

**WRITTEN COMMENTS OF THE
MANUFACTURERS OF EMISSION CONTROLS ASSOCIATION
ON CALIFORNIA AIR RESOURCES BOARD'S
PROPOSED SHORT-LIVED CLIMATE POLLUTANT REDUCTION STRATEGY**

May 26, 2016

The Manufacturers of Emission Controls Association (MECA) is pleased to respond to the California Air Resources Board's request for public comments on its proposed Short-Lived Climate Pollutants Reduction 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 developing a short-lived climate pollutants reduction strategy. As pointed out in the proposed strategy, cutting emissions of short-lived climate pollutants such as methane and black carbon provides a significant pathway for slowing the impacts of climate change. Specifically, reducing black carbon emissions from mobile sources results in important health-related co-benefits of reduced exposure to particulate emissions. The proposed strategy rightly points out California's impressive track record in reducing black carbon emissions from mobile sources over the past fifty years through implementation of ARB's Diesel Risk Reduction Plan, which includes the adoption of stringent particle mass emission standards for new vehicles and engines and the implementation of emission reduction policies for existing diesel engines. Furthermore, ARB is set to reduce PM and black carbon emissions from the light-duty sector through its Advanced Clean Cars Program. 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.

MECA compliments ARB for acknowledging the need to improve methane inventories, including funding a study to look into methane leakage from oil and gas wells and pipelines. However, we also suggest that ARB research diurnal, running loss and fueling methane emissions that also may significantly contribute to the inventory. Given California's large investment in natural gas engines and infrastructure, it is appropriate for ARB to consider all potential methane sources in its baseline inventory and future projections. Because the current proposed strategy ignores these other sources of methane emissions, it does not fully estimate the entire well-to-wheels methane emissions footprint. Furthermore, ARB should consider providing funding to research directed at emission control technologies that could reduce tailpipe methane emissions from vehicles, including catalyst solutions.

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 (DPFs) on new and existing diesel engines provide nearly 99.9% reductions of black 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 DPFs) 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. ARB recently finalized and adopted its Procedure for Approving Aftermarket DPFs for On-Road Heavy-Duty Diesel Engines, and MECA urges staff to work quickly and efficiently with Aftermarket DPF manufacturers to approve devices.

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 particulate filters due to their low particulate mass emissions. Particulate 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 particulate filters to stoichiometric heavy-duty natural gas engines and enact appropriate policies that force filter use 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 50-60% 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 ensure further reductions in black carbon emissions from this sector and result in additional public health and climate change benefits. The European Union is set to finalize in July a Stage 5 off-road diesel engine regulation that will likely include a particle number-based emission limit to force the use of DPFs on a large segment of off-road diesel engines. In addition, China has planned by 2019 to implement China IV standards that would require DPFs on nonroad engines operating in metropolitan areas. 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 DPFs. 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 NO_x, 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, which will emit as much as four to five times more PM in actual use than similar engines certified with 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 nonroad Tier 4 engines certified without a DPF. MECA also believes that ARB (and EPA) should 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 nonroad Tier 4 final engines are delivering the emission reductions affirmed in the nonroad Tier 4 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 in their LEV III requirements a 1 mg/mile particulate matter standard for light-duty vehicles over the FTP test cycle. 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 6×10^{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). MECA estimates that the Euro 6 GDI particle number limit of 6×10^{11} particles/km is equivalent to roughly 0.5 mg/mile, which is 50% lower than the 1 mg/mile standard being considered by ARB (“Ultrafine Particulate Matter and the Benefits of Reducing Particle Numbers in the United States,” http://www.meca.org/resources/MECA_UFP_Report_0713_Final.pdf). Black carbon particles have high surface area and low mass, so a small mass of black carbon could lead to disproportionately large climate and health impacts. As mass emission standards continue to tighten, ARB should consider alternative metrics (e.g. particle number) to accurately characterize black carbon emissions and their impacts on climate and health.

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 (GPFs) in order to comply with these regulations. Auto manufacturers are already working to bring forward these ultra-low PM, Euro 6-compliant gasoline engines to the European market in the coming 6 to 12 months. Nearly all auto manufacturers that sell into the European market are working with MECA members on potential applications of GPFs on GDI 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 GPF, the first public announcement on a GPF-equipped GDI vehicle (the U.S. version of the Mercedes S500 is not equipped with a GPF). Last year MECA’s sister organization in Europe, AECC (see: www.aecc.eu), 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.

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 GPFs have 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, 2013-01-0836, 2015-01-1073, and 2016-01-0925; SAE paper no. 2013-01-0527 authored by Environment Canada and MECA). Like DPFs, GPFs 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 GPFs are properly designed and installed, the impact on the backpressure and fuel-efficiency of the vehicle has been shown to be minimal. Ford presented data at the 2016 SAE Congress (SAE 2016-01-0941), that showed immeasurable fuel economy impact of fully aged and ash loaded GPFs on two full size passenger cars.

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 this 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 particulate 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 GPFs 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, CO₂-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 GPF. 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.

MECA encourages ARB to continue its leadership in reducing black carbon emissions by specifying comprehensive future black carbon reduction strategies in its short-lived climate pollutant reduction strategy that drive the application of high efficiency particulate filters on all applicable mobile source engines and vehicles.

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