**COMMENTS OF THE
MANUFACTURERS OF EMISSION CONTROLS ASSOCIATION
ON THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S RULEMAKING TO
REVISE LIGHT-DUTY VEHICLE GREENHOUSE GAS EMISSION STANDARDS AND
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION'S RULEMAKING
ON CORPORATE AVERAGE FUEL ECONOMY STANDARDS FOR MODEL YEAR
2021 THROUGH 2026**

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The Manufacturers of Emission Controls Association (MECA) offers comments in response to the NHTSA "Safer Affordable Fuel-Efficient Vehicles Proposed Rule for Model Years 2021–2026 Passenger Cars and Light Trucks" or EPA Proposed Light Duty Vehicle greenhouse gas emission standards for model years 2021-2026. We oppose the preferred alternative and urge NHTSA and EPA to work with the California Air Resources Board to find a compromise that continues to reduce GHG emissions year over year and ensures continued investment and job growth in developing fuel efficient technologies. Suppliers have continued to innovate and introduce new technologies since the last CAFE/GHG rule and subsequent Midterm Evaluation. The current standards have resulted in significant investment and job creation, and the pace of efficiency technology introduction and breadth of available efficiency technology options have grown beyond early projections. Well known conventional technologies as well as new advanced technologies are able to be applied across the light-duty vehicle fleet to increase fuel efficiency while lowering tailpipe emissions. Our industry continues to respond to the need for cleaner, more efficient vehicles by innovating and commercializing the technologies that will help our customers meet fuel economy and GHG requirements in the U.S. and abroad.

MECA is a non-profit association of the world's leading manufacturers of emission control, combustion efficiency and GHG reduction technology for mobile sources. MECA members supply the full complement of electrified and electric vehicle technologies from micro-hybrid start/stop and mild hybrid 48 volt systems, full hybrid and plug-in hybrid architectures to all electric battery and fuel cell components. Our members have over 40 years of experience and a proven track record in developing and manufacturing clean mobility solutions for a wide variety of on-road and off-road vehicles and equipment, including extensive experience in developing criteria pollutant and GHG reducing emission controls for gasoline and diesel light-duty vehicles in all world markets. Our industry has played an important role in the emissions success story associated with light-duty vehicles in the United States and has continually supported efforts to develop innovative, technology-forcing, emissions programs to mitigate air quality problems and minimize the impacts of climate change.

Summary

MECA would like to provide comments on the following issues that were requested in the current NPRM. More details will be provided on each issue further in this document.

1. Economics: MECA believes that implementing the proposed alternative in the NPRM may result in loss of jobs from the automotive industry, which the NPRM analysis itself estimates to be over 600,000 jobs from 2017 to 2030. Suppliers who have invested in technology development and manufacturing of new technologies to enable automakers to achieve the original (baseline) standards are at risk for those investments to be stranded as some forecasted demand between automakers and suppliers for advanced fuel saving technologies is in jeopardy of declining. For example, the NPRM analysis predicts lower penetration of many technologies (compared with the original rule), which directly impacts revenue, jobs and investment by many suppliers. Finally, because other nations in Europe and Asia continue to tighten fuel economy and CO_2 emissions, there is a likelihood of engineering and future manufacturing investment shifting from the U.S. to other countries.

2. Technology leadership: The U.S. has been the world leader in clean vehicle technology in response to performance-based and technology forcing regulations to protect air quality and provide consumers fuel efficient vehicles. The current light-duty GHG and CAFE standards have led to an unprecedented introduction of innovative and advanced GHG technologies such as advanced fuel injectors in downsized GDI engines, turbochargers, cooled-EGR systems, 48V mild hybrid systems, dynamic cylinder deactivation, batteries, motors and electronic controls. Other countries have followed our lead, however, and they will surpass our passenger vehicle emission and climate standards if the NPRM is finalized as proposed. This will effectively cede our leadership to foreign nations and put U.S. companies at a competitive disadvantage and potentially repeat the history of the 1970s when U.S. automakers were outcompeted by smaller, more efficient, foreign companies.

3. Environmental disbenefits: The Draft Environmental Impact Statement to support the NPRM concludes that the preferred alternative will result in a net loss of over $4 billion in climate benefits compared to the baseline rule. Furthermore, modeled emissions of every conventional pollutant increase in 2050 due to the preferred alternative relative to the current standards.

4. One National Program: MECA supports “One National Program” that is founded on a negotiated set of standards between NHTSA, EPA and California with increasing stringency. An agreed upon set of standards should allow the federal agencies to satisfy their statutory requirements and the state of California and Section 177 states to achieve their air quality and climate goals. A negotiated outcome, among these agencies offers the best hope for a successful, lasting program without the business uncertainty caused by protracted litigation.

