine states (Connecticut, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island, and Vermont) have opted into the ZEV program. California and those nine states account for about 28% of new vehicle sales in the United States (2015). Some automakers,

because of their product mix, sell roughly 50% of their vehicles in these ten states. Thus, the ZEV regulation is effectively a national regulatory program even though it has never been subjected to a national cost-benefit analysis.

CARB lessened the compliance burden of the ZEV program with a "travel provision" that allows ZEVs produced in one state to count toward compliance obligations in other ZEV states. The travel provision is scheduled to expire next year (2017), and will be replaced temporarily by complex eastern and western compliance pools from 2018 to 2021. However, PEV sales in California will no longer be able "travel" to other areas for compliance purposes. Thus, the ZEV requirements will soon become a significant challenge for the nation's automakers and dealers, and will have national economic ramifications.

3. What are the barriers to widespread commercialization of PEVs?

The number of PEVs sold in the United States from 2010 to 2015 has grown at a lesser rate than expected by both the federal government and PEV producers, and, in fact, the national rate of PEV sales declined in 2015 compared to 2014 (Carley et al, 2016). Early indications are that the national volume of PEV sales in 2016 will increase modestly. In total, approximately 114,000 PEVs were sold in 2015, which is about 0.7% of the 17 million new passenger vehicles sold in the US (Carley et al, 2016). In California, where PEV promotion activities are arguably the best developed, the PEV penetration rate (about 3%) is much higher than the national average, but well below the 18% level that CARB projects for 2025 due to the ZEV regulation. PEV sales in the Northeastern states are well below the California sales rate. In 2014 California alone

accounted for more than one third of PEV sales in the United States (National Research Council, 2015a, 42).

The National Research Council (2015a) undertook a major study of the obstacles to commercialization of PEVs, and highlighted the following key factors: most consumers are satisfied with their gasoline-powered cars and light trucks; the perceived financial costs of PEVs (e.g., higher purchase price and questionable resale value) are worrisome relative to the perceived financial benefits (e.g., savings in fuel and lower repair costs); the nonmonetary advantages of PEVs (e.g., quieter ride, acceleration capability, and sustainability profile) are less salient than the nonmonetary concerns (e.g., the limited driving range of BEVs, a perceived shortage of recharging infrastructure, and long recharging times); complexity and incompatibility concerns about making the transition to a PEV (e.g., perceived difficulty in obtaining permits for at-home installation of charging equipment, the need to figure out whether proprietary charging stations and incompatible chargers or plug types will be a problem, and uncertainty about the payment methods for electricity purchases); perceived difficulty in obtaining a test drive of a BEV or PHEV; the limited visibility of PEVs and charging infrastructure in most communities; and the lack of consumer awareness of the many federal, state and local incentives for purchase and use of PEVs.

A recent Harris survey of 1,052 US residents found that 67% of respondents don't know anyone who has owned a BEV, PHEV or even a conventional hybrid-electric vehicle like the Prius. The survey demonstrated that misperceptions of the PHEV were particularly severe, as the average respondent underestimated the typical driving range of a PHEV by more than 50% (Harris,

2016).

Since the ZEV regulation was amended by CARB in January 2012, three new developments have made it less likely that consumers will consider purchasing a PEV in the near future. Each of these developments weakens the financial rationale for a PEV purchase.

First, in 2012 average fuel prices were approaching $4 per gallon and were expected to continue their upward march. But, the unexpected happened. Due to rapid changes in global oil markets (e.g., the shale revolution in North America and a slowdown in the rate of growth of China's economy), fuel prices have declined by almost 50%, and forecasters expect average fuel prices in the US to remain below $3.00 per gallon through 2025. Fuel prices in California tend to be significantly above the national average and the rate of decline in fuel prices has been lower in California. Low fuel prices are known to weaken consumer interest in alternative technology vehicles while hurting the resale values of those vehicles (Carley et al, 2016; Sawyers, 2016).

Second, the NHTSA and EPA programs are increasing the average fuel efficiency of gasoline vehicles. As the average fuel efficiency of passenger vehicles increases to more than 40 miles per gallon in 2025 (measured as on-road fuel economy), the incremental fuel savings from operating a PEV diminish (Carley et al, 2016).

