

Federal Advisory Committee Act
Clean Air Act Advisory Committee

Mobile Sources Technical Review Subcommittee

Co-Chairs: Mr. Drew Kodjak and Ms. Gay MacGregor

Designated Federal Official: Ms. Elizabeth Etchells

Summary of the Subcommittee's Meeting on October 6, 2011 Washington D.C.

Introduction/Opening Remarks

Mr. Drew Kodjak (ICCT, Co-Chair) and Ms. Gay MacGregor (EPA, Co-Chair) called the meeting to order at approximately 9:00 am. Mr. Kodjak and Ms. MacGregor welcomed attendees, reviewed the day's agenda, and asked for a vote on the minutes of the October 5, 2010 Mobile Sources Technical Review Subcommittee (MSTRS) meeting (approved). Mr. Kodjak and Ms. MacGregor asked for all members present to introduce themselves.

Presentations and meeting topics for this meeting are as follows:

- Office Director Comments – Margo Oge, EPA
- Presentation: SmartWay Legacy Fleet Work Group Meeting – Terry Goff, Caterpillar and Buddy Polovick, EPA
- Presentation: World Bank Initiatives on Green Trucks/Freight Transport Initiatives – Shomik Mehndiratta, World Bank
- Presentation: European Development of a Certification Method to Quantify the FC and CO₂ Emissions of Complete Heavy-Duty Vehicles– Tony Greszler, Volvo
- Presentation: U.S. HDV GHG and Fuel Efficiency Final Rule– Byron Bunker, EPA
- Presentation: Perspectives on the Heavy-Duty Vehicle GHG/FE Program – Jed Mandel, EMA
- Presentation: Technologies for Greenhouse Gas Emissions Control – John Wall, Cummins
- Presentation: Powertrain Technologies and Innovation – Tom Stover, Eaton
- Presentation: U.S. Department of Energy Vehicle Technologies Program – Pat Davis, DOE

Presentations are posted online at the MSTRS website: http://www.epa.gov/air/caaac/mobile_sources.html. As the presentations are posted for public view, the notes below primarily reflect the discussions that occurred in response to the presentations.

Comments from the EPA's Office of Transportation and Air Quality Director – Margo Oge, EPA

Margo Oge thanked everyone for their participation in the meeting and then provided a brief overview of the programs currently ongoing in EPA's Office of Transportation and Air Quality (OTAQ). The final rulemaking for Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles was finalized on August 9, 2011. The rule was completed with collaboration from industry, environmental groups and the public, which had broad support for various reasons. The rule covers model years 2014-2018, which together form a comprehensive heavy-duty vehicle national program. The EPA and the National Highway Traffic Safety Administration (NHTSA) have adopted standards for CO₂ emissions and fuel consumption, respectively, tailored to each of three main regulatory categories: combination tractors; heavy-duty pickup trucks and vans; and vocational vehicles. The payback period for the rule is estimated to be between a few months to a few years. Then, Ms. Oge highlighted the work of EPA and NHTSA in reducing greenhouse gas emissions and improving fuel economy of light-duty vehicles. The final rulemaking establishing standards for 2012-2016 model year vehicles was finalized in April 2010. Now, there is focus placed on developing a set of standards for model years 2017-2025. Currently, the notice of intent is scheduled to be published in mid-November 2011. Next, Ms. Oge provided an overview of the effort with the Department of Transportation (DOT) to develop a fuel economy label to address technologies that do not completely rely on oil, such as plug-in hybrid vehicles. Lastly, Ms. Oge remarked on the continuing work with the Tier 3 program. There are currently discussions with the auto industry and the State of California to effectively reduce sulfur in fuel in order to gain emissions reductions in the existing fleet. Ms. Oge ended her remarks by allowing time for questions; however, no questions were posed.

Ms. Oge then made a few announcements regarding EPA staff. Ms. Sarah Dunham has been promoted to the Director of the Office of Atmospheric Programs. Karl Simon is becoming the Director of the Transportation and Climate Division of OTAQ, while Byron Bunker is replacing Karl as the Director of the Compliance Division of OTAQ.

