WRITTEN COMMENTS OF THE
MANUFACTURERS OF EMISSION CONTROLS ASSOCIATION
ON CALIFORNIA AIR RESOURCES BOARD'S
SHORT-LIVED CLIMATE POLLUTANTS REDUCTION STRATEGY
CONCEPT PAPER

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The Manufacturers of Emission Controls Association (MECA) is pleased to respond to the California Air Resources Board's request for public comments on its Short-Lived Climate Pollutants Reduction Draft Strategy.

MECA is a non-profit association of the world's leading manufacturers of emission control technology for mobile sources. Our members have over 40 years of experience and a proven track record in developing and manufacturing emission control technology for a wide variety of on-road and off-road vehicles and equipment, including extensive experience in developing emission controls for gasoline and diesel engines and vehicles in all world markets. Our industry has played an important role in the emissions success story associated with mobile sources in the United States, and has continually supported efforts to develop innovative, technology-forcing, emissions programs to deal with air quality problems.

MECA commends ARB on its efforts to develop a short-lived climate pollutants reduction strategy. As pointed out in the draft strategy document, cutting emissions of short-lived climate pollutants such as methane and black carbon provides a significant pathway for slowing the impacts of climate change, and in the case of black carbon emissions from mobile sources, the important health-related co-benefits of reduced exposure to particulate emissions. The draft strategy document rightly points out California's impressive track record in reducing black carbon emissions from mobile sources over the past fifty years through the adoption of stringent particle mass emission standards for new vehicles and engines, and the implementation of emission reduction policies for existing diesel engines that resulted from ARB's Diesel Risk Reduction Plan. However, more can be done to reduce black carbon emissions from the transportation sector and MECA's comments will focus on these additional opportunities to reduce black carbon emissions from mobile sources.

Black carbon emissions from diesel engines/vehicles can be significantly reduced through emission control technology that is already commercially available. High efficiency diesel particulate filters on new and existing diesel engines provide nearly 99.9% reductions of carbon emissions. As has been shown in the heavy-duty highway sector, DPFs are extremely efficient at reducing particulate emissions over a wide range of particle sizes, including reducing emissions of the smallest, ultrafine particles emitted by a diesel engine. In the highway, heavy-duty sector, DPF-equipped engines are routinely being certified at PM emissions levels that are 90% or more below the 0.01 g/bhp-hr 2010 EPA PM heavy-duty highway diesel engine standard. The "bonus" PM reductions provided by DPFs in the highway sector provide significantly more public health benefits than estimated by EPA in their final 2007-2010 heavy-duty highway regulation. In addition to "bonus" public health benefits afforded by DPFs, DPFs have also provided important co-benefits on climate change due to the large reductions in black carbon

emissions that result from the use of high efficiency DPFs (an ARB funded study highlighting the significant impact of reducing black carbon emissions from diesel engines on climate change was released in June 2013). The addition of a more effective heavy-duty inspection and maintenance program in California is needed to ensure that DPF-equipped trucks and buses continue to deliver significant reductions in black carbon emissions over the long operating lives of these vehicles. A companion policy to a more effective heavy-duty inspection and maintenance program is the adoption of robust requirements for diesel aftermarket emission control products (including filters) that provide end-users with proven, affordable replacement parts for older vehicles that are still on the road long after the manufacturer warranty has expired.

It is also worth noting that stoichiometric, heavy-duty natural gas engines have been shown to emit large numbers of ultrafine particulates that are largely the result of the consumption of lubricant oil during the engine combustion process (see ARB's funded work published by West Virginia University on particle emissions from stoichiometric natural gas bus engines published in *Environmental Science & Technology* in 2014). These stoichiometric heavy-duty engines are currently certified without filters due to their low particulate mass emissions. Filters on these stoichiometric natural gas engines would significantly reduce the ultrafine particle emissions from these engines and provide additional climate and public health benefits. MECA encourages ARB to investigate the benefits of applying filters to these engines and enact appropriate policies that force the use of high efficiency filters on these engines.