5. Flexibility: MECA supports flexibilities such as off-cycle credits that incentivize reduction of all GHGs through all technologically feasible options. Such flexibilities

drive technology innovation and achieve real fuel economy and climate benefits, while allowing vehicle manufacturers to meet the regulatory objectives by the most cost effective means. Furthermore, MECA supports a supplier pathway to obtain conditional credits for new off-cycle GHG technologies.

Economic Impact to Supplier Industry of Rolling Back Current GHG/CAFE Standards

Companies that design and manufacture emission control and efficiency technology products to meet these standards employ nearly 300,000 people at over 1200 facilities across North America (see https://www.bluegreenalliance.org/wp-content/uploads/2017/05/Supplying-Ingenuity-vFINAL-low-res.pdf). The clean mobility industry exists largely because the Federal government, California and the Section 177 states have required pollution reductions from vehicles and fuels to achieve health-based air quality standards to achieve their public health and environmental goals. MECA supported the original GHG and CAFE standards when originally finalized, as well as the determination that the standards were appropriate based on the thorough analysis of technology and costs published in the TAR. Three years later we recognize that some automakers are finding it challenging to meet the original standards due to the early deployment of the most cost effective technologies, the pace of increasing annual fuel economy requirements and the level of consumer demand for the most fuel efficient and electrified vehicles. While there may be justification to allow additional flexibilities or consideration of alternate rates of increasing stringency of fuel efficiency (decreasing GHG emission) requirements, it is clear to technology solution suppliers that an indefinite flat line of the 2020 standards will have an adverse impact on air quality and the emission control industry.

MECA conducted a survey to better understand the impacts of the proposal on our member companies. The vast majority of our members responded that investments have been made in response to the original GHG and CAFE standards and over half of MECA member companies have experienced job growth in response to the standards. In 2018, the emission control industry was on pace to invest over $3 billion in research and development to develop the technologies needed to meet future emission standards, but a majority of MECA members expect the current preferred alternative will result in diversion of future investments overseas. The regulatory impact analysis to support the NPRM concludes that when the preferred alternative is fully implemented, it will result in an annual loss of 50 to 60 thousand jobs, totaling over 600,000 lost jobs from 2017 to 2030. Furthermore, the Union of Concerned Scientists worked with Synapse Energy Economics, Inc. to run economic modeling scenarios assuming the administration finalizes the preferred alternative and found that compared to the standards on the books today, this rollback would: (1) Increase consumer spending on gasoline by about $20 billion in 2025 and nearly $50 billion by 2035; (2) Economy wide, reduce employment by 60,000 in 2025 and 126,000 in 2035; and (3) Reduce gross domestic product by $8 billion in both 2025 and 2035 (http://www.synapse-energy.com/sites/default/files/Giving-Back-Half-the-Gains-17-072.pdf).

The NPRM's preferred alternative to flat line the 2020 standard out indefinitely has injected uncertainty in the emission control market that may strand current investments, and potentially jeopardize new investments in American manufacturing of advanced clean car technologies. Investments that would have been made in the U.S. may go to regions where the standards will continue to be progressively tightened. Furthermore, weakening of the GHG standards will disrupt the long-negotiated One National Program that is in place now through 2025, as California and Section 177 states have signaled their plans to exit the program, resulting in litigation that would take years to resolve. This extended period of uncertainty would only provide additional impetus for suppliers to look at other countries, where tighter GHG regulations are more certain, for making new manufacturing investments instead of the U.S. Due to the economics of long term investments in manufacturing and supply chain management, there is a very low chance of jobs and investments returning to the U.S. once they are moved overseas because the overseas markets will be more mature and it may be more cost effective to ship parts back to the U.S. instead of building manufacturing capacity in the U.S.

Automotive suppliers represent the largest sector of manufacturing jobs in the nation. Suppliers have made long-term investment decisions based on the MY 2017-2025 standards set in the original rulemaking that was completed in 2012. In fact, automotive suppliers have seen an overall 23 percent increase in employment since 2012, which can partly be attributed to advanced technology development spurred by the 2012 rulemaking. While supplier direct employment in the U.S. is highest in Michigan, Ohio, and Indiana, the highest growth over the past few years has been seen in the Southeast region (https://www.mema.org/sites/default/files/resource/MEMA_ImpactBook.pdf). Relaxing the stringency of the standards may cause adverse economic impacts, including loss of jobs. These initial job loses will most likely be in application engineering, but the long term impacts of stranded investment may lead to questioning the risk of future investments in the U.S. when other regions offer regulatory certainty.

