Motor & Equipment Manufacturers Association
Your First Call for Global Intelligence on the Motor Vehicle Supplier Industry

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Via Regulations.gov

January 31, 2011

The Honorable Ray LaHood
Secretary
U.S. Department of Transportation
Washington, DC 20590

Ms. Lisa P. Jackson
Administrator
Environmental Protection Agency
Washington, DC 20460

RE: Proposed Rules for Greenhouse Gas Emission Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles

Dear Secretary LaHood and Administrator Jackson:

The Motor & Equipment Manufacturers Association (MEMA) represents over 700 companies that manufacture motor vehicle parts for use in the light vehicle and heavy-duty original equipment and aftermarket industries. Motor vehicle parts manufacturers are the nation's largest manufacturing sector. MEMA represents its members through four affiliate associations: Automotive Aftermarket Suppliers Association (AASA); Heavy Duty Manufacturers Association (HDMA); Motor & Equipment Remanufacturers Association; and, Original Equipment Suppliers Association (OESA).

MEMA is encouraged by the carryover of the National Program approach to the medium- and heavy-duty vehicle standards. MEMA supports a uniform National Program that allows the vehicle and engine manufacturers to focus their resources on investing in the best technologies available and will feed the ability of suppliers to advance development and commercialize new technologies. MEMA and the supplier industry are committed to policies that enable the introduction of new technologies needed to support sustainable mobility.

Once the agencies complete the rulemaking for model year 2014-2018 medium- and heavy-duty vehicle and engine standards, MEMA encourages the agencies to continue the National Program as they consider the next phase of standards for MY2019 and beyond.

Below are highlights of our comments to the proposed rulemaking.

- Advanced Technologies Listed for Credit Should be Expanded
- Advanced Vehicle Technologies Credits are Needed for Vocational Vehicle Category
- Power Pack Testing Should be Expanded to Other Drivetrain, Non-Engine, and Advanced/Innovative Technologies
- Innovative Technologies Should Have a Defined Review and Approval Process
- Innovative Technologies Should not be Restricted and Should be Available Beyond MY2018
- Duty Cycle Should Define Targets and Classification for Overlapping Classes for Class 7 and 8 Vehicles
- Mass Reduction Proposals Should be Reevaluated
- GEM Input Credits for Idle Reduction Should be Modified
- Additional Simulation Drive Cycles are Needed to Capture More Vocational Applications
- Performance Based Standards Should be the Goal

Suppliers are a key part to producing the results outlined by the Administration. However, without taking the steps summarized above, we will not achieve maximum efficiency. MEMA welcomes the opportunity to work with the NHTSA and the EPA as we move forward in this important endeavor.

Sincerely,

Robert E. McKenna
President & CEO

Automotive Aftermarket Suppliers Association
Heavy Duty Manufacturers Association
Motor & Equipment Remanufacturers Association
Original Equipment Suppliers Association

Motor & Equipment Manufacturers Association
Response to the
Department of Transportation, National Highway Traffic Safety Administration
and the Environmental Protection Agency
RE: Proposed Rules for Greenhouse Gas Emission Standards
and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles
Docket Nos. NHTSA-2010-0079; EPA-HQ-OAR-2010-0162; FRL-9219-4

Introduction

The Motor & Equipment Manufacturers Association (MEMA) represents over 700 companies that manufacture motor vehicle parts for use in the light vehicle and heavy-duty original equipment and aftermarket industries. Motor vehicle parts manufacturers are the nation's largest manufacturing sector.[1] MEMA represents its members through four affiliate associations: Automotive Aftermarket Suppliers Association (AASA); Heavy Duty Manufacturers Association (HDMA); Motor & Equipment Remanufacturers Association; and, Original Equipment Suppliers Association (OESA).

MEMA and HDMA submit these comments on behalf of commercial heavy-duty vehicle suppliers. Founded in 1983, the HDMA represents over 150 U.S.-based commercial vehicle suppliers. As an industry, trucks and trailers provide over 150,000 direct supplier jobs. Heavy-duty suppliers provide original equipment parts used to manufacture commercial vehicles and related equipment as well as aftermarket replacement parts needed to repair and maintain those vehicles in service.

The primary driver of the industry is truck freight. As an industry, truck freight represents more than 72 percent of all U.S. freight tonnage hauled. While 100 percent of all U.S. cities are serviced by truck freight, 80 percent of them are serviced *only* by truck freight. Due to shipping costs and vehicle size and weight, most heavy-duty vehicle parts manufacturing remains in the United States. As with the light-vehicle supplier sector, the heavy-duty supplier sector is divided into tiers (Tier 1, Tier 2, Tier 3, etc.) and is dependent on a healthy economy generating freight ton-miles demand.

Heavy-duty suppliers provide more than 50 percent of new vehicle value and have a considerable role in the design, testing, and engineering of new vehicle parts and systems. This role continues to grow over time as federal requirements and customers demand cleaner and more fuel efficient advanced components and systems for commercial vehicles. The industry recognizes this need and works closely with their customers – engine and vehicle manufacturers – to develop and manufacture the necessary technologies and to implement them on a wide variety of commercial vehicle applications with varying degrees of performance and impact. The assortments of technologies and products have a favorable effect and directly improve commercial vehicle performance, safety, fuel efficiency, and emissions.

[1] Motor vehicle parts suppliers are the nation's largest manufacturing sector, directly employing 685,892 U.S. workers and contributing to over 3.29 million jobs across the country. Suppliers manufacture and remanufacture the parts and technology used in the domestic production of more than 11 million new cars and trucks produced each year, as well as the aftermarket products necessary to repair and maintain over 254 million vehicles on the road today.

The state of the nation's economy in recent years has severely challenged all sectors of the motor vehicle industry and many suppliers continue to face financial shortfalls. As with the light-vehicle National Program for fuel economy and greenhouse gas (GHG) emission standards, MEMA is encouraged by the carryover of the collaborative efforts between the federal agencies – the National Highway Traffic Safety Administration (NHTSA) and the Environmental Protection Agency (EPA) – to approach medium- and heavy-duty vehicles standards similarly. MEMA supports a uniform National Program based on GHG reduction and increased fuel economy because it allows vehicle and engine manufacturers to focus their resources on investing in the best technologies available. This, in turn, feeds the ability of the supplier base to advance development and convert research technologies into commercially viable products. Once the agencies are finished with this rulemaking for Model Year (MY) 2014-2018 medium- and heavy-duty vehicle standards, MEMA encourages the agencies to continue this path of work as they consider the next phase of standards for MY2019 and beyond.

While MEMA is supportive of the proposed measures overall, there are some specific items where we urge the NHTSA and EPA to consider the following points, which are addressed in this comment submission.

- **I. Additional Proposed Regulatory Flexibility Provisions**
  - **A. Advanced Technologies Listed for Credit Should be Expanded**
  - **B. Advanced Vehicle Technologies Credits are Needed for Vocational Vehicle Category**
  - **C. Power Pack Testing Should be Expanded to Other Drivetrain, Non-Engine, and Advanced/Innovative Technologies**
  - **D. Innovative Technologies Should Have a Defined Review and Approval Process**
  - **E. Innovative Technologies Should not be Restricted and Should be Available Beyond MY2018**
- **II. Proposed Compliance, Certification, and Enforcement Provisions**
  - **A. Duty Cycle Should Define Targets and Classification for Overlapping Classes for Class 7 and 8 Vehicles**
  - **B. Mass Reduction Proposals Should be Reevaluated**
  - **C. GEM Input Credits for Idle Reduction Should be Modified**
  - **D. Additional Simulation Drive Cycles are Needed to Capture More Vocational Applications**
- **III. Proposed Diesel and Gasoline Engine Standards for Heavy-Duty Pickups and Vans**
  - **A. Performance Based Standards Should be the Goal**

MEMA welcomes the opportunity to work with NHTSA and EPA as we move forward together in this important endeavor.