These same opportunities for increased protection of public health and reduced climate change impacts are lost on EPA Tier 4 final off-road diesel engines that are not certified with DPFs. Recent EPA certification information for off-road diesel engines certified in model year 2015 indicates that more than half of the engine families, for engines rated from 37-560 kW, were certified without DPFs. In some cases, OEMs are choosing to remove DPFs that were certified with engines for Tier 4 interim compliance in certifying their Tier 4 final configurations. MECA encourages ARB to characterize the regulated and unregulated exhaust emissions of similar Tier 4 final nonroad diesel engines certified with and without DPFs to more completely understand the impacts of these alternative compliance pathways on public health and climate change. A Tier 5 off-road diesel engine regulation that forces the use of best available PM controls would provide additional public health and climate change benefits associated with further reductions in black carbon emissions from this sector. The European Union is due to finalize soon a Stage 5 off-road diesel engine regulation that will likely include a particle number-based emission limit to force the use of filters on a large segment of off-road diesel engines. California (and the U.S.) needs to continue its leadership role on reducing black carbon emissions from diesel engines by putting policies in place that ensure that off-road diesel engines (including applications in agriculture, construction, locomotive, and marine) utilize high efficiency filters. The advent of SCR catalyst-coated filters (now commercialized for light-duty diesel applications) allows for the design of compact diesel emission control systems that can simultaneously provide high reductions in PM/black carbon and NOx, pollutants important to both California's ambient air quality and climate change policy goals.

MECA is concerned about the PM emissions durability of nonroad Tier 4 engines certified without DPFs. There is ample evidence that engine-based PM control strategies are prone to higher in-use emissions than DPF-equipped engines, due to factors such as cold starts,

poor maintenance, and the large variety of duty cycles encountered in the nonroad sector. Given the expected, relatively small compliance margins of nonroad Tier 4 final engine designs that do not utilize DPFs, MECA believes that ARB (and EPA) should closely scrutinize Tier 4 final certification packages of non-DPF diesel engines and allocate extra compliance and enforcement resources to follow up with in-use emissions testing of any Tier 4 nonroad engines certified without a DPF. MECA also believes that ARB and EPA should also strongly consider adoption of a manufacturer run, in-use emissions testing program in the nonroad sector that utilizes the latest portable emissions measurement technology to ensure that Tier 4 final nonroad engines are delivering the emission reductions associated with the Tier 4 nonroad standards. The nonroad sector could also benefit from the adoption of on-board diagnostic requirements that are similar in scope to the heavy-duty highway diesel on-board diagnostic requirements required by ARB. In-use testing and OBD ensure that the emissions performance of the engine/equipment is maintained over the regulated full useful life.

Additional reductions in black carbon emissions will result from the light-duty sector through ARB's lower LEV III PM limits. MECA strongly supported and agreed with ARB's decision to include a 1 mg/mile particle matter standard for light-duty vehicles over the FTP test cycle in their LEV III requirements. In their Tier 3 final regulation, EPA has only harmonized with the LEV III 3 mg/mile FTP PM standard and not included a 1 mg/mile FTP PM standard. The 2012 decision by the European Commission to establish a particle number emission standard for light-duty vehicles powered by gasoline direct injection (GDI) engines as a part of their Euro 6 light-duty emission standards provides a more stringent particle emission limit for these GDI vehicles in the same time frame as the Tier 3/LEV III 3 mg/mile PM standard (phase-in for the LEV III/Tier 3, 3 mg/mile PM standard starts in 2017; implementation of the Euro 6 GDI particle number limit of 6 X 10^{11} particles/km [equivalent to the Euro 5 light-duty diesel particle number limit], measured using the European PMP particle measurement protocol, begins in September 2017; see: ec.europa.eu/enterprise/sectors/automotive/documents/directives/motor-vehicles/index_en.htm).