Putting Technology Leadership in Jeopardy

Vehicle manufacturers are poised to rely on a systems approach to meeting future tailpipe emission and fuel economy standards that will likely include fuels as well as on vehicle technologies. Some manufacturers may choose higher compression ratio engines requiring higher octane fuels. MECA supports fuel neutral standards and clean fuels, including ultra-low sulfur gasolines at several octane levels and ultra-low sulfur diesel. As detailed in EPA's draft Technical Assessment Report (TAR), there is a large set of technology combinations available to reduce greenhouse gas emissions from passenger vehicles and light-duty trucks, including fuel efficient advanced gasoline and diesel powertrains. Thus far, the vast majority of technologies that have been deployed across the light-duty fleet represent technologies that have existed for decades and are just now being designed into conventional internal combustion diesel and gasoline engines in response to GHG and CAFE requirements. For the period out to 2025, there are likely to be numerous cost-effective ways to improve fuel economy without extensive use of full electrification. Further tightening in fuel consumption and CO_2 emissions will likely require gradual deployment of electrified technologies and all electric propulsion. MECA members are committed to provide the full spectrum of technologies that allow all of these fuel efficient powertrains to meet the GHG requirements as well as the corresponding Tier 3 criteria pollutant standards. As the conventional technologies are deployed, suppliers will continue to innovate new technologies on engines and transmissions as well as electrification to reduce vehicle CO_2 and GHG emissions to help their customers meet future standards. We urge the agencies to focus on setting performance based policies that drive innovation in all areas of vehicle fuel efficiency technologies.

The draft TAR outlined a range of powertrain technologies that manufacturers are deploying to improve the efficiency of their engines. The rapid introduction of innovative GHG technologies is due in part to advances in computing power that are available on today's vehicles. Well known technologies such as turbochargers, exhaust gas recirculation (EGR) systems, advanced fuel injectors, variable valve actuation technology, 48V mild hybrid systems, advanced exhaust controls and powertrain control modules were anticipated to be applied to both light-duty gasoline and diesel powertrains to meet the original 2025 standards. Auto manufacturers will take advantage of the synergies between advanced emission control technologies and advanced powertrains to optimize their performance with respect to both GHGs and criteria pollutant emissions. MECA members offer a large portfolio of technologies for reducing both GHGs and criteria pollutants from advanced gasoline and diesel engines (see MECA's Tier 3 technology report: http://www.meca.org/resources/LEV_III-Tier_3_white_paper_0215_rev.pdf).

In the last six years, cars have seen the introduction of more new efficiency technology at a higher pace than ever before, and this has made buying new cars more appealing to consumers, resulting in record car sales. A 2017 analysis by ICCT, with input from MECA members and other suppliers, projected an 8-10% greater CO_2 reduction benefit at a 36% lower cost of technologies to meet the 2025 standards than originally estimated by EPA in its final determination (see http://www.theicct.org/US-2030-technology-cost-assessment). However, the costs for compliance modeled in the current NPRM appear to apply too much technology to achieve the original standards, which artificially biases the costs higher than they would be in real life. In other words, some have argued that the VOLPE model adds more technology than needed to comply with GHG and CAFE standards, which suggests that compliance with the regulation would lead to higher priced vehicles than estimated by other models, including those run by EPA. The NPRM analysis fails to accurately model how an OEM will comply with the standards. A common approach is for an OEM to optimize compliance for a given vehicle platform across the car's product lifecycle, leading to initial over compliance with the standard that generates credits that can be used to compensate for under compliance with the standards at the end of the vehicle platform's life. Resources for the Future reported that the current NPRM analysis predicts the cost of technology necessary to comply with the 2025 standards to be more than two times higher than the costs reported in the analysis done to support the original regulation. However, the whole vehicle cost in the new assessment is only about 50 percent higher ($1300 vs. $1950 in 2016 dollars). While the new NHTSA analysis provides some explanations for increased vehicle costs, the agency does not adequately describe why total technology costs would be so much higher than the cost per vehicle (see http://www.rff.org/blog/2018/questions-about-trump-administration-s-cost-benefit-analysis-its-proposal-freeze-cafe).