I. Additional Proposed Regulatory Flexibility Provisions

The agencies' considerations for applying flexibility provisions in the form of credits are supported by MEMA and we encourage their application. MEMA believes that these credits/flexibilities are absolutely necessary not only to help various advanced technologies penetrate the marketplace, but also to encourage continuous innovation and improvements. The NHTSA and EPA specifically request comment in the NPRM about the suggested 1.5 multiplier.[2] MEMA supports the 1.5 multiplier and urges the agencies to incorporate it into the final rule. The credit provided from advanced and innovative technologies is the primary impetus (appropriately so) to integrate these technologies onto vehicles. The end result is real-world impact on reducing commercial vehicle fuel consumption and emissions.

[2] 75 FedReg at 74255

A. Advanced Technologies Listed for Credit should be Expanded

The NPRM proposes that the following technologies be made eligible for credit: Hybrid Powertrains (designs that include energy storage systems); Rankine Cycle Engines (waste heat recovery); All-Electric Vehicles; and, Fuel Cell Vehicles. The agencies acknowledged in the NPRM, that their proposal would create "additional opportunities for manufacturers to reduce their GHG emissions and fuel consumption" and that those opportunities would "provide additional incentives for manufacturers to innovate and to develop new strategies and cleaner technologies." MEMA fully supports the agencies' approach and their inclusion of these proposed technologies.

At the same time, however, MEMA strongly believes that there are other opportunities the agencies should recognize under the regulatory flexibility banner and MEMA recommends the agencies should expand their list to include other technologies as eligible for credit. The Advanced Technology list proposed by the agencies omits other advanced drivetrain and advanced accessory technologies, primarily because the fuel efficiency and emissions benefits are perceived as small or insignificant. In fact, while the direct measure benefit may be "small" – perhaps in some cases maybe only one or two percent impact on fuel consumption – these contributions can be larger, they are meaningful, and they do have a favorable impact on overall fuel consumption and emissions output.

All vehicle categories would benefit from a variety of these advanced technologies, but the introduction and adoption of new advanced transmission/drivetrain and engine technologies in the vocational category can offer the largest potential benefit (10 to 15 percent emissions reduction over a large vehicle base, which is up to 85 percent of the segment), while providing manufacturers and fleets with additional flexibility beyond engine improvements to achieve the EPA proposed standards. *(For more information, please see the Section I-B.)*

MEMA urges the agency to include other technology areas for credit. Promoting flexibility will increase market penetration and commercialization of these important technologies as well as drive continuous innovation and improvements.

While we recognize the agency's desire to receive specific input and data on these advanced technologies, the comments herein are general in nature. MEMA fully expects several member companies to supply separate, individual company comments specific to their product mix, technology expertise, effectiveness information, recommended testing procedures, and other relevant research data.

Therefore, MEMA recommends that the agencies add the following advanced technology categories that would be eligible for credit in the final rule: (1) advanced transmission and drivetrain technologies; (2) advanced engine accessory technologies; and, (3) tire/wheel accessories. As appropriate, MEMA has provided some examples of technologies to explain the potential of some of these technology categories (*also see Appendix A*). Please note that the technologies listed herein are not intended to be comprehensive and MEMA strongly advises the agencies to review companies' specific comments for technology details.

1) Advanced Transmissions and Drivetrain Technologies

There are various advanced transmission drivetrain technologies being developed. Generally speaking, these technologies optimize gear shifting that helps to save fuel and extend clutch service life. In many cases, the technology cost of these advanced drivetrain technologies would not increase total vehicle cost and in other cases would provide fuel cost reductions that would provide a return on investment that is acceptable to fleets in the truck market, which typically ranges 18-24 months.

AMTs

Examples of advanced drivetrain technologies are Automated Mechanical Transmissions and Automated Manual Transmissions (both go by the acronym AMT) and Dual Clutch

Transmissions (DCT). Automatic systems have a communication system between the engine, clutch and transmission, which protects the entire drivetrain, and a drive program, which always selects the most economical engine speed. In manual systems, sensors help prevent accidental gear changes and precision shifts help the transmission remain highly efficient while delivering the power necessary. In some cases the technology can be equipped with clutch-dependent and drive-dependent power-take off units (PTOs). Also, advanced transmission technologies can not only provide comfort and reliability for the operator, but, when combined with application-specific gears and software, the transmission can operate at maximum efficiency. These "customized" transmissions can reduce emissions and fuel consumption by lowering engine speeds or by compensating for high loads and increasing torque demands so that the transmission works as efficiently as required for the application. Also, advancements in materials and transmission housings can help save weight, which has an additive contribution to vehicle efficiency, and, has the added benefit of abating noise.

High Efficiency Drive Axles

Other examples of advanced drivetrain technology include high efficiency axle systems. Parasitic losses in the drive axle of commercial vehicles range from 4 to 7 percent. Through development of advanced mechanical systems and/or the application of electronic controls, parasitic losses can be significantly reduced, perhaps by over 50 percent. The resulting improvement in fuel efficiency correlates strongly with this increased axle efficiency. Development and commercialization of these technologies promise to deliver meaningful improvements in GHG emissions and fuel consumption during the regulatory period of these proposed rules.

2) Advanced Engine Accessory Technologies

There are also a range of engine accessories that contribute to an engine's fuel efficiency and emissions output. Various mechanical and electrical accessory technologies can impact efficiencies in various ways. In some cases the measure is small, but, again, these efficiencies and improvements can be beneficial when combined appropriately with other technologies.

Electrical Accessories

An example of an electrical accessory is an Electronic Air Control system. The system is a compact, electronically controlled air treatment system. The system integrates the air dryer, unloader valve, multi-circuit protection valve, and the park brake mechatronics. Its primary functions are air quality assurance, pressure control, air distributions (defined per customer priorities), and information management. The sensors enable optimized system control, plus on-board/off-board diagnostics. The software algorithms determine when it is favorable for the air compressor to build air and when it is favorable to purge the air dryer. The result is lower fuel consumption. Measurements have shown up to one percent reduction of fuel consumption. These systems would also be particularly appropriate (indeed necessary) for vehicles that operate under full battery electric operation.

Mechanical Accessories

Some examples of mechanical accessories are clutched accessories. First, Clutched Air Compressor disengages during the portion of the duty cycle when no air is demanded. This reduces parasitic drag and reduces fuel consumption. Testing has shown a range of one to three percent reduction in fuel consumption. Second, a Clutched Turbocharged Air Compressor routes pressurized air from the engine's turbocharger to the air compressor intake port. Specific power consumption of the compressor is reduced by 30 to 50 percent compared to a naturally aspirated air compressor. Turbocharging of the air compressor has shown an additional one percent of fuel savings when combined with the compressor clutch. Third, a hybrid water pump which uses an electric motor most of the time to reduce parasitic losses, but is driven by a belt at higher loads when maximum cooling is needed, can show a fuel savings of up to two percent.

Superchargers
Superchargers have provided performance, power and fuel efficiency in the passenger car market for decades. Next generation superchargers designed for diesel engines have the capability to increase vehicle power and acceleration for a wide range of vehicles. Superchargers will increase fuel economy thru engine downsizing, lower particulate emissions (reduction in transient smoke) and GHGs.

Other Engine Boosting Technologies
An example of one type of an engine boosting technology enabler is a Pneumatic Booster System. The system is placed near the air intake manifold on an engine and monitors the Controller Area Network (CAN) for specific signals. Once the conditions for activation are met, the system injects compressed air from an auxiliary air tank into the engine manifold, delivering the desired amount of air that the diesel combustion processes require. Typically, when a driver presses down on the throttle to demand acceleration, there is a delay in engine response because of turbo lag. This lag constitutes the time difference between acceleration demand and the maximum air delivery of the turbocharger. The system overcomes turbo lag by instantaneously injecting the desired air into the intake manifold, allowing the turbocharger to spin up to its full capacity and take over the air delivery demands. The result is lower average engine speed which translates to lower fuel consumption. Testing has resulted in one to three percent reduction of fuel consumption.

3) *Tire and Wheel Accessories*

Improper tire pressure is a safety issue that, unfortunately, is often overlooked. Small decreases in tire pressure, even just a few pounds per square inch (psi) results in decreased fuel efficiency, tire life, safety, and vehicle handling/performance. In the commercial vehicle market, there are a variety of systems available to *passively* monitor tire pressure (tire pressure monitoring systems) as well as to *actively* manage and maintain proper tire pressure (central tire inflation systems).