SmartWay Legacy Fleet Work Group Meeting – Terry Goff, Caterpillar and Buddy Polovick, EPA

Mr. Polovick provided a summary of the first meeting of the SmartWay work group. He reviewed the work group charge. The charge is to make recommendations that will enable EPA to sustain its legacy fleet programs and potentially extend SmartWay into the broader transportation supply chain by maximizing opportunities for program efficiencies and strategic program growth. He also reviewed the subgroups of the work group and the potential products of each. The three subgroups include one to focus on accelerating and sustaining SmartWay, another to focus on opportunities for supply chain fuel and emissions reductions in freight

modes, and a third to examine opportunities in the nonroad sector. Work products from the first group may include recommendations in how to broaden the stakeholder base, enhance the program, and integrate advanced technologies, operational strategies and practices into the SmartWay program. Potential products from the second group are recommendations on harmonizing the metrics and methods for supply chain performance assessment. Prospective products from the third group include recommendations for using market drivers to reduce emissions from nonroad engines and vehicles.

Discussion

A MSTRS member asked about the expected products and timeline of the workgroup. Buddy and Terry responded that many workgroup members themselves are already engaged in some aspects of SmartWay and have specific ideas in mind for improving the program. The hope of the workgroup is to have concrete suggestions for ways to improve efficiency, including developing a SmartWay-type program for the non-road sector.

World Bank Initiatives on Green Trucks/Freight Transport Initiatives – Shomik Mehndiratta, World Bank

The World Bank has recently undertaken “Green Freight” initiatives in China and Brazil in an effort to reduce local air pollution and mitigate climate change. In both countries, trucking accounts for a large proportion of fuel use and emissions from the transport sector, both of which have been increasing since the 1980’s and are expected to continue to increase. In these countries, fuel costs make up 40-60% of total truck operating costs, which is considerably more than in the U.S. or in Europe. Due to these operational costs, there is local interest in reducing fuel use. The World Bank has carried out pilot testing of energy efficiency technologies and practices in China and found that some fuel reduction strategies that are effective in the U.S. and Europe are not effective in countries like China, where trucks do not reach high speeds for sustained periods. Pilot testing of several fuel reduction strategies is now also being conducted in Brazil. The World Bank has recommended that the governments of these countries continue developing integrated infrastructure systems, consider regulatory approaches and financial incentives to accelerate fleet turnover, encourage voluntary efforts by the private sector, and support a culture of innovation for the future fleet. The World Bank proposes to help these countries undertake these activities by providing technical assistance and policy dialog. It may also conduct further initiatives in other countries. In these efforts, the SmartWay program has been instrumental in providing technical expertise to the World Bank and lending credibility to its initiatives.

Discussion

John Wall (Cummins, Inc.) asked whether anything has been done to look at road speeds in other countries, since it was Cummins’ experience in India that trucks have smaller engines and travel more slowly. Mr. Mehndiratta responded that the road and vehicle situation in India is vastly different from the examples he presented for Brazil and China.

Mr. Kodjak noted that two aspects of SmartWay that has led to its success are the collaboration between the EPA and the stakeholders and the tuning of the program to meet the stakeholders' needs. It seems that many other countries do not have the same level government support, and non-governmental organizations (NGOs) may need to provide this support. Mr. Mehndiratta responded that he believes the credibility of SmartWay has it allowed to be adopted or used as inspiration elsewhere, since it does not advocate a single technique or technology. Mr. Mehndiratta also noted that research institutions are providing support to their efforts in Brazil.

An attendee asked if there was any government support for infrastructure in these countries. Mr. Mehndiratta responded this was outside the scope of his work.

Tony Greszler (Volvo) stated he agrees with the idea that taking a model built for the U.S. will not necessarily apply elsewhere, and he asked what models and techniques are available to help modify the program for other countries. Mr. Mehndiratta responded that much collaboration is needed to tailor the program to each application.