Finally, although there has been an encouraging reduction in the average cost of producing a PEV (Nykvist and Nilsson, 2015; Clark and Campbell, 2016), and significant declines in retail pricing (for purchase or lease) of PEVs, the future of federal and state tax incentives for

purchasing PEVs is in doubt. Some projections suggest that the generous federal income tax credit for PEVs (up to $7,500 per vehicle) will begin to phase out for manufacturers before 2025, when the ZEV regulations become most stringent (EEE Inc., 2014; National Research Council, 2015a). The federal tax credit for installation of home recharging stations has already been terminated. Some states (Colorado, Connecticut and Massachusetts) have recently added PEV incentives but other states (California, Georgia and Illinois) have terminated or scaled back their incentive programs to purchase PEVs. Some states are actually taxing PEVs on the basis that PEV owners should contribute funds for road maintenance and repair, though this basis has been criticized (National Research Council, 2015a).

While many forces are operating against commercialization of PEVs, both the National Research Council (2015a) and Carley et al (2016) discuss a variety of complementary policies that can be adopted by governments at all levels to accelerate the commercialization process. A coalition of the ZEV states has developed an MOU to push commercialization of PEVs through new policies. If such policies are not adopted, the ZEV requirements could become quite onerous.

4. Will the ZEV Requirements Reduce Emissions of Greenhouse Gases?

Not necessarily (see generally, Linn and McConnell, 2013). Automakers are allowed to count ZEVs in their compliance calculations for the NHTSA and EPA performance standards. Indeed, the federal programs provide temporary bonus credits to automakers that comply with PEVs and other advanced technology vehicles, and those bonus credits may cause a net increase in GHG emissions compared to the rate of emissions without bonus credits (Jenn et al, 2016). For

manufacturers who are constrained by the federal CAFE and GHG programs, each sale of a ZEV permits that manufacturer to sell another vehicle that has relatively low fuel economy or a high rate of GHG emissions (National Research Council, 2015a; Carley et al, 2016).

I am aware of no serious analysis showing that the ZEV program will cause a significant reduction in GHG emissions on a national basis. An earlier study of CARB's GHG program projected that the program would do far less to reduce GHG emissions than anticipated, since the CARB GHG program is nested within the increasingly stringent national CAFÉ program (Goulder et al, 2012). A similar analysis needs to be conducted for the nested ZEV program.

Proponents of the ZEV program argue that, even if the ZEV requirements do not reduce GHGs in the short run (due to the compliance averaging in the federal program), the ZEV requirements should demonstrate innovative technology that will allow the federal standards to be tightened in the long run (after 2025) (Sperling, 2014). The innovation argument has some merit, but there are a variety of public policies that can be employed to boost innovation and commercialization of advanced technology vehicles. The U.S. Department of Energy has a substantial R&D program underway to foster the commecialization of PEVs and FCVs. Several small countries (e.g., Norway and the Netherlands) have made more progress than California in commercializing PEVs (measured by the PEV share of new vehicle sales), yet those countries do not have ZEV requirements (e.g., see Holtsmark and Skonhoft, 2014). Indeed, no other jurisdiction in the world has imposed ZEV requirements on automakers (Carley et al, 2016), though I have heard that the Canadian province of Quebec and the European Commission are considering ZEV-like programs. Given that the ZEV requirements will impose significant costs on automakers,

dealers, and consumers yet may not reduce GHG emissions significantly, I recommend that the federal midterm review re-examine the ZEV requirements.

5. Did the Obama administration use EPA's authority under the Clean Air Act to coordinate the ZEV requirements with the EPA and NHTSA regulatory programs?

No, not explicitly. During the 2009-2012 period, the Obama administration sought to harmonize regulatory requirements so that automakers could comply with the three regulatory programs (the NHTSA CAFE standards and the EPA and CARB GHG standards) by producing one fleet of vehicles on a national basis. The harmonization effort was sometimes called a uniform national program, and it was an appealing concept to automakers, dealers, and other stakeholders.

For reasons that are not entirely clear, the ZEV program was never formally incorporated into the harmonization effort. NHTSA and EPA did not incorporate CARB's 2012 ZEV regulation into the baseline vehicle fleet when the federal standards for 2017-2025 were analyzed. Nor did CARB consider the federal programs when the the 2012 ZEV amendments were enacted, in part because the 2017-2025 federal rulemaking was completed after the 2012 ZEV amendments were finalized in January 2012.