Advanced systems, combine the monitoring and the management technologies to be a completely automated system to alleviate the need for actively maintaining tire pressure by the operator/fleet and continuously monitors and applies air pressure, when needed, to the appropriate tire/wheel position. Typically, a tire pressure management system has the following components: centralized processor, air compressor, air control valves and rotary seals near each wheel. The system takes periodic tire pressure readings and makes adjustments according to the desired pressure setting. These systems typically come with several pre-defined settings but also allow the user to enter their own pressure setting, if needed. Also, the pressure settings, current pressures and flat/leak notifications can be on a dash display. By maintaining proper pressures, not only does it provide the obvious safety benefit of mitigating potential flat tires, but also the consistent pressure maintenance helps retain the optimum rolling resistance, which maintains optimal fuel efficiency.

B. Advanced Vehicle Technologies Credits are Needed for Vocational Vehicle Category

MEMA urges the agencies to adopt guidelines that the application of advanced vehicle technologies in the vocational category, which, under the proposal, achieves improvements to emissions mainly with engine enhancements. But there is a gap between engine and vehicle improvement targets. Furthermore, there are very few variables available for manufacturers to achieve the overall targets in the vocational segment.

In the vocational segment there are several advanced technologies newly entering the market that offer significant additional emissions reduction – potentially as large as 10 to 15 percent. These technologies are entering the market slowly, partially because they address a specific transient behavior characteristic of the vocational market and are different from line-haul applications. (*Note: Typically, the traditional way technologies enter the business stream is through the line-haul segment and then adapted to the vocational sector.*)

Earlier we mentioned examples of advanced drivetrain technologies – Automated Mechanical Transmissions and Automated Manual Transmissions (AMTs) and Dual Clutch Transmissions (DCT). Power pack testing is proposed by the EPA as an alternative, voluntary certification for hybrid vehicles because the proposed procedures for vocational vehicles do not recognize GHG emissions reduction due to hybridization. Without any modification, the power pack testing procedures applied to non-hybrid drivetrains measure the GHG improvement of an advanced drivetrain. In effect, this extension offers the vehicle manufacturers additional flexibility or variables to achieve the EPA targets and drives the market to introduce these commercially available technologies into the vocational segment.

Today, the vocational market is dominated by Automatic Transmissions (AT) based on Torque Converter Automatic technology; with more than 85 percent market share, it is the de facto baseline transmission today. MEMA examines the following categories of GHG improvement: (a) the baseline, engine-based improvement as prescribed by the NPRM; (b) hybrid systems; and, (c) advanced transmissions/drivetrains (*see Figure I-1 below*).

The vocational segment uses about 1 million barrels of oil per day, which is significant. The certification procedure in the NPRM saves four to eight percent fuel, based on an assumed penetration of hybrids between three and 10 percent during the period 2014–2017. The proposed extension of the rule allows for an additional 4.5 percent fuel savings, or alternatively, increased flexibility to achieve the five to 10 percent GHG reduction targets.[3]

Figure I-1

Technology	Test methodology	GHG improvement	Market penetration	Total GHG impact	Status
Baseline engine	Engine FTP	3-5%	100%	3-5%	In NPRM
Hybrid	PowerPack	30%	3-10% *	1-3%	In NPRM
Advance Drivetrain	PowerPack	10%	40%	4.5%	Extension

** Hybrid penetration rates are based on Calstart predictions that factor in the effects of incentivizing this technology through regulatory action and reduction of costs from $40k/system to $25k/system. The advanced drivetrain solutions assume pull through regulatory action and cost neutral compared to baseline.*

C. Power Pack Testing Should be Expanded to Other Drivetrain, Non-Engine, and Advanced/Innovative Technologies

MEMA agrees with the inclusion of the power pack testing and certification process included in the NPRM. It is the cornerstone of the rules flexibility, as it allows those technologies that contribute to fuel consumption and emissions reductions, but cannot be captured in the engine test procedure, to be measured.

Vocational truck vehicle and duty cycle diversity requires a power pack framework to ensure the deployment in the market of hybrid and, as we propose, other drivetrain technologies that best realize fuel efficiency and maintain fleet choice. The most flexible testing and certification regime includes a three pronged approach: (1) engine-centric (with enhanced credits for approved

[3] These fuel consumption reductions have been validated on experimental vehicles by independent entities such as Southwest Research Institute and U.S. Army Tank-Automotive and Armaments Command (TACOM).

components); (2) power pack; and, (3) whole vehicle. The engine-centric approach does not cover drivetrain contributions like hybrid power systems to vehicle fuel economy. A whole-vehicle testing strategy will inherently restrict the diversity of solutions tailored to a very specific set of vocations and duty cycles, ultimately impeding the introduction of fuel efficiency improvements via the drivetrain, as well as being extremely complicated. A power pack framework will help avoid the unintended consequences of certification methodologies that are restricted to engine only and/or whole vehicle testing protocol.

Expanding the power pack test proposed for hybrid technologies to other drivetrain and non-engine technologies such as engine boosting to allow them to receive credits under the Advanced Technology and Innovative Technology Programs will drive innovation and reduce emissions with little to no cost.

Since the power pack testing proposed for quantifying the benefits of advanced drivetrain and engine boosting technologies is identical to that developed by the EPA for hybrid systems, there is no incremental cost on the procedural side of the testing. From a testing perspective, MEMA believes that power pack testing is a more cost-effective alternative to full vehicle chassis test. As the proposed testing would be voluntary in the first phase, it will not add undue effort to the manufacturers.

The CARB transient duty cycle weighting proposed in the rule will not properly capture the efficiencies of the advanced technologies in the vocational segment. Re-weighting the program to better reflect vocational and transient cycles is appropriate to insure that the performances of advanced technology vehicles are captured. The CARB cycle, as proposed, has too high of a speed to be representative of mixed city-highway driving and urban work cycles, which is the typical real-world experience of vocational vehicles. The addition of the 55 mph and 65 mph segments skews the test even further away from typical urban cycles. In order to capture the full benefit of these new technologies in the vocational cycle, the testing duty cycles must more closely represent their real world application. Additional duty cycles are needed including transient and power-take-off (PTO) cycles, to provide the flexibility needed to capture fuel efficiency and GHG benefits of the varying applications to which hybrid systems can be applied.

Electric Vehicles and Plug-in Hybrids

There is limited information in the NPRM regarding the certification process for verifying electric vehicle (EV) fuel economy and GHG emissions. The agencies should take a similar course as they did in the light-duty vehicle (passenger car) National Program rulemaking and exempt upstream emissions for the first phase of the rule. Additionally, the NPRM does not mention plug-in hybrid electric vehicle (PHEV) although the potential market penetration of PHEVs equals or exceeds EVs. It is important for the agencies to recognize PHEVs in the rule as they represent the natural progression from HEV to EV and make significant contributions to GHG emission and fuel consumption reductions. Failure to establish PHEVs in the rule will prevent the commercialization of these technologies as well as the potential cost reduction of electric drive components (such as batteries, motors and inverters) through increased manufacturing volumes and additional demand.

D. Innovative Technologies Should Have a Defined Review and Approval Process

MEMA supports the agencies' inclusion of innovative technology credits. There are many technologies that contribute measurably to vehicle fuel efficiency and emissions output that may not be appropriately credited in the existing engine test cycle(s). The challenges, of course, are quantifying those contributions and obtaining the credit. The NPRM considers an "innovative technology" to be "those [technologies] that are newly introduced in one or more vehicle models or engines, but that are not yet widely implemented in the heavy-duty fleet. This could include known technologies not yet widely utilized in a particular subcategory."[4]

[4] 75 Fed Reg at 74257

Certainly, MEMA recognizes that the agencies were purposefully vague so as to permit them maximum discretion and latitude when innovative technologies are submitted to them for review and credit eligibility. In lieu of a definition, which, we concede, would be limiting and potentially counterproductive, at a minimum, therefore, the agencies should prescribe a specific process/procedure in the final rule by which innovative technologies can be submitted for eligibility review and consent. Having a process outlined will provide a clear path for all involved parties to follow. This way, suppliers, OEMs, engine manufacturers, and, indeed, the regulators themselves can have confidence in a uniform process to manage the eligibility review for "unconventional" innovative technologies.