Dr. Mridul Gautam (West Virginia University) asked for Mr. Mehndiratta's personal opinion of how the SmartWay program might be applied in the Indian market. Mr. Mehndiratta responded that infrastructure would be needed to be completely overhauled and there would need to be technical and political support. Dr. Edgar Blanco (MIT) stated that from his own research, no country will be able to use the SmartWay program as is, but other countries can apply some of the techniques SmartWay has created.

European Development of a Certification Method to Quantify the FC and CO₂ Emissions of Complete Heavy-Duty Vehicles – Tony Greszler, Volvo

The European Union (EU) Commission is working to develop a strategy to target fuel consumption and CO₂ emissions from heavy-duty vehicles. Work towards this strategy is split into two lots of work. The objectives of the lots are to: (Lot 1): assess the amount and reduction potential of Greenhouse Gas (GHG) emissions from Heavy Duty Vehicles (HDV), and (Lot 2): propose a method to quantify such emissions for whole vehicles as well as for vehicle components. Another lot, Lot 3, an extension of Lot 2, has been established to draft legislation. A final report from Lot 1 stated that performance requirements, best practices, speed reduction, fuel taxes, road user charges, labeling, incentives, and other techniques have the potential to reduce CO₂ from heavy duty vehicles. It also stated that the most meaningful metric of performance would be in relation to the work performed and that any potential standards should take into account specific duty cycles for different classes or applications of heavy-duty vehicles. The preliminary result of Lot 2 is a simulation tool that calculates engine power demand and speed based on a defined vehicle driving cycle. Most components of the certification procedure using this tool should be available by the end of 2011. Lot 3 is expected to be completed in 2012, which will entail draft legislation covering 95% of EU heavy-duty vehicles. Industry input to the EU Commission in this process has included recommendations that there be an integrated approach to CO₂ emissions, with a procedure for fuel efficiency calculations of complete vehicles, that policies be cost-effective and globally harmonized, and that emissions trading schemes be considered. In a preliminary European Automobile Manufacturers' Association (ACEA) study of heavy-duty vehicle fuel efficiency, seven different vehicle classes and missions

were identified for vehicles over 7.5 tons gross vehicle weight, and one drive cycle was assumed for each. While the drive cycle is very important to estimating fuel consumption, accurate data on aerodynamics, rolling resistance, weight, and other factors are also important to obtaining an accurate simulation. ACEA's input to the EU Commission included recommendations that legal requirements result in the intended effects on the road and that compliance should be verifiable by standardized and accurate procedures.

Discussion

Mr. Wall stated there is industry interest and ongoing discussion about whether any potential standards will be for the engine or for the whole vehicle. There is concern among the manufacturers about this issue.

Tom Cackette (CARB) asked whether there was any idea yet about how regulations would be formed. Mr. Greszler stated that data is still in the development stages in gauging methodologies. One possible format that could be adopted is a grams per mile (or gram per volume-mile) limit.

U.S. HDV GHG and Fuel Efficiency Final Rule– Byron Bunker, EPA

Based on recommendations from the National Academy of Sciences, in May of 2010, President Obama directed EPA and the National Highway Traffic Safety Administration (NHTSA) to develop a joint national program for medium- and heavy-duty vehicles. In September 2011, EPA and NHTSA finalized a rule to address greenhouse gases and fuel consumption by medium- and heavy-duty vehicles. This rule applies to all on-highway vehicles that are not regulated by Corporate Average Fuel Economy (CAFÉ) standards, beginning with the 2014 model year and increasing in stringency through 2018. The rule sets separate standards for engines and vehicles; sets separate standards for fuel consumption and CO₂, nitrous oxide, methane, and hydrofluorocarbons; provides incentives for advanced technologies (e.g., electric and hybrid vehicles); allows for manufacturer flexibilities, including averaging, banking and trading; and includes new compliance methods for heavy-duty hybrids and innovative technologies not contemplated in existing engine and vehicle test procedures. The standards are broken into three distinct categories, including categories for line haul tractors, heavy-duty pickups and vans, and vocational trucks. For line haul tractors, engines and tractors are regulated separately; engine standards are met through the same procedures as for criteria pollutants; and tractor standards are met through a compliance model. For heavy-duty pickups and vans, the standards are similar to those for light-duty vehicles, with the same CO₂ gallons/mile metric and gallons/100 miles metric for fuel efficiency. For the vocational vehicles, the standards apply to manufacturers of chassis and engines, not bodies. Overall, the final rule is expected to have net benefits in exceedance of the costs, with a one-to two-year payback period, depending on vehicle type.