Nonetheless, there are some fragmentary provisions that seem to link the ZEV program to the federal programs. For example, the federal programs for model years 2017-2025 provide bonus compliance credits for vehicle manufacturers that choose to offer PEVs and other advanced technology vehicles. Those bonus PEV credits were never justified by any cost-benefit analysis,

but the federal schedule calls for a phase out of those bonus credits just as the stringency of the ZEV requirements begin to intensify (Carley et al, 2016). Moreover, the EPA program is not yet penalizing PEVs for emissions that they may induce at the electric powerpoint, which causes PEVs to be a somewhat more attractive compliance choice for automakers than they would be if upstream emissions from PEVs were counted against PEVs. For a temporary period, CARB also provides limited ZEV credits to automakers that overcomply with the federal GHG requirements.

Each of these fragmentary provisions suggests that there was some recognition in 2012 that the ZEV and federal programs needed to be coordinated. Nonetheless, there is no careful analysis in any EPA, NHTSA or CARB document that coherently explains why it makes sense to impose the ZEV requirements on automakers, given that those same automakers are already subject to the 2017-2025 NHTSA and EPA/CARB GHG requirements. Specifically, the incremental costs and benefits of the ZEV program on a national basis, over and above the federal programs, have not yet been computed by the federal government or CARB.

6. From a technology perspective, do the federal regulations push automakers in a different direction than the ZEV requirements?

Yes, and the conflicts between technological pathways are becoming more apparent as the more stringent compliance deadlines draw closer.

The NHTSA and EPA regulations are performance standards that induce vehicle manufacturers to compare fuel-saving technologies in terms of cost-effectiveness. A technology with a good

(low) cost-effectiveness ratio is favored over a technology with a poor (high) cost-effectiveness ratio. The OMEGA and Volpe simulation models used by EPA and NHTSA, respectively, are designed to help vehicle manufacturers find combinations of technologies (sometimes called technological pathways) that will achieve compliance with the federal programs at minimum cost to automakers and consumers.

Both NHTSA and EPA, backed by a recent report from the National Research Council (2015b), have stressed that large-volume production of PEVs and FCVs will not be necessary to meet the federal requirements. A series of refinements to the gasoline-powered vehicle (e.g., transmission refinements, small turbocharged gasoline engines, various degrees of downweighting, and mild-hybrid concepts such as stop/start systems) are believed to be sufficient for many of the automakers to achieve federal compliance through model year 2025. In other words, PEVs and FCVs are simply not cost-effective technologies compared to the large suite of technologies that can be deployed to meet the 2025 federal requirements (National Research Council, 2015b).

The ZEV regulation is also a performance standard but it has been designed differently and more prescriptively than the federal performance standards. Automakers earn no ZEV credits for making investments in small turbocharged engines, lightweight materials, stop-start systems or even full conventional hybrids such as the Toyota Prius (though the Prius did earn some ZEV credits in earlier years). As a practical matter, it appears that only offerings of BEVs, PHEVs and FCVs will earn ZEV credits. And CARB has designed the 2018-2025 requirements so that most automakers cannot achieve compliance entirely with PHEVs. In other words, each major automaker's compliance plan must include at least a minimum number of BEVs or FCVs.

In effect, the federal programs are inducing automakers to make large investments in advanced gasoline technologies but those investments will not help companies comply with the ZEV requirements -- except for a brief period when overcompliance with the federal standard does generate some ZEV credits. Meanwhile, the ZEV requirements -- which cover about 28% of the new vehicle fleet nationally -- appear to require automakers to make large investments in entirely new propulsion systems that are intended to replace gasoline propulsion systems. From an engineering-economics perspective, the following fundamental question needs to be addressed in the federal midterm review: Does it make sense to require automakers to make investments in refinements to the internal combustion engine if California and nine other states are determined to require automakers to abandon the internal combustion engine in favor of BEVs or FCVs?

7. Does the draft TAR (EPA/DOT/CARB, 2016) provide a technical and economic foundation for regulators at EPA, NHTSA and CARB to consider regulatory-reform options that might coordinate the ZEV program with the federal programs?

As currently organized, the draft TAR appears to have the limited purpose of helping EPA and NHTSA decide whether to retain or refine the model year 2022-2025 federal performance standards. There is no indication that EPA, NHTSA and CARB are planning a regulatory deliberation that will seek to explicitly harmonize the ZEV regulation with the federal programs. However, CARB is now conducting its own review of the ZEV program (CARB, 2016) and the results of that review, expected at the end of calendar year 2016, could lead to a recognition at

CARB and/or at EPA/NHTSA that a more formal coordination effort is required. The draft TAR does contain a careful analysis of the technology costs for PEVs and FCVs, and that information is likely to be useful, once it is refined based on public comment.