A suggested approach is for the agencies to provide a formal means for suppliers to submit technical justification directly to the agencies. Successful review of the data would lead to some form of provisional certification for the technology. This evaluation process would need to be conducted only once, even if multiple OEMs eventually include the innovative technology(ies) in their vehicle certification packages.

It is recognized that the agencies may not be receptive to the idea of "certifying" technologies separate from a complete vehicle certification. Providing a forum for suppliers to present the technical justification would at least allow the agencies to become familiar with a technology prior to submission by the OEMs in the vehicle certification package, which should facilitate and accelerate the approval process.

To allow the agencies to gauge industry interest in a proposed innovative technology, the supplier/owner of the technology could be asked (or required) to present letters from one or more OEMs that expresses OEM interest in the technology. Such informal endorsements would be an indication that there is indeed sufficient interest in a technology to warrant a detailed review.

MEMA urges the agencies to consider these alternate approaches for certifying innovative technologies.

E. Innovative Technologies Should not be Restricted and Should be Available Beyond MY2018

NHTSA and EPA also asked for comment on restricting the innovative credit within the subcategory under which it was generated; MEMA does not agree and prefers that the innovative technology credits should be transferable among categories. Furthermore, MEMA requests that the agencies consider extending the availability of innovative technology credits beyond MY2018.[5] This will provide continuous momentum to evolve and elevate more innovative technologies. Perhaps some of the innovative technologies considered as eligible under this rule for MY2014-2018 will be – as characterized in the NPRM – "common" by 2018. MEMA strongly encourages the agencies to continue the availability of such a credit program in the next rulemaking phase beyond MY2018. By not limiting this credit to just 2018, the OEMs and engine manufacturers will be incentivized to always look beyond the horizon. Also, component manufacturers/suppliers will be encouraged to continue to innovate new and creative technologies to take the next generation of commercial vehicles to another level of efficiency and performance.

II. Proposed Compliance, Certification, and Enforcement Provisions

The NPRM sought comment on the use of the International System of Units (SI), specifically, in the proposed Part 1066. The goal of EPA and NHTSA is to ultimately seek global harmonization of the test procedures; having them in all based on SI units would make that process less complicated. MEMA agrees with the agencies and supports the use of SI units; not mixing English and SI units is recommended and preferred.

[5] 75 Fed Reg at 74257

A. Duty Cycle Should Define Targets and Classification for Overlapping Classes for Class 7 and 8 Vehicles

The classification of vehicles as combination tractor trailer versus vocational vehicle in the Class 7 and 8 categories may limit the introduction of hybrid technologies. MEMA believes that the duty cycle – not the vehicle size/weight, axle, tires, etc. – should define the targets and classification of these vehicles. For example, beverage delivery trucks (which fall into these class categories) are leading the way in adoption of hybrid technologies. If classified as a tractor trailer, by weight, instead of vocational, by duty cycle, there would be no way to test the hybrid system for certification. Similarly, intermodal drayage tractor trailer combinations used at or near seaports and railyards, typically operate at low speed, with substantial periods of idling and start/stop operation. Evaluation of this vehicle application using the linehaul simulation duty cycle would totally ignore the benefits of the zero emissions vehicle (ZEV) operating mode available with some hybrid systems that make them well suited for the ports application.

The potential unintended consequence of this approach could prevent viable technologies from being utilized and/or overlooked for a category where significant improvements can be realized for those Class 7 and 8 vehicles that do not experience the typical "line-haul" duty cycle.

The agencies ought to reconsider the potential unintended consequence of their approach. Specifically, it is recommended that the agencies classify Class 7 and 8 vehicles according to application and duty cycle rather than strictly by weight and configuration.

B. Mass Reduction Proposals Should be Reevaluated

1) Other Weight Reduction Components Should be Considered for Combination Tractors (Class 7 & 8) GEM Model Certification

MEMA applauds the agencies for including weight reduction via lightweight wheels and tires in the NPRM. However, there are additional weight-saving technologies available in the market today that have been ignored in the proposal and should be considered. As noted in the NPRM, the wide variety of options on a truck makes it difficult to create a baseline from which to measure. However, ultimately, truck manufacturers should receive credit in the GEM model for any and all weight reductions that do not compromise function and reliability. Without an incentive for implementing, these light weighting technologies may never make it on a commercial vehicle.

While all commercial vehicles are different, general assumptions can be made for additional components such as cab structures, frame rails and cross members, as well as fifth wheels. The GEM simulation model could then include a drop down menu, allowing for lightweight versions of these technologies to be selected so that the manufacturers receive credit. Admittedly, this might not be an exact measurement due to variances in design; however, applying a credit for a typical weight savings would serve the goal of the rulemaking in lieu of not allowing any credit at all.

2) Weights and Costs for Class 7 & 8 Wheels/Tires Should Reflect Real World

The agencies should revisit the present assumptions relative to weight savings and to the cost of implementation. Based on information from an industry supplier of lightweight wheels, Figure II-1 documents the following weight data that are well-recognized and accepted by the commercial vehicle industry. Please note the comparison of the wheel weights provided in the Draft Regulatory Impact Analysis[6] to the wheel weights as recognized by MEMA. (*Note: For confirmation, these proposed weights were reviewed with OEMs and each concurred with following weight assessment.*)

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[6] Table 2-20, pg. 249, *Draft Regulatory Impact Analysis: Proposed Rulemaking to Establish Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles*, EPA-420-D-10-901, October 2010

Figure II-1

Weight Reduction Technology	Weight Reduction (lb) Draft RIA	Weight Reduction (lb) MEMA
Single Wide Tire (per tire)	57	67
High strength steel dual wheel (per wheel)	8	12
Aluminum dual wheel (per wheel)	21	31
Light weight aluminum dual wheel (per wheel)	30	33
Steel single wide wheel (per wheel)	27	26
Aluminum single wide wheel (per wheel)	82	82
Light weight aluminum single wide wheel (per wheel)	90	94

MEMA's data relative to the cost up charge for shifting to lightweight wheels differs from what is presently noted in the NPRM. While the proposal appears to have included list pricing for the wheel/tire up charge, typical fleet customers pay less than direct pricing utilizing the truck OE catalog/order book, less traditional discounts. In Figure II-2, please note the wide variation between the agencies' presumed costs and those seen in the real-world.

Figure II-2

Application	EPA/NHTSA Class 7	EPA/NHTSA Class 8	MEMA Class 7	MEMA Class 8
Single Wide Tire (per tire)	$322	$644	$0	$0
Aluminum Steer Wheel	$523	$523	$250	$250
Aluminum Wheels – Dual	$1,569	$2,615	$500	$1,000
Aluminum Wheel – Single Wide	$627	$1,254	$378	$756

Finally, there is a positive offset to the up charges noted in the previous figure. It is generally recognized in the industry that truck tractors equipped with 100 percent aluminum wheels increase the resale value of the truck in the range of $1,100 and $1,775[7] because the return on investment is favorable. Similar to our earlier discussion with OEMs about weight savings, while this is not quantifiable from their standpoint, OEMs generally agreed that there is increased value in the resale market with aluminum wheel-based trucks.

Figure II-3

Residual Value (resale)	Class 7	Class 8
Aluminum Steer	$575	$575
Aluminum Dual	$600	$1,200
Aluminum Single Wide	$600	$1,200

Therefore, with this additional cost and weight information, MEMA asks the agencies to reevaluate the costs and weights for incorporating lightweight wheels and single wide tires.

3) Include Mass Reduction for Vocational Vehicles

The agencies ought to seriously reconsider their exclusion of mass reduction relative to increasing fuel efficiencies and lowering emissions for vocational vehicles. Reducing weight without compromising function and reliability can contribute to reduced GHG emissions and fuel consumption.