This European light-duty GDI particle number limit in conjunction with the adoption of real-world driving emission (RDE) requirements for light-duty vehicles will cause European auto manufacturers to introduce cleaner technologies such as advanced fuel injection systems and/or gasoline particulate filters to comply with the European Euro 6 GDI particle number limit and associated real-world driving emission requirements. Auto manufacturers are already working to bring forward early introductions of these ultra-low PM, Euro 6-compliant gasoline engines to the European market in the coming 12 to 18 months. Nearly all auto manufacturers that sell into the European market are working with MECA members on potential applications of particulate filters on gasoline direct injection vehicles. In August 2014, the German Traffic Club (VCD, see www.vcd.org) reported that the Mercedes S500 GDI European passenger car is now equipped with a gasoline particle filter, the first public announcement on a filter-equipped GDI vehicle (the U.S. version of the Mercedes S500 is not equipped with a GPF). MECA's sister organization in Europe, AECC (see: www.aecc.eu), has recently benchmarked the emission performance of a GPF-equipped Mercedes S500 and found that this vehicle comfortably meets the European GDI particle number limit in both test cycles and real-world driving conditions.

Gasoline particulate filters (GPFs) are based on the same, wall-flow ceramic filters that have been successfully applied on tens of millions of light-duty and heavy-duty diesel vehicles in Europe and the U.S. for more than 10 years. The performance and application of these gasoline particulate filters has been highlighted in a number of recent technical publications in both the U.S. and Europe (e.g., SAE paper nos. 2010-01-0365, 2011-01-0814, and 2013-01-0836; SAE paper no. 2013-01-0527 authored by Environment Canada and MECA). Like diesel particulate filters, gasoline particulate filters are capable of reducing particle/black carbon emissions by more than 85% over a wide range of particle sizes, including high capture efficiencies for ultra-fine particulates. The application of a GPF on a four-cylinder gasoline direct injection vehicle is expected to cost approximately $100-120 (see ICCT's GPF cost estimate available here: www.theicct.org/estimated-cost-gasoline-particulate-filters), making this emission control technology a cost-effective solution for reducing particulate emissions from future gasoline vehicles (even lower GPF cost estimates have been recently discussed in Europe). When these filters are properly designed, the impact of a GPF installation on the backpressure and fuel-efficiency of the vehicle has been shown to be minimal.

ARB and EPA need to make sure that these same ultra-low PM, Euro 6 GDI engine/emission technologies are also utilized in the U.S. ARB will be reviewing the stringency and timing of its 1 mg/mile FTP PM LEV III limit in the coming year, and MECA believes that ARB should consider adoption of the European Union's Euro 5 diesel and the Euro 6 diesel/GDI particle number limits (or some other similarly stringent standard of particle emissions) to ensure that future light-duty vehicles employ the best available technology for controlling particle and black carbon emissions. A particle number standard could also be implemented as an optional compliance path along with ARB's 1 mg/mile, mass-based standard. Given the readiness of GPFs to reduce particle emissions from GDI engines, MECA believes that ARB should give strong consideration to earlier implementation of their 1 mg/mile standard (currently set to begin phase-in with the 2025 model year) and/or a particle number standard.

As part of their short-lived climate pollutants strategy, ARB should give some consideration to additional light-duty vehicle incentives that encourage the use of high efficiency filters on future gasoline vehicles. This might include a black carbon credit scheme that is available as part of ARB's light-duty greenhouse gas emission standards. Such a strategy would provide OEMs with a black carbon-based, CO_2-equivalent credit for going beyond the 3 mg/mile or 1 mg/mile LEV III PM standard through the application of ultra-low black carbon technologies, such as a high efficiency filter. The application of best available filtering technology on future gasoline vehicles will provide additional black carbon reductions from this sector and further health benefits for the citizens of California. A black carbon credit might also have applicability in other mobile source sectors as a part of current or future fuel efficiency/greenhouse gas programs.

The particle/black carbon emission issues cited in these comments for diesel and gasoline engines and vehicles are discussed in more detail in MECA's report: "Ultrafine Particulate Matter and the Benefits of Reducing Particle Numbers in the United States," available on MECA's website at: http://www.meca.org/resources/reports. MECA encourages ARB to continue its leadership on reducing black carbon emissions by specifying specific future black carbon reduction strategies in its upcoming, finalized short-lived climate pollutant reduction

strategy that rely on the application of high efficiency particle filters on all applicable mobile source engines and vehicles.

CONTACT:

Joseph Kubsh
Executive Director
Manufacturers of Emission Controls Association
2200 Wilson Boulevard
Suite 310
Arlington, VA 22201
Tel.: (202) 296-4797 x107
E-mail: jkubsh@meca.org