A careful reader of the draft TAR will recognize that the EPA and NHTSA modeling are not consistent in the way that they are addressing the ZEV requirements. Like it did in 2012, NHTSA, through its Volpe modeling, proceeds as if the ZEV program does not exist. In 2012 EPA's OMEGA modeling also did not account for the ZEV requirements, but the EPA modeling in the 2016 draft TAR has moved in a different direction.

Specifically, instead of framing the ZEV regulation as a policy supplement to the federal programs (through exercise of EPA's waiver authority), the EPA modeling treats the ZEV regulation as an external influence on the baseline fleet of vehicles for model years 2022-2025, where the baseline fleet is the projected fleet of vehicles that automakers will sell if the federal standards are frozen at 2021 levels. The rate of GHG emissions in the baseline fleet is lower with inclusion of the ZEV regulation (than the rate would have been without the ZEV regulation) because PEVs reduce GHG emissions. As a result, EPA's GHG standards for 2022-2025 are estimated to be less costly for automakers. The draft TAR explains that the incremental costs of the 2022-2025 federal standards are estimated to be lower by EPA than NHTSA because EPA's modeling allows the ZEV regulation to influence the baseline fleet while the NHTSA modeling does not incorporate the ZEV program in the baseline.

The costs of the ZEV program are not presented in the draft TAR. The GHG emissions benefits

of the ZEV regulation appear to be incorporated in the EPA modeling but they are not isolated explicitly.

A close look at the volume of PEVs in the EPA baseline fleet reveals that EPA has made some strong assumptions. The draft TAR projects that the number of PEVs sold without ZEV regulation will continue to grow significantly through 2025, presumably due to market forces and state/federal incentives/subsidies. This is a questionable assumption given that gasoline prices are not expected to grow rapidly (thereby restraining consumer interest in PEVs), and some of the federal and state incentives for PEVs and FCVs are likely to be lessened or removed by 2025. Moreover, in the absence of the ZEV requirements, Tesla's business model would be adversely affected (i.e., Tesla cannot sell ZEV credits at $5,000+ per credit to other automakers if the ZEV program does not exist) (Knittel, 2013), and many of the major automakers might diminish or terminate their PEV offerings if the ZEV regulation did not exist (National Research Council, 2015a, 6). Thus, most of the volume of PEVs projected in the draft TAR for the baseline model-year 2025 fleet (1.2% of national vehicle sales) arguably should be attributed to the ZEV regulation rather than market forces. Moreover, the total number of PEVs projected for 2025 in the draft TAR (3.0% of national vehicle sales) may not be consistent with the PEV forecasts for California made by CARB in 2012 and 2016, and that potential discrepancy needs to be clarified or resolved. Thus, some subtle reframing and reconsideration of the projected PEV volumes is necessary if decision makers are to use information in the TAR in an analysis of the relative magnitude of the incremental costs and benefits of the ZEV regulation.

8. Would it be prudent for Congress to authorize an independent analysis of the interaction

of the ZEV program with the federal programs?

A useful supplementary analysis of the ZEV regulation in the final TAR might proceed as follows. Start with the NHTSA approach to the baseline fleet, which excludes consideration of the ZEV regulation in the projection of the baseline fleet. Estimate the costs and benefits of the MY 2022-2025 federal standards compared to the ZEV-less baseline fleet. Then, with EPA's waiver authority as the policy context (since the waiver for California could be withdrawn or extended), compute the incremental costs and benefits of the ZEV regulation, given that the MY 2022-2025 EPA and NHTSA standards take effect, whether in their current or revised form.

Since the incremental assessment of the ZEV regulation is likely to raise some tensions among policy officials at CARB, EPA and NHTSA, it might be wise for the U.S. Congress to direct that the incremental assessment of the ZEV regulation be performed by an independent body such as the General Accountability Office, the Congressional Budget Office or the National Research Council. An incremental assessment of the ZEV regulation will be complex and will likely take at least six months to complete (under optimistic circumstances). Thus, Congress needs to act promptly to ensure that the incremental ZEV assessment does not unduly slow the pace of the midterm review.

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