At a minimum, the agencies should consider including lower-weight wheels and tires for the vocational vehicle GEM model, similar to the proposed combination tractor trailer vehicle GEM model. Ideally, the expanded inclusion of other lighterweight technologies and applications (e.g. aluminum bodies, cross-members, and bumpers) would provide

[7] Data from the National Automobile Dealers Association's *Commercial Truck Guide*

additional benefits and incentives for mass reduction if they were also included in the GEM simulation model for vocational vehicles.

C. GEM Input Credits for Idle Reduction Should be Modified

There are several issues that should be addressed regarding the idle reduction credit in the GEM Model for the combination tractor trailer vehicle category (Class 7 and 8).

1) Credit Should be Based on Merit of Individual Idle Control Technology

The Draft Regulatory Impact Analysis (RIA) published by EPA and NHTSA addresses idle control technologies and states that today's technologies include: auxiliary power units (APUs); fuel operated heaters (FOHs); battery air conditioning systems (BACs); and, thermal storage air conditioning systems (TACs).[8] The RIA Table 2-22 assumes all idle reduction devices use 0.2 gallons of fuel per hour (gal/hr).

Each idle reduction technology should be given credit based on the fuel consumption and emissions of that technology and not be treated under the assumption that all devices consume 0.2 gallons of fuel per hour. This approach would be consistent with the different levels of credit given to different types of aerodynamics and tires. The various idle control technologies listed in the RIA have fuel consumption from the battery APU of almost zero to the diesel engine APU of approximately 0.3 gal/hr fuel consumed and also emit different amounts of GHG.

A complete chart in Appendix B illustrates MEMA's proposed modifications to Table 2-22 in the RIA. It shows the recommendation for credit based on the fuel consumption and GHG emissions of each technology. Using mid-idle figures, MEMA offers the following recommendation per technology (*Figure II-4 is an excerpt from Appendix B*):

Figure II-4

Excerpt from Appendix B

Technology	Mid-Idle @ 2,500 hrs.
Fuel Cell Auxiliary Power Unit (APU)	7.7
Diesel Engine APU	6.1
Fuel Operated Heater (FOH)	9.1
Battery AC System (BAC)	9.2
Thermal Storage AC System (TAC)	9.2
Combination FOH & BAC	9.0
Combination FOH & TAC	9.0

Electrified Parking Spaces at truck stops have not been addressed for credits in this response. Even with the existence of equipped stops along the I-65 corridor and a few other areas, commercial truck drivers cannot count on a space being available when they need it even if some equipment exists at the stop. Considering the mandatory five minute shutdown that will be required, drivers will need to equip their trucks with idle reduction equipment such as FOHs and/or APUs, BACs and TACs. This will help ensure their safety if their out-of-service hours occur away from truck stops and/or if inclement weather or equipment failure leaves them stranded along the road. Once the truck is equipped with an idle reduction system, the Electrified Parking Spaces are of no additional value for credits.

2) Operation Time for Idle Reduction Technologies Should be Revised

The agencies assumed that the average Class 8 sleeper cab spends 1,800 hours in extended idle per year and travels about 250 days per year. MEMA recommends that the

[8] Page 2-50, *Draft Regulatory Impact Analysis: Proposed Rulemaking to Establish Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles*, EPA-420-D-10-901, October 2010

agencies use 2,500 annual hours for APUs and 1,250 annual hours for FOHs to better reflect real-world application and experiences. Our recommendations are based on the following reference information:

- We agree with the agencies' proposal that in order to qualify for credits, it is mandatory that the truck be equipped with an automatic engine shut-off system. Future five-minute mandatory engine shutdown will support increased annual hours of operation for idle reduction equipment.
- According to the agencies' data in the RIA of 250 days of travel, and that Class 8 sleeper truck drivers must have 10 hours out-of-service daily, idle time of 2,500 hours per year is reasonable for use of an idle reduction technology.
- According to the data on the EPA SmartWay website, 2,400 hours per year is stated for idle hours on a Class 8 sleeper truck. "Some surveys say that trucks idle anywhere from 6-8 hours a day for as many as 250 to 300 days each year."[9] Idling for 8 hours per day for 300 days per year equals 2,400 hours.
- In the 2005 publication from Argonne National Laboratory, *Comparing Emissions Benefits from Regulating Heavy Vehicle Idling* the assumptions stated "Cab comfort devices were assumed to operate 7 hours per day, 303 days per year, except for the heater which runs 150 days per year." These calculations result in annual operation of 2,121 hours for APUs and 1,050 hours for the FOH. Also, the assumptions "Heater and current truck idling emissions and fuel consumption were derived from EPA (Lim, 2002) measurements, assuming 50% air conditioning and 50% heat."
- The newly implemented Federal Motor Carrier Safety Administration (FMCSA) Compliance, Safety, Accountability (CSA 2010) driver guidelines reduce the number of hours that a driver is allowed to operate the truck each day by one to two hours. As a consequence, the truck would be out of service for 250 to 500 additional potential hours of idle or use of an idle reduction device especially with five-minute mandatory shutdown. This results in an increase over SmartWay's 2,400 hour idling hour figure to 2,650 to 2,900 hours.

The chart in Appendix B illustrates MEMA's proposed modifications to the RIA Table 2-22. It shows the recommendation for credit based on the recommended hours of operation for various APUs, FOHs, and combination units.

3) The Idle Fuel Consumption Rate Should be Revised

The RIA assumed that the main engine consumes about 0.8 gal/hr during idling. Based on the aforementioned Argonne report, EPA SmartWay, and actual field experience, MEMA recommends that 0.87 gal/hr fuel consumed by the main engine during idle be used in the calculations for credit. Our recommendations are based on the following reference information:

- The midpoint data indicates the figure 0.87 gal/hr for mid-RPM idle with A/C on 50 percent of the time should be used as the fuel-consumption for a Class 8 sleeper truck[10]
- EPA's SmartWay program website states that idle fuel consumption is 0.82 gal/hr and acknowledges that high idle can consume more than 1.0 gal/hr[11]

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[9] Reference: http://www.epa.gov/smartway/transport/what-smartway/idling-reduction.htm "What SmartWay Can Do for You," online 2011.
[10] Reference: http://www.transportation.anl.gov/pdfs/TA/361.pdf "How Much Could You Save by Idling Less?" U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, and the Argonne National Laboratory, 2006
[11] Reference: http://www.epa.gov/smartway/transport/calculators/calculatorexplanation.htm "SmartWay Technology Package Savings Calculator Explanation of Assumptions," online 2011.

- In actual field operations, many truck drivers operate at higher RPMs during extended idle not only when operating the A/C system, but also to provide more power for hotel loads. In addition, truck drivers use high idle to minimize engine vibration while they are sleeping. Higher RPM at idle results in fuel consumption in excess of 0.8 gal/hr.

The chart in Appendix B illustrates MEMA's proposed modifications to the RIA Table 2-22. It shows the recommendation for credit based on the fuel consumption of 0.87 gal/hr of the main engine during idling.

4) Class 7 and 8 Day Cabs Should Receive a Percentage of Credit Given to Class 8 Sleeper Cabs

The agencies must consider typical real-world operation issues that also impact their idling assumptions. Regarding the operation of Class 7 and 8 Day Cabs, MEMA notes that there are increasing requirements for companies that operate these vehicles to reduce their idle for "start-stop" operations, such as waiting in long lines to pick-up and drop-off, or where they may not be allowed to leave the truck or to sit at idle, such as at container docks. Restrictions on idling impact these Day Cab carriers in a very direct way. As examples, SmartWay partner shippers do not allow idling on their property and more and more cities/municipalities face non-attainment of air quality standards and must enforce idling restrictions.[12] Some trucking operations are moving to a regionalized system in order to accommodate driver and customer preferences; consequently, utilization of Day Cabs – and associated idling – will increase.

MEMA recommends that Class 7 and 8 Day Cabs be credited with 35 percent of the credit given to Class 8 Sleeper Cabs when equipped with comparable technology. Offering credits for Day Cabs equipped with idle reduction technologies will result in reduced idling in Day Cabs and the desired result of reduced fuel consumption and emissions for the full slate of vehicles in the combination tractor category.