EPA raises similar concerns that the CAFE model assumes more costly technology packages than necessary to meet vehicle standards and that the model overestimates costs by assuming fleets that over comply will make sub-optimal use of available credits. In emails and memos published to EPA's docket on August 14, 2018, EPA staff strongly pushed back against modeling assumptions for technology costs and effectiveness as well as the modeled safety and other benefits of the VOLPE analysis that underlies the current NPRM (https://www.regulations.gov/contentStreamer?documentId=EPA-HQ-OAR-2018-0283-0453&attachmentNumber=5&contentType=pdf). EPA reanalyzed the data with different input cost assumptions and concluded that projected per-vehicle technology costs in MY30 for meeting the current standards would be almost $500 lower than the VOLPE model. EPA's analysis also yielded a consumer payback period of 3.5 years for the current standards compared to 11.6 years under the VOLPE modeling approach. Finally, EPA's modeling suggests that the preferred alternative would reduce "net social benefits" by $83 billion per year, compared to a draft conclusion that the NPRM would boost such benefits by $49 billion annually. Some specific technology issues addressed by EPA in the June 18 memo include:

- NHTSA model assumes the incremental effectiveness of the more advanced turbocharged engine (TURBO2) compared to the less advanced version (TURBO1) engines is often negative.
- The addition of cooled exhaust gas recirculation (CEGR1) onto turbocharged engines (TURBO2) provides no relative benefit, despite the additional cost of the technology. Given this input assumption, the CAFE model outputs, as expected, do not show application of CEGR1.
- On average, 48V Mild Hybrid with a crank-integrated starter-generator (CISG) is the same, or slightly worse than with a belt-integrated starter-generator (BISG) despite having a higher cost.
- Some 12V Stop-Start applications have negative effectiveness values. In addition, stop-start systems were assumed to cost $466-$521, which is higher than estimates provided by suppliers.
- The cost of Dynamic Cylinder Deactivation (ADEAC) is 2-4 times higher than industry quoted costs for the version of the technology which is going into production in MY2019. In addition, there appears to be errors in the inputs into the VOLPE model regarding cylinder deactivation (DEAC) and ADEAC because the price of the latter scales with number of cylinders while the price of the former does not.
- NHTSA's assumed battery costs are nearly double those derived from Argonne's BatPaC model.

A recent report by the Environmental Defense Fund (EDF) used the OMEGA model to look at costs and effectiveness of multiple technologies to achieve the current GHG and CAFE standards. In this paper the authors point out that many of these modeling studies focus on currently available technology options and ignore future innovation in new technologies or evolution of current technologies. (https://www.edf.org/sites/default/files/content/final_public_white_paper_post_2026_co2_reductions2.27_clean.pdf). Since 2015, new technologies were announced for commercialization before 2020 that were not previously considered during the Mid-term Evaluation. Some U.S. vehicles are currently being offered for sale with 48V mild hybrid systems, which have already been seeing higher penetration in European vehicle platforms. The more stringent CO_2 standards in Europe have led one industry group to project that by 2020, 48V cars will outpace European sales of full hybrids, including plug-ins that can be recharged with a cable and driven in electric-only mode. By 2025, the group predicts 55 percent of all cars sold in Europe will be equipped with 48V technology (http://europe.autonews.com/article/20170923/ANE/170929892/). However, the NPRM's analysis concludes that 48V mild hybrid technology, which would have achieved 32% fleet penetration by 2029 as a result of the original standards, will not be found on future U.S. passenger cars and light trucks.

Some of the new technologies that will be in production prior to 2021 but were either not considered in the NPRM or projected to be too expensive include dynamic cylinder deactivation, variable compression ratio and electric boost. Dynamic cylinder deactivation utilizes high speed computing to electronically control the deactivation and firing fraction of any cylinder independently of the others depending on the load at each engine rotation as a way to further optimize efficiency. This technology has the potential to improve fuel economy by 10-17% and up to 20% when combined with 48V mild hybrid technology. While dynamic cylinder deactivation has been introduced on two MY 2019 U.S. vehicles (https://www.caranddriver.com/news/2019-chevy-gmc-trucks-get-smarter-fuel-saving-cylinder-deactivation), the technology's future is uncertain if fuel economy standards are frozen. The NPRM's analysis concludes that dynamic cylinder deactivation penetration will drop to 0%. Variable compression ratio (VCR) is another fuel saving technology that has been introduced since the finalization of the draft TAR. Several design approaches for variable compression have been discussed in the literature as a way to optimize compression ratio and combustion efficiency inside the cylinder based on the power demand. This technology is expected to achieve approximately 10% improved fuel economy. Nissan has begun offering vehicles equipped with its "Multi-Link" VCR system starting with MY 2018 (http://articles.sae.org/15040/). Electric boost is another new technology not modeled in the NPRM. Electric boost is used in combination with a main power turbo and often as part of a 48V mild hybrid system on a vehicle. Electric boost technology can quickly deliver boost as the power turbine comes up to full boost power in order to reduce turbo-lag and enable engine downsizing and down-speeding. Electric boost has been reported to yield as much as a 5% fuel savings over the test cycle.