Discussion

One MSTRS member asked how it would be possible to share policy and technical information with other countries. Mr. Bunker responded that the EPA has contacts from

collaboration with some other countries. Ms. Oge added that there has been a commitment with the European Union, China and Japan on this issue.

Dr. Guatam noted that a 90 ft. wind tunnel is being constructed at WVU for research.

Jacky Grimshaw (Center for Neighborhood Technology) stated that she believes the rule provides great community benefit. She also asked which small businesses were exempt from the rule. Mr. Bunker responded that as identified through the regulatory impacts analysis of the rule, small businesses comprise less than 1 percent of the engine market as well as the vocational market. These small engine and vocational vehicle manufacturers would be exempt from the rule.

Nancy Seidman stated that the costs and savings seem very reasonable, and she asked why EPA did not require greater reductions. Mr. Bunker responded that the costs discussed for the program are the average costs and noted that some the off-the-shelf technologies are ready to be used, while other technologies are not quite ready for mass use yet.

Perspectives on the Heavy-Duty Vehicle GHG/FE Program – Jed Mandel, EMA

The EMA is a trade association that includes the leading manufacturers of heavy-duty on-highway engines and trucks. The association has promoted a systems-based approach to reduce emissions from heavy-duty vehicles, involving engine improvements, ultra-low sulfur diesel fuel and aftertreatment devices. The EMA supports the current greenhouse gas/fuel economy rule because it provides environmental benefits while reducing the costs of goods movement, encouraging fleet turnover, and keeps trucking competitive with other modes of transportation. In addition, the rule provides alignment/harmonization of requirements for the industry, thereby limiting the potential for local rules, which could differ from locale to locale. In the future, EMA would like to see North American (and worldwide) regulatory alignment. In addition, EMA is in favor of pursuing additional greenhouse gas reductions and fuel efficiency improvement opportunities (e.g. through trailer regulations, operational efficiencies) and potentially another phase of the current program.

Discussion

Al Jessel (Chevron) asked whether Jed expects the current program to result in a quick payback period. Mr. Mandel responded that he believes it will, for the most part. However, hybrids may not have as quick a payback period, but there is high interest in hybrid technology. Mr. Mandel also noted that it is important that manufacturers have appropriate lead-time to develop new models using the required technology and that any emissions reduction program should allow for market stability to be attained.

Technologies for Greenhouse Gas Emissions Control – John Wall, Cummins

Cummins makes large and small engines varying from 109 to 3,500 HP. In developing low emissions technology, Cummins takes into consideration the customers' needs and tries to

match the technology used for that application to the desired outcome. Their products must be durable, reliable, low maintenance, low cost, and low noise, as well as fuel efficient and low in emissions. One engine technology Cummins has been working on with the Department of Energy (DOE) to achieve high efficiency clean combustion is premixed –charge compression ignition (PCCI). To reduce CO₂ emissions and improve fuel efficiency, several technologies, such as hybrid technology, waste heat recovery, and low temperature aftertreatment, are available, but it is important to choose the right one or the right mix for the application. For instance, hybrids are better suited to vehicles that make frequent stops, whereas waste heat recovery is better suited to vehicles that make fewer stops. Cummins is also working on the SuperTruck project with DOE to develop a more efficient tractor-trailer system.

Discussion

Due to time constraints, questions were held until after the last presentation in this group of presentations about advanced technologies for heavy-duty vehicles.