D. Additional Simulation Drive Cycles are Needed to Capture More Vocational Applications

The proposed vocational drive-cycle in the NPRM does not provide enough variation to capture true performance of vehicles in the vocational space. MEMA recommends that the agencies provide CILCC as the general purpose mixed urban/freeway cycle, potentially with a 20 percent freeway weighting and to use four representative cycles (mixed urban/freeway, city bus, refuse, utility). The cycles should be used for both power pack and full chassis.

III. Proposed Diesel and Gasoline Engines Standards for Heavy-Duty Pickups and Vans

A. Performance-Based Standards Should be the Goal

The agencies have proposed "separate targets … for gasoline-fueled (and any other Otto-cycle) vehicles and diesel-fueled (and any other Diesel-cycle) vehicles."[13] This proposal is counter to what EPA and NHTSA have done in the light-duty vehicle National Program, where the GHG and fuel economy target values are common regardless of powertrain.

MEMA acknowledges the recommended technology packages and the relative efficiency of gasoline and diesel vehicles differ. Still, in spite of the agencies' apparent "overall goal of remaining fuel-neutral"[14] and their belief that the proposed standards "represent roughly equivalent

[12] Reference: http://www.epa.gov/smartway/documents/420b06004.pdf. Site lists nearly 30 states with anti-idling legislation.
[13] 75 Fed Reg at 74191.
[14] *Id.* at 74190; *see also id.* at 74213 ("applying standards for all regulated criteria pollutants and GHGs regardless of fuel type").

stringency levels for gasoline and diesel vehicles, which is important in ensuring [the] proposed program maintains product choices available to buyers,"[15] the separate target values for spark-ignition (i.e., gasoline) and compression-ignition (i.e., diesel) vehicles do not align with performance based standards as seen in other criteria emissions (as specified in 40 CFR Parts 69, 80 and 86) or the recently promulgated light-duty GHG emission standards. By way of example, regardless of the phase-in option selected, a MY2014 heavy-duty (HD) diesel pickup truck with a work factor of 3,000 pounds would have a GHG target of 511.4 g/mi under EPA's proposed formula in Section 1037.104(a)(2)(ii) (*[0.0478 x 3000] + 368*), while a MY2014 HD gasoline pickup truck, with an identical work factor, would have a GHG target of 515.6 g/mi under that formula (*[0.0482 x 3000] + 371*). While understanding the agencies' technology feasibility assessment, the resultant diesel target value is lower, which is to say, gasoline HD pickups and vans under the proposed rule would be able to emit higher GHG levels than diesel heavy-duty pickups and vans.[16]

The same disparity exists for fuel consumption: the fixed target standard for a MY2016 HD diesel pickup truck with a work factor of 3,000 pounds would be 4.6 gal/100 miles under NHTSA's proposed Section 535.5(a)(2)(ii) (*[0.000432 x 3000] + 3.33*), while the fixed target standard for a MY2016 HD gasoline pickup truck with the same work factor would be 5.5 gal/100 miles (*[0.000513 x 3000] + 3.96*). Once again, understanding the agencies' technology feasibility assessment, the diesel fixed target standard is lower, meaning that gasoline HD pickups and vans would be able to consume more fuel than diesel HD pickups and vans.

MEMA's calculations for a HD pickup truck with a work factor of 3,000 pounds further reveal that the difference between the diesel and gasoline GHG target values increases over time, going from 0.8 percent in MY2014 to 5.9 percent in MY2018 or MY2019 (depending on which phase-in schedule is selected). Rather than converging towards the same value, the separate diesel and gasoline GHG targets diverge over the model years in question. The same holds true for the proposed fuel consumption standards, where the difference between the phased-in (i.e., second alternative) target standards widens from 15.5 percent in MY2013 (assuming early compliance) to 21.3 percent in MY2018.

Under EPA's proposed Section 1036.108(a)(1)(ii), the GHG standard for a MY2016 light HD diesel engine used in a Class 2b-5 vocational vehicle would be 600 g/hp-hr (dropping to 576 g/hp-hr in MY2017), whereas for a MY2016 gasoline engine used in the same type of vehicle, the standard would be 627 g/hp-hr (with no decrease in MY2017).[17] Additionally, light HD diesel engines used in MY2014 and MY2015 vocational vehicles would be subject to the same 600 g/hp-hr standard, while gasoline engines used in MY2014 and MY2015 vocational vehicles would not be subject to any GHG emissions standard because the 627 g/hp-hr level would not take effect until MY2016. This difference in standards could result in an unintended shift in market share leading to an increase in overall GHG emissions. EPA and NHTSA state that they "are not basing the proposed standards on a targeted switch in the mix of diesel and gasoline vehicles," and that "the proposed program does not force, nor does it discourage, changes in a manufacturer's fleet mix between gasoline and diesel vehicles."[18] MEMA appreciates these remarks and the technology timeline driving the different standards for this rulemaking, but reiterates that the proposed standards are not equivalent, nor do they converge toward a common value.

In the next and all future rulemakings to amend the HD National Program that results from this first rulemaking, EPA and NHTSA should work to establish common, performance-based GHG and

[15] *Id.* at 74194-95.
[16] Unlike the proposed GHG standards, the proposed emissions standards for CH_4 and N_2O are performance based– the same 0.05 g/mile and 0.05 g/hp-hr levels apply to "all [heavy duty pickups and vans]" and to HD engines of "all fuel types."
[17] Under NHTSA's proposed section 535.5(d)(1), the fuel consumptions standards for MY 2017 light HD diesel and gasoline engines used in vocational vehicles would be 5.66 gallons per 100 bhp-hr and 7.06 gallons per 100 bhp-hr, respectively.
[18] *Id.* at 74232; *see also id.* at 74191 (stating that "[w]ith the proposed attribute-based standards approach, EPA and NHTSA believe there should be no significant effect on the relative distribution of vehicles with differing capabilities in the fleet, which means that buyers should still be able to purchase the vehicle that meets their needs").

fuel consumption standards, as is the case with the light-duty vehicle National Program. MEMA maintains that instituting performance-based standards is the best way to ensure that (a) unintended market shifts do not in fact occur because of the standards, and (b) the overarching and important objectives of reducing GHG emissions and improving fuel efficiency are not unintentionally compromised.

Conclusion

The supplier community is continually evolving various technologies to help vehicle and engine manufacturers reach the ultimate goal to produce cleaner, greener, efficient vehicles. MEMA and the supplier industry are committed to policies that enable the introduction of new technologies needed to support sustainable mobility. The interconnectedness of the industry drives the need for consistent, long-term policies, regulations and standards so that all stakeholders can more effectively incorporate more “green” technologies into the nation’s fleet.

MEMA supports the approach taken by the Administration to bring together the medium- and heavy-duty vehicle fuel efficiency standards and GHG emissions standards into a joint Heavy-Duty National Program. A uniform program not only allows vehicle manufacturers to invest in the appropriate technologies their vehicles need to reach and exceed the targets, but also helps the supplier base convert research technologies into commercially viable products. Suppliers are a key part to producing the results outlined by the Administration.

MEMA urges the EPA and NHTSA to adopt our recommendations to expand the advanced technologies eligible for regulatory flexibility credits. Also, we urge the agencies to prescribe a clear process by which stakeholders can submit innovative technologies for regulatory flexibility credits. MEMA made several recommendations to revise and/or reconsider some of the assumptions relative to the various compliance provisions made in the NPRM for not only this final rule, but for the next phase of rulemaking for these vehicles.