By flat-lining the 2021-2025 GHG standards, the agencies remove regulatory stability from the supplier industry, which jeopardizes engineering investments that are needed to deploy technologies to simultaneously reduce criteria and GHG pollutants and support their customers in integrating the technologies into vehicles that meet CO_2 and fuel economy targets. In fact, the presence of the most stringent standards in the U.S. has provided domestic suppliers and vehicle manufacturers with a competitive advantage over their foreign competitors through the early adoption and optimization of technologies on vehicles. Relative to the current standards, the NPRM's preferred alternative projects that in 2029 the penetration of turbochargers and GDI engines will decline by 13%, while advanced cylinder deactivation, 48-volt mild hybrid, strong hybrids and plug-in hybrid systems are projected to virtually disappear in the U.S. However, our members see growing demand for these technologies overseas, which will lead to shifting of manufacturing investments and application engineering resources out of the U.S.

Air Quality and Climate Benefits Foregone by the Proposal

There is a significant linkage between ground level ozone concentrations and climate change impacts. One example was detailed by a group of researchers from the United Kingdom in a 2007 Nature publication. In this work, ground-level ozone was shown to damage plant photosynthesis resulting in lower carbon dioxide uptake from plants that have been exposed to higher levels of ozone. Other studies have shown that increasing average annual temperatures are likely to result in even higher levels of ozone in the environment. Emission reductions aimed at lowering ambient ozone levels, such as lower emissions of volatile organic compounds (VOCs) and NOx, will have a positive impact on climate change, as well as human health. Policies that aim to reduce ambient ozone levels may also become more necessary and important to either mitigate the climate change impacts of ground level ozone or to mitigate higher ozone levels that result from climate change.

California and Section 177 States Must Meet Their Air Quality Goals

MECA opposes EPA's revoking of California's GHG waiver, which MECA supported in 2012. For over 50 years, California has played a leadership role in advancing vehicle standards and air quality policies that created a market for clean vehicle technologies. In fact the Clean Air Act viewed California as a laboratory for innovative policies that drive early technology introduction. These emission standards and policies were adopted federally a few years later and eventually internationally. In 2013, California was granted that waiver to set standards out to 2025. This waiver provided regulatory certainty and a market driver for suppliers to invest and create manufacturing jobs. Revoking an existing waiver is very different than denying a waiver because once a waiver is granted, industry takes action, makes investments and commits resources with an expectation of return on those investments through regulatory certainty. Revocation of the waiver at this time will result in stranded investments and market risk that will lead manufacturers to question the stability of future investments in the U.S. In fact, revoking an existing waiver is unprecedented and impacts businesses that have hired workers and made investments based on regulatory expectations. While we may not always agree with every detail of California's regulations, there is no question that California's authority has been critical in driving the commercialization of innovative emission reducing technologies and creating important U.S. supplier manufacturing jobs. Therefore, MECA opposes revoking California's GHG waiver.

Level Playing Field for All Technology Pathways

Adsorbed Natural Gas (ANG) is a new low-pressure gas storage technology that utilizes an activated carbon adsorbent to store natural gas. ANG technology enables vehicles to be conveniently refueled with natural gas at a home or small business using a small 900-1200 psi compressor. ANG is much different than the existing compressed natural gas (CNG) technology. CNG requires the use of costly, high-pressure (3600 psi) compressors and only 742 publicly available CNG refueling stations exist. The ability to refuel ANG vehicles on natural gas at home for a price of $0.50 per gallon equivalent makes the technology affordable and attractive for dual-fuel, light-duty applications. The first dual-fuel ANG vehicles are being certified now, and the technology will be commercialized over the next 1-2 years. However, the

2012 EPA/NHTSA rule establishing GHG and CAFE standards for 2017 and later light-duty vehicles greatly incentivized electric vehicles but added burdensome range and drive-to-empty restrictions on dual-fuel natural gas vehicles and removed incentives for all natural gas vehicles. EPA/NHTSA placed the unreasonable range and drive-to-empty restrictions on dual-fuel natural gas vehicles to qualify for full use of the utility factor scheme because of the limited number of public high pressure refueling locations for CNG vehicles. While the range restrictions make the practical construction of a dual-fuel vehicle nearly impossible, very lax range restrictions for EVs were put in place to encourage their production. The range restrictions are unnecessary for all natural gas vehicles, but they are simply unwarranted for natural gas vehicles with ANG technology. EPA developed the restrictions because of the limited accessibility to refueling points for CNG vehicles. ANG technology has home and small business refueling accessibility that much more closely resembles that for PHEVs and BEVs, and cost to refuel with natural gas can be as little as $0.50 per GGE. The range restrictions for dual fuel ANG vehicles should be no more severe than for PHEVs. The 0.15-incentive-multiplier for GHG compliance should be reinstated for dedicated and dual fuel natural gas vehicles.