Powertrain Technologies and Innovation – Tom Stover, Eaton

Eaton is a diversified power management company that makes products for many industries, including truck and automotive drivetrain and powertrain systems. Eaton has been making high efficiency vehicle components starting with motors for electrical vehicles in the 1970's and producing over 5,500 hybrid vehicle systems since 2000. Yet, there are challenges to hybrid vehicles in the vocational truck segment due largely to high initial costs. Eaton's short-term goal is to achieve a 5-year payback, with a 3-year payback as the ultimate goal. In trying to make more fuel-efficient vehicles, they have found that one key is to have fast, efficient shifting and supercharging. In the near term, Eaton plans to improve engine efficiency using existing technologies with new calibrations, then adding new controls and new boosting technologies in the 2014-2016 timeframe, with new architectures and more radical technologies being used beyond that timeframe to achieve further efficiencies. Eaton is also looking at the engine downsizing advancements in light-duty hybrid systems that could be used in heavy-duty vehicle classes 2b-3. Going forward, Eaton is planning to invest in cost-reduction and performance improvement technologies.

Discussion

Due to time constraints, questions were held until after the last presentation in this group of presentations about advanced technologies for heavy-duty vehicles.

U.S. Department of Energy Vehicle Technologies Program – Pat Davis, DOE

The U.S. DOE has a \$300 million budget for 2011 to work on advanced technologies for high efficiency clean vehicles. A large percentage of this budget is being spent on further improving hybrid electric systems. Work is also being done on advanced combustion engine research and development, materials technology, fuel technologies, and technology education, training, and related activities. The DOE is also involved in the 21st Century Truck Partnership, which brings together four federal agencies and 15 original equipment manufacturers (OEM) and

suppliers to make trucks and buses safer, cleaner, and more efficient. The DOE is also involved in the SuperTruck program, which has a target of improving Class 8 truck efficiency by 50%. Awards have been given to Cummins/Peterbilt, Daimler Trucks, Navistar, and Volvo to develop efficient tractor-trailer systems through this program. In the Navistar SuperTruck project, the technologies used to date include extended peak cylinder pressure capability, high injection pressure, electrical turbo-compounding with an advanced air system, and a hybrid powertrain. The Daimler SuperTruck team is studying or has included waste heat recovery, a re-designed aftertreatment system, an engine using an optimizing controller, and reduced drivetrain parasitics in its SuperTruck. The Cummins/Peterbilt SuperTruck team has undertaken analysis of vehicle aerodynamics, design of an advanced transmission, integration of waste heat recovery, and a performance assessment of a solid oxide fuel cell-based auxiliary power unit. The Volvo team is just getting started on its SuperTruck project. In a preliminary analysis of alternative fuel advanced powertrain heavy trucks, compared to the baseline diesel truck, a diesel SuperTruck should have a payback period of approximately one year with a breakeven diesel price of \$3.50. A SuperTruck configured to use liquefied natural gas should have a payback period of approximate 1.5 years with a breakeven diesel price of \$2.95, but has the drawback of oversized fuel tanks. Other heavy trucks were also investigated, including those configured to use compressed hydrogen, low temperature hydrogen fuel cells, solid oxide fuel cells, and electric batteries, but these were found to have long payback periods and higher breakeven diesel prices, suggesting the diesel or liquefied natural gas SuperTrucks are the most viable in the marketplace.

Discussion (reflecting questions for each of the presenters in the group of presentations about advanced technologies for heavy-duty vehicles)

Dr. Gautam asked about the extent of infrastructure that has been developed to support advanced technologies like natural gas vehicles. Mr. Davis responded that infrastructure is still needed and its lack represents a huge challenge to the use of the technology. Economic incentives and other types of incentives are needed to advance the infrastructure.

Adjournment

Ms. MacGregor noted the possible dates for the next MSTRS meeting include the end of April or beginning of May and asked for feedback from the members on these dates. She also explained the process for adding new members to the MSTRS committee, which will involve response to a Federal Register notice that solicits information about potential interested members. With no further comments or questions from the MSTRS member, speakers, or audience, the meeting was adjourned.