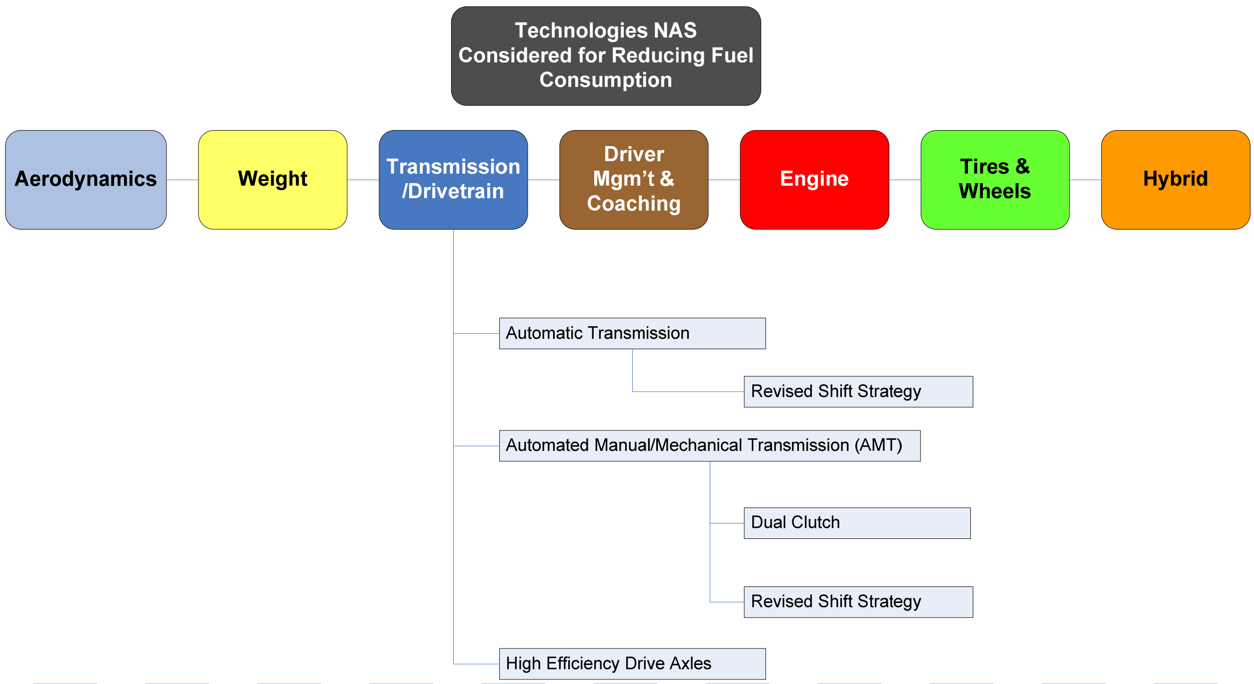
We look forward to working with the agencies and other stakeholders as we proceed with this and future rulemakings.

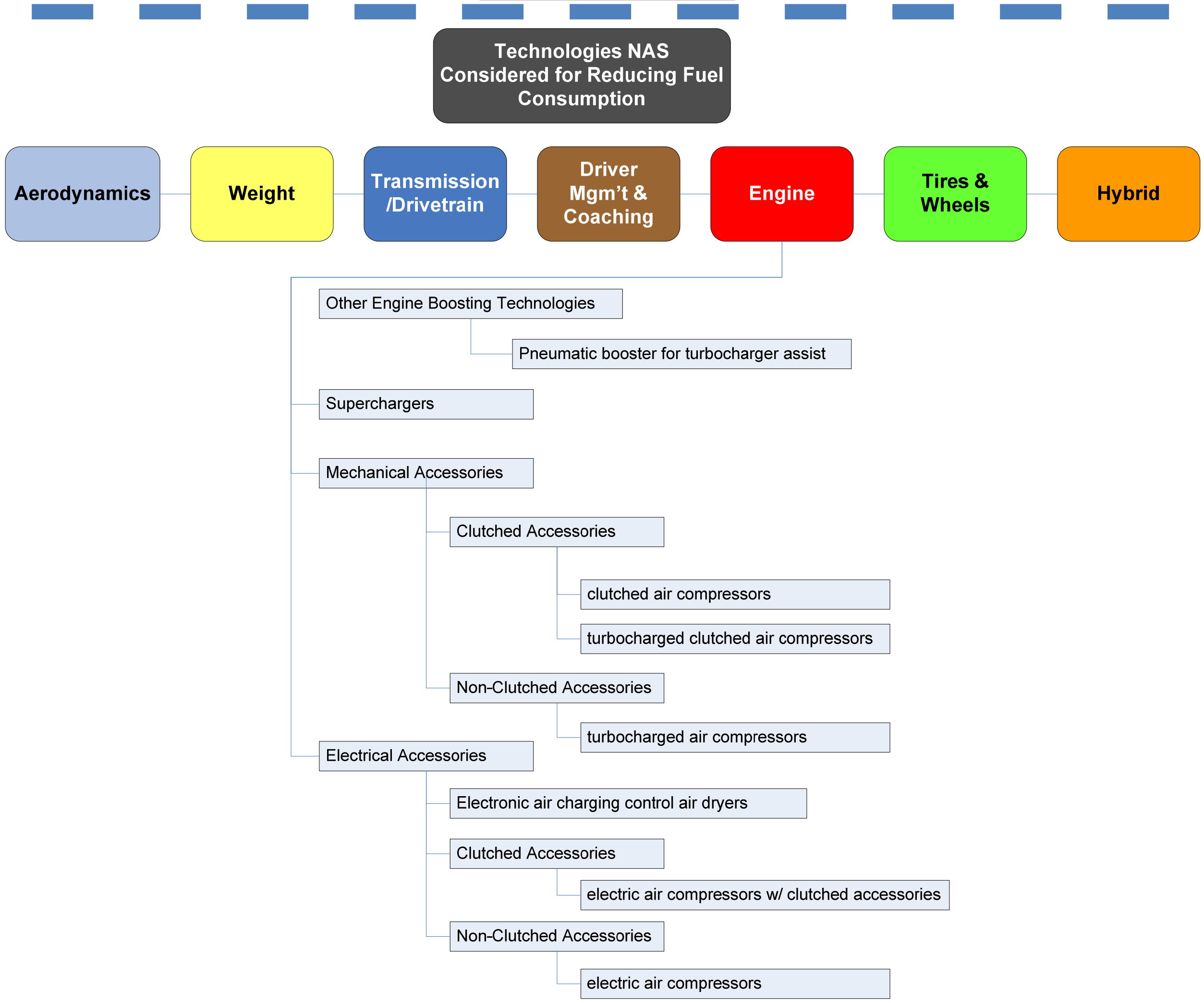
# # #

Appendices

APPENDIX A

NOTE: For the purposes of this appendix, the illustrations below utilize a similar category nomenclature that were used in the National Academy of Sciences (NAS) report to NHTSA on March 31, 2010.





APPENDIX A

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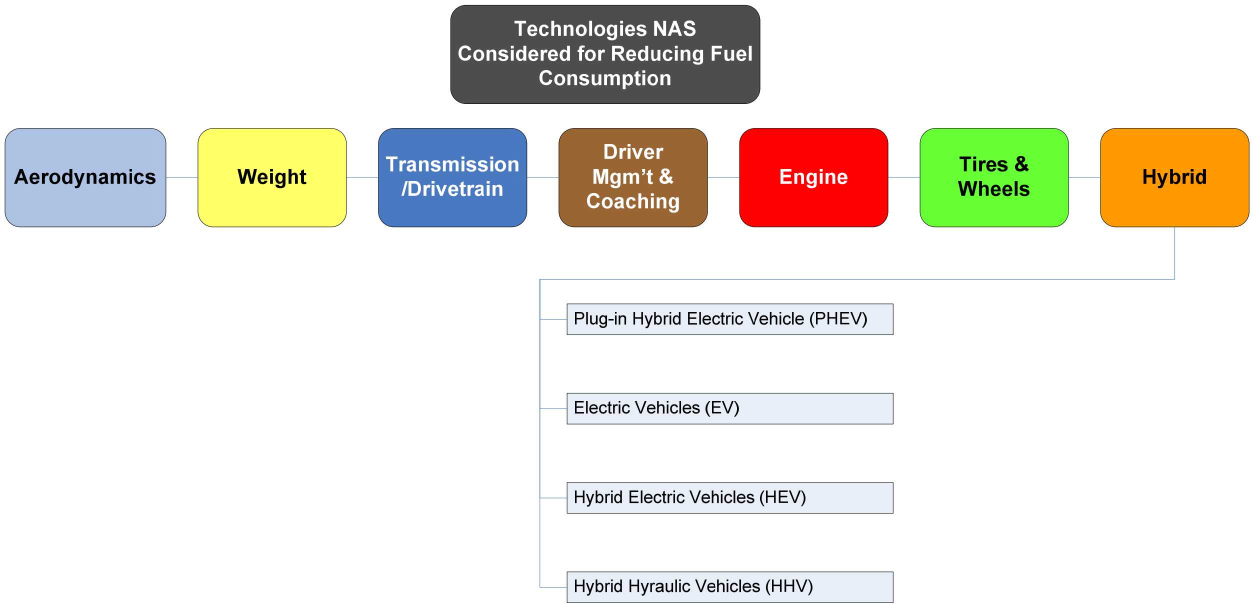