MECA supports the early introductory use of incentives to promote innovative technologies that can be disadvantaged by lack of customer exposure and experience. However, in order for a technology to be a sustainable and durable solution, it must demonstrate the ability to compete on the same basis with other technologies to allow consumers the choice that meets their needs and meets performance based standards. EPA recognized this in the original rule by phasing out credits for MY2022-2025 PHEVs, BEVs and FCEVs. These powertrain technologies have been around for decades and have matured to the point where almost every manufacturer is offering multiple models equipped with these technologies, allowing consumers to make informed choices with respect to advanced powertrain vehicles. A recent ICCT report (https://www.theicct.org/sites/default/files/publications/Integrating-EVs-US-EU_ICCT_Working-Paper_22062017_vF.pdf) points out that California forecasts only 8% EV penetration in 2025 due to credit multipliers, which means that it will be difficult for the state to meet its 30% target by 2030 unless the current credit scheme is revised. In fact, in their report ICCT cautions that long term reliance on credit multipliers for ZEV technology may result in the unintended consequence of increasing real world emissions from the remaining non-ZEV portion of the fleet that is allowed to emit at higher levels.

Furthermore, various federal and state tax credits have been and still are in place to provide consumers incentives for purchasing these vehicles. With the growing emphasis on real world emission reductions, it becomes increasingly important to consider all emissions to the environment, including upstream emissions. Numerous studies have shown that in many parts of the country, the temporary 0 gram/mile upstream emissions factor is not delivered in the real world. The EPA transportation office's regulatory-based emissions standards and voluntary programs have always been both fuel- and technology-neutral since the first standards were set in the 1970s. MECA believes that EPA should continue to set performance-based standards that assess technology pathways based on delivering the intended emission reductions over the full well-to-wheels vehicle life cycle in the real world.

Flexibility and Credits Needed for Real Emission Reductions

MECA continues to recognize the benefit to real-world CO_2 reductions via the off-cycle credit program as a policy to expand the available technologies that vehicle manufacturers can deploy to meet the goals of the regulation. Furthermore, MECA supports increasing the current off-cycle credit cap to 15 grams per mile. The existing off-cycle methodology allows suppliers to partner with their customers to apply for off-cycle credits. After several years of implementation, suppliers have found it difficult to convince vehicle manufacturers to commit the full complement of resources needed to evaluate technologies on fully integrated vehicles without compelling data and assurance that the Agency believes a technology shows promise. Suppliers do not have the resources or expertise to fully integrate a technology into a vehicle to demonstrate its CO_2 reduction potential. Even a conservative estimate of the amount of credit a technology may offer would justify deployment of resources to fully demonstrate a technology. We continue to believe that a parallel supplier pathway to contingent pre-certification would greatly expand the available technologies and resources for full demonstration across a fleet of integrated vehicles by the OEM to ultimately confirm the real world CO_2 reductions of a given technology. Expanding the off-cycle credit review process to include EPA, NHTSA and the California Air Resources Board may be one consideration in the future to allow for resource sharing among the agencies for reviewing data and evaluating off-cycle technology pathways.

MECA represents both on-cycle and off-cycle technology suppliers, and therefore we are committed to credit policies that ensure measurable and verifiable CO_2 emission reductions in the real-world. There are several policy examples where certification flexibilities have been used to incentivize early market introduction of advanced technologies. For example the Eco-innovation program that is part of the European Commission's light-duty GHG standards provides a pathway for both technology suppliers and vehicle manufacturers to demonstrate and apply for off-cycle technologies (https://circabc.europa.eu/sd/a/bbf05038-a907-4298-83ee-3d6cce3b4231/Technical%20Guidelines%20October%202015.pdf). Furthermore, EPA's Technology Verification Program for diesel retrofits under DERA provides an example of a step-wise process that allows for an initial demonstration and conditional pre-approval of a technology's emission reduction potential prior to completing a full verification process. In addition, this type of approach offers manufacturers a pathway to manage uncertainty during the resource-intensive processes of full certification and compliance.

A potential approach to certifying technologies for off-cycle credits, could begin with modeling using EPA's ALPHA model or initial demonstration of the technology on a limited number of vehicles, combined with fleet simulation data across broader vehicle categories and real-world conditions under which the technology may offer CO_2 reductions. After review of the preliminary data, EPA could assign a conservative and conditional pre-approved credit value to a technology that the supplier could use to get its OEM customers interested in allocating the resources to complete the full off-cycle credit application. Once introduced into the market, a more accurate and statistically sound assessment of the CO_2 reduction benefits of the technology can be demonstrated following the first three years of real-world, market deployment across the manufacturer's fleet. Following a review of the field results, the final credit allocation could be adjusted appropriately based on real-world experience. The OBD system that records the fuel consumption of a vehicle may be a way to obtain a statistical representation of the real-world off-cycle credit value by averaging over hundreds or thousands of vehicles in the field. MECA and our members would like to work with EPA staff to develop a clearly defined, rigorous approach that involves the technology supplier as well as the vehicle manufacturer in the application process through a step-wise pathway that manages the risk of complete certification. Such an approach would also allow EPA, the suppliers and the vehicle manufacturers to best manage their resources.