Mobile Sources Technical Review Subcommittee

October 6, 2011

Presenters and Subcommittee Members in Attendance

| Name | Organization | Organization Abbreviation (as used in this document) |
|---------------------|---|---|
| Bob Babik* | General Motors | GM |
| Thomas Balon* | MJ Bradley and Associates, LLC | MJ Bradley |
| Byron Bunker | US Environmental Protection Agency | EPA |
| Cheryl Bynum | US Environmental Protection Agency | EPA |
| Tom Cackette* | California Air Resources Board | CARB |
| Pamela Campos* | Environmental Defense Fund | EDF |
| Nicholas Cernansky* | Drexel University | Drexel University |
| Pat Davis | US Department of Energy | DOE |
| Elizabeth Etchells | US Environmental Protection Agency, Designated Federal Official | EPA |
| Steven Flint* | New York Department of Environmental Protection | NY DEP |
| Mridul Gautam* | West Virginia University | WVU |
| Terry Goff* | Caterpillar | Caterpillar |
| Tony Greszler | Volvo | Volvo |
| Jacky Grimshaw* | Center for Neighborhood Technology | CNT |
| Al Jessel* | Chevron Corporation | Chevron |
| Lee Kindberg* | Maersk | Maersk |
| Drew Kodjak* | International Council on Clean Transportation, Co-chair --MSTRS | ICCT |
| Joseph Kubsh* | Manufacturers of Emissions Controls Association | MECA |
| Michael Leister* | Marathon Petroleum Company LLC | Marathon |
| Gay MacGregor | US Environmental Protection Agency | EPA |
| Jed Mandel | Engine Manufacturers Association | EMA |
| Arthur Marin* | Northeast States for Coordinated Air Use Management/ Northeast States Center for a Clean Air Future | NESCAUM |
| Shomik Mehndiratta | The World Bank | World Bank |
| Margo Oge | US Environmental Protection Agency | EPA |
| Buddy Polovick | US Environmental Protection | EPA |

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|------------------|--|---------------|
| | Agency | |
| Michael Rodgers* | Georgia Institute of Technology | GIT |
| Ichiro Sakai* | American Honda Motor Company, Inc. | Honda |
| Robert Sawyer* | University of California, Berkeley | UC - Berkeley |
| Nancy Seidman* | Massachusetts Department of Environmental Protection | MassDEP |
| Tom Stover* | Eaton Corporation | Eaton |
| Luke Tonachel* | Natural Resources Defense | NRDC |
| John Viero | Ford Motor Company | Ford |
| John Wall | Cummins Inc. | Cummins |

* Denotes Subcommittee Member or alternate

Attendees

| | |
|-------------------|--|
| Alison Bird | FedEx |
| Joe Bachman | US Environmental Protection Agency |
| Mike Bauburg | Peabody Energy |
| Edgar Blanco | Massachusetts Institute of Technology |
| Jim Blubaugh | US Environmental Protection Agency |
| Wanda Burget | Peabody Energy |
| John Cabaniss | Global Automakers |
| Patrick Calpin | NADA/AID |
| Mark Cauchi | Environment Canada |
| Mihai Dorobantu | Eaton Corporation |
| Sarah Dunham | US Environmental Protection Agency |
| Tim Dzojko | Kraft Foods |
| Chris Hess | Eaton Corporation |
| Christine Koester | US Environmental Protection Agency |
| Britney McCoy | US Environmental Protection Agency |
| Bobby McMahan | IWP News |
| Leigh Merino | Motor and Equipment Manufacturers Association (MEMA) |
| Mark Monohon | NGK Spark Plugs USA, Inc. |
| David Patterson | Mitsubishi Motors |
| Anita Rajan | Mitsubishi Motors |
| Karl Simon | US Environmental Protection Agency |
| Sam Waltzer | US Environmental Protection Agency |
| Rob Wilson | Sensors Inc. |

EPA Contractor Support

| | |
|----------------|-------------------|
| Denise Grubert | EC/R Incorporated |
| Lesley Stobert | EC/R Incorporated |