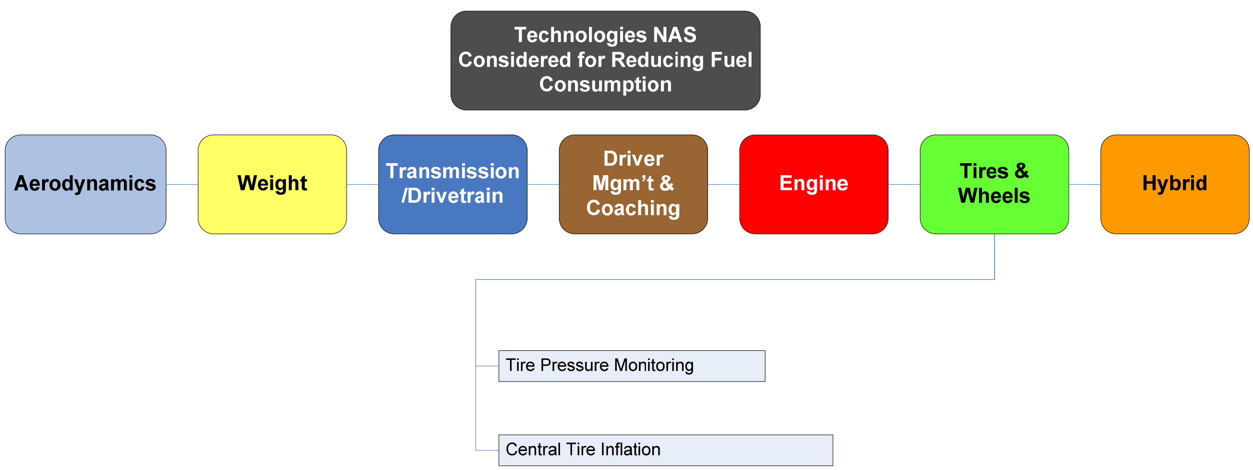

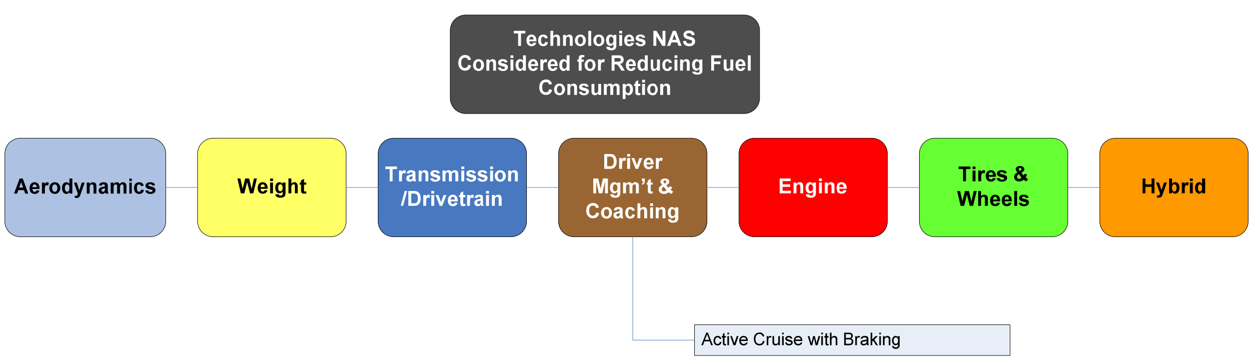

APPENDIX B

Idle Credit Calculation – Proposed Modification to Draft RIA Table 2-22

Idle Credit Calculation - Proposed Modification to Table 2-22 in RIA

	Idle Fuel Consumption (gal/hr)			CO2 g/gal	Idle CO2 emissions (g/hr)			Idle Hours per Year		Idle CO2 emissions per year (g)						Miles per year	Payload (tons)	GHG emissions due to idling (g/ton-mile)					
Baseline	EPA RIA	*Argonne Mid- Idle	High Idle		EPA RIA	Argonne Mid- Idle	High Idle	EPA RIA	250 dy*10 hrs/dy	EPA RIA @ 1800 hrs	EPA RIA @ 2500 hrs	Mid -Idle @ 1800 hrs	Mid -Idle @ 2500 hrs	High Idle @ 1800 hrs	High Idle @ 2500 hrs			EPA RIA @ 1800 hrs	EPA RIA @ 2500 hrs	Mid -Idle @ 1800 hrs	Mid -Idle @ 2500 hrs	High Idle @ 1800 hrs	High Idle @ 2500 hrs
	0.80	0.87	0.98	10,180	8,144	8,857	9,976	1,800	2,500	14,659,200	20,360,000	15,941,880	22,141,500	17,957,520	24,941,000	125,000	19	6.2	8.6	6.7	9.3	7.6	10.5
Idle Reduction Technologies:																							
Diesel Engine APU **	0.30			10,180	3,054			1,800	2,500	5,497,200	7,635,000	5,497,200	7,635,000	5,497,200	7,635,000	125,000	19	2.3	3.2	2.3	3.2	2.3	3.2
Savings / Credit =																		3.9	5.4	4.4	6.1	5.2	7.3
Fuel Cell APU	0.15			10,180	1,527			1,800	2,500	2,748,600	3,817,500	2,748,600	3,817,500	2,748,600	3,817,500	125,000	19	1.2	1.6	1.2	1.6	1.2	1.6
Savings / Credit =																		5.0	7.0	5.6	7.7	6.4	8.9
FOH (Fuel Operated Heater)	0.04			10,180	407			800	1,250	325,760	509,000	325,760	509,000	325,760	509,000	125,000	19	0.1	0.2	0.1	0.2	0.1	0.2
Savings / Credit =																		6.0	8.4	6.6	9.1	7.4	10.3
Battery AC System (BAC) ***	0.025			10,180	255			1,000	1,250	254,500	318,125	254,500	318,125	254,500	318,125	125,000	19	0.1	0.1	0.1	0.1	0.1	0.1
Savings / Credit =																		6.1	8.4	6.6	9.2	7.5	10.4
Thermal Storage AC System (TAC)	0.025			10,180	255			1,000	1,250	254,500	318,125	254,500	318,125	254,500	318,125	125,000	19	0.1	0.1	0.1	0.1	0.1	0.1
Savings / Credit =																		6.1	8.4	6.6	9.2	7.5	10.4
Combination FOH & BAC	0.04/0.025			10,180	407/255			1,800	2,500	325,760	509,000	325,760	509,000	325,760	509,000	125,000	19	0.2	0.3	0.2	0.3	0.2	0.3
Savings / Credit =																		5.9	8.2	6.5	9.0	7.3	10.2
Combination FOH & TAC	0.04/0.025			10,180	407/255			1,800	2,500	325,760	509,000	325,760	509,000	325,760	509,000	125,000	19	0.2	0.3	0.2	0.3	0.2	0.3
Savings / Credit =																		5.9	8.2	6.5	9.0	7.3	10.2

* Publication from DOE, Argonne Lab http://www.transportation.anl.gov/pdfs/TA/361.pdf
Referencen on page 2-51 in RIA, footnote 60

** http://www.ncsc.ncsu.edu/cleantransportation/docs/MIRT_APU_Prep_Kit_Design_Install_final10-28-08.pdf
Page 14 shows average fuel use varies from 0.26 to 0.31 gal/hr. Numerous diesel APU manufacturers websites show 0.3gal/hr.

*** Both battery & thermal storage systems use power from the engine to recharge

MEMA's recommended credit for idle reduction technologies