Another opportunity for EPA to offer incentives for manufacturers to deploy proven effective technology is for the reduction of black carbon because of its extreme global warming potential. Black carbon is a major component of particulate matter emissions from mobile sources and is believed to have a significant net atmospheric warming effect by enhancing the absorption of sunlight due to its 20 year global warming potential of 3200 times that of an equivalent mass of CO_2 (Bond et al, 2013, doi:10.1002/jgrd.50171). Black carbon is a mix of elemental and organic carbon emitted by fossil fuel combustion, bio-mass burning, and bio-fuel cooking as soot. Black carbon is a dominant absorber of visible solar radiation in the atmosphere. Anthropogenic sources of black carbon are transported over long distances and are most concentrated in the tropics where solar irradiance is highest. Because of the combination of high absorption, a regional distribution roughly aligned with solar irradiance, and the capacity to form widespread atmospheric brown clouds in a mixture with other aerosols, emissions of black carbon are thought to be the second strongest contribution to current climate change, after CO_2 emissions.

According to scientists at the Scripps Institute of Oceanography and University of Iowa, soot and other forms of black carbon could have as much as 60% of the current global warming effect of carbon dioxide. Black carbon plays a major role in the dimming of the surface and a correspondingly large solar heating of the atmosphere. For example, the retreat of the Himalayan-Hindu Kush glaciers is one of the major environmental problems facing the Asian region. The glacier retreat has accelerated since the 1970s and several scientists have speculated that solar heating by soot in atmospheric brown clouds and deposition of dark soot over bright snow surfaces may be an important contributing factor for the acceleration of glacier retreat. A recent study published in a 2009 issue of Nature Geoscience (vol. 2, 2009) by researchers from the NASA Goddard Institute and Columbia University found that black carbon is responsible for 50% of the total Arctic warming observed from 1890 to 2007 (most of the observed Arctic warming over this timeframe occurred from 1976 to 2007).

For gasoline vehicles, direct injection technology has been deployed at a rapid pace, enabling gasoline engines to achieve greater fuel efficiency. Although significant advances have also occurred in improving the efficiency of naturally aspirated engines, GDI is expected to continue as the dominant pathway to introduce fuel into combustion engines because in addition to improving fuel economy, GDI delivers performance benefits such as increased torque. Modern GDI engines emit more particulate matter in the form of black carbon than traditional port fuel injected (PFI) engines. Certain driving conditions, such as hybrid engine starts during high load conditions can also lead to higher PM emissions. Emissions controls, such as advanced fuel injectors and gasoline particulate filters (GPF) can ensure that these more fuel-efficient gasoline engines meet and exceed tough EPA and California criteria emission regulations. All European, Chinese and Indian cars will employ these advanced technologies to meet more stringent particle number emission standards, but the same cars will be sold without the best controls in the U.S. where a 3 mg/mile PM limit will not demand them. MECA recommends that EPA consider offering automakers CO_2 equivalent black carbon credits for substantially outperforming PM emission standards. EPA should also consider aligning the Tier

3 PM standard with LEV 3 beyond 2025. The reduction of black carbon will come with the health co-benefits of reduced toxicity associated with gasoline PM.

The agencies requested comment on whether to retain air conditioning refrigerants and leakage, and nitrous oxide and methane emissions, for compliance with CO_2 standards after MY 2020 as well as whether to change existing methane and nitrous oxide standards that were finalized in the 2012 rule. MECA supports retention of these for compliance with CO_2 standards and supports the existing standards for methane and nitrous oxide because catalyst technologies provided by MECA members that reduce these climate forcing gases are readily available and cost effective. The ability to trade reductions in these climate forcing gases in exchange for CO_2 gives vehicle manufacturers the flexibilities they need to comply with the emission limits by the most cost effective means. While total nitrous oxide emissions are much lower than CO_2 emissions, nitrous oxide is approximately 310 times more powerful than CO_2 at trapping heat in the atmosphere. Nitrous oxide is emitted directly from motor vehicles and its formation is highly dependent on temperature and the type of emission control system used. Temperatures favorable for nitrous oxide formation are achieved inside catalytic converter systems, especially during cold-start conditions when engine exhaust temperatures are lower. Catalyst efficiency and age are also important factors in nitrous oxide formation, and at higher efficiencies and lower ages, nitrous oxide formation is lower. On late model light-duty gasoline vehicles, modern three-way catalyst-based emission control technology combined with effective cold-start engine calibration strategies are very effective at controlling vehicle nitrous oxide emissions. Light-duty vehicle N_2O emission test results published by ARB and Environment and Climate Change Canada in *Atmospheric Environment* (vol. 43, 2009) indicate that vehicles certified to the lowest emission certification categories (e.g., SULEV standards) also have extremely low nitrous oxide emissions (in the range of 0.0-1.5 mg/km). Tightening of hydrocarbon and NOx emission standards over time with the parallel introduction of more effective emission control systems have resulted in lower emissions of nitrous oxide from today's vehicles compared to older vehicles certified to less stringent hydrocarbon and NOx standards. The performance of NOx emission control technologies for diesel vehicles such as SCR catalysts and passive NOx adsorber catalysts can also be optimized to minimize nitrous oxide emissions from diesel engines.

According to the United Nation's International Panel on Climate Change (IPCC), methane is more than 20 times as effective as CO_2 at trapping heat in the atmosphere. Methane is a byproduct of imperfect fuel combustion. Methane emissions from mobile sources are emitted from exhaust from vehicles using hydrocarbon fuels, and they are a function of the type of fuel used, the design and tuning of the engine, the type of emission control system, the age of the vehicle, as well as other factors. Although the anthropogenic contribution of road transport to the global methane inventory is less than 0.5% and methane emissions from gasoline vehicles are small in terms of global warming potential when compared to nitrous oxide emissions, they can be high in natural gas-fueled vehicles, as methane is the primary component of natural gas. On medium- and heavy-duty gasoline vehicles, modern three-way catalyst-based emission control technology is effective at reducing all hydrocarbon exhaust emissions including methane. Tightening of hydrocarbon emission standards over time with the parallel introduction of more effective emission control systems have resulted in lower emissions of methane from today's vehicles compared to older vehicles certified to less stringent standards. Catalyst designs can also be optimized in concert with engine control strategies to oxidize methane exhaust emissions from motor vehicles, including vehicles that operate exclusively on natural gas or dual-fuel vehicles that can operate on either natural gas or gasoline. Advanced gasoline and diesel powertrains for light-duty vehicles in conjunction with advanced emission control technologies can be optimized to minimize emissions of both nitrous oxide and methane emissions.

Lighter Weight Components Increase Fuel Economy without Sacrificing Safety

Manufacturers have been using high-strength steel and aluminum and other lightweight materials to significantly reduce the weight of the biggest vehicles on the road. Studies have shown that this results in safety improvements of the heaviest vehicles, including SUVs and cross-overs, which are currently among the most popular models of vehicles purchased today (see Lawrence Berkeley National Lab Report https://www.regulations.gov/document?D=EPA-HQ-OAR-2015-0827-11039). Automotive suppliers have responded to OEM requests to use weight reduction to achieve GHG and CAFE goals by providing light-weight on-engine and exhaust components that significantly reduce the weight of vehicles with absolutely no impact on safety. MECA members have developed exhaust components such as dual wall exhaust manifolds to replace cast iron components and insulated dual wall exhaust pipes and catalyst housing that reduce the weight of the upstream portion of the catalyst system. The downstream portion can be lightened by replacing the muffler with acoustic noise canceling technology to quiet the exhaust and reduce backpressure at highway speeds. In addition, on engine components such as dual wall and water cooled turbocharger housings are used to reduce weight of traditional turbocharger housings. These methods to reduce weight of a vehicle in no way impact safety while contributing to higher fuel economy. Performance-based standards for safety should be used to ensure vehicles pass all federal requirements and allow innovation to bring appropriate solutions.

Conclusion

In summary, MECA supports a negotiated outcome between NHTSA, EPA and California that preserves one national program. The uncertainty associated with flat-lining standards that have already been incorporated into suppliers' short and long term planning may strand investments, as well as jeopardize new investments in American manufacturing of advanced clean car technologies supporting nearly 300,000 U.S. jobs. The U.S. must continue its leadership role as a producer and exporter of advanced clean and efficient vehicles, or jobs and investments will move outside of our borders and we will be forced to import these components in the future when fuel prices rise and tighter standards are reintroduced. In addition, we believe that MY 2021/2022 standards should remain in place as contracts for these vehicle platforms have already been negotiated. We encourage the Agencies to stick with a proven model where investment in the environment leads to jobs and economic growth. Our members are prepared to support their OEM customers to deploy technologies that ensure that the cleanest and most efficient vehicles are made in this